National Flood Insurance Program

Report to Congress on Reinsuring NFIP Insurance Risk and Options for Privatizing the NFIP

August 13, 2015

Homeland Security

Foreword

I am pleased to present the National Flood Insurance Program (NFIP) Report to Congress on NFIP Reinsurance and on Privatizing the NFIP which has been prepared by the Federal Emergency Management Agency (FEMA).

This document was compiled pursuant to requirements in the *Biggert-Waters Flood Insurance Reform Act of 2012*, , Div. F-Miscellaneous, title II, Secs. 100232(a) and (c), of the "Moving Ahead for Progress in the 21st Century Act" or the "MAP-21"(Pub. L. No. 112-141) (July 6, 2012).

Congressional staff validated the single combined report approach in March 2015. This report provides rationale for combining the reports, and satisfies requirements in the *Biggert-Waters Flood Insurance Reform Act of 2012*, Section 100232 (a) and (c), with this report and the following appendices:

- Appendix B: "Flood Insurance Risk Study: Reinsurance Study"
- Appendix C: "Flood Insurance Risk Study: Options for Privatizing the NFIP"

For the complete reporting requirements of the legislative language see Appendix A.

This report is being provided to the following Members of Congress:

The Honorable Richard Shelby
Chairman, Senate Committee on Banking, Housing and Urban Affairs

The Honorable Sherrod Brown
Ranking Member, Senate Committee on Banking, Housing and Urban Affairs

The Honorable Jeb Hensarling
Chairman, House Committee on Financial Services

The Honorable Maxine Waters
Ranking Member, House Committee on Financial Services

Inquiries relating to this report may be directed to me at (202) 646-3900 or to the Agency's Acting Associate Administrator for Federal Insurance and Mitigation, Roy Wright, at (202) 646-2781.

Sincerely,

W. Craig Fugate

Administrator

Introduction

Pursuant to Section 100232, paragraphs (a) and (c) of the *Biggert-Waters Flood Insurance Reform Act of 2012* (Biggert-Waters Act), this Report addresses the two required reports to Congress by providing one combined report on (1) reinsurance: transferring NFIP risk to the private sector reinsurance and capital markets and (2) privatization: options, methods and strategies for privatizing the National Flood Insurance Program (NFIP).

FEMA requested, and Congressional staff concurred,[1] that the two Congressional reports be submitted as a single combined report to permit Congress to review both topics concurrently. The two topics are interrelated in a number of important ways, specifically:

- Any pathway to privatizing the NFIP would involve considerations of reinsuring the flood insurance risk, first as an initial measure by the NFIP and then as a critical part of most privatization scenarios;

- Considerations for both privatizating the NFIP and reinsuring NFIP risk require the use of catastrophe models to present the NFIP risk profile in a format similar to that used by the private sector reinsurance firms and property and casualty insurance companies to analyze and price other catastrophic perils such as wind risk and earthquake risk.

The Biggert-Waters Flood Insurance Reform Act of 2012, Section 100232, requires that FEMA conduct assessments and provide several reports to Congress. This report addresses two of those required assessments and reports, which are:

- **Transferring NFIP Risk through Reinsurance**:
    a. Section 100232 (c)(1)(A): Conduct an assessment of the capacity of the private reinsurance, capital and financial markets to assume a portion of the insurance risk of the NFIP, and
    b. Section 100232 (c)(1): Submit a report on the findings of the reinsurance assessment, including:
        i. Determining the cost of transferring risk through reinsurance and assessing whether any proposed reinsurance rates are:
            1. reasonable and appropriate, and
            2. sufficient to maintain the ability of the NFIP to pay claims,
        ii. Describing likelihood of minimizing NFIP borrowing through carrying out reinsurance,
        iii. Describing the fluctuations in historical reinsurance rates, and
        iv. Presenting a cost-benefit analysis of the impact on the NFIP of securing reinsurance from the private markets.

[1] The House Financial Services Committee Staff concurred with FEMA providing a single combined report in December 2015 and the Senate Banking Committee Staff concurred in February 2015.

- **Privatizing the NFIP:**
    a. Section 100232(a)(1): Conduct an assessment of options, methods and strategies for privatizing the NFIP, and
    b. Section 100232(a)(2): Submit a report with recommendations for the best manner to accomplish privatization.

To provide information relative to the assessments, FEMA engaged a contractor, Guy Carpenter & Company LLC ("GC"), to perform a Flood Insurance Risk Study (FIRS). The one-year FIRS project commenced in late 2013 and intensively studied NFIP privatization and reinsurance issues. It also introduced a probabilistic model for projecting NFIP financial results under a variety of scenarios. That new NFIP catastrophic risk model provided quantitative results in a manner similar to the way that the private sector insurance industry presents the effects of other catastrophic perils such as earthquake and wind events.

Section I of this report provides a background for the FIRS project and a description of the studies provided by GC, which includes a Reinsurance Study and a Study of Options for Privatizing the NFIP.

Section II of this report presents the Reinsurance Study.

Section III of this report presents Options for Privatizing the NFIP.

Section IV of this report describes FEMA's approach for adopting the Federal Data Protocol required by BW-12, Section 100232(c)(2).

Appendix A contains the complete legislative language of the Biggert-Waters Act section that this report addresses.

Appendix B is the GC Flood Insurance Risk Study: Reinsurance Study

Appendix B1 is Technical Appendices to GC's Reinsurance Study.

Appendix C is the GC Flood Insurance Risk Study: Options for Privatizing the NFIP.

Biggert-Waters Flood Insurance Reform Act of 2012
Flood Insurance Risk Study:
Reinsurance Study
Options for Privatizing the NFIP

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Background

FEMA commissioned the Flood Insurance Risk Study (FIRS) to comply with the requirements set forth in Section 100232 "Reinsurance," paragraphs (a) and (c) of the Biggert-Waters Act.

The studies resulting from the FIRS project, included in Appendices B and C of this document, were prepared by Guy Carpenter & Company LLC ("GC"), a leading reinsurance brokerage firm, and by Oliver Wyman, Inc. and AIR Worldwide acting as Subcontractors to GC in connection with Contract No. HSFE60-13-C-0056, effective September 30, 2013. FEMA awarded the contract to GC due to GC's expertise in the property and casualty (P&C) insurance and reinsurance markets, its in-house reinsurance database, and its ability to model the NFIP risk profile using three respected commercial models of catastrophic flood insurance risk developed by AIR Worldwide, RMS, and EQECAT. GC provided the two major studies, enumerated below, to FEMA in September 2014. They are attached as appendicies for this report to Congress:

Appendix B: The Reinsurance Study
Appendix C: Options for Privatizing the NFIP

Those two major studies are the work of FEMA contractors and do not necessary present (1) FEMA's views, or (2) authoritative reports of NFIP programmatic details. However, the studies do provide critical information about:

1. The financial and insurance markets and the ability to transfer NFIP insurance risk to the private sector and
2. Options and considerations for privatization of the NFIP.

The Reinsurance Study articulates the range of financial risk transfer mechanisms available from the private insurance and capital markets, and those mechanisms' applicability to the NFIP. Additionally, it details the current state of the P&C insurance and reinsurance markets and provides an historical perspective of market cycles and trends in insurance and reinsurance rate and capacity levels. It also provides details of how several versions of hypothetical NFIP reinsurance programs could be designed and selected. Finally, it shows how the most comprehensive of those hypothetical reinsurance programs might perform if implemented.

The Study of Options for Privatizing the NFIP presents the important considerations and challenges relating to options for NFIP privatization, including:

- A review of international case studies,
- NFIP stakeholder perspectives,
- The considerable hurdles confronting potential privatization strategies, and
- Considerations for managing the range of services that the NFIP provides in addition to insurance if the NFIP were to be privatized.

FEMA is not making a recommendation at this time regarding "the best manner to accomplish the privatization" of the NFIP. Any specific privatization strategy is complex and involves significant policy decisions that would require a variety of stakeholders to have input. FEMA is presenting this report without a recommendation to provide Congress and other policy makers with access to the wealth of data and the information presented in the two studies.

Upon the completion of the FIRS project FEMA determined that reinsuring a portion of the NFIP's insurance risk would be a logical step toward privatization and could provide an additional lever in the financial management of the NFIP. FEMA therefore decided to establish a working group to recommend whether to implement a small pilot reinsurance program to study NFIP reinsurance in greater detail. The objectives of the working group are to:

- Examine the issues that would arise from the establishment of an NFIP reinsurance program,
- Develop a design, a marketing plan, and the contractual language for a pilot reinsurance program,
- Specify the knowledge to be gained from a pilot program, and
- Recommend whether to implement a pilot program.

The working group expects to complete its work during fiscal year 2016.

I. The Reinsurance Study

The Reinsurance Study, included in Appendix B with technical appendices included in Appendix B1, provides assessments of the P&C insurance industry and the reinsurance markets from both current and historical perspectives, including their capacity to take on the catastrophic risk of flood insurance, and a cost benefit analysis of transferring NFIP insurance risk to the private sector.

The study indicates that the world's reinsurance markets[2] currently have available capacity and interest in providing coverage for a portion of the NFIP's catastrophic risk. The reinsurance markets' interest in the NFIP is due to the following:

- The recent emergence of "convergence capital," i.e., capital providing risk transfer capacity that is coming from non-traditional sources, such as pension funds;
- Favorable recent loss experience of the reinsurance markets in covering catastrophic insurance risks;
- The increasing capital available to the primary P&C insurance companies, resulting in less of a need for them to purchase reinsurance coverage;
- The opportunity that the NFIP presents for the reinsurance markets to diversify their risk profiles.

On the other hand, the current lack of understanding of the details and the magnitude of the NFIP's catastrophic risk is likely to limit the capacity those markets would be willing to provide in the near term. To effectively communicate the NFIP's risk to the reinsurance markets, the NFIP's insurance risk must be modeled in the same manner used to model the catastrophic risk of other perils, such as earthquake and hurricane wind using the latest generation of risk models. On the other hand the NFIP's current statistical method of developing an aggregate risk estimate is rudimentary compared to the detailed flood risk models now becoming available commercially.

Although still in its infancy, there has been recent progress in the modeling of US flood insurance risk by a number of commercial modeling firms using advanced statistical modeling techniques. The FIRS project utilized three prominent commercial models to estimate the current NFIP risk profile. The results included quantification of the NFIP's catastrophic risk, which is large compared with other public insurance programs, such as state sponsored insurance programs like the Florida Citizens Property Corporation, the California Earthquake Authority and the North Carolina Joint Underwriting Association/Insurance Underwriting Authority. Those three smaller public insurance programs rely on a number of mechanisms to manage their catastrophic risk including reinsurance, authority to assess their participating insurance company and policyholders, and large cash reserves. (Please see pages 155-160 of Appendix B for a detailed comparison of the NFIP to other public insurance programs.)

[2] The term, "reinsurance markets," as used in the Reinsurance Study (attached as Appendix B) refers to the firms of the global reinsurance industry. The major global reinsurance firms operate internationally with centers in London, continental Europe, Bermuda, New York City and Asia.

Unlike other public programs, the NFIP relies almost entirely on the ability to borrow from the U.S. Treasury when claims losses exhaust the National Flood Insurance Fund. U.S. Treasury borrowing has historically provided the NFIP with a retrospective source of risk funding. By comparison, transferring its insurance risk to the private sector through reinsurance would be a more expensive alternative for the NFIP.

The Reinsurance Study at Appendix B includes analyses of several hypothetical NFIP reinsurance programs. For example, "Option 1," described on page 162 and following, would provide $17 billion of reinsurance coverage after the NFIP had paid out $8 billion in aggregate losses in a given calendar year. The expected annual reinsurance recovery from Option 1 was estimated to be $0.8 billion, while the estimated gross annual cost would be $2.2 billion or 2.75 times the estimated annual recovery, a ratio that is fairly typical for comparable catastrophic reinsurance programs. The $2.2 billion annual cost of such a reinsurance program is large, however, when compared to the current aggregate annual premium of the NFIP of $3.7 billion, and raises the question of how the NFIP would fund a significant reinsurance program.

There are important reasons that the NFIP might consider transferring risk through reinsurance, despite the cost. A significant reinsurance program would:

- Stabilize the NFIP financial results, thereby reducing the probability of borrowing after large flood events;
- Help to establish a routine reinsurance facility for flood risk among the global reinsurance markets, thereby providing assurance to the P&C insurance industry that reinsurance would be available for primary insurance companies considering entering the US residential flood insurance market.
- Provide data to the NFIP regarding private sector pricing levels, i.e., "market pricing," for flood insurance.

A cost benefit analysis of the NFIP engaging in reinsurance is presented in the final third of the Reinsurance Study.

II. The Privatization Study, "Options for Privatizing the NFIP"

The Privatization Study, included in Appendix C, presents a comprehensive review of the key issues involved when evaluating the options, methods, and strategies for privatizing the NFIP. The study presents issues assembled from case studies of how flood risk is handled in other countries, reviews U.S. stakeholder perspectives, and considers privatization options for the NFIP.

A. International Case Studies

The Privatization Study examined the treatment of flood risk in other nations, focusing on the United Kingdom, the Netherlands, France, and Spain. Review of the evolution of flood coverage in those nations and the resulting insurance structures provides valuable contributions to the NFIP privatization dialogue, particularly regarding the question of mandatory purchase requirements. However, the case studies also show that the United States is unique in many ways, including the nature and magnitude of the U.S. flood insurance risk, the Federal/state insurance regulatory dichotomy, and the long established history of the NFIP including its wide variety of flood-related services. Those key differences make it difficult to draw conclusions from examples abroad.

B. Privatization Hurdles and Considerations

Most stakeholders interviewed in the course of the Privatization Study agreed that greater private market participation in the flood insurance market would potentially provide benefits for the public. They also identified the following hurdles to attracting participation by primary P&C insurance companies under any NFIP privatization strategy:

- **Availability of data and analytics**: Primary insurance companies need comprehensive data and robust analytics to evaluate the flood risk. The difficulties in finding and sharing data on flood exposures and losses, as well as in developing credible analytics for modeling exposures and losses present significant challenges;
- **Underwriting freedom and full risk rates**: Primary insurers must have sufficient underwriting freedom, including in rate-making, contract form design, and the selection of risks. Assurance of the ability to establish adequate premium rates is key;
- **Market size**: There must be a large enough potential market for flood insurance, so that the expected returns would compensate insurers for their start-up costs and so that adverse selection by policyholders would be minimized;
- **Competition from the NFIP**: There is a perception that NFIP premium rates undercut those that would be available from the private sector;
- **Insurability of the flood risk**: The private sector insurers' concerns about the catastrophic nature of the U.S. residential flood insurance risk indicates that a robust reinsurance market for flood insurance, as well as a significant continuing Federal presence in the residential flood insurance market, would probably be necessary in

order to attract significant private sector participation. For example, the insurance markets might call on the Federal Government to provide reinsurance protection for catastrophic flood events.

In addition to the challenges of attracting private sector participation in the residential flood insurance market, privatizing the NFIP would present the following key challenges for Federal policy makers:

- Retiring the NFIP's current $23 billion debt which is likely to grow larger, not smaller, over the near term;
- Providing affordable flood insurance for at-risk structures situated in flood-prone areas;
- Providing U.S. communities and the public with the wide variety of services, other than insurance, for which FEMA is responsible and which are largely financed by NFIP revenues, including:
  - Floodplain mapping,
  - Floodplain management policy setting and technical assistance,
  - Building science research and technical assistance,
  - The Hazard Mitigation Assistance Programs,
  - The Community Rating System (CRS).[3]
- Ensuring that U.S. communities would be at least as well-protected from major flood events after privatization as before.

It should be noted that even if the Federal government does not engage in an explicit strategy to privatize the NFIP, the passage of the Biggert-Waters Flood Insurance Reform Act of 2012 may have provided an implicit one. As FEMA gradually raises most NFIP premiums to the full risk levels required by the Act and imposes the additional charges that finance the NFIP Reserve Fund, FEMA expects several NFIP premium categories to reach the threshold levels that would attract private sector interest in providing flood insurance. While the subsequent passage of the Homeowner Flood Insurance Affordability Act of 2014 delayed some of those premium increases, it generally has not rescinded them. Therefore, over time the residential flood insurance market may naturally evolve into a system with much greater private sector participation.

[3] The NFIP's Community Rating System (CRS), established in 1990, is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

C. Privatization Options

Section 4 of the Privatization Study presents a discussion of options and strategies for privatizing the NFIP. That section, included in pages 50 to 94 of the Study, is organized into the following five parts:

- Approaches to flood risk financing – offering a decision framework for evaluating the various privation options;
- Hurdles to privatization – presenting the five major hurdles that have historically inhibited the private sector from addressing the flood insurance needs of residential risks in the United States (the five hurdles are presented in greater detail in Appendix B, pages 101 to 108, of the Study);
- Privatization options for the NFIP – introducing five primary alternatives for increasing the private sector's role in flood insurance;
- Selecting a pathway to privatization – presenting the challenges and timing issues of a transition strategy; and
- Additional considerations – addressing the complex of further issues that would evolve from in any privation strategy.

III. The Federal Data Protocol

The Federal Data Protocol required by the Biggert-Waters Act, Section 100232(c)(2) is important because a common rationale articulated by private sector insurers for not entering the flood insurance market is that they cannot obtain the granular, detailed data from the NFIP that is necessary for them to assess the U.S. flood risk. Under the Privacy Act of 1974, FEMA must protect "personally identifiable information" ("PII"), such as names and addresses of building owners that are NFIP policyholders, from unauthorized uses. FEMA has adopted a two-phased approach to meeting, and in fact going beyond, the requirement of the Act, as follows:

A. FEMA has revised the System of Record Notice (SORN) for the NFIP Legacy Systems to expand the list of "routine uses" to include providing PII data to reinsurance companies that bid on FEMA "requests for proposal" ("RFP").

B. FEMA is exploring the idea of routinely providing detailed, granular NFIP policy and claims data, scrubbed of PII, to authoritative entities who make appropriate requests for that data.

Appendix A: Legislative Language

This report has been prepared in response to requirements included in the *Biggert-Waters Flood Insurance Reform Act of 2012*, (Pub. L. No. 112-141). The applicable sections are as follows:

A. SEC. 100232. REINSURANCE.

(a) FEMA AND GAO REPORTS ON PRIVATIZATION.—Not later than 18 months after the date of enactment of this Act, the Administrator and the Comptroller General of the United States shall each—

(1) conduct a separate study to assess a broad range of options, methods, and strategies for privatizing the National Flood Insurance Program; and

(2) submit a report to the Committee on Financial Services of the House of Representatives and the Committee on Banking, Housing, and Urban Affairs of the Senate with recommendations for the best manner to accomplish the privatization described in paragraph (1).

(c) REINSURANCE ASSESSMENT.—

(1) PRIVATE MARKET PRICING ASSESSMENT.—Not later than 12 months after the date of enactment of this Act, the Administrator shall submit to Congress a report that—

(A) assesses the capacity of the private reinsurance, capital, and financial markets to assist communities, on a voluntary basis, in managing the full range of financial risks associated with flooding by requesting proposals to assume a portion of the insurance risk of the National Flood Insurance Program;

(B) describes any responses to the request for proposals under subparagraph (A);

(C) assesses whether the rates and terms contained in any proposals received by the Administrator are—

(i) reasonable and appropriate; and

(ii) in an amount sufficient to maintain the ability of the National Flood Insurance Program to pay claims;

(D) describes the extent to which carrying out the proposals received by the Administrator would minimize the likelihood that the Administrator would use the borrowing authority under section 1309 of the National Flood Insurance Act of 1968 (42 U.S.C. 4016);

(E) describes fluctuations in historical reinsurance rates; and

(F) includes an economic cost-benefit analysis of the impact on the National Flood Insurance Program if the Administrator were to exercise the authority under section 1335(a)(2) of the National Flood Insurance Act of 1968 (42 U.S.C. 4055(a)(2)), as added by this section, to secure reinsurance of coverage provided by the National Flood Insurance Program from the private market.

(2) PROTOCOL FOR RELEASE OF DATA.—The Administrator shall develop a protocol, including adequate privacy protections, to provide for the release of data sufficient to conduct the assessment required under paragraph (1).

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FLOOD INSURANCE RISK STUDY

Reinsurance Study

FEDERAL EMERGENCY MANAGEMENT AGENCY

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Prepared by ("Consultant"):

Project Lead: Jake Clark, Guy Carpenter
Lead Report Author: Alex Bernhardt, Guy Carpenter
Contributing Authors / Reviewers:

- *Guy Carpenter*: Greg Alberti / Cory Anger / Lucy Dalimonte / Jonathan Hayes / Rob Mckenzie / Lara Mowery / Chris Sykes / John Tedeschi
- *AIR Worldwide*: Brandie Andrews / David Lalonde / John McIlwaine / John Rowe
- *Oliver Wyman*: Dennis Chira / Matthew Leonard

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EXECUTIVE SUMMARY

This study of financial risk transfer mechanisms and their possible applicability to the National Flood Insurance Program (NFIP) is a part of the Flood Insurance Risk Study (FIRS) that was commissioned by FEMA to comply with the requirements set forth under Section 100232 paragraphs (a), (c) and (e) of the Biggert-Waters Flood Insurance Reform Act pertaining to private reinsurance. This report was prepared by Guy Carpenter, acting as the lead contractor in connection with Government Contract No. HSFE-60-13-C-0056, effective September 30, 2013. Guy Carpenter's sub-contracting partners AIR Worldwide, Oliver Wyman and Marsh also contributed to this report.

The objective of this report is to articulate the range of financial risk transfer mechanisms available in the private market and their possible applicability to the NFIP. The study includes a survey of the (re)insurance and capital markets' past, present and possible future capabilities and capacities to partner with the NFIP. The study also evaluates the potential costs and benefits to the NFIP and its policyholders and stakeholders in securing reinsurance to stabilize future loss activity. The topics addressed in this study are included in three broad sections detailed as follows:

- **Current Market Assessment (Present)**
    - The contents of this section were drawn from literature research, market interviews, Guy Carpenter's knowledge of market trends and capital providers, and economic modeling and analysis conducted as part of the FIRS project.
    - Research contemplated and included a broad array of industry sectors including the US insurance market (including private US Property & Casualty insurers and State-operated residual markets), global reinsurance market (including both traditional and alternative, insurance linked securities providers) and the global capital markets.
    - The analysis outlines the current dynamics at play across these various private (and public in the case of residuals) risk transfer markets with a view toward determining their potential capacity to finance US flood risk on either a primary or secondary portfolio basis.
    - To round out this section, a high-level overview of the reinsurance market is provided including the organizations that support such business (both traditional reinsurers as well as capital market providers), and the initial secondary capacity potentially available to support the NFIP today and over the medium-term.
- **Historic Market Assessment (Past)**
    - This section is designed to provide the NFIP an historic context within which to place the Current Market Assessment.
    - The analysis summarizes market trends across the US insurance and global reinsurance market over the past two to three decades looking at both the asset and liability (underwriting) side of (re)insurer income statements. Detailed assessments of historical (re)insurer capacity and pricing are also included.
    - Perspective is provided around the insurance cycle and the multifarious market and human factors giving rise to it.
    - Some particular attention is paid in this section to the ongoing shift in the global property catastrophe reinsurance market given the relatively recent entrance of third-party investors and the rise in usage of insurance linked securities.
- **Cost Benefit Analysis (Future)**
    - Finally, this section builds off of the research and findings put forth in the Current and Historic Market Assessments. It is designed to answer two questions:

- Can the financial markets be expected to provide enough capacity to meaningfully lessen the financial consequences of the NFIP's flood claim volatility and thereby reduce the degree to which the NFIP might be required to call on the US Treasury and by extension US taxpayers for further financial assistance?
- What are the cost-benefit implications of such support under different financial scenarios?

While this study (part A of the FIRS project) is a standalone report designed to convey the ability of the (re)insurance sector to support the NFIP's mission, it should be read in the context of the other technical studies submitted by the Consultant alongside it, including the Privatization Study (part B of the FIRS project) and the Flood Insurance Financial Model (part C of the FIRS project). The insights and analyses offered herein are the result of the project team's best efforts to complete a thorough, well-rounded and unbiased review of complex and nuanced subject matter. Descriptions of market segments and risk transfer options available to NFIP were rendered as complete and detailed as possible given the timeframe provided to complete the project.

CURRENT MARKET ASSESSMENT

1 PREFACE

For reference, FEMA's preliminary guidance as presented in the Flood Insurance Risk Study (FIRS) project Request for Quotes (RFQ) and carried forward into the Consultant's Performance Work Statement (PWS) is restated in Table 1 with respect to the Current Market Assessment section of the Reinsurance Study.

Table 1 – National Flood Insurance Program Flood Insurance Risk Study; Reinsurance Study; Current Market Assessment Description

NFIP FIRS Reinsurance Study Current Market Assessment Description
The Contractor shall perform an assessment of the *capacity* of the private sector insurance, reinsurance, capital and financial markets to assume portions of the insurance risk of the NFIP. The Contractor is expected to: a. Determine the type of information requested by reinsurance firms to provide an appropriate quote. b. Conduct literature research, investigations, modeling and analyses to study the private sector's *capacity* to assume a significant portion of the flood insurance risk of the United States and report the results of those investigations to FEMA. The research should include analyses of a broad array of instruments, including insurance, reinsurance, catastrophe bonds, weather derivatives, flood insurance pools, microinsurance, insurance arrangements directly with local communities, including tribal governments, and any other appropriate instruments. c. Identify the companies, associations and organizations, including appropriate organizations outside the United States that could provide such *capacity*.

Consistent with the above this analysis will outline the current dynamics of various private risk transfer markets[1] with a specific view towards determining their potential capacity to finance US flood risk. The report will also outline typical reinsurance processes and procedures in the interests of helping the NFIP more fully assess the means of utilizing its ability to purchase private reinsurance.

Despite a variety of challenges, which must be addressed in order to place the National Flood Insurance Program (NFIP) back on firm financial footing, the private financial markets including the reinsurance sector can play a meaningful role in the organization's reform efforts, whatever shape they may ultimately take. While it should be recognized that engaging private risk transfer markets in and of itself is unlikely to provide the solution to all of the NFIP's various challenges it remains

[1] Note per common practice the term "markets" herein is used variously to refer to both marketplaces (e.g. the reinsurance market) as well as risk-bearing entities individually (e.g. XYZ Re is a market for flood risk).

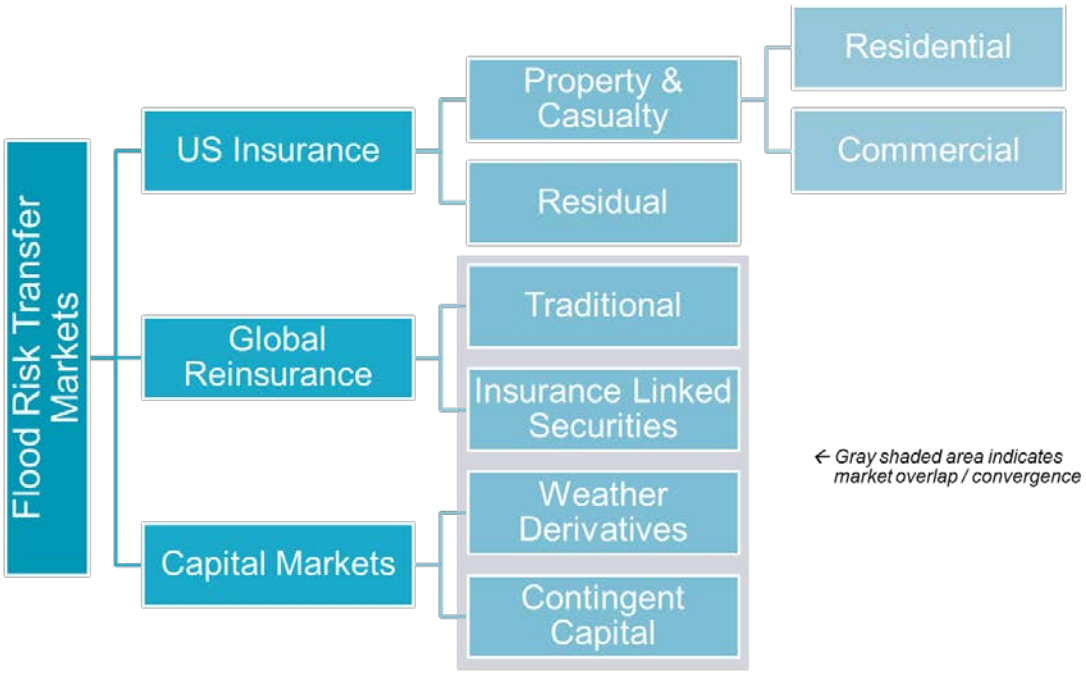
important to highlight what role private risk transfer markets can play potentially as part of a comprehensive risk management strategy for NFIP and FEMA as the US Government looks to address the NFIP's known design issues that have led to its current debt to the US Treasury.

2 MARKET LANDSCAPE

In order to assess the capacity of the private insurance, reinsurance and capital markets to assume portions of the primary property insurance risk of the NFIP, it is useful to establish a schema through which potential risk bearers[2] may be investigated. Figure 1 outlines the framework used within this portion of the Reinsurance Study report.

This framework divides potential flood risk transfer markets in the US into 3 primary segments and corresponding sub-segments. It can be a challenge to maintain crisp delineations between financial market segments since roles and attentions can and do shift. For instance, much is presently being made of the ongoing convergence of the reinsurance and capital markets across the insurance linked securities (ILS) space (represented in Figure 1 below by the grey shaded area). Another implication that must be considered when addressing issues related to catastrophe management is the influence of quasi-public entities (e.g. state-level residual markets) on private sector dynamics. Acknowledging these factors, we have attempted to point out where overlaps exist.

Figure 1: Schematic of Potential Private US Flood Risk Financing Markets



The three main market segments are addressed in the following order herein: (1) US Insurance, (2) Global Reinsurance, and (3) Capital Markets. For each of these segments and accordant sub-segments, we evaluate:

- Current market size as measured by premium and/or limit where available;
- Current market capacity as measured by available risk capital and;

[2] This paper only addresses *ex ante* risk financing mechanisms. *Ex post* mechanisms, such as fiscal budgetary reallocations, emergency loans or the sale of assets to pay for flood losses after they have occurred, are not addressed.

- Current key participants in each sector by market share.

Following this assessment we characterize each segment's current appetite for and underwriting approach to flood risk. We also posit certain ways in which this appetite may be expanded and outline some of the challenges to such expansion. Since many aspects of the current US private flood insurance market are somewhat opaque (e.g. private flood insurance is rarely reported by insurers as a separate line of business), we focus on the general capacity of insurers to assume a new class of catastrophe risk. Ultimately, our goal is to determine the private sector's capacity to assume US flood risk across a variety of privatization scenarios, which will be explored further in separate parts of the FIRS project.

A. US Insurance

The US Insurance market is divided generally into three broad segments: Property and Casualty (P&C), Accident and Health (A&H) and Life. For the purposes of this analysis only the P&C segment is directly relevant to NFIP so our analysis focuses thereon. The US P&C market constitutes a diverse amalgamation of business lines and carrier types. For the sake of facilitation we have divided our assessment between the private P&C and the public state-level residual property markets. Within the P&C market separate attention is paid to admitted versus non-admitted policy issuance, residential versus commercial risk and primary versus excess coverage forms.

1. Property & Casualty Market

Collectively the US Property and Casualty (P&C) insurance industry booked $523 billion in Direct Written Premium (DWP) in 2012. Catastrophe exposed lines of business (LOBs) accounted for $238 billion of this total, or about 45%[3]. The largest P&C insurers in the US market (all lines) and the largest catastrophe insurers are listed by group market share in Figures 2 and 3[4]. The top 10 carriers are the same in both lists, albeit in a somewhat different order.

[3] Source SNL; Catastrophe Risk LOBs include: Allied Lines; Commercial Auto Physical Damage; Commercial Multiple Peril (Non-Liability); Earthquake; Farmowners Multiple Peril; Federal Flood; Fire; Homeowners Multiple Peril; Inland Marine; Multiple Peril Crop; Private Passenger Auto Physical Damage.

[4] All market share exhibits in this report come from SNL data and are for the 2012 year unless otherwise noted.

Figure 2: US Property & Casualty Industry Market Share, All Lines

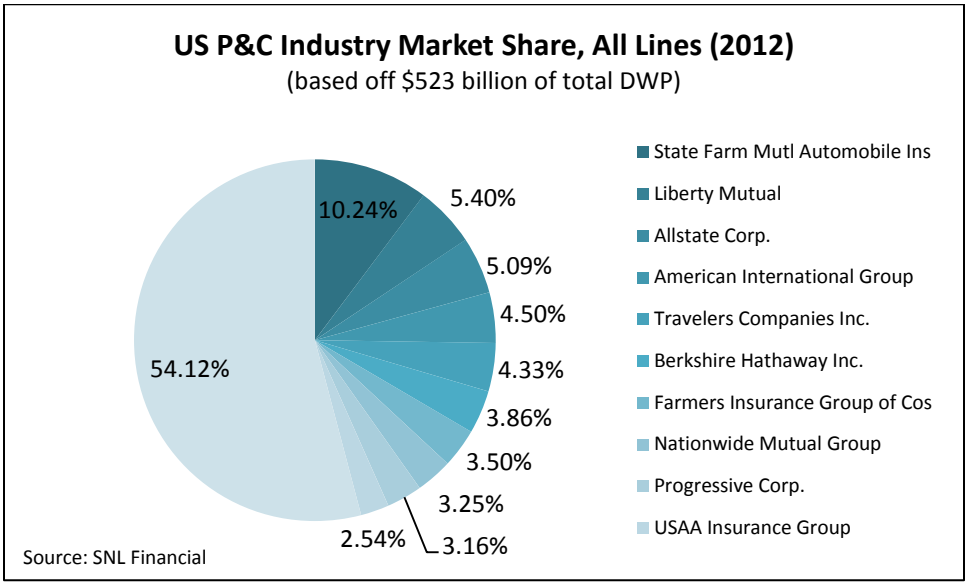
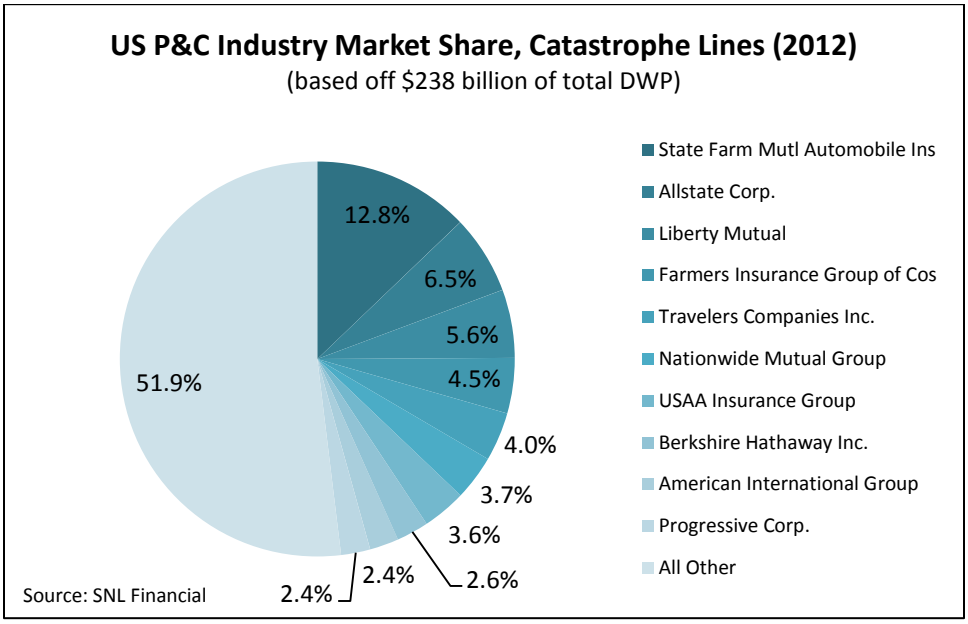


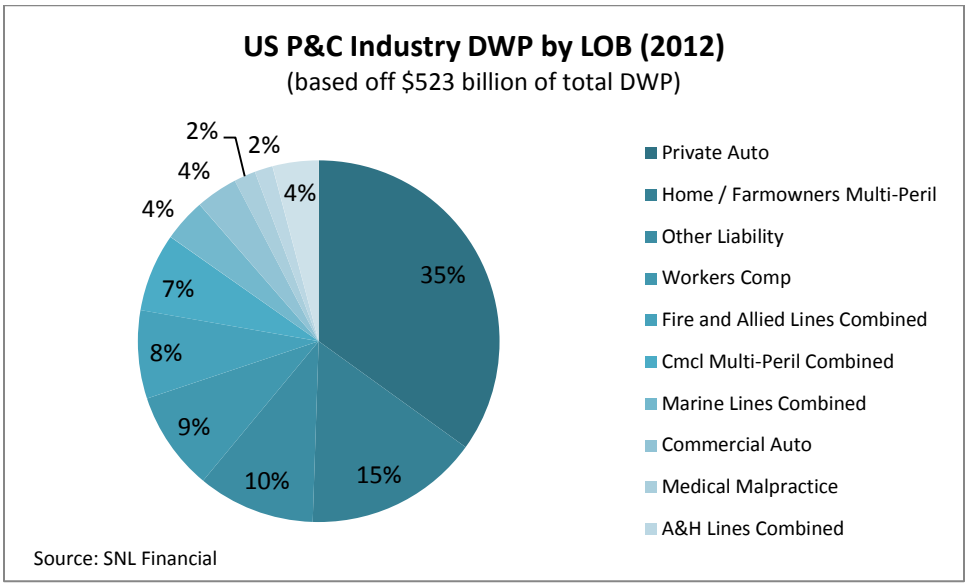
Figure 3: US Property & Casualty Industry Market Share, Catastrophe Lines



Given the catastrophic nature of the flood peril and the lines of business written through the NFIP, we focus our analysis on catastrophe-exposed property lines of business. This is consistent with our ingoing hypothesis that companies operating in lines of business adjacent and related to flood are the most likely to provide additional or new flood risk transfer capacity in future. We also recognize up front that most property insurers also underwrite casualty risk and utilize their underwriting capital to support both classes and have made adjustments to our analysis accordingly.

This stated Figure 4 illustrates the composition of the U.S. P&C market by line of business. Private and Commercial Auto insurance together constituted almost 40% of total market DWP in 2012. Whereas the main property-driven coverages including Homeowners and Farmowners (HO+FO), Fire and Allied Lines and Commercial Multi-peril constituted around 30%. It should also be noted that some catastrophe lines of business, such as Auto Physical Damage, which can include Comprehensive coverage, are not highly relevant to NFIP's business though contribute a great deal to the exposure of some of the largest catastrophe exposed insurers listed in Figure 3. For example, Progressive, which is a leading auto insurer, does not figure in the top 100 Homeowners carriers[5].

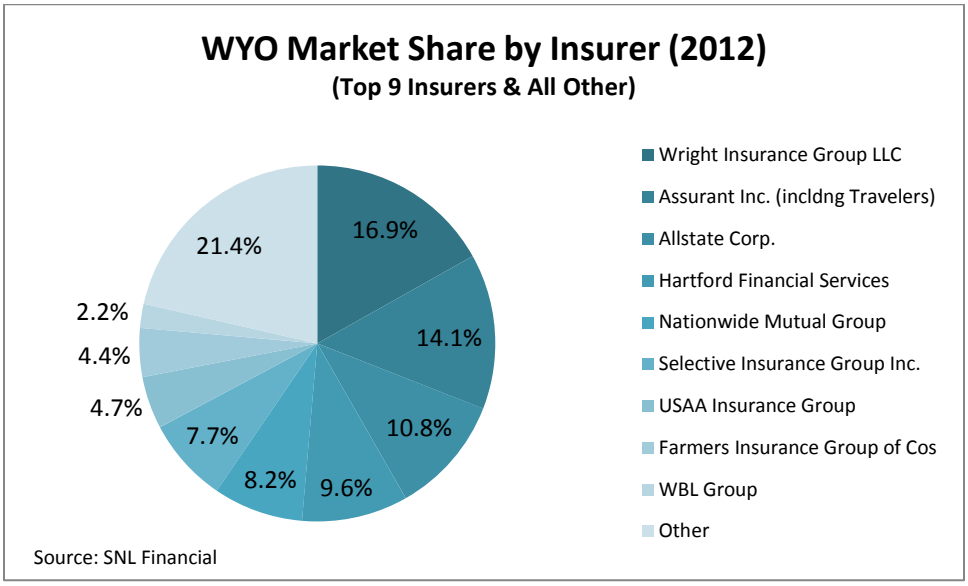
Figure 4: US Property & Casualty Industry Direct Written Premium by Line of Business



It is also important to recognize that the NFIP has an active relationship with the private US P&C insurance market through its "Write-Your-Own" (WYO) program. Over 80 insurers are currently registered as WYO carriers and are authorized to sell NFIP policies to the general public. Of these over 30 are also registered under NFIP's Mortgage Portfolio Protection Program (MPPP). The top nine WYO carriers are shown in Figure 5 by their share of total WYO premium placed in 2012 (please note that Travelers' WYO portfolio which was purchased in 2013 by Assurant has been added to Assurant's share in 2012 for illustrative purposes and business managed by NFIP's Direct Servicing Agent (DSA) is not included in the total).

[5] Note: most auto policies with comprehensive physical damage protection cover losses from flood. Note some mobile home coverages are also written on Auto forms.

Figure 5: Write-Your-Own Carrier Market Share (excluding NFIP direct serviced business)



Since the US P&C insurance industry is a likely source of private flood risk capacity and many major players are already involved in the flood space through the WYO program these carriers will play a role in any potential NFIP privatization effort. Indeed an effort to privatize the program using primary insurer capacity would enable WYO carriers to put their expertise in flood risk gleaned through WYO participation to further use. This would be consistent with FEMA's stated goals with respect to the operation of the WYO program which are as follows[6]:

- Increase the NFIP policy base and the geographic distribution of policies;
- Improve service to NFIP policyholders through the infusion of insurance industry knowledge;
- Provide the insurance industry with direct operating experience with flood insurance.

As such these carriers warrant special attention. Their current and prospective role in the US flood market will therefore be analyzed further in subsequent sections.

Another important up-front consideration is the nuance of property coverage provision in the US. Table 1 below describes the main catastrophe perils covered by various lines of property business. It also calls out the methods and means by which certain perils are addressed and covered (or excluded) by the market today. As is clear from this chart, flood risk is currently underwritten by the private market using a variety of different coverage forms and techniques.

[6] http://www.fema.gov/national-flood-insurance-program/what-write-your-own-program

Table 2: Perils covered under select[7] catastrophe exposed lines of business.

Select Catastrophe Exposed Lines of Business (LOB)[8]	Main Natural Catastrophe Peril(s)	Comments	US DWP, 2012 ($000, SNL Financial)
Homeowner and Farmowners (HO+FO)	Hurricane (HU); Straightline Wind; Tornado/Hail; Wildfire; Weight of Snow and Ice; Fire Following EQ	Standard EQ and *Flood* exclusions; sewer back up and mold coverage non-standard; excluded perils can be written back in via endorsement or via accompanying peril-specific policy	$82,111,923
Fire	Wildfire; Conflagration	Covers both residential and commercial risks	$30,528,199
Commercial Multiperil	Same as HO+FO; EQ; *Flood*	Coverage often provided on an "all risks" basis; catastrophe perils often sublimited	$23,501,754
Inland Marine (IM)	Same as HO+FO; sometimes EQ and *Flood*	Covers both residential and commercial risks; Difference in Conditions (DIC) policies which fill in standard coverage gaps (e.g. EQ/*Flood*) are often written on IM forms	$15,756,978
Allied Lines	Same as HO+FO; sometimes EQ and *Flood*	Covers both residential and commercial risks; Dwelling Fire policies for low-income or second homes often written on Allied forms; Allied coverage often written appurtenant to standard property coverage (e.g. standalone Wind in FL)	$12,883,301
Federal Flood[9]	*Flood*	NFIP Write-Your-Own (WYO) carriers only; no risk borne by private market	$2,876,016
Earthquake (EQ)	EQ	Named peril coverage only; sometimes termed as "earth movement"	$2,847,490

To further summarize Table 2, the three main methods by which flood policies can be issued include:

- As an **endorsement** to an existing property policy;
- As a **standalone** Allied Lines, Inland Marine or Named Peril policy or;
- As a **covered peril** in a standard HO+FO or Commercial Multiperil property policy.

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[7] Some catastrophe exposed LOBs are excluded from this table as deemed irrelevant to this study. These include: Commercial Auto Physical Damage; Multiple Peril Crop and; Private Passenger Auto Physical Damage

[8] For a full description of what is covered by each line of business refer to the NAIC: http://www.naic.org/documents/industry_rates_pc_matrix.pdf and http://www.naic.org/documents/library_home_business_definition_pc.pdf

[9] Federal Flood LOB in SNL only includes NFIP premium written via WYO program. NFIP direct business not captured.

Unfortunately, due to this diversity of policy issuance treatment within the context of current insurance industry reporting standards it is difficult to adjudge the precise magnitude of the private flood market. Nonetheless, we have done our best to identify the key carriers operating in each sub-segment of the private flood market. Overall, the NFIP has very limited private market competition in the primary flood insurance market. Though beyond the NFIP's current purview – or more explicitly in the excess residential and commercial insurance markets – flood capacity is regularly deployed and in meaningful amounts by a variety of insurers.

Based on our estimations which are covered in more detail in subsequent sections, the market for private flood insurance in the US is fairly vibrant with a reasonably long list of active players particularly in commercial lines. Primary residential flood providers are not as common – unsurprising given the function and presence of the NFIP. Most private residential flood insurance is being conducted on an excess basis with a focus on high-value homes. In total, the market for private residential flood is a fairly modest niche when measured by overall premium volume and value at risk.

On the other hand the market for primary and excess commercial flood coverage in the US is fairly significant in overall size in part because many commercial policies are written on an "all risks" basis. Mitigating the size of this segment is the common practice of sublimiting the peril of Flood to some amount lower than the full value of the insured property and the usual incidence of substantial Self-Insured Retentions (SIRs) held net by insureds on large commercial accounts. While this is important from the standpoint of industry underwriting expertise, since only 5% of NFIP policies are non-residential[10] and since private market flood solutions (at least for medium-to-large risks) are already reasonably abundant in the commercial market, any potential difficulty in attracting private capital to the US flood business will center on the residential market. This is further demonstrated through high-level industry risk analysis which shows that commercial exposures are far less at risk to the peril of storm surge than residential exposures (see Appendix D – AIR Industry Storm Surge Modeling Methodology).

In terms of capacity, the US P&C industry is currently very well capitalized with total capital and surplus standing at nearly **$600 billion** as of year-end 2012 after posting a five-year average net income of $27 billion – about a 5% return on average equity over the same time period. These facts bespeak a generally healthy operating sector and emphasize the resilience of the sector to the financial crisis which did not impair many carriers certainly relative to the banking sector where significant regulation was required to stabilize the system. With capital levels as high as they have ever been and a DWP-to-surplus ratio of 0.88, the industry seems generally well positioned to deploy more of its capital to assume more and diverse risk. This could bode well for any attempts by the US Government to further engage the private market in the financing of US flood risk.

This being said, while the financial position of the industry is certainly favorable at present, not all metrics are rosy. For instance, the industry posted a combined ratio of 103% in 2012 resulting in a meaningful underwriting loss. While the first nine months of 2013 are showing signs of underwriting improvement, if the investment environment were to deteriorate unduly without any widespread correction in premium rates or business volume/makeup, or if the industry were to experience a significant series of catastrophe losses, this could have a serious impact on industry profitability and

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[10] http://www.fema.gov/flood-insurance-statistics-current-month/policies-force-occupancy-type as of Nov 2013; 292,000 of 5.5 million total NFIP policies are classified as non-residential.

drive capital levels lower. More discussion on potential factors which could impact the market's overall capacity will be included in the cost/benefit analysis portion of this report.

Moreover, it is important to keep in mind that the P&C industry's capital is available to support a variety of liabilities, not just catastrophe risk. Companies must also utilize their capital to support various casualty lines of business, such as Workers' Compensation. While it is difficult to ascertain what portion of current industry capital is allocable to catastrophe lines, some estimates peg the proportion as low as 20%[11]. Taking 45% (or the same portion of industry DWP dedicated to catastrophe lines) as the high end of the spectrum, we arrive at a **$120 billion to $270 billion** estimated range of dedicated catastrophe capital across the US P&C insurance industry.

Offsetting the risk of negative impacts on the capital base of the US P&C insurance industry as a whole are several external sources of liquidity. These include the global reinsurance market which is highly active in the assumption of catastrophic risk from P&C insurers in particular and the ability to raise additional funds from debt or equity investors after a loss event. Both of these factors will be discussed in more detail in subsequent sections of this report.

Earthquake

With the above framework established it is useful to look at the market for standalone EQ insurance in the US which in many ways serves as a relevant proxy for a larger standalone private flood insurance market should one eventually develop beyond its current diffuse state. Specifically, the two perils are similar inasmuch as they are both generally excluded from standard HO+FO coverage and they both have catastrophic loss potential.

Since standalone EQ is a separately reported LOB according to NAIC standards, related data is readily available to facilitate analysis. There are several lessons to be learned from such an analysis of standalone EQ business that are relevant to NFIP's privatization efforts. Some conclusions around the industry's capacity to support single-peril catastrophe exposed business can also be drawn.

Overall the US standalone EQ market accounted for $2.8 billion in DWP in 2012, equivalent to about 80% of the NFIP's total premium volume for the same year[12]. While EQ premium data is not broken out between residential and commercial classes or primary and excess layers, by some measures the US standalone EQ market can serve as a solid proxy for a private standalone flood insurance market.

Figure 6 shows the market share leaders for standalone EQ in the US. With the exception of California Earthquake Authority (CEA) which is a residual market operated by the State of California, all of the others on this top-ten list are active private market participants. Looking at some of the individual players it is possible to infer which types of standalone EQ business are being written (e.g. residential vs. commercial). Since no federal or state-level mandatory purchase requirements exist for EQ insurance as they do for flood, EQ insurance is written entirely on a voluntary basis (barring any requirements maintained by private lenders operating in peak EQ zones for instance).

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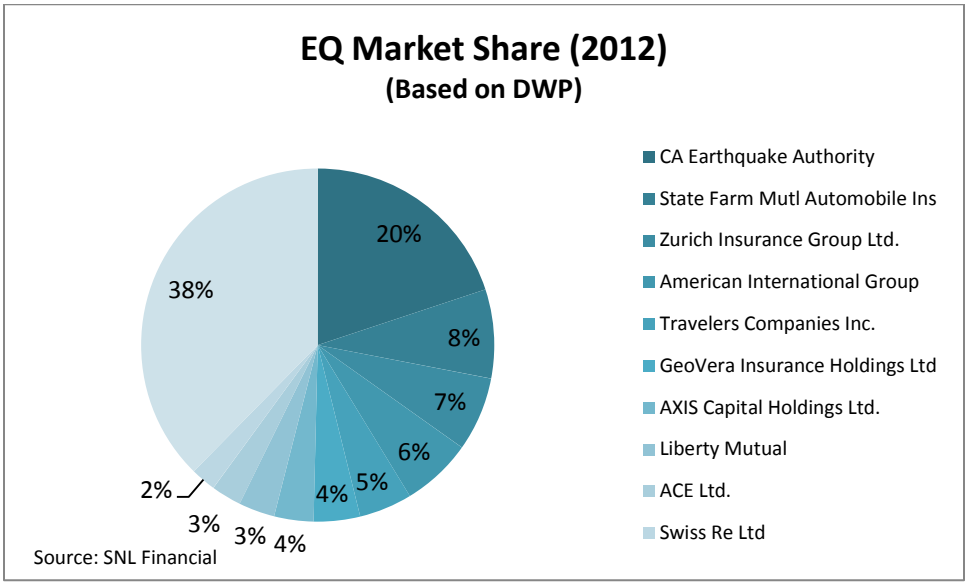
[11] King, R.O.; Congressional Research Service; Financing Natural Catastrophe Exposure: Issues and Options for Improving Risk Transfer Markets; Aug, 2013; Page 16.

[12] Source: SNL Financial; exclusive of Lloyd's of London.

Figure 6: US Earthquake Insurance Market Share



For instance GeoVera, a specialty insurer with a focus on catastrophe risk, only writes standalone EQ for homeowners along the US West Coast and in the New Madrid seismic zone region[13]. The CEA also only writes standalone EQ insurance for homeowners in California. Together these two organizations account for about a quarter of the national market. Other carriers listed in Figure 6 are likely writing a mixture of coverage for residences and businesses on both a primary and excess basis.

Focusing on California – where EQ risk in the US is most concentrated (see Figure 7 for a visual depiction) – the dynamics of a purely voluntary catastrophe insurance market become notable. Today across the state, just 11 percent of residences are protected with EQ insurance, compared to about 33 percent with coverage in 1994 directly following the Northridge Earthquake. If Northridge were to occur again today according to CEA it would result in a $20 billion uninsured loss in the State[14].

The relevance here for flood insurance is the importance of the Mandatory Purchase Requirement (MPR)[15] to the take-up and affordability of NFIP and/or private flood policies. Just as homeowners in notable EQ-exposed areas do not purchase EQ insurance voluntarily in large numbers, the same seems to hold true for homeowners exposed to floods. This is consistent with RAND's 2006 market penetration study[16] which found that while a third of NFIP policies are written outside SFHAs, the nationwide market penetration rate outside SFHAs is only about 1 percent and the market penetration rate for homes in SFHAs but not subject to the MPR is on the order of about 20 percent.

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[13] http://www.geovera.com

[14] CEA Press Release; More Californians risk financial catastrophe, 20 years after Northridge earthquake; Jan, 2014.

[15] For more on the MPR see FEMA's Mandatory Purchase of Flood Insurance Guidelines.

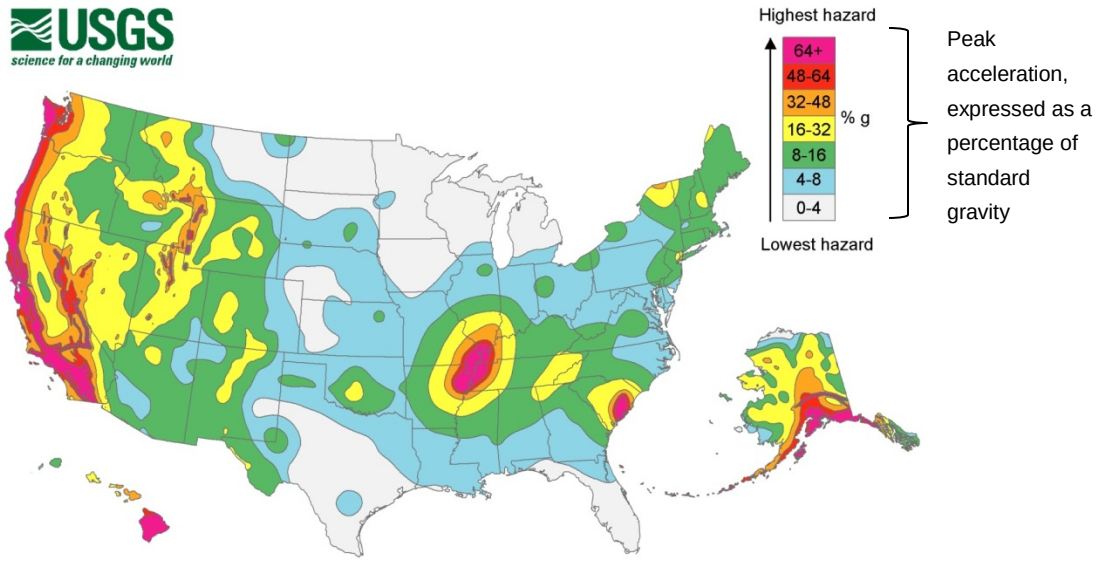
[16] RAND; The National Flood Insurance Program's Market Penetration Rate: Estimates and Policy Implications; 2006.

In some instances this is an issue of education – prospective policyholders are simply unaware of the risks they face. In other instances it boils down to the perceived value of available products – in the instance of EQ deductibles for available products are very high and coverage can be restrictive leading many potential insureds to believe they would be so badly off in the case of a large event even with insurance that the annual cost of coverage isn't justified. Though in most cases the decision not to purchase insurance for rare but extreme events without some external compulsion boils down to human psychology. To quote from Dr. Howard Kunreuther's testimony to the US Senate Small Business Committee on the subject[17]:

> *"…although intuitive perceptions of risk are relatively accurate over a broad range of situations, this is not the case for unfamiliar risks that involve small probabilities and high degrees of uncertainty…In situations of extreme events, consumers are likely to deviate from expert assessments of probability and judge the likelihood of an event by its salience…There is thus a tendency to ignore rare risks until after a disaster occurs."*

Another item to note from Figure 7 is the geographic orientation of EQ exposure relative to hurricane and therefore storm surge exposure. As is clear, EQ risk geographically complements national exposure to coastal flood risk and, intuitively, the correlation between these two major perils is effectively nil[18]. While multiperil analysis is beyond the scope of this study it is clear that some effort to link insurance coverage for flood to insurance coverage for EQ could result in some positive synergy from a disaster risk management and financing standpoint.

Figure 7: USGS National Earthquake Hazard Map



[17] Howard Kunreuther; Remarks for the U.S. Senate Small Business Committee Roundtable; Washington, DC - March 14, 2013; Improving Insurance Decisions in the Most Misunderstood Industry.

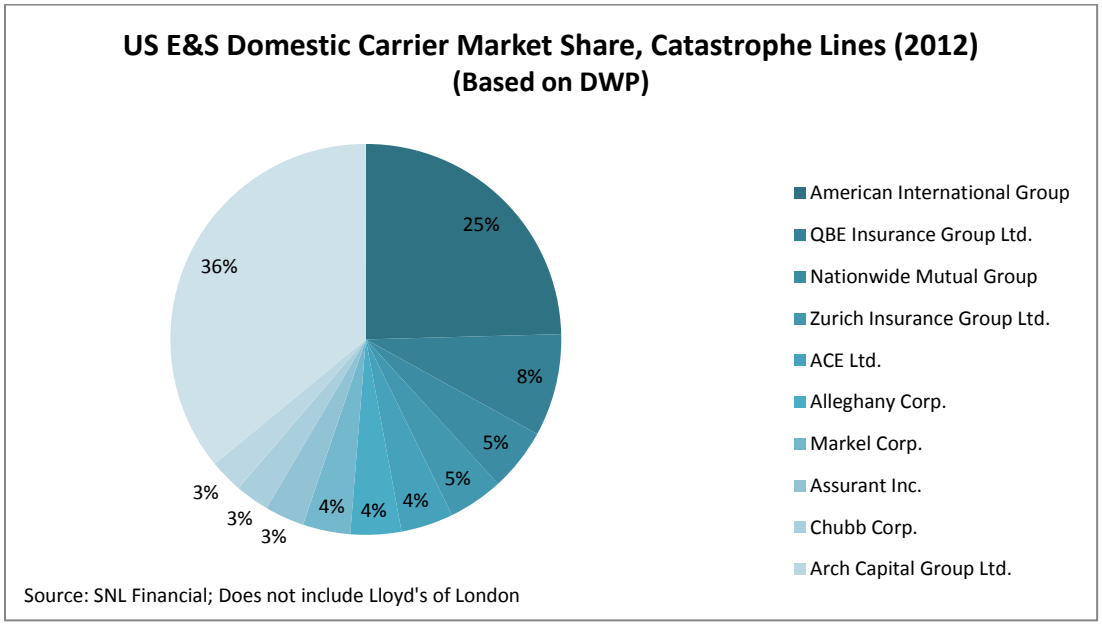
[18] There is a correlation between inland flood risk and EQ. For instance there is a chance of meaningful flood losses as a result of an EQ such as through damage to dams that could flood downstream properties or causing massive landslides that block river flow and thus create a flood.

Admitted vs. Non-Admitted

Catastrophe insurance business is written by US insurers through a variety of different policies and by a variety of different means. One important consideration for an analysis of flood risk capacity is the interplay between the admitted and non-admitted (a.k.a. excess and surplus (E&S) or surplus lines) markets. Admitted carriers are licensed by and required to file rates and forms with state regulators for approval. Their policies are backed by state guarantee funds in the event of insurer insolvency and licensed insurers pay certain fees and taxes for this privilege. Non-admitted carriers on the other hand, though approved as such by state insurance regulators, are not subject to the same oversight and have freedom of rate and form. These insurers are thus subject to a variety of special restrictions. For instance, in many jurisdictions surplus lines brokers/agents are required to collect at least 3 refusals from admitted companies before writing a policy with a surplus lines carrier.

As a reference point, the largest US-domiciled E&S carriers by market share are shown in Figure 8[19]. American International Group (AIG) is by far the largest domestic E&S carrier writing a substantial portion of its surplus lines book through its Lexington subsidiary.

Figure 8: US Excess and Surplus Domestic Carrier Market Share, Catastrophe Lines



Surplus lines carriers tend to focus on specialized, large or non-standard risks which might otherwise be difficult for admitted carriers to cover due to their covariant risk profile or bespoke underwriting requirements for example[20]. To quote from NAPSLO[21], (the National Association of Professional Surplus Lines Offices):

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[19] Surplus lines data cited in this section only account for domestic carriers meaning it does not account for the E&S business written by Regulated Alien carriers such as Syndicates at Lloyd's of London which provide significant additional capacity.

[20] It is worth mentioning that there is some ebb and flow of business between the admitted and non-admitted markets depending on market conditions and underwriting cycle.

"The surplus lines industry is important because it provides a market for insurance covering hard to place risks that are not written by the standard markets. There are three basic categories of surplus lines risks: ***Non-standard risks*** *which have unusual underwriting characteristics;* ***Unique risks*** *which admitted carriers do not offer a filed policy form or rate; and* ***Capacity risks*** *where a client seeks a higher level of coverage. Examples of such risks include aviation, product liability, inland marine, earthquake, and professional liability."*

E&S writers tend to use wholesalers, which often act as centralized repositories for highly specialized or niche risks, as their primary distribution channel. E&S carriers also regularly support "program business" using Managing General Agents (MGAs), a specialized class of insurance wholesalers with the ability to underwrite business on behalf of carriers. Oftentimes catastrophic risks fall into the E&S market where freedom of rate and form is important considering: A) the lack of general consensus around the potential frequency and severity of certain catastrophic risks and; B) the value of capitalizing upon rapidly hardening rates and increased take-up in a post-loss underwriting environment. For example, while E&S business makes up less than 5% of overall US P&C market activity[22], in specialist classes of catastrophe exposed business such as standalone EQ, the E&S market plays a significant role (see Table 3).

Table 3: Excess & Surplus Market Influence – All Lines vs. Earthquake

The Influence of the E&S Market	Total US P&C DWP (000s)	US E&S DWP (000s)	% E&S
All LOBs	$523,879,204	$25,447,585	4.86%
EQ	$2,847,490	$650,980	22.86%

Given the E&S market focuses on specialized and, in many cases, more volatile risks than the Admitted market, this gives the E&S market a different return profile than the Admitted market so that the sector's operating performance often outpaces the total P&C industry's as in 2012 (see Table 4). On the flip side E&S carriers can also underperform the market in years of steep catastrophic losses.

Despite this year-to-year return volatility, the E&S segment tends to be just as financially sound as the admitted segment as it has performed well over time. In 2012, for the ninth year in a row, the surplus lines industry reported no Financially Impaired Companies (FICs) compared to 21 in the US admitted P&C market. This statistic is somewhat misleading since the E&S market is much smaller than the admitted market; therefore it is more useful to look at Financial Impairment Frequency (FIF = # of FICs / Total # of Companies in Class). Even with the absence of surplus lines financial impairments from 2004 to 2012, the surplus lines average FIF of 0.88% from 1977 to 2012 remains close to the admitted company average impairment rate of 0.89% for the same period[23].

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[21] From NAPSLO website accessed on 12/24/13; http://www.napslo.org/imispublic/AM/Template.cfm?Section=About

[22] E&S DWP in this section refers only to the business written by domestic E&S carriers. Foreign domiciled E&S writers – so-called Regulated Aliens – such as Lloyd's of London are treated separately.

[23] AM Best Segment Review, Surplus Lines Results Stumble Amid Sandy Losses, but Premium Growth Continues; Sept, 2013. It should be noted that an equivalent FIF does not equal equivalent risk to the consumer. Since non-admitted companies lack the backing of state guarantee funds non-admitted company impairments adversely impact insureds without providing for any claim recoverability in the event of company insolvency.

Table 4: 2012 operating performance of Excess & Surplus market against overall Property & Casualty market.

Surplus Lines Specialists, Operating Performance (2012)[24]	Combined Ratio	Pre-Tax Return on Revenue (ROR)	Pre-Tax Return on Equity (ROE)
Surplus Lines Specialists[25]	99.3%	15.7%	7.7%
Total P&C Industry	103.1%	7.7%	6.0%

Among the domestic insurers in the top ten writers of E&S business in the US, four are currently registered under the WYO program. These four are listed in Table 5 and would be barred under current WYO program restrictions from directly[26] offering private primary standalone flood insurance products. Their existing distribution channels through wholesalers and their presence in the E&S market, where flexibility in rate and form are paramount, would give them a potential advantage toward implementing private flood insurance programs in any privatization scenario.

Table 5: WYO Carriers and Excess and Surplus Market Leaders

Top 10 E&S *and* a WYO Carrier*
Nationwide
Assurant
Zurich
QBE

**Carriers in bold are also Top Ten WYO carriers*

Lloyd's of London

Lloyd's has been active in the United States since the late 1800s and plays an extremely important role in the surplus lines market. According to AM Best[27], a (re)insurance rating agency, with all syndicates taken together Lloyd's was the top writer of US non-admitted business in 2012 with almost $6.3 billion in E&S DWP. The United States is Lloyd's biggest market, with surplus lines and reinsurance activities generating the majority of the group's revenues. The Lloyd's market entertains extremely varied P&C risks and has been instrumental in the niche private flood insurance market. As such Lloyd's will feature prominently in other sections of this report.

In addition to Lloyd's, a number of other regulated aliens[28] write E&S business in the US as well. Altogether these other carriers control about $2.7 billion of DWP. This puts the total size of the US E&S market accounting for both domestic and foreign carriers at nearly $35 billion.

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[24] Ibid

[25] Average comprised of US domiciled insurers that primarily write surplus lines and/or specialty admitted business.

[26] WYO companies are able to write private standalone flood insurance products through separate legal entities.

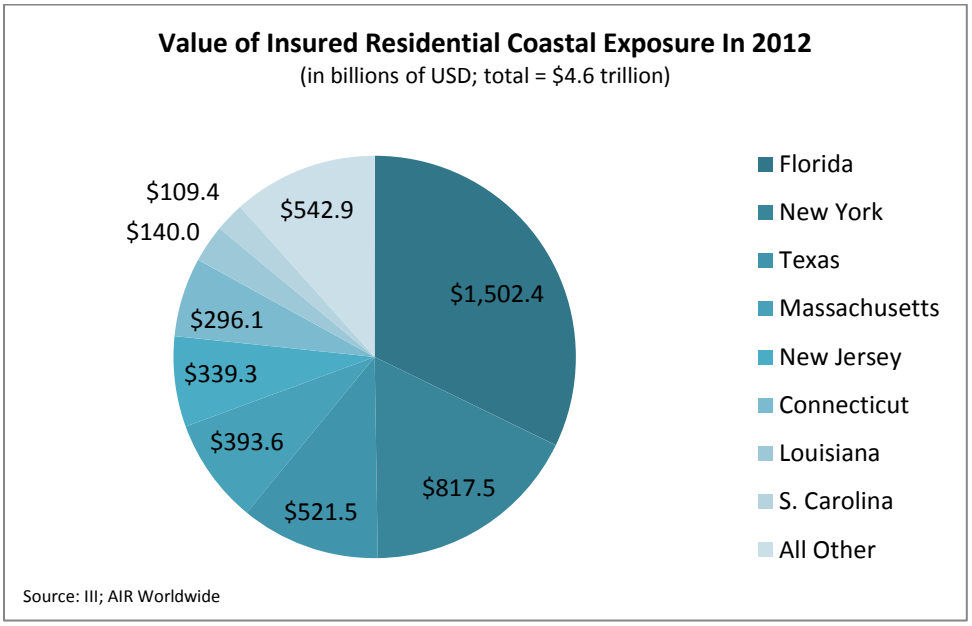
[27] Ibid, 21

[28] An alien insurer is formed following the laws of one country and offers insurance or reinsurance in another country.

Residential Insurers

Current estimates produced by AIR Worldwide (AIR) place the Total Insured Value (TIV) of coastal residential properties at $4.663 trillion[29]. The distribution of this exposure by coastal state is shown in Figure 9. Substantially all of this insured value is covered against coastal wind giving a sense of the extent to which the US residential property insurance market is willing and able to support catastrophe risk.

Figure 9: 2012 Insured Coastal Exposure – Residential



NFIP's policies in the same geographic area included in the abovementioned coastal industry exposure study amount to about 70% of NFIP's in force TIV or close to $900 billion[30], 95% of which is residential. The NFIP therefore effectively underwrites flood risk for about 18% of otherwise insured properties in 145 counties lining the Atlantic and Gulf coasts. Presuming all NFIP covered properties also carry basic HO protection and are therefore already insured for wind this creates a substantial correlation issue for any US flood insurance privatization effort to contend with.

Of course many coastal counties extend inland some distance, which means that not all of the properties in AIR's analysis are exposed to storm surge risk. It should also be noted that while the counties represented in AIR's coastal analysis estimate are certainly the most exposed to named-storm risk, the risk of damage from wind extends well inland. Thus in order to more precisely determine residential exposure to storm surge risk in the US – the peril currently driving NFIP's exposure to catastrophic loss – and the overlap with current wind insurance markets, it is necessary to drill down a bit further. According to AIR, the value of single family homes exposed to storm

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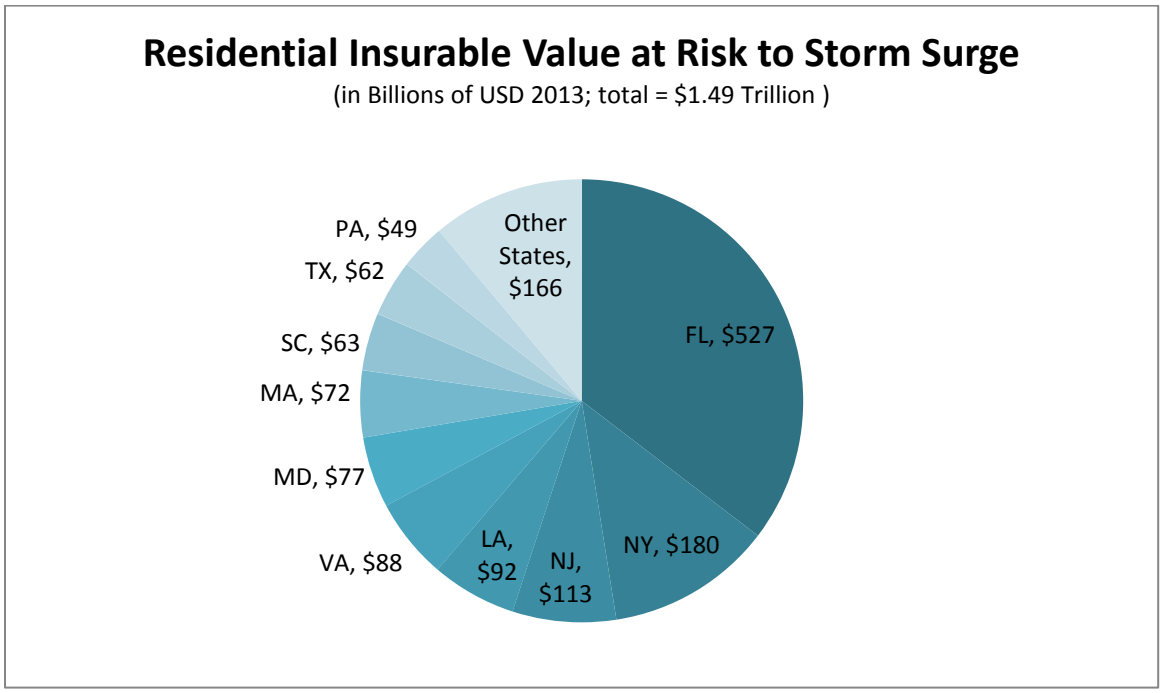
[29] AIR Worldwide Corporation; The Coastline at Risk: 2013 Update to the Estimated Insured Value of U.S. Coastal Properties; 2013. This analysis covers 145 coastal counties along the US Eastern Seaboard and Gulf. Total insured value of properties is an estimate of the cost to replace structures and their contents, including additional living expenses and business interruption coverage, for all residential and commercial property in the state that is insured.

[30] TIV computed for the same geographic area as AIR "Coastline at Risk" study (Ibid, 15) using NFIP policy data as of August 31, 2013 accessed from NFIP Statistics Page.

surge is $1.49 trillion along the Atlantic and Gulf coasts[31]. A breakout of this exposure by state is shown in Figure 10.

In the same counties identified as having exposure to storm surge, AIR estimates a total insured value at risk to wind of over $7.6 trillion. These two figures taken together can be useful in the assessment of private market capacity to bear flood risk since the risk of coastal flooding is largely dependent upon a landfalling tropical storm or hurricane and since there is substantial correlation between the coastal property risk already written by private and residual market insurers and properties exposed to storm surge. For instance, if we assume the full value of storm surge risk ($1.49 trillion) were to be insured by the private market[32] it would increase its exposure to hurricane-linked losses in storm surge exposed counties ($7.6 trillion) by an average of 20% across the board.

Figure 10: Total Storm Surge Exposure by State



However since the incidence of a landfalling hurricane does not necessarily result in losses from coastal flooding, the correlation between the two perils is not quite one-to-one. Since coastal exposure as defined by AIR is all exposed to wind risk, to some degree the difference between the coastal exposure and the storm surge exposure numbers in each jurisdiction could be deemed the uncorrelated portion of the two perils. This could have a positive impact on the market's ability to

[31] Source: AIR Worldwide. Insurable (both insured and uninsured) property values, 2013. Note that a total of 269 counties are exposed to storm surge, many of which are non-coastal.

[32] The only privatization scenario in which the private market could find itself insuring the entirety of insurable US storm surge risk would need to involve some combination of A) an extension to the mandatory purchase requirement extension and/or an expansion of SFHAs to include all storm-surge exposed properties plus; B) the summary run-off of the NFIP. The authors recognize that this is a highly unlikely outcome from a public policy perspective but the comparison it engenders is useful nonetheless as an extreme scenario for assessing the potential strain of privatization on private market capacity.

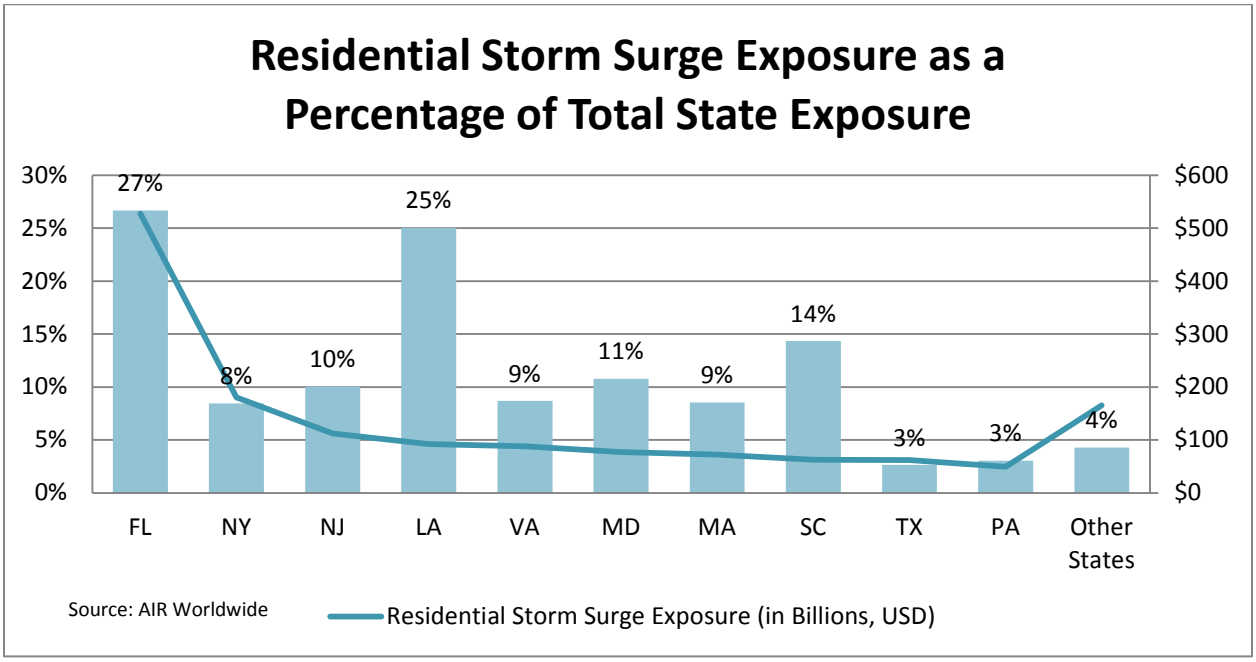
address the issue of correlation between wind and storm surge risk. Put simply, if the private insurance industry's exposure to wind risk is substantially larger than its potential exposure to storm surge, adding this additional peril to the mix should not have an undue impact on available capacity especially given the current excess supply situation and general interest from reinsurers regarding taking on more coastal wind exposure.

Additionally, many private coastal wind insurers are already pricing their HO policies implicitly for some amount of storm surge risk since after large wind events it is sometimes difficult to ascertain the precise cause of loss (an issue referred to as "concurrent causation" in industry parlance). There are also elements of political and reputational risk at play – state or even federal politicians have been known to intervene into insurance markets especially after large loss events (see Meteorological Event Sandy for a recent example[33]). Even without political interference, policyholders that have suffered losses which are questionably covered may be disgruntled or, worse, file suit if they do not receive a prompt payment for loss. Therefore, if NFIP were to offload all of its business to private US property insurers today, they should be able to offer policyholders on the coast purchasing both wind and flood protection some diversification benefit, even if only a modest one (depending of course on the availability of reinsurance, adequate pricing technology, etc.). From the perspective of consumers this would also be a boon as it would eliminate any potential claim issues related to concurrent causation.

Figure 11 shows AIR's insurable storm surge exposure estimates as measured against its statewide insured exposure estimates. As can be seen from this graphic, storm surge exposure represents a significant portion of total state exposure in many instances – over 20% in FL and LA – whereas it represents only a relatively small portion in other states – 3% in TX. In absolute dollar terms FL also tops the list followed by NY, NJ and LA. This has specific implications for state-level disaster risk management which are discussed in more detail in the section on Residual Markets below. Please note, Figure 11 is a logical progression of states and mirrors the order of Figure 10.

[33] http://money.cnn.com/2012/11/01/real_estate/sandy-hurricane-deductible/index.html

Figure 11: Storm Surge Exposure as a Percentage of Total State Exposure in Select States



Also of note from these exposure analyses is the extent to which NFIP is (and is not) covering storm surge risk. The total value of economic residential exposure to storm surge risk as calculated by AIR incidentally happens to be similar in size to NFIP's overall TIV presently in-force ($1.288 trillion at August 31, 2013). However, there is only limited overlap between these figures. According to AIR, extensive areas along the Atlantic and Gulf coasts that are exposed to storm surge risk do not fall within a FEMA Special Flood Hazard Area (SFHA). They are thus not required to purchase flood insurance and, as already mentioned, very few homeowners outside of SFHAs elect to do so voluntarily. Looking at coastal states (Figure 12) AIR determined that over 40% of properties exposed to storm surge do not fall within a FEMA SFHA and thus likely only a small portion of these policies are insured against flood. This large gap in coverage represents a significant exposure to individuals, financial markets and taxpayers since un(der)insured catastrophe risk invariably increases the fiscal strain on governments in one manner or another.

Solving for this mismatch between market perceptions of exposure to storm surge and the MPR could be a crucial issue for NFIP to contend with going forward. Extending SFHAs to all areas exposed to storm surge risk for instance would increase NFIP's exposure to loss in peak zones though it would also serve to significantly diversify the organization's risk profile and, presuming risk-based pricing, decrease the Federal Government's exposure to post-disaster relief costs.

However, before making any such changes, NFIP is already contending with the issue of lender compliance within the existing MPR parameters. According to RAND, lender compliance with the MPR is in the range of 75-80%[34] meaning NFIP's exposure to storm surge risk should be perhaps 25% higher than it currently is. Solving for this current gap could have a host of implications which warrant further exploration.

[34] RAND; The Lender-Placed Flood Insurance Market for Residential Properties; 2007.

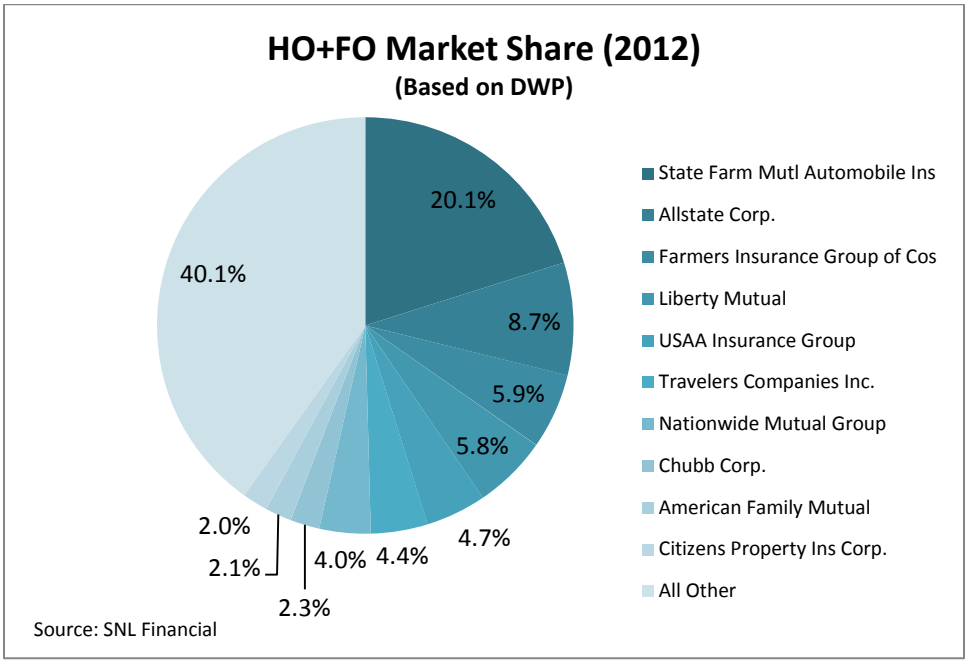
Figure 12: Properties Exposed to Storm Surge Risk and in FEMA SFHAs

State	Exposure Vulnerable to Flood or Storm Surge	Exposure in both a SFHA and a Surge Zone	Percent of Exposure in both a SFHA and a Surge Zone	Exposure only in a SFHA	Percent of Exposure only in a SFHA	Exposure only vulnerable to Storm Surge	Percent of Exposure only vulnerable to Storm Surge
FL	$811,571,107,790	$294,456,330,742	36.3%	$284,126,866,534	35.0%	$232,987,910,514	28.7%
NY	$214,249,809,734	$45,829,462,459	21.4%	$33,983,776,672	15.9%	$134,436,570,603	62.7%
TX	$171,664,420,542	$19,267,185,936	11.2%	$109,865,651,178	64.0%	$42,531,583,428	24.8%
LA	$162,007,101,437	$34,254,553,934	21.1%	$69,558,612,548	42.9%	$58,193,934,955	35.9%
NJ	$142,301,301,080	$64,143,822,229	45.1%	$29,761,802,106	20.9%	$48,395,676,745	34.0%
VA	$105,031,757,310	$17,116,379,953	16.3%	$17,094,846,649	16.3%	$70,820,530,708	67.4%
PA	$89,278,801,334	$1,407,784,735	1.6%	$39,875,812,429	44.7%	$47,995,204,170	53.8%
MA	$87,652,101,531	$12,027,386,741	13.7%	$15,178,115,198	17.3%	$60,446,599,591	69.0%
MD	$83,239,422,891	$11,334,289,865	13.6%	$5,770,424,930	6.9%	$66,134,708,096	79.5%
SC	$72,061,458,917	$38,097,457,550	52.9%	$9,313,090,419	12.9%	$24,650,910,948	34.2%
Other	$266,072,188,599	$66,972,277,345	25.2%	$100,495,578,291	37.8%	$98,604,332,962	37.1%
Total	$2,205,129,471,164	$604,906,931,489	27.4%	$715,024,576,955	32.4%	$885,197,962,720	40.1%

Zooming out from the coast, the Homeowners line of business, including the much smaller though often jointly treated Farmowners segment (HO+FO), is the largest contributor to US insurer catastrophe risk – an $82 billion industry in and of itself (SNL, 2012). The top ten writers of HO+FO business in the US control about 60% of the market (Figure 13) though there are hundreds of small-to-midsized HO+FO writers operating around the country including many local farm mutuals. Altogether, mutual companies (including those listed in the top ten) control about half of the HO+FO market[35].

[35] http://www.namic.org/aboutnamic/overview.asp; accessed December 26, 2013

Figure 13: Homeowner+Farmowner Carrier Market Share (2012)



By and large, typical HO+FO writers do not write flood risk on their own paper since flood is excluded from standard HO+FO policies. Moreover, quite a few HO+FO carriers are restricted from offering certain private alternatives due to their affiliation with the WYO program[36]. In fact, six of the top ten writers of HO+FO in the US are registered WYO carriers per Table 5.

Operating under the presumption that WYO carriers are some of the most well-versed in flood underwriting and thus possibly best positioned to assume flood risk on a purely private basis going forward, it is useful to show as in Table 6 which carriers have an overlap in expertise and market share in certain areas of the market. These carriers could reasonably be expected in the event of market privatization to assume flood risk relatively quickly given their large active distribution networks and some extant intellectual capacity when it comes to flood risk underwriting.

Table 6: WYO Carriers and Homeowner+Farmowner Market Leaders

Top 10 HO+FO *and* a WYO Carrier*
Allstate
Nationwide
USAA
Farmers
Liberty Mutual
American Family

**Carriers in bold are also Top Ten WYO carriers*

[36] As per Article XIII – Restrictions On Other Flood Insurance; 44 CFR Part 62, Appendix A. WYO Companies agree that all flood insurance sold shall be written pursuant to the Arrangement. The restriction applies solely to policies that only provide flood insurance unless such offerings are over and above the limits available under the NFIP.

Of the top ten HO+FO carriers, four are not WYO companies for various reasons, some publicly cited. Below is a list of those carriers among the top ten HO+FO writers in the US that are not part of the WYO program along with some explanation for their non-participation (where available):

- State Farm was #1 in terms of HO+FO direct premiums in 2012, but wrote no NFIP premiums. The company exited the WYO program in 2011 giving up the management of its then approximately 10.5% share of the WYO market to NFIP to manage direct. According to public statements by the company the reasons for its exit from the WYO program related to the company's internal costs associated with managing NFIP's periodic reauthorizations and delays by Congress. The company also cited a desire to focus on its own risk-bearing business[37].
- Travelers was #6 in terms of HO+FO DWP in 2012 though in mid-2013 sold its WYO renewal rights to Assurant. Travelers had an approximately 7.7% market share of WYO business in 2012 though said the business overall was "non-core" to its operations. Selling the book eliminated the "operational complexity associated with maintaining separate underwriting and claim processes required for participation"[38].
- Chubb was #8 in terms of HO+FO DWP in 2012, but is not a WYO program carrier. The company does offer its own primary and excess flood insurance coverage to HO policyholders (discussed in more detail below).
- Citizens Property Ins. Corp. (a.k.a. Florida Citizens) was #10 in terms of HO+FO DWP written in 2012. Florida Citizens is a not-for-profit, tax-exempt government corporation and a residual market for multiperil HO/commercial or wind-only coverage in Florida State. Flood risk falls outside of the company's legislative mandate.

As a result of State Farm's exit from the program and other residual business, in 2012 about 15.5% of all NFIP business was managed by NFIP directly[39]. While not a clear part of any public statement, some exits from the WYO program (and some refusals to enter) may be related in part to concerns surrounding reputation risk. Given that WYO insurers are "white labeling" NFIP policies (meaning putting their brand on the policy), affected customers look to WYO insurers to resolve flood claims and related disputes as soon as possible. When there are delays in claim payments from NFIP to the WYO carrier (as sometimes may occur if NFIP exhausts its borrowing authority or is in between legislative authorization periods) then the WYO carrier is in a position of having to front claim payments and/or deal with unhappy customers until the NFIP's claims-paying authority is resolved.

All of this being said there is a private market for residential flood insurance in the US which bears further exploration. To guide this exploration it is useful to look separately at the various subsections of the private residential flood market delineated in Figure 14.

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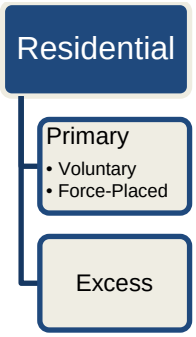
[37] http://www.heraldtribune.com/article/20100604/article/6041050?p=1&tc=pg

[38] http://www.insurancejournal.com/news/national/2013/08/23/302727.htm

[39] Calculated using 2012 earned premium (SNL Financial for WYO market share; NFIP Statistics online for total NFIP premium); direct business administered by the NFIP DSA.

Figure 14: Residential Flood Insurance Market Subsegments



Primary

Voluntary

Very few private insurers compete with NFIP in the primary voluntary flood insurance market. Within SFHAs, most private sector involvement is occurring on an excess basis above the maximum limits provided by NFIP[40]. Outside these areas, voluntary purchasing is quite limited. In addition, the federal restriction placed on WYO carriers against offering standalone private flood products that compete with the NFIP curtails the potential involvement of over 80 carriers from the private primary flood insurance market.

Given this relative market vacuum and the rate increases implemented by Biggert-Waters 2012 (BW-12), a number of private carriers have announced in recent months the launch of (or an intention to launch) a primary NFIP alternative coverage offering presumably to take advantage of a more favorable rating environment for certain policies[41]. In addition there are a variety of state legislative efforts ongoing to encourage private market involvement in flood insurance. Despite this recent flurry of activity, our research indicates that only a handful of such alternatives have been in place for very long. Fewer still have achieved any significant scale in relation to NFIP's market share.

Perhaps the most notable private primary residential flood insurance program is offered by WNC First, a MGA operating out of CA and FL[42] supported by Syndicates at Lloyd's and Philadelphia Insurance (a Tokio Marine Group company). Though even this program, which has been in place for many years remains quite small and selective and is commercially focused. Other such programs of which we are aware[43] include (but are not necessarily limited to) the following:

- SWBC, another MGA, writes primary residential flood on behalf of Lloyds and Lexington (an AIG company);
- AIG's Private Client group focuses on high-value HO business and offers flood protection[44];

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[40] $250,000 building / $100,000 contents for residential, $500,000/$500,000 for commercial.

[41] See these recent announcements by Homeowners Choice and The Flood Insurance Agency (Lloyds) for examples.

[42] See WNC First's Private Flood Insurance Program description here.

[43] Information sourced from online research and from a list of private flood insurance carriers compiled by Bruce A. Bender, Bender Consulting Services, Inc. (May 2010).

[44] http://www.aig.com/coverage-highlights_3171_440970.html

- ACE Private Risk Service, which focuses on high-value HO insurance and offers protection
- Chubb, also a high-value HO specialist can offer flood coverage to its existing HO customers;
- Fireman's Fund, an Allianz subsidiary, offers flood coverage as an endorsement to its "Prestige Home Premier" policy[45] and;
- Privilege Underwriters Reciprocal Exchange (PURE) is a WYO carrier that offers various endorsements to its issued NFIP primary policies to extend NFIP coverage in scope and limit[46].

There are some clear similarities between the programs described above. In particular their focus on high-value homes is notable. Such homes tend to command higher premiums than mean, median or low value homes and therefore the extra expense of flood underwriting can be more readily justified. High-value home owners are also more likely to demand and see value in (and pay extra for) the convenience of "one-stop shopping" for their HO insurance as well as for a very high-touch claims process (a service which is universally touted by high-value home insurers). Moreover, high-value homes tend to have better flood protections in place than typical homes making them better risks from the insurer's perspective. Of the programs listed above only some will consider homes in NFIP-designated "V Zones", properties falling under the Coastal Barrier Resources Act (CBRA or COBRA) or in Otherwise Protected Areas (OPA) or in a non-participating community.

Some carriers will offer primary residential flood coverage via a separate Difference in Conditions (DIC) policy which typically provides coverage for perils excluded from standard HO+FO policies. These usually include both Earth Movement (EQ and Landslide) and Flood. Such DIC coverages seem to be most popular in western states where EQ is the driving concern. Some notable residential DIC programs include the following:

- Trustco, Inc. – Homeowners Catastrophe Insurance Trust
- Griffin Underwriting Services – Earthquake and DIC Program
- Poulton Associates, Inc. – Natural Catastrophe Insurance Program
- Safehold Special Risk, Inc. – Natural Disaster Protection Program

All of the above listed programs are underwritten at least in part by Syndicates at Lloyd's. Based on market research conducted by the authors and industry sources[47] Lloyd's appears to have a sizable presence in the US residential DIC market.

In summary, the current primary private residential flood insurance market amounts to a highly selective pricing exercise by involved insurers. On a voluntary basis, superior, larger and/or more highly protected risks (e.g. high-value homes or those falling outside of SFHAs) are the focus of the private market. The uncertainty associated with these properties is minimized by their locations and/or expensive flood protections available predominantly to the wealthy. Those insurers focusing on this segment also tend to write this business as part of a suite of other insurance products for the same customer. All of these factors in turn limit the need for sophisticated underwriting techniques to write these flood risks profitably and increases open market competition for such business.

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[45] http://www.firemansfund.com/personal-insurance/Pages/surface-waterflood-optional-endorsement.aspx

[46] http://www.pureinsurance.com/high-net-worth-insurance/insurance-products/flood-solutions

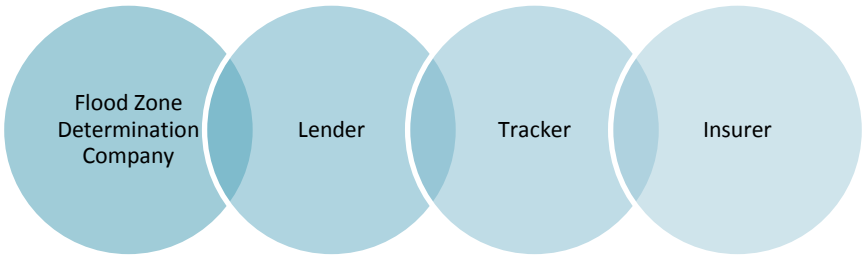
[47] Ibid, 40

Lender Placed

According to a 2007 study by RAND on the lender-placed flood insurance market[48] the number of primary lender-placed policies on residential structures was somewhere in the range of 130,000 to 190,000[49]. This was equivalent at the time to between 2.6% and 3.8% of residential NFIP policies in force. Extending this ratio to present day with 5.23 million residential policies in force[50], the private lender-placed market could account for as many as 200,000 unique standalone flood policies where other flood insurance does not otherwise exist.

The lender-placed market is a specialized niche with a unique value chain (see Figure 15). Of the primary actors in the flood insurance market, two are specific to the lender-placed market – Trackers and Flood Zone Determination Companies. Demand in this market segment is driven not by consumers but by lenders by virtue of their necessary compliance with the Mandatory Purchase Requirement (MPR)[51] and their desire to protect their loans from default in the event of various natural perils, including flood. Flood zone determination companies are often hired by lenders to determine if a loan is subject to the MPR and to monitor changes to NFIP flood maps which might alter MPR compliance rules for certain loans. Trackers are often hired by lenders to determine if the lender's borrowers are maintaining adequate insurance in accordance with the MPR. If a tracker has determined per appropriate regulatory protocols[52] that a borrower has not maintained adequate insurance, the lender will then direct the appointed private insurer to issue a policy for the borrower's property without homeowner consent.

Figure 15: Lender-Placed Flood Insurance Market Value Chain[53].



Private lender-placed policies are typically much more expensive than NFIP offered alternatives and therefore usually do not remain in place for very long. According to RAND (2007) as many as 50% of all lender-placed flood policies are cancelled within 90 days of issuance and replaced with a NFIP Standard Flood Insurance Policy (SFIP).

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[48] Ibid, 32

[49] Ibid, 32. According to RAND: "Private insurers also appear to write a sizable number of gap policies, although data on gap policies are sketchy. Including gap policies may increase the number of private policies to between 180,000 and 260,000. Gap policies do not increase the total number of households covered by flood insurance, but rather increase the dollar amount of flood coverage in place."

[50] As of November 30, 2013. NFIP statistics webpage.

[51] For more on the MPR see FEMA's Mandatory Purchase of Flood Insurance Guidelines.

[52] Ibid

[53] Adopted from Ibid, 28

Some of the MGAs mentioned in previous sections of this report, including WNC First and SWBC, offer lender-placed flood insurance programs backed predominantly by Lloyd's but also carriers such as Lexington, QBE and Axis. Assurant notably also offers and administers a lender-placed program in house.

In the primary residential flood insurance market overall private market activity is limited by comparison to the NFIP. The private lender-placed market controls at any one point in time perhaps 4% of the volume of policies issued by NFIP. While the size of the private voluntary market is more difficult to estimate, its focus on high-value homes outside of SFHAs significantly limits its actual and potential scope and affectivity from the perspective of reducing the Federal Government's liability for damages caused by floods and increasing the resilience of flood-exposed homeowners in other income brackets.

In areas where the risk of flooding is high, the ability for private insurers to have rate flexibility will be required to see meaningful private market interest. At present this ability is hampered by persistent NFIP subsidies in certain areas which impede private competition and a lack of technology and data amongst insurers to support the underwriting of highly exposed risk and an accordant lack of reinsurance capacity. In some cases the pricing deemed adequate by markets may fall somewhere between current levels and those mandated at the extreme end after full implementation of BW-12 as modified by the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA-14), in which case some gradual privatization of the US flood insurance market should be expected as BW-12 and HFIAA-14 get implemented.

Since market behavior can be erratic in new areas, there is no telling the extent of privatization that will occur naturally as a consequence of recent legislation. If over time the private market succeeds in taking the best priced and protected risks out of the NFIP this will create an adverse selection issue for the government insurer to contend with. This would naturally align the functionality of the NFIP more closely with that of state property residual markets which are designed specifically to take on risks deemed too risky by the private market at large.

Excess

Similar to the primary private flood market, the excess private flood market focuses predominantly on high-value homes. This is in part a consequence of the $250,000 max building Actual Cash Value (ACV) limit being provided by NFIP on a primary basis – any excess policy from NFIP's perspective would need to attach at this level, effectively eliminating any homes worth less than $250,000 from the purview of this private market segment.

In addition to the providers of primary residential flood insurance listed in the preceding section of this report all of which have their own excess offering, some carriers' involvement in the private flood insurance market is exclusive to the excess segment. An example of a recent private flood insurance market entrant would be Ironshore, which launched an excess flood offering in 2013 for homes greater than $1 million in value[54]. Additionally, a number of WYO carriers offer coverage in

[54] http://www.insurancejournal.com/news/national/2013/12/04/313005.htm

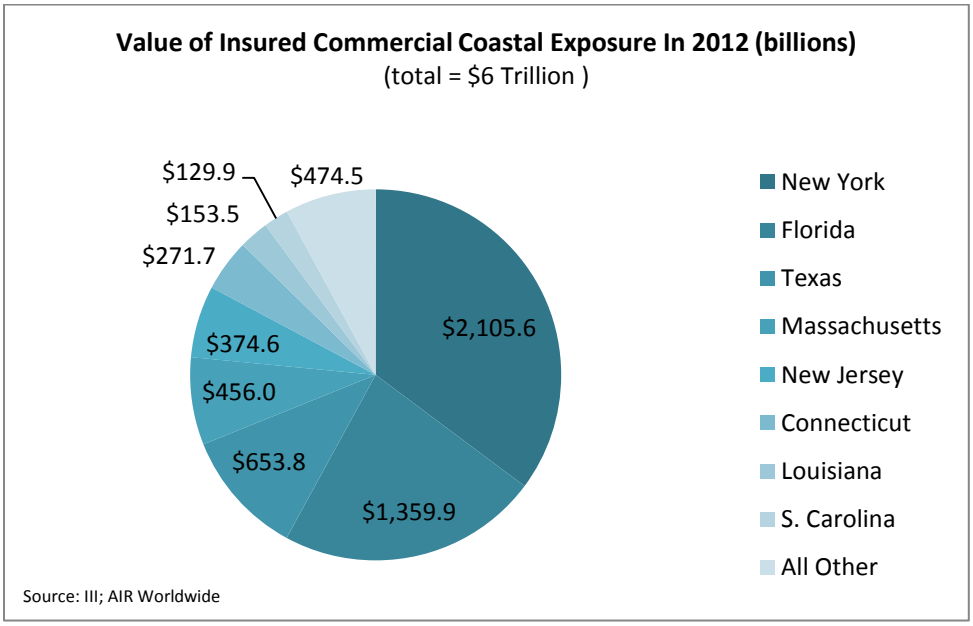
excess of NFIP policies to accommodate policyholders with a need for additional limit or broader coverage. Examples of carriers like this include Assurant, Wright and Pacific Specialty[55].

Commercial Insurers

Since only 5% of NFIP's business is non-residential in nature[56] the ability of the private commercial insurance market to underwrite related flood risk is less relevant to any efforts involving privatization or reinsurance of NFIP's portfolio than the residential segment. Based on some high-level risk relative analysis (see Appendix – AIR Industry Storm Surge Modeling Methodology for reference), the commercial segment is also a much smaller driver of industry loss potential with respect to storm surge than residential. Nevertheless, commercial insurers are an integral part of the overall US P&C insurance market and warrant some attention.

Current estimates place the total insured value of coastal commercial properties at nearly $6 trillion. The distribution of this exposure by coastal state is shown in Figure 16. Substantially all of this insured value is covered against coastal wind – and a large though indeterminate portion against coastal flood – giving a sense of the extent to which the US primary residential property insurance market is willing and able to support such catastrophe risk.

Figure 16: 2012 Insured Coastal Exposure – Commercial



NFIP's policies in the same geographic area included in the abovementioned coastal industry exposure study amount to about 70% of NFIP's in force TIV or close to $900 billion[57] only 5% of which is commercial. The NFIP therefore effectively underwrites flood risk for about 1% of the non-

[55] Information sourced from online research and from a list of private flood insurance carriers compiled by Bruce A. Bender, Bender Consulting Services, Inc. (May 2010).

[56] NFIP Statistics Webpage

[57] TIV computed for the same geographic area as AIR "Coastline at Risk" study (Ibid, 12). NFIP policy data as of August 31, 2013 accessed from NFIP Statistics Page.

residential properties along the Eastern and Gulf coasts which are already insured for wind (presuming all NFIP covered properties also carry basic Commercial property protection).

Figure 17: Commercial Multiperil (Non-Liability) Market Share (2012)

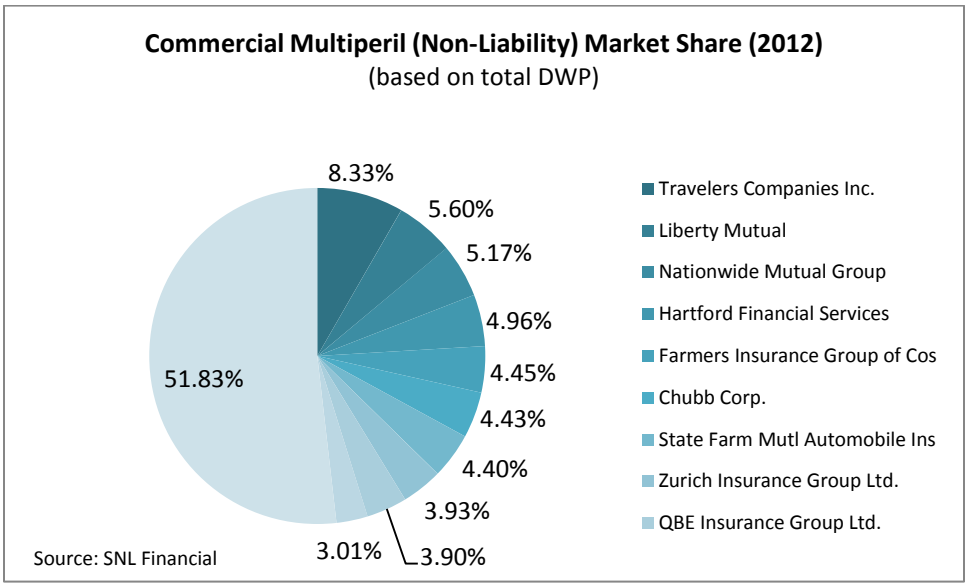
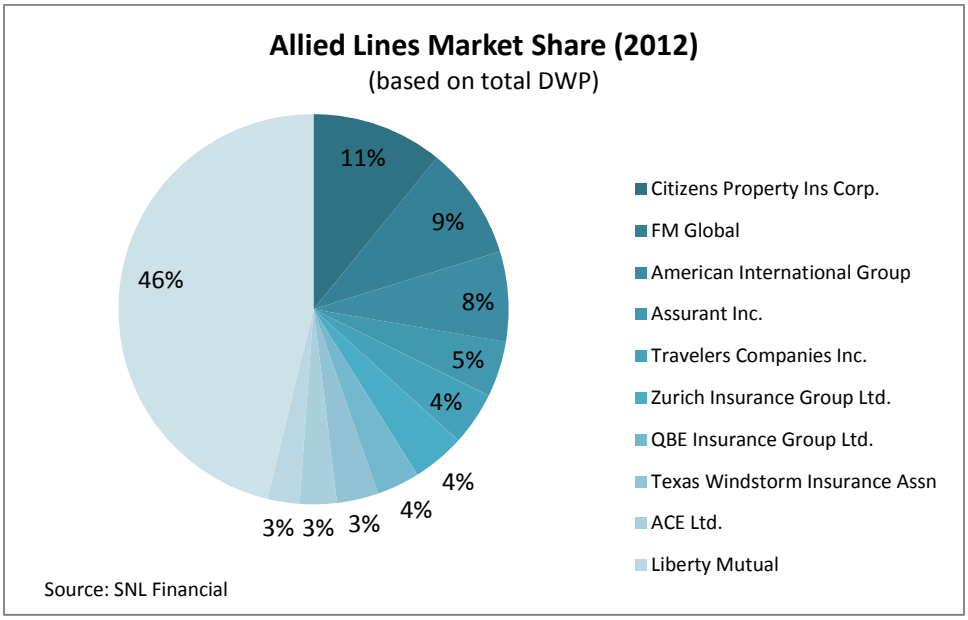


Figure 18: Allied Lines Market Share (2012)



Figures 17 and 18 show the market share percentages for the Commercial Multiperil and Allied Lines LOBs. Allied lines policies can cover both residential and commercial risks. Under the former category, low income housing or vacation homes are often written as Dwelling Fire policies and tend to be booked under Allied Lines. Such policies usually exclude flood and earthquake damage in line with the standard HO+FO market.

However other allied lines policies are written appurtenant to standard property policies and explicitly cover traditionally excluded perils like flood and earthquake. Such catastrophe oriented Allied Lines protection is more common in the commercial market. Table 7 shows the overlap between WYO carriers and various commercial lines of business. This overlap is most relevant for those Commercial Multiperil writers with a presence in the "main street" or small-to-medium sized commercial risk market as this type of business would be a good fit for NFIP commercial policies given only $500,000 in maximum ACV limit provided for commercial risks.

Table 7: Write-Your-Own Carriers and Allied/Commercial Multiperil (Non-Liability) Market Leaders

Top 10 Allied *and* a WYO Carrier*	Top 10 Comm. Multi *and* a WYO Carrier*
Assurant	**Nationwide**
Zurich	**Hartford**
QBE	**Farmers**
Liberty Mutual	Zurich
-	QBE
-	Liberty Mutual

**Carriers in bold are also Top Ten WYO carriers*

Residual Market

Residual market insurers (a.k.a. shared or involuntary insurance programs) are established by State governments to provide mostly high-risk policyholders with access to insurance coverage which may not be readily available via the open market. In the US, residual market property insurance is provided by Fair Access to Insurance Requirements (FAIR) Plans, Beach and Windstorm Plans and two state-run insurance companies in FL and LA: Florida Citizens Property Insurance Company (Florida Citizens) and Louisiana Citizens Property Insurance Corporation (Louisiana Citizens)[58].

Over the past 40 years, different residual market mechanisms have been developed for different reasons. FAIR Plans were created to ensure the continued provision of basic property insurance in urban areas whereas Beach and Windstorm Plans were founded to provide largely wind-only protection in natural catastrophe-prone areas. Generally residual markets are intended to be run in the same fashion as professional insurers, though some unique characteristics of residual markets include the following:

- Ideally rates are risk-based and higher than those charged in the open market;
- Scope of coverage is sometimes constricted versus open market policies;
- Private market insurers active in each State are required to share in the annual deficit or surplus of the State's residual market depending on loss experience or in some notable states (e.g. NC, FL, MS, LA, TX) to support the residual market if its accumulated surplus funds have run dry.

When the claims-paying capacity of a residual market is exhausted in a particular year an assortment of mechanisms are in place on a state-by-state basis to cover losses:

[58] At present no state residual property insurance market provides flood insurance coverage.

- **Levy of assessments**: When losses exceed claims-paying capacity in a given year, FAIR and Beach and Windstorm plans are required by state law to assess participating insurers.
- **Issuance of revenue bonds**: Plans also have the ability to finance losses and raise additional capacity via the issuance of bonds. Post-event bond issues are most common (as in Louisiana and FL after the 2005 loss year) though pre-event bond issues may also be completed by some plans for funding future hurricane seasons.
- **Reinsurance and capital markets**: Many plans also buy reinsurance or access the capital markets, providing them with additional layers of catastrophic coverage, the increased ability to fund losses and consequently to delay or avoid potential assessments[59].

Residual markets are structured in a variety of ways with respect to their financial relationship with the State's private insurance market. Assessments typically are based on an individual insurer's market share in the state though in some states (e.g. FL) the assessment is a percentage of premiums and is passed through directly to consumers. In short residual markets allow for three structural assessment options:

- **Non-recoupable insurer assessments**: Member companies share in residual market's profits and losses. Once the residual market exhausts its claims paying capacity its insurer members assume outstanding liabilities. Member companies are then liable for assessments which come due within X days after the assessment is levied. There are generally no specific provisions made for recouping assessments.
- **Recoupable insurer assessments**: In recoupable assessment states member insurers do not share in profits, but are assessed for losses beyond available funds to pay losses. Assessments are due within X days after the assessment is levied and recoupment may be allowed via a line-item premium surcharge on renewal policies. Recoupment lag creates a cash-flow issue for insurers or recoupment may be impractical for an insurer to assess, creating an unfunded liability for the company.
- **Policyholder assessments**: Policyholder assessments are generally made secondary to insurer assessments. These assessments do not create cash flow or liability issues for insurers. The proceeds from policyholder assessments are generally used to finance bond issuances.

In 2012, U.S.'s FAIR Plans accounted for the majority of overall residual market policies and exposure in force. When comparing total policies (both residential and commercial) in the FAIR and Beach/Wind Plans, FAIR Plans account for 80% of the total (Figure 19). Following a similar path, of the $818 billion exposed to loss the FAIR Plans accounts for about 78% (Figure 20). The states of FL and LA have been able to create a hybrid property insurance market of last resort that offers wind-only coverage for insureds along the coastline as well as HO insurance coverage statewide for those unable to find practical coverage in the private market. Florida Citizens was formed by combining the State's Residential Property and Casualty Joint Underwriting Association (its FAIR Plan) and the Florida Windstorm Underwriting Association (its wind pool). Louisiana similarly combined its FAIR and Coastal Plans to create Louisiana Citizens.

In merging their FAIR Plans and wind pools, these two states were able to streamline their residual markets to achieve two necessary objectives:

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[59] Insurance Information Institute, RESIDUAL MARKET PROPERTY PLANS: FROM MARKETS OF LAST RESORT TO MARKETS OF FIRST CHOICE; AUGUST 2013.

- First, they achieved federal income tax-exempt status which allows them to accrue a surplus more quickly without having to deal with corporate income taxes, which enhances their claims-paying capacity for a catastrophic event.
- Second, they reformed the way deficits are handled post-loss in order to create revenue streams from the grouping of regular and emergency taxations, which the corporation can use to back the issuance of pre- and post-event bonds to improve the liquidity of the residual market.

Figure 19: US Residual Market Policies In Force

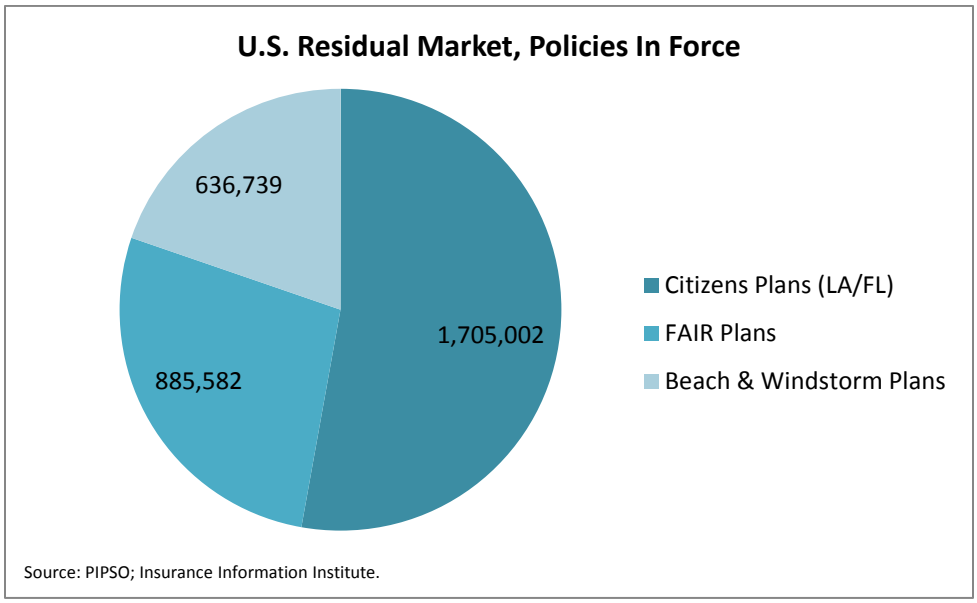
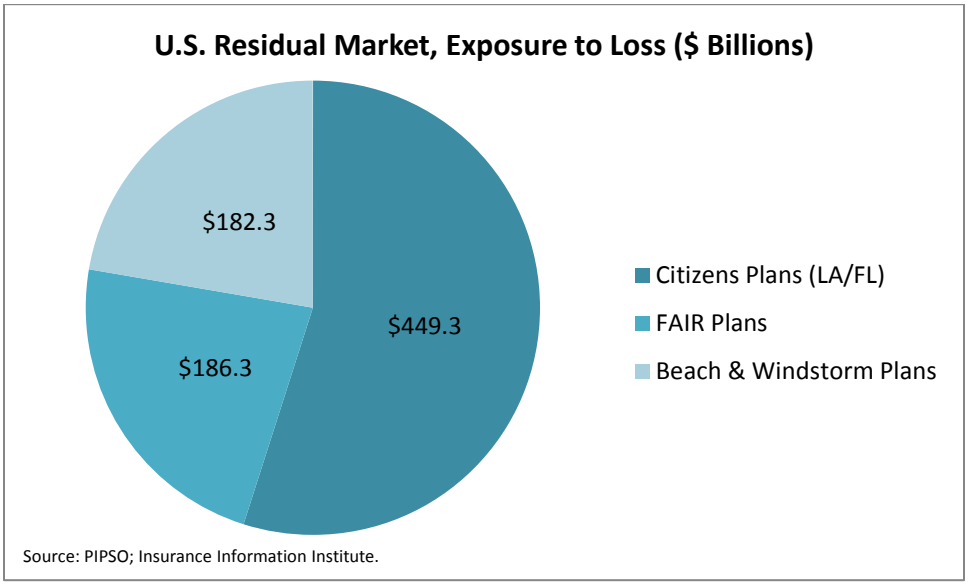


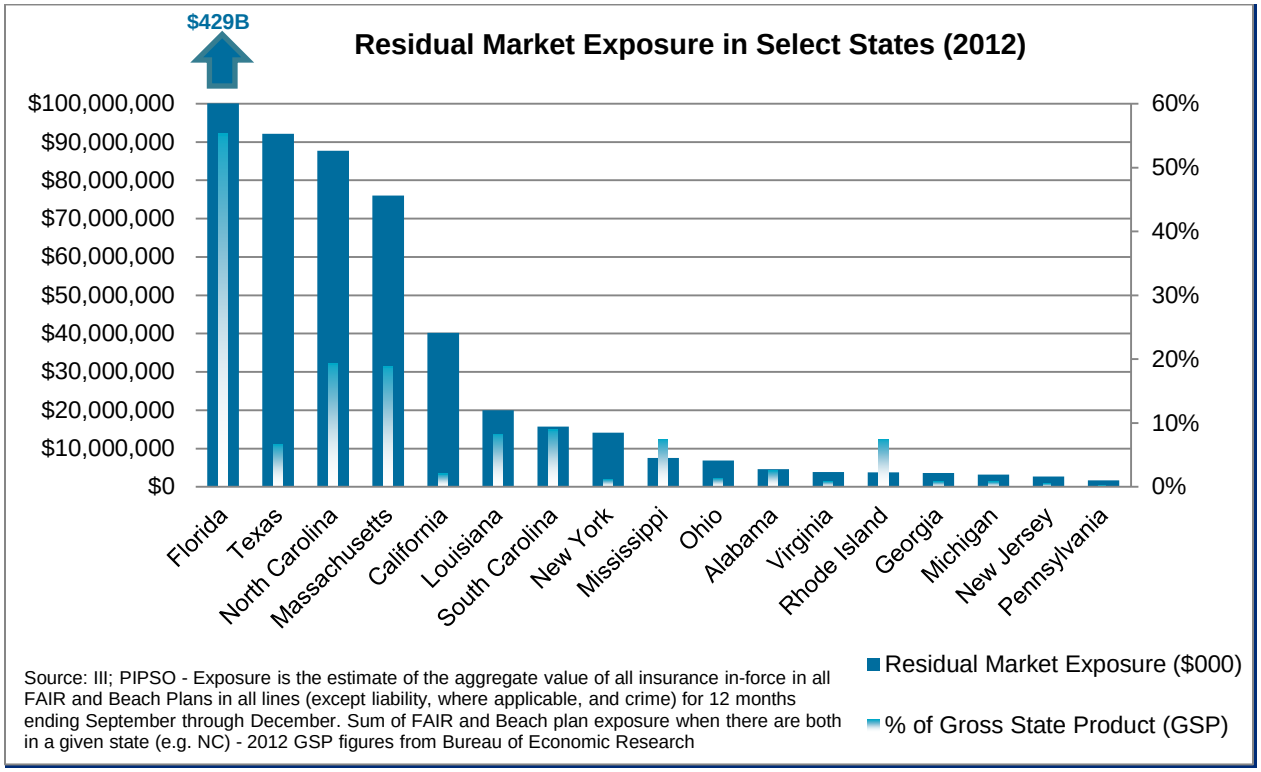
Figure 20: US Residual Market Exposure to Loss



While a streamlined insurer has helped FL and LA to better manage their residual market exposures, the magnitude of this exposure remains significant by any measure in most states, especially FL. By looking at individual jurisdictions as in Figure 21, the significance of residual

property market exposure to state operations is clear. In FL, total residual market exposure was equal to 55% of Gross State Product (GSP)[60] in 2012. This same metric was nearly 20% in NC and MA though below 10% in all other states with residual markets.

Figure 21: Vulnerability of State Budgets to Residual Market Property Insurer Exposure (2012)



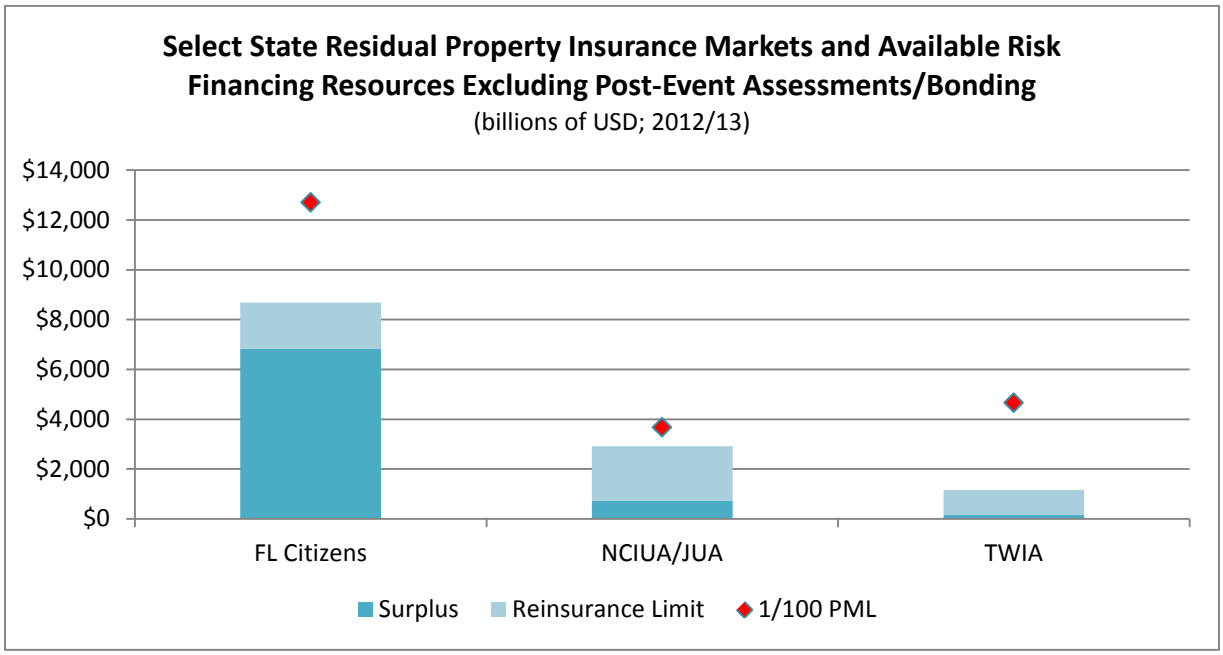
Source: III; PIPSO - Exposure is the estimate of the aggregate value of all insurance in-force in all FAIR and Beach Plans in all lines (except liability, where applicable, and crime) for 12 months ending September through December. Sum of FAIR and Beach plan exposure when there are both in a given state (e.g. NC) - 2012 GSP figures from Bureau of Economic Research

Since there is no easy benchmark for the management of residual market exposure against GSP, it is useful to look a bit further at each market's Probable Maximum Loss (PML) potential as measured against available claims paying resources not including assessments or post-event bonding. While wind pools accumulate surpluses in storm-free years, tail risk in many states is still not properly funded even when considering both surplus and private risk transfer solutions such as reinsurance. Figure 22 shows wind risk as measured by the 1% occurrence exceedance probability loss amount, or "1/100-year PML," recently reported by select large pools side-by-side with the risk financing resources available to each pool for the 2013 hurricane season[61].

[60] GSP is also referred to as State Gross Domestic Product.

[61] Source: Guy Carpenter, Residual Markets Specialty Practice. Risk financing resources include surplus and reinsurance limit purchased. Note, different methodologies are used by each market to compute PMLs, and surplus and reinsurance figures are as of different dates for each insurer cited though all from 2012 or 2013.

Figure 22: 1/100 Year PMLs and Claims Paying Capacity for Select State Residual Market Property Insurers Excluding Post-Event Assessments/Bonding



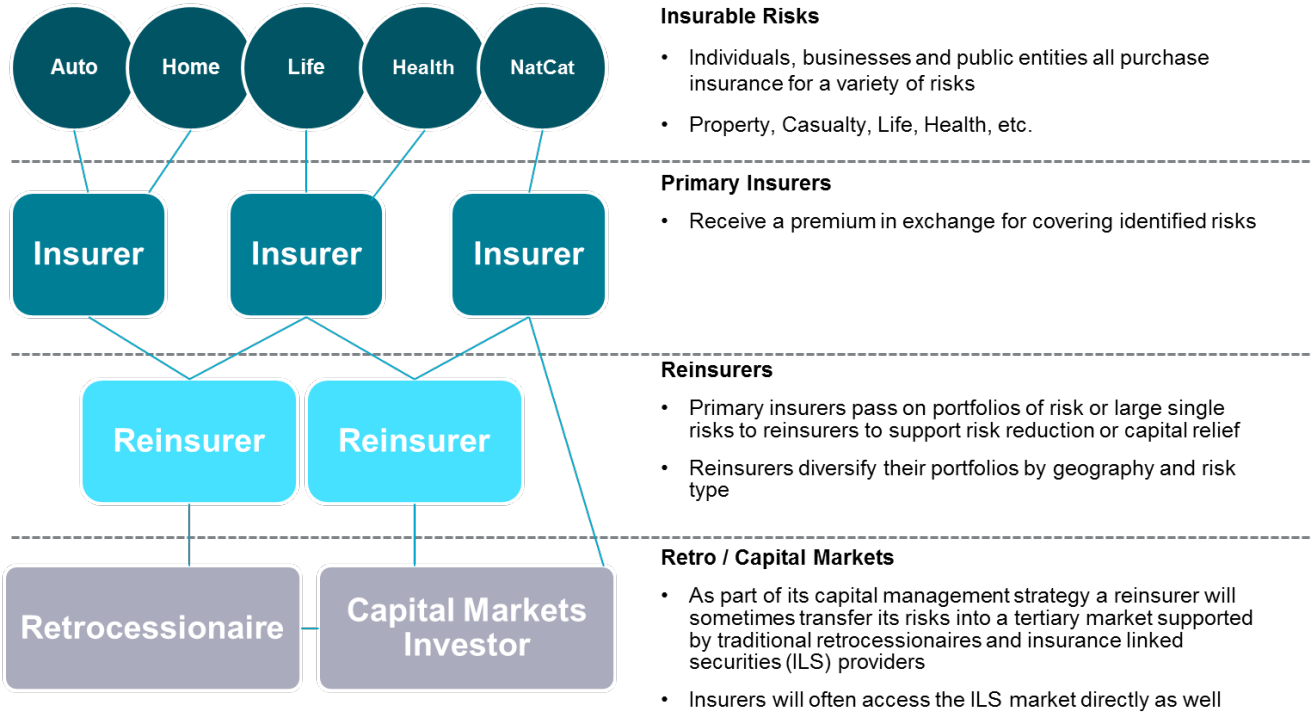
In FL, a 1/100 year event would result in a $4 billion unfunded loss to Florida Citizens or about 0.5% of 2012 GSP. When losses exceed each insurer's claims-paying capacity they will generally be able to recoup their net loss amounts through assessments to insurers/policyholders in the state or bond issuances though this can have a negative impact on the state's economic situation. To put the aforementioned 1/100 FL loss scenario in context, FL's real GSP growth was 2.4% in 2012, up from 0.9% in 2011. A large unfunded loss which would be assessed to insurers and policyholders could set back the State's overall fiscal standing substantially as it continues its tepid recovery from the financial crisis.

Overall residual market property insurers have evolved into a major component of the US property insurance market. And in some NFIP privatization scenarios involving dispensation of flood risk management responsibility to the state-level, their involvement in deleveraging NFIP may be necessary. However, given the extent of their existing exposure management issues and potential capital shortfalls in the event of significant hurricanes, state residual market property insurers may not be a good source for US flood risk unless their own fiscal positions can first be strengthened.

B. Global Reinsurance

Reinsurance is essentially "insurance for insurance companies". Reinsurers are in the business of assuming individual or, more often, portfolios of risk from insurers in exchange for actuarial premiums reflective of the risk assumed. A primer on reinsurance is included in the Appendix to this report and the historical underpinnings of the current market are discussed in detail in the accompanying Historical Market Assessment. As a basis for this review of the global reinsurance market an illustrative (re)insurance risk transfer value chain graphic is provided in Figure 23.

Figure 23: Global (Re)Insurance Value Chain[62].



The functionality and fluidity of this value chain is influenced by a variety of exogenous factors such as the global interest rate environment and catastrophe loss activity. Many of these factors are discussed in significant detail in other sections of this Reinsurance Study, though one such factor bearing mention here is the ongoing and sizable shift in the reinsurance sector's capital mix.

Today's reinsurance industry is operating in an evolving landscape defined by a strong influx of new capital from a variety of sources including institutional investors such as pension funds. This capital continues to bring the reinsurance and capital markets closer together in form and function, hence the term "convergence capital". As a result of this capital influx, competition and innovation in the reinsurance market are being spurred as reinsurers search for ways to deploy underutilized capacity and maintain premium income.

While property catastrophe business has been the focus of most convergence capital investments to date, the excess supply in this important market sector has started to spill into tangential areas (e.g. casualty lines). The January 1, 2014 renewals saw significant downward pricing pressure across most lines of business as high levels of capital and capacity, along with a consolidation in reinsurance purchasing, relatively low cat losses and strong primary insurer balance sheets, resulted in supply being much more abundant than demand. A more rigorous view of the various supply and demand factors impacting the market can be found in Table 8.

[62] Adopted from Swiss Re's Essential Guide to Reinsurance, Page 8.

Table 8: Factors influencing global reinsurance supply and demand.

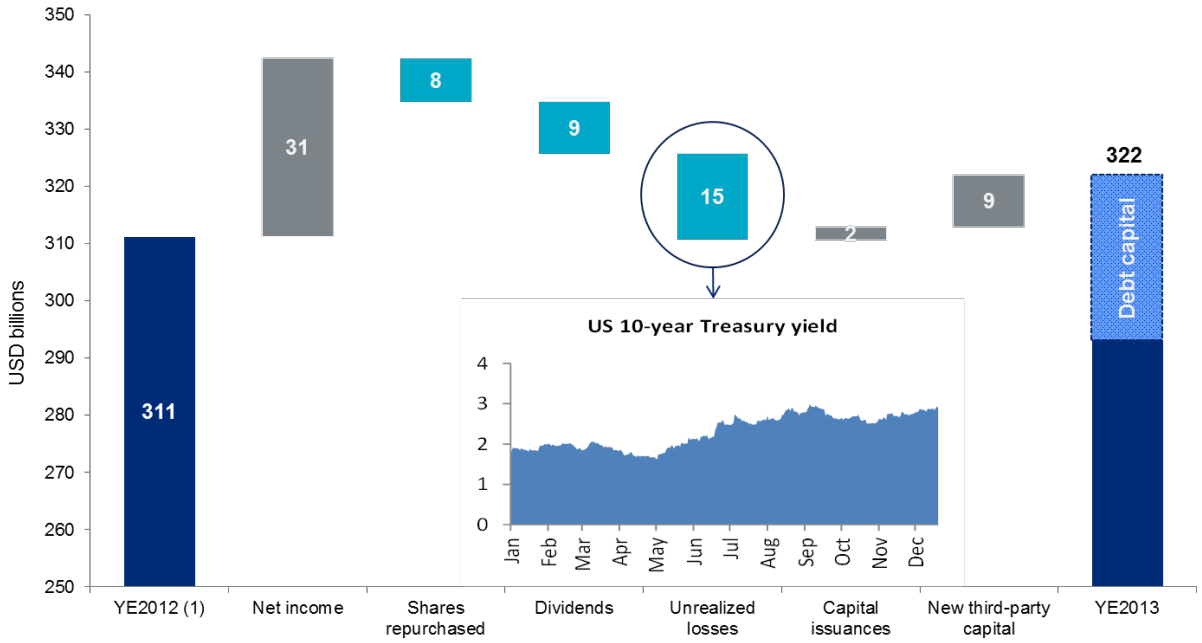
Supply		Demand	
Positive	Negative	Positive	Negative
Growing capital base of traditional reinsurers	Interest rate rises and resultant unrealized losses	Investment losses	Strong primary insurer balance sheets
Increased investments in collateralized reinsurance vehicles given attractive returns	Increasing return potential from other asset classes	Strengthening regulatory capital standards (e.g. Solvency II; NAIC RBC)	More consolidated purchasing for large cedants
Lower than 10-year average insured catastrophe loss activity	Reserve strengthening	Low market valuations for insurers' shares	Limited real premium growth in developed markets
-	Low market valuations of reinsurers' shares	Increasing volatility brought on by weather and demographic shifts	Lagging insurance demand growth in difficult economic environment and highly competitive market

Taken altogether the global reinsurance industry controls a significant amount of capital. Though looking at gross unadjusted surplus alone would represent a significant overstatement since many reinsurers have various draws on their resources other than pure reinsurance underwriting risk. The best available estimate of *dedicated* reinsurer capital supporting both life and non-life reinsurance business worldwide is **$322 billion** as at year-end 2013[63].

The evolution of this capital base through the 2013 underwriting year is shown in Figure 24. In short, the 2013 change in dedicated capital is a result of several countervailing factors including underwriting profits from low catastrophe claims, convergence capital inflows, unrealized mark-to-market losses, sustained share buybacks and dividend payments. After accounting for all of these moving pieces the sector's balance sheet remains in a strong position with capital at near record levels.

[63] Guy Carpenter estimate based off a joint study by GC and AM Best to estimate dedicated reinsurance capital.

Figure 24: Evolution of Dedicated Global Reinsurer Capital in 2013 (Source: Guy Carpenter)[64].



This capital base supports roughly **$230 billion** in global reinsurance premiums of which about $180 billion is non-life[65]. Taking these global premium and capital numbers as a basis for further analysis, the reinsurance industry is writing business at roughly a 0.71 premium to surplus ratio across all lines. While the premium-to-surplus ratio for reinsurers should generally be lower than for primary companies due to the higher risk potential and volatility embedded in their business, a ratio this low bespeaks ample room for the assumption of additional risk. This is especially true when considering the industry's decision to voluntarily repurchase shares to the tune of $8 billion (on top of $9 billion in dividend payments) in 2013 implying a lack of underwriting uses for this capital.

Given recent occurrences, the trend of capital markets convergence in the reinsurance market is expected by most practitioners to continue for the foreseeable future. As capital markets investors increase their presence and influence in the reinsurance market it will have far-reaching implications for both clients and reinsurers.

In the short term the abundance of risk capital seeking deployment predominantly in the property catastrophe risk transfer market will cause significant downward pressure on property catastrophe reinsurance pricing. This is excellent news for buyers although creating a challenge for traditional reinsurers since it will inevitably result in margin pressure in a historically profitable though highly volatile line of business. Over time this margin pressure may extend deeper into other lines of business as ILS investors and funds become savvier and more adventurous and as traditional reinsurers look to shift their focus away from property catastrophe to avoid the increased competition.

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[64] Debt capital is subordinated debt. It can contain convertible debt and debt that has lenient term. It's debt that behaves like equity which is why it's included in with capital.

[65] Swiss Re; 2012 Financial Report.

Many traditional reinsurers are taking note of this trend and are responding by developing their own third-party capital management units to position themselves to leverage new sources of capital. Through these units they use their underwriting expertise and successful underwriting track records to attract investor funds; often such arrangements are managed through financial vehicles that are referred to as sidecars[66]. Sidecars are structured to enable investors to assume risk and earn a return on defined segments of a (re)insurer's book of business. By participating in the ongoing convergence between reinsurance and the capital markets such reinsurers are adopting a very different and in some ways more efficient business model as an asset manager. This allows them the opportunity to securitize the most capital-intensive parts of their business while providing valuable cost-efficient capacity to their clients by leveraging their extant distribution channels, brand value and depth of underwriting, risk management and claims management expertise. Reinsurers are also using this capital to manage their own risk more efficiently through collateralized reinsurance and ILS purchases. *It is likely that this represents the beginning of a fundamental shift in the underpinnings of the reinsurance market which we expect will be to the benefit of reinsurance purchasers.*

Running against this trend will be cedant (a purchaser of reinsurance) concerns around upsetting existing reinsurer relationships and the reliability of new market entrants. Though over time if the ILS and convergence market proves itself to be a more prominent and permanent fixture (especially after an eventual large industry loss event such as a major FL hurricane) these concerns may erode as could traditional relationships in favor of more efficient and effective risk transfer solutions. Given all of the above, the following sections of this report differentiate between the traditional and ILS segments while also acknowledging their increasing areas of overlap. Both segments could be potential sources of risk transfer capacity for flood risk.

Another problem widening the gap between reinsurance and ILS supply and demand is the general lack of probabilistic models outside of peak zones and addressing perils other than EQ and hurricane. Natural disaster risk assessment relies on probabilistic catastrophe models and historical data. In order to underwrite extreme risk, the reinsurance industry is dependent upon a robust understanding of each covered peril as grounded in sound analytical practices. In this regard probabilistic models have a special role as they serve to provide sufficiently robust risk assessment capability for reinsurers and ILS investors to put their capital at risk. Table 9 describes the differences between the three main types of model and the importance of probabilistic perspectives.

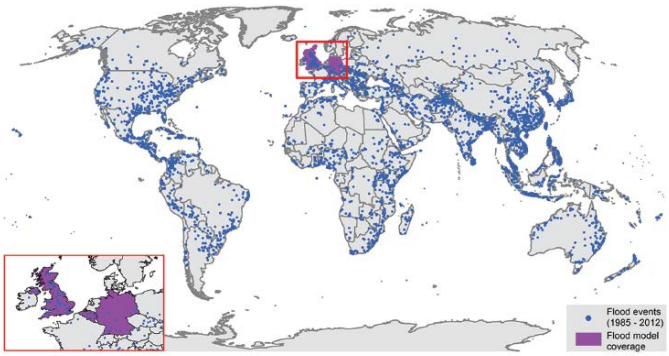
[66] Sidecars were initially created by Bermuda reinsurers in the 1990's, but took on greater prominence following Hurricane Katrina in 2005. One of the earliest examples is Top Layer Re, which was created by Renaissance Re and State Farm

Table 9: The Special Role of Probabilistic Models

Model Type	Description	Conclusions on Severity	Conclusions on Frequency
Deterministic Models	Modeling the impact of a single discrete historic or simulated event	**YES**	NO
Zonation/Rating Models	Modeling the probability of event incidence and identify vulnerability to a given peril	NO	**YES**
Probabilistic Models	Modeling a series of simulated events accounting for their occurrence probability over time	**YES**	**YES**

The three main catastrophe modeling companies, AIR Worldwide (AIR), EQECAT and Risk Management Solutions (RMS), have traditionally created modeling solutions for perils and territories considered to be peak risks. Although each modeling company has in recent years launched products for countries outside the more established markets of the United States and Western Europe, several gaps in coverage remain. This is particularly pronounced for the peril of flood.

Figure 25: Global Probabilistic Flood Model Coverage by Three Main Model Vendors[67]



Flood risk is not very often modeled at a global level. According to a September, 2012 study[68] it was striking to note that no probabilistic flood models existed for Australia, New Zealand, the Republic of Ireland or the United States (see Figure 25). While the flood modeling landscape is changing rapidly due to recent advances in technology and increased exposure to coastal climate-driven perils worldwide[69] reinsurers are currently struggling to monitor and measure their flood

[67] Source: Guy Carpenter & Company, LLC, Dartmouth Flood Observatory from Cold Spots Heating Up: The Impact of Insured Catastrophe Losses in New Growth Markets; Sept, 2012

[68] Ibid

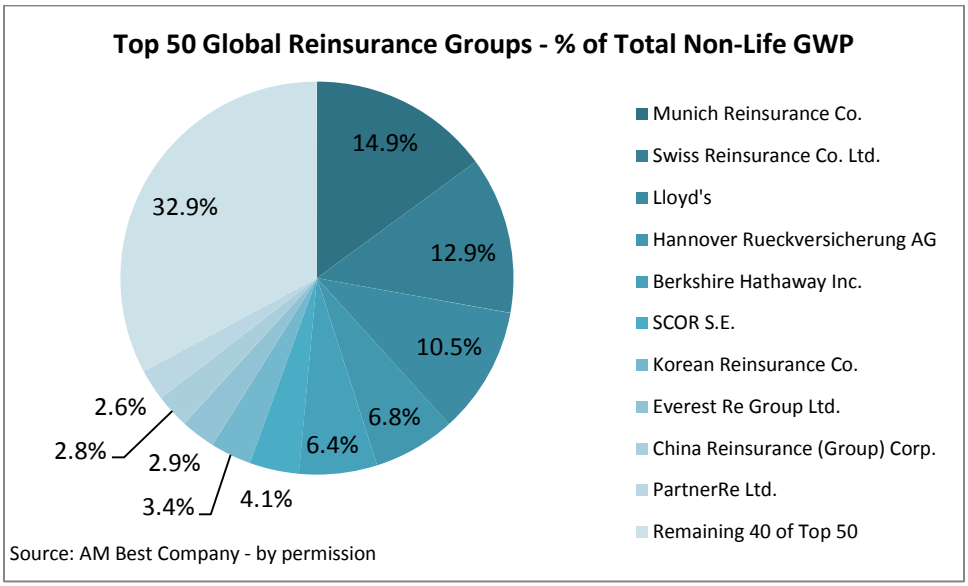
[69] To be explored further in Section C.1 of the FIRS project. Though in short, several commercial model vendors including AIR Worldwide and RMS intend to release inland flood models for the US within the next two years.

exposures in non-modeled countries. Moreover, for the models that exist, it is important that (re)insurers are aware of their limitations and consider the impact that these shortcomings have on their ability to control and price their risk exposures.

1. Traditional

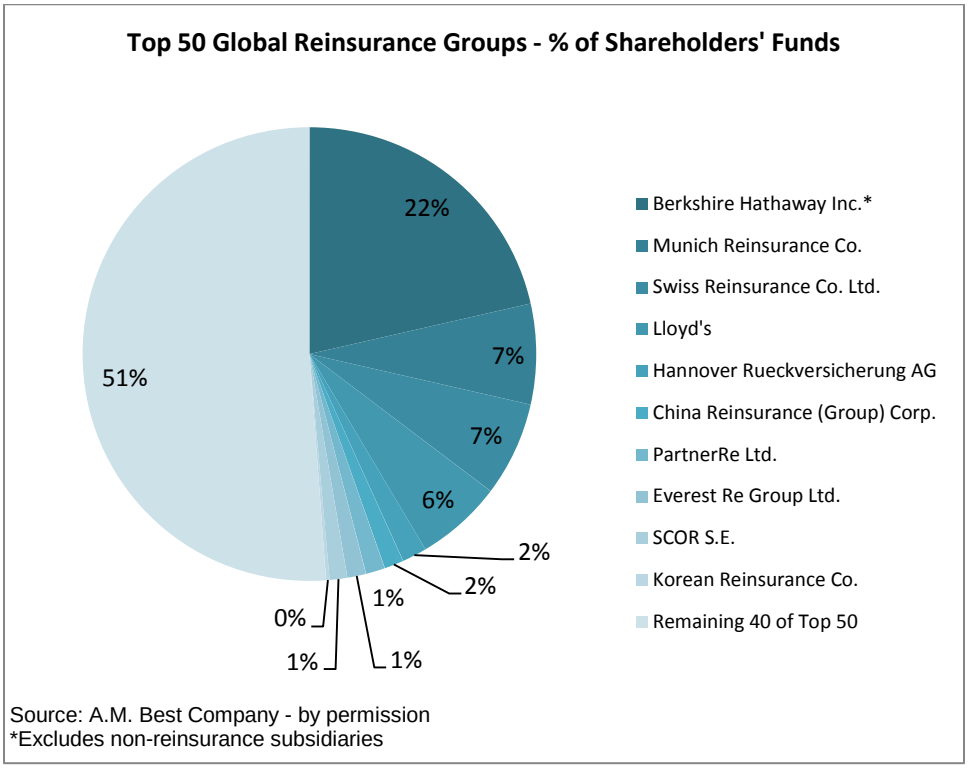
According to AM Best the top 50 reinsurance groups worldwide wrote nearly $220 billion in total Gross Written Premiums (GWP) in 2012 accounting for both life and non-life lines of business. Over $150 billion of this total was non-life. The 10 largest groups wrote over 50% of the total non-life business or about $96 billion. These same top 50 reinsurers control over $500 billion in shareholders' funds and the top 10 control nearly half of this total, or $247 billion[70]. The distribution of premium and surplus amongst the top 50 leading reinsurance groups is illustrated in Figures 26 and 27.

Figure 26: Top 50 Global Reinsurance Groups – Share of Non-Life Gross Written Premium



[70] AM Best; Total Shareholders' Funds excludes non-reinsurance subsidiaries of Berkshire Hathaway.

Figure 27: Top 50 Global Reinsurance Groups – Share of Shareholders' Funds

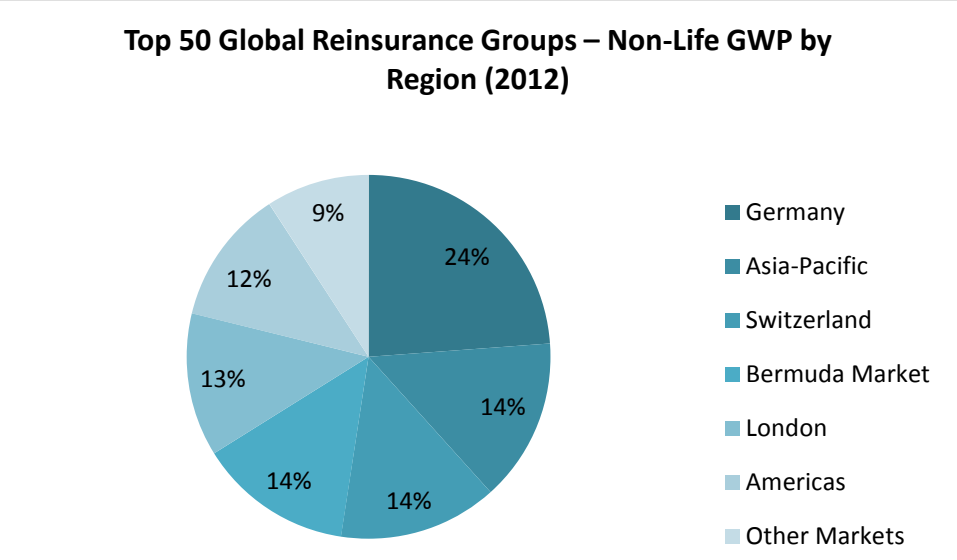


According to AM Best, over the last five years an index of major global reinsurers posted an average 8.3% ROE[71]. While there was some notable variance in the performance of individual index members year-to-year, overall the reinsurance industry has maintained attractive returns relative to the US primary insurance market over the time frame surveyed. It remains to be seen whether this level of returns can be sustained by traditional reinsurers going forward given the increasing pressure being placed on their business models by alternative capital sources.

The reinsurance industry is a global industry with premiums written by companies domiciled in key regions across the globe. There are marked concentrations of reinsurance activity in certain individual countries such as Germany, Switzerland, London, and Bermuda. The Americas and Asia-Pacific regions host a large number of reinsurers as well (note, while there are a few companies in Asia-Pacific and Latin America that support U.S. catastrophe business, most focus on the needs of local insurers). Based on the domicile of the ultimate parent, the distribution of non-life reinsurance GWP and surplus by region are shown in Figures 28 and 29.

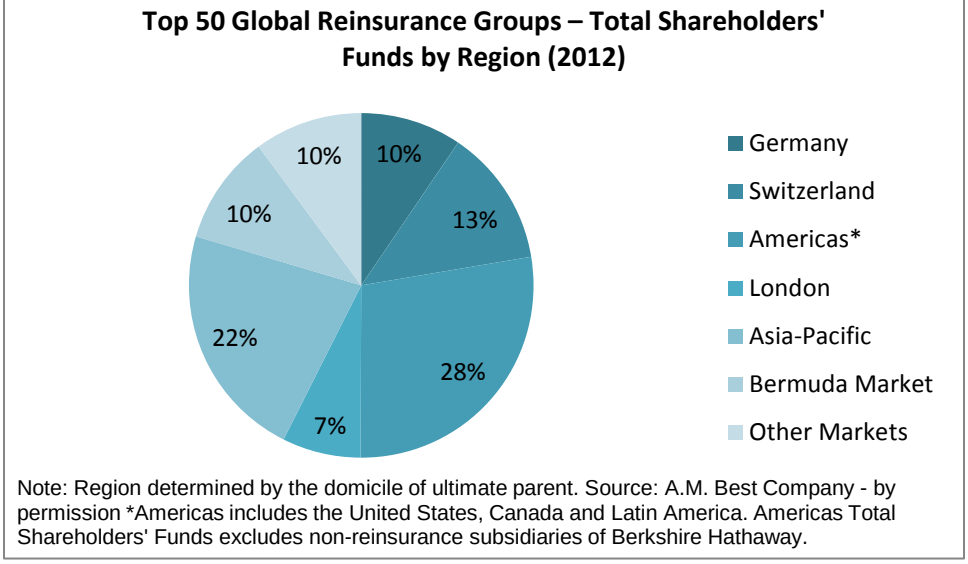
[71] AM Best; Best's Special Report, Segment Review; The Capital Challenge: Reinsurance Capacity Overshadows Market; Aug, 2013. ROE index members include Lloyds, Munich Re, Swiss Re, Hannover Re, Scor and the US & Bermuda market.

Figure 28: Top 50 Global Reinsurance Groups – Non-Life Gross Written Premium by Region



Note: Region determined by the domicile of ultimate parent.
*Americas includes the United States, Canada and Latin America. Americas also includes GWP of National Indemnity & General Re Corp. (subsidiaries of Berkshire Hathaway).
Source: A.M. Best Company - by permission

Figure 29: Top 50 Global Reinsurance Groups – Shareholders' Funds by Region



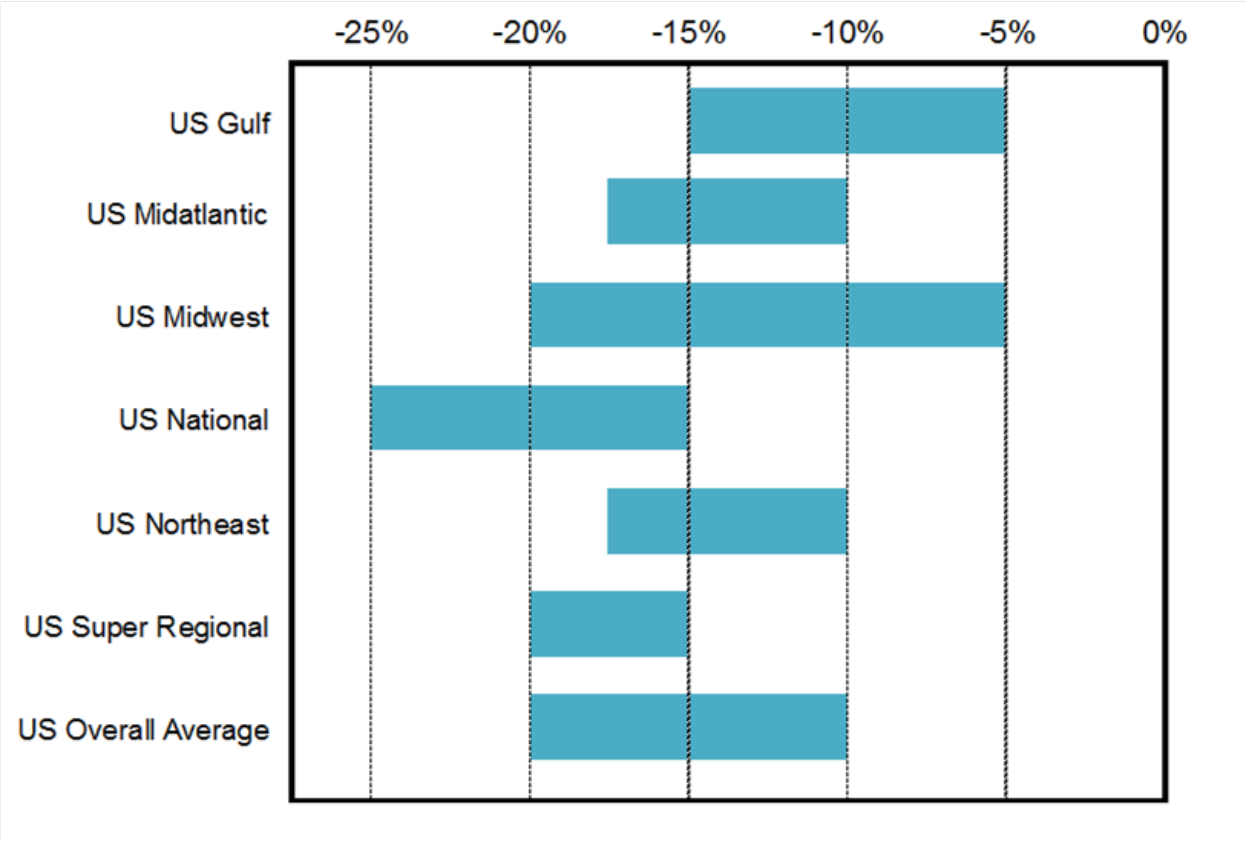
Note: Region determined by the domicile of ultimate parent. Source: A.M. Best Company - by permission *Americas includes the United States, Canada and Latin America. Americas Total Shareholders' Funds excludes non-reinsurance subsidiaries of Berkshire Hathaway.

Further evidence of excess capacity manifested recently during the January 1, 2014 reinsurance renewals. In the US property catastrophe market, of all authorized capacity 26% was left unutilized. This was up significantly from 15% at January 1, 2013[72].

[72] Guy Carpenter Property Specialty analysis.

Also in the US property catastrophe market, Guy Carpenter's US Rate on Line index, a risk relative measure of pricing movements, decreased by 15% overall, though by more in some areas of the market depending on the geographic makeup of the subject portfolio and historic factors (see Figure 30)[73]. Adjusting to the ongoing shift in its capital base, reinsurers focused on tailoring solutions and adding value while cedants identified their own priorities and pursued structures that best met their combination of coverage and pricing goals. While price tended to be the priority for many cedants, some common coverage enhancements were also sought including extended hours clauses in occurrence definitions; full terrorism coverage excluding NBCR; contractual agreement to advance claims payments; multiple year coverage and; improved reinstatement terms.

Figure 30: Typical US Property Catastrophe Risk Adjusted Price Change by Peak Zones



2. Insurance Linked Securities (ILS)

In general, an ILS is an investment whose underlying performance and risk of loss is tied to an insurance risk, often a catastrophic one. An ILS can originate in the form of a bond (e.g. covering catastrophe, mortality, longevity or morbidity risk), a collateralized reinsurance contract, an equity investment in a special purpose vehicle (e.g. a (re)insurance "sidecar"), or a derivative instrument,

[73] Source: Guy Carpenter Property Specialty. This chart represents the range of risk adjusted price change on Guy Carpenter handled accounts during the 2013-14 renewal season; insurance carriers are segmented by the region in which their portfolios are concentrated. Super Regionals have significant portfolios in more than one zone; Nationals are those that write across the U.S.

such as an option or industry loss warranty (ILW)[74]. Each of these products is described in more detail in Table 10.

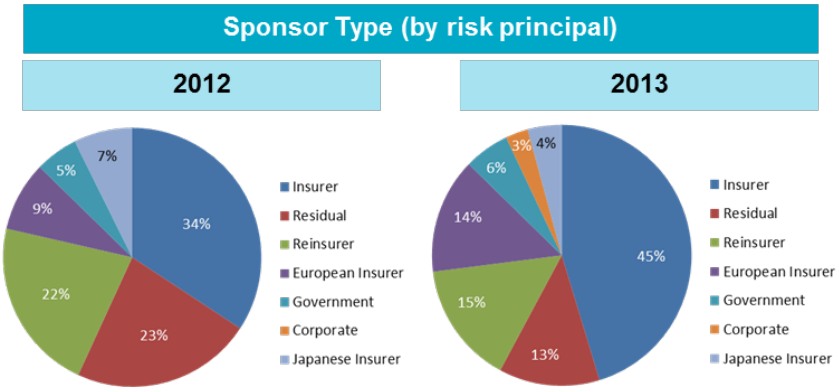
Table 10: Descriptions of Typical Secondary Risk Transfer Products – Traditional and ILS

Product	Description
Traditional Reinsurance (via Rated Entity)	• Uncollateralized bi-party reinsurance contract in which protection buyer relies on protection seller's credit rating as an indication of its ability to honor claim obligations • Makes up the gross majority of the reinsurance market, tends to a be a relationship driven market • Protection buyer is a primary insurer
Catastrophe Bond (144A and Private)	• 144 securities issued by a special purpose entity to facilitate the transfer of the insured losses associated with significant catastrophe events from insurers and reinsurers to capital markets investors • Private issuances also available usually for lower limit transactions • Typically three year scheduled maturities • Indemnity and non-indemnity triggers
Industry Loss Warranty (ILW)	• Bi-party (non-dealer intermediated) contract between protection buyer and protection seller in which protection seller sustains full or partial loss if industry losses associated with a covered event exceed a certain threshold
Collateralized Reinsurance (Direct Basis)	• Collateralized bi-party reinsurance contact in which protection buyer can rely on specific collateral (typically cash, an LOC or short-term U.S government debt) as support for the protection sellers obligation • Protection seller does not need a credit rating • Protection buyer is a primary insurer
Collateralized Reinsurance (Partnership basis "Sidecar")	• Provide investment capital that supports a certain sponsor's book of business or a portion of a sponsor's book of business • A sidecar is a limited purpose reinsurance companies that provide insurers and reinsurers with alternative capital to reduce earnings and capital volatility developed in response to hurricanes and other catastrophes

ILS are sponsored by a variety of entities, though in 2013 over 90% of risk principal for 144A catastrophe bonds (the most prominent and public segment of the ILS market) was issued to support (re)insurers (see Figure 31). Within the (re)insurer category a significant diversity of entities participated in the market. This included insurers from a variety of geographic domiciles (e.g. Japan, Europe and US) and insurers with divergent ownership profiles (e.g. private and public/residual markets). Corporations and governmental entities have also accessed ILS risk transfer capacity though to a lesser extent.

[74] Most definitions of ILS do not include collateralized reinsurance though for the purposes of this analysis it was deemed more effective and appropriate for this sub-class to be included.

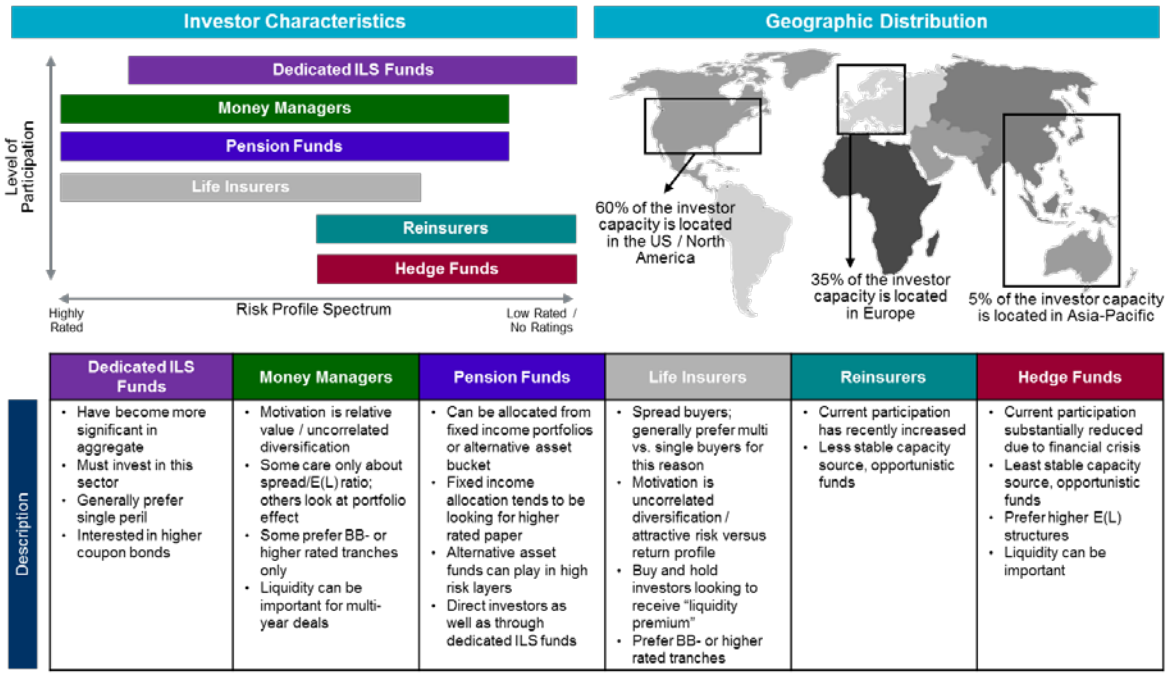
Figure 31: 144A Catastrophe Bond Sponsor Type by Risk Principal[75]



On the other side of ILS transactions, investor counterparties are an equally diverse group (see Figure 32). In recent years capital has entered the ILS space from a variety of sources including hedge funds and reinsurers preferring to operate on the riskier end of the deal spectrum and life insurers, money managers and pension funds preferring to operate on the more predictable end of the deal spectrum. While some of these capital sources have developed a sufficiently robust understanding of the ILS market to underwrite deals in house (e.g. Ontario Teachers' Pension Fund being a prominent non-reinsurance example) most prefer to take a more passive role by investing in specialist ILS funds many of which have invested themselves in the development of sophisticated natural catastrophe and other risk assessment techniques.

[75] Source: GC Securities. 144A catastrophe bonds are public placements restricted for sale to qualified institutional buyers, or QIBs. Private cat bonds, where a bond is placed directly with a handful of selected investors, allow primary insurance issuers to avoid some of the costly legal, catastrophe-modeling, and rating agency hoops associated with a public sale. Though since their issuance is not openly tracked they are not included in this and subsequent charts.

Figure 32: State of the ILS Investor Base (2013)[76]



Of the many ILS funds active in the market today, the ten largest are listed in Table 11 ranked by total estimated capital under management. These ten specialists control nearly $30 billion in capital which is a significant portion of the overall limit deployed by the ILS market which is estimated to be about $45 billion at September 1, 2013[77].

Table 11: Ten Largest ILS Funds by Estimated Capital (YE2013)

Company	Est. Capital (M)
Nephila Capital	$ 8,000
Credit Suisse Asset Management	$ 4,000
Fermat	$ 4,000
LGT (formerly Clariden Leu)	$ 4,000
DE Shaw	$ 2,000
Securis	$ 2,000
CATCo	$ 1,800
Elementum	$ 1,300
Aeolus Re Ltd.	$ 1,100
Pioneer Capital	$ 1,000

[76] Source: GC Securities.

[77] Guy Carpenter 2013 Midyear Report. Not all funds held by individual investors are necessarily deployed.

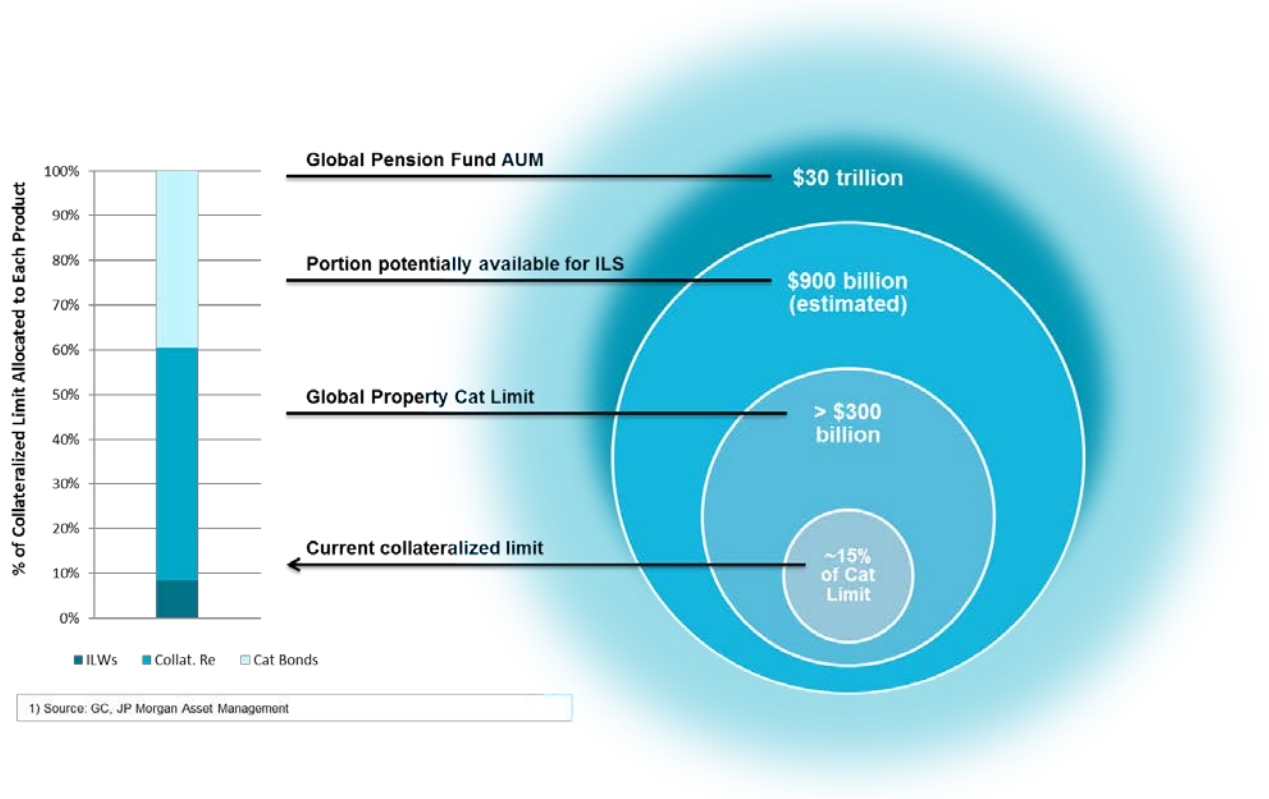
The reinsurance market has undergone significant change since early 2012, experiencing dynamic growth due in large part to the influx of convergence capital from institutional investors seeking access to the reinsurance space. The surge in capital over the last two years in particular has transformed the nature of the sector's capital structure as investors supply capacity through a combination of alternative and traditional vehicles. The impact of alternative markets has so far been most acute in lines where advanced modeling and reliable loss data are available, such as peak catastrophe risks in the United States.

The growth in convergence capital has in some instances resulted in ILS catastrophe risk pricing decoupling from price expectations in the traditional reinsurance market, with ILS products in some cases offering the most competitive terms for reinsurance buyers. Lower cost of capital assumptions and non-correlation of risk with their broader investment portfolio for convergence players has enabled the ILS market to provide very competitive pricing for certain peak risks. Strong appetite for US hurricane catastrophe bonds during 2013 tightened spreads in the secondary market by an average of approximately 45 percent on a weighted notional basis since issuance in 2012. Despite the significant decrease in ILS pricing over the last 12 months, investor demand continues to be robust.

Pension funds have been a major contributor to the growth in new capital. Their focus on relatively remote peak peril catastrophe risk resulted in the catastrophe bond market growing strongly during 2013, with issuance reaching a record high of $7.1 billion, surpassing 2007's previous record total. Risk capital outstanding also reached an all-time high of $18.6 billion last year[78].

[78] Numbers reflect only 144A P&C catastrophe bond issuance. Source: GC Securities.

Figure 33: The Potential Influence of Pension Funds on the Reinsurance Market; Sidebar: Collateralized Reinsurance by Product Type.



While current collateralized capital is not supported exclusively by pension funds, the pension fund markets' capacity to disrupt the comparatively much smaller reinsurance market is significant and needs to be put in context. Per Figure 33, with an allocation of just ~3% of its $30 trillion in assets under management to ILS the pension fund industry would increase the amount of collateralized capital available for catastrophe reinsurance to three times the amount of currently available property catastrophe deal limit[79]. This figure is, of course, much greater than currently needed, demonstrating the existing convergence-driven supply excess. And while it would be unrealistic to expect the pension fund market to deploy its max capital to the ILS asset class anytime soon (and not at all without comparable demand), pension funds have so far made very small investments in reinsurance relative to their overall size. A modest increase in pension fund participation in the property reinsurance segment could have a significantly larger impact than has been seen to date.

Theoretically given the appetite among pension fund investors for uncorrelated alternative assets like ILS we can foresee a future state where a reinsurance buyer's demand for limit rather than available market capacity is the only constraint on maximum capacity available per program. Assuming that the NFIP decides to transfer some of its tail risk into the ILS market, such a program could be the sort of issue that would draw significant investor interest to the space and allow for increased pension fund allocations accordingly.

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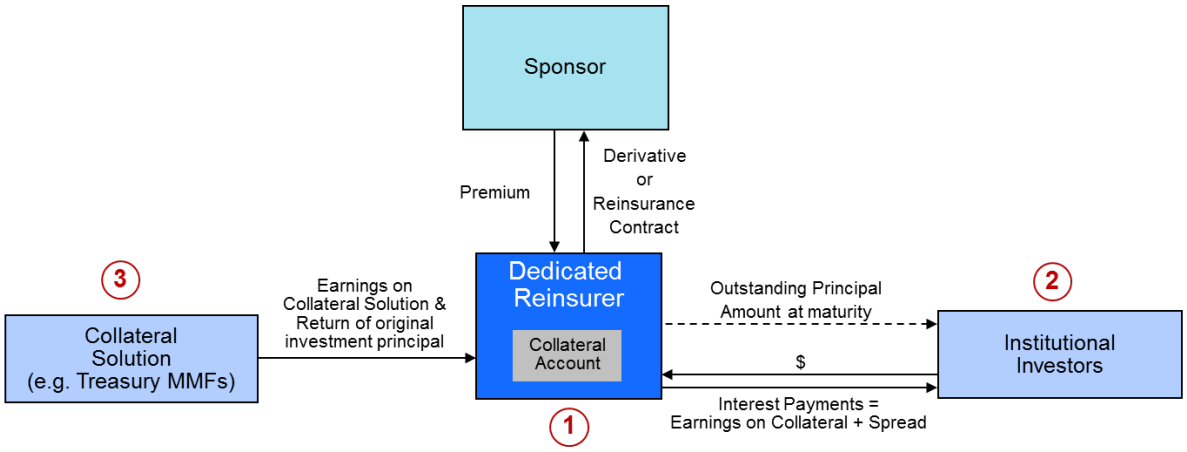
[79] Guy Carpenter; CAPACITY: EVOLUTION, INNOVATION AND OPPORTUNITY; January 1, 2014 Renewal Report. Based on Guy Carpenter's analysis of pension fund possible capital allocation percentages to the (re)insurance space in consultation with sector experts a maximum of $900 billion could potentially be available for insurance-linked investments.

ILS products are distinguishable from traditional reinsurance products in many ways though one key difference is the way in which they are structured. Whereas traditional reinsurance products tend to be backed by the overall financial strength of the reinsurer counterparty, ILS products tend to be fully funded or collateralized by ILS investors. Structurally this usually entails the establishment of a Letter of Credit (LOC) with a bank (for collateralized reinsurance) or a "bankruptcy remote" Special Purpose Vehicle (SPV) to hold the collateral (for catastrophe bonds) until the counterparty obligation established by the risk transfer agreement has expired or the collateral funds have been exhausted by losses.

For catastrophe bonds (presently the most common form of ILS based on issuance volume) an SPV is usually established in one of three offshore jurisdictions – Bermuda, Cayman or Ireland. This SPV then serves as the sponsor's counterparty for the risk transfer arrangement. It is also the repository for ILS investor funds which are held in a collateral account within the SPV and invested in high-quality securities for the duration of the transaction or until principal is called upon due to a loss having been triggered. A detailed depiction of a typical catastrophe bond transaction structure is shown in Figure 34.

Figure 34: 144a Catastrophe Bond – Dedicated Reinsurer Transaction Structure



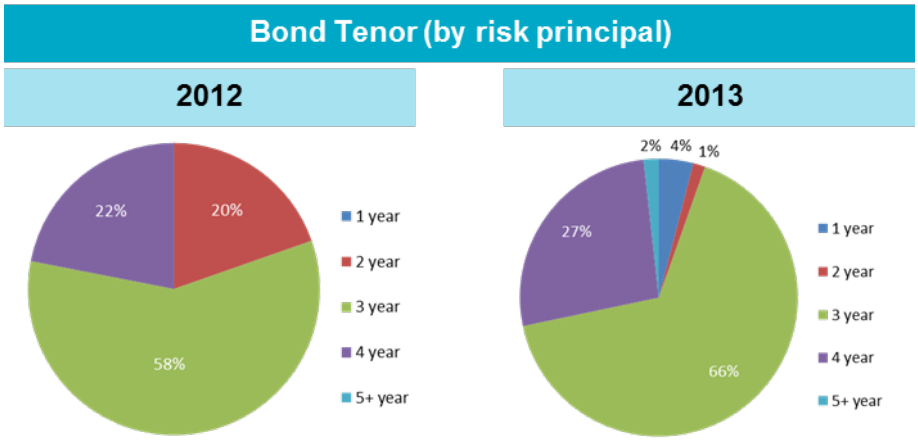
1) Dedicated Reinsurer is formed in either Bermuda, Cayman Islands or Ireland
   - Provides reinsurance or derivative protection solely to Sponsor
   - Owned by a charitable trust
   - Catastrophe bond is not a debt obligation of Sponsor
   - Dedicated Reinsurer does not consolidate onto Sponsor's balance sheet under FIN46R

2) Dedicated Reinsurer offers "Principal At-Risk" Notes
   - Purchased by only institutional investors
   - Collateralizes Dedicated Reinsurer's claims paying capacity obligations to sponsor in the event the catastrophe occurs

3) Proceeds from the Notes offering are reinvested into highly quality assets, most commonly US Treasury Money Market Funds

In addition to being collateralized catastrophe bonds are also often issued for multiyear terms whereas traditional reinsurance products tend to renew annually. In 2013 two-thirds of catastrophe bonds issued had a 3-year tenor. Some were even placed with 4- and 5-year terms (see Figure 35). Placing coverage on a long-term basis has the positive effect of smoothing out annual market pricing fluctuations since the cost of coverage is usually agreed at issuance for the full term. It also helps to amortize the costs associated with the issuance of some ILS products across the deal term. This is most notable for catastrophe bonds which can be costly to implement due to regulatory compliance requirements governing securities issuance and other factors (see Reinsurance Placement Process section in Appendix for more details).

Figure 35: Catastrophe Bond Tenor by Risk Principal



ILS products are also distinguishable in that they cannot generally accommodate reinstatements. Reinstatements are a common provision in traditional property catastrophe reinsurance agreements whereby a reinsured is able to keep full coverage in place even after a large loss event by allowing (usually automatically) for the repurchase of exhausted limit using agreed upon payment methods (e.g. premium *prorata* as to amount of limit exhausted). This is generally seen as a drawback of using collateralized risk transfer since it subjects any cedant wishing to replace recently exhausted coverage to having to enter the market again to seek replacement limits which can be more costly in a post-loss environment. Recently, however, the single limit feature of many collateralized products has spawned creative structures to provide protection for second and third events. Such coverage is often provided in conjunction with low probability capacity.

ILS solutions can cover loss in a variety of different ways. Many perform in a similar fashion to traditional reinsurance by providing indemnity-based protection where losses are covered in line with the sponsor's loss experience. However other types of loss triggers are used to structure ILS solutions including industry loss warranties, parametric indices and catastrophe models. Figure 36 shows the distribution of the loss trigger types used for 144A catastrophe bonds in 2012 and 2013 and Table 12 includes a description of each trigger type.

Figure 36: Catastrophe Bond Trigger Types by Risk Principal

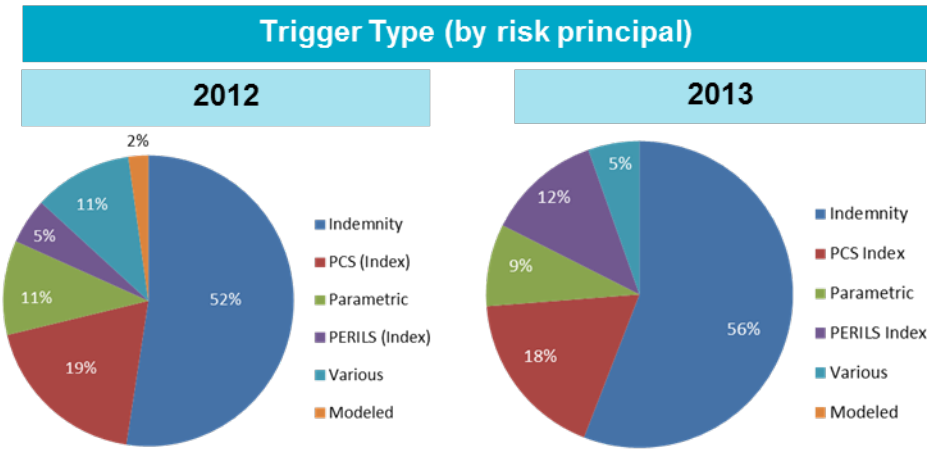
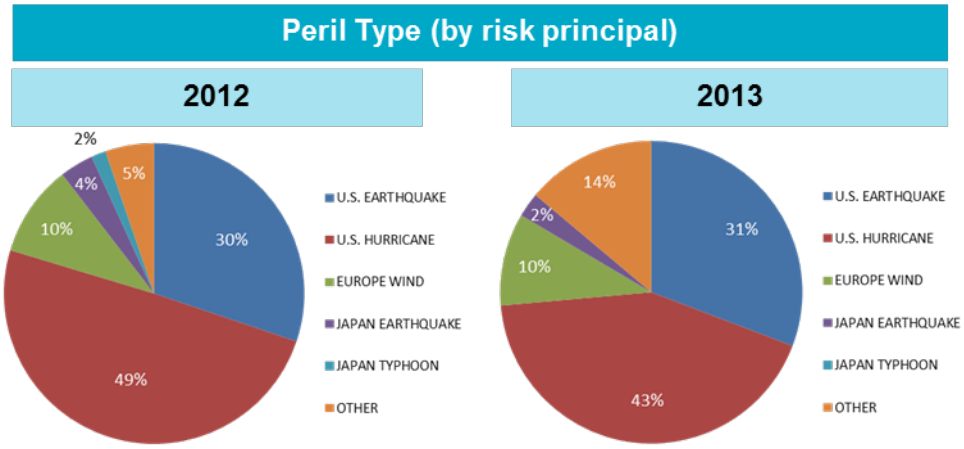


Table 12: Types of loss calculation methods (e.g. triggers) used to structure catastrophe bonds (Source: GC Securities).

Trigger Type:	Indemnity		PCS/PERILS Index		Modeled-Loss	Parametric
Notable Example:	Traditional Third Party Modeled or Sponsor Modeled Excess of Loss	Dual Trigger Indemnity and Industry Loss	CWIL – County / CRESTA Level Resolution*	Weighted State / Country / Line of Business Structure	Based on Cedant's portfolio	Payout exclusively based on specifically calibrated formula
Description:	Bond payout based on actual losses where initial modeling is determined by third party for insurer transactions or sponsor for reinsurer transactions	Bond payout based on the joint occurrence of (i) indemnity losses in excess of a threshold amount and (ii) minimum industry losses (i.e. PCS or LAZR trigger) or event parameters being met	Payouts based on county / CRESTA-level PCS/PERILS industry loss based on modeling firm's estimation of losses within a region's loss; Provides further increased hedging resolution	Predecessor to LAZR structure that weights each state/country's PCS/PERILS loss by line of business; Provides increased hedging resolution over "unweighted" PCS/PERILS structures	Notional portfolio exposure based on cedant's exposure portfolio	Formulaic payout based on observed event parameters such as earthquake moment magnitude at specified measurement locations or hurricane windspeed and storm track
Pros/Cons and Typical Uses:	Can be more challenging (including lower available capacity and increased pricing) for commercial lines business (or reinsurance business); accepted for personal lines business	Pricing may be based on the likelihood of the first trigger (industry loss or event parameter) rather than the expected loss of the indemnity layer; best suited for per occurrence structures	Reduces basis risk with little or no impact on capacity or pricing relative to other PCS/PERILS triggers	Potential for basis risk if underlying exposures are not uniform within each state/country and/or line of business	Customized trigger allows for basis risk reduction without specific disclosure of underlying exposure data	Subject to basis risk, best suited for identifiable key exposures

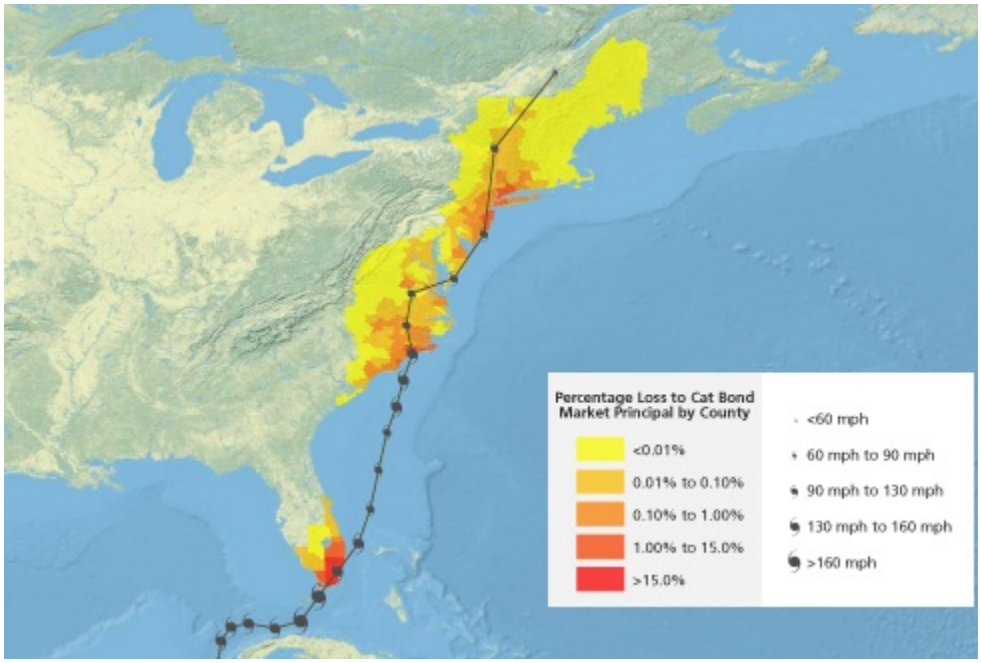
Using most of the trigger types above, ILS products have actually been or theoretically could be structured to protect issuers against any major catastrophic peril. However, at present the market is heavily weighted toward US hurricane and earthquake risk. Over 70% of issuance in 2013 covered these two perils (see Figure 37).

Figure 37: Catastrophe Bond Peril Coverage by Risk Principal



While the share of hurricane-exposed catastrophe bonds has diminished somewhat in 2013 versus the year prior, there remains substantial wind risk concentration in the catastrophe bond market. According to an analysis conducted by AIR Worldwide[80] a single hurricane could trigger 68% of all catastrophe bond tranches in the market today and cause roughly a 60% loss in the total principal value of the cat bond market outstanding at the time of the analysis ($17 billion as @ 9/30/13). Figure 38 depicts the simulated storm track which would cause this level of damage.

Figure 38: Simulated Storm with 0.01% Occurrence Probability and Percent Loss to Cat Bond Market



Of the perils covered by catastrophe bonds to date notably very few have covered flood risk, and only one has covered storm surge risk – MetroCat Re Ltd (see Table 13). Beyond the uniqueness

[80] AIR Worldwide; Uncovering Florida Hurricane Risk with the Catastrophe Bond Database; Nov 2013.

of the peril covered, MetroCat was notable in many other ways: it was issued ultimately to the benefit of a public-benefit corporation, the New York Metropolitan Transit Authority (per Figure 31 only 9% of issued bonds in 2013 were issued by corporations or governmental entities including MetroCat) and the transaction utilized a novel and thoughtful array of water-level measurement sources in a parametric trigger structure to align with the sponsor's storm surge risk exposure in the New York City metropolitan area.

Despite (or perhaps because of) these unique qualities, the bond experienced very strong investor demand. With broad-based and robust support from over 20 investors, the transaction demonstrated the depth and sophistication of capital markets capacity as it expands its footprint in the insurance, reinsurance and retrocession marketplaces. This transaction highlights the flexibility of capital markets-based risk transfer capacity to accept and strongly support bespoke ILS solutions – in this case a new peril and a first of its kind trigger structure – to meet the specific needs of clients.

Table 13: New York Metro Transit Authority Storm Surge Catastrophe Bond Transaction Summary

MetroCat Re Ltd. (Series 2013-1) - At a glance:
• **Issuer / SPV**: MetroCat Re Ltd. (Series 2013-1) • **Cedant / Sponsor**: First Mutual Transportation Assurance Co. (FMTAC – New York Metro Transit Authority (MTA) captive insurance company) • **Placement / structuring agent/s**: GC Securities is lead manager, joint structuring agent, and sole bookrunner and Goldman Sachs is co-senior manager and joint structuring agent • Risk modeling / calculation agents etc.: RMS • **Risks / Perils covered**: Storm surge (named storm induced) • **Size**: $200m • **Trigger type**: Parametric • **Trigger design**: Binary, single trigger • **Ratings**: S&P: 'BB-' • Date of issue: Jul 2013 • **Loss probabilities**: The triggering, exhaustion and expected loss probabilities (which in this case were all the same given the binary nature of the trigger) were calculated by RMS and ranged from 1.67% to 1.71% annualized. • **Price**: The final price of the bond ended at 4.5%, less than 3X expected loss. • To summarize, the transaction utilized a fairly straightforward binary parametric trigger design – if a Named Storm results in Storm Surge Height (SSH) above a predetermined value, FMTAC receives the full principal value of the bond. The cover is fully collateralized minimizing credit risk and in place for 3 years with a 1-year extension option. Such long-term coverage offers MTA the benefit of price stability in the face of catastrophe (re)insurance market cycles. The parametric trigger also affords a quick payout, so no need to wait for traditional indemnity-based loss adjustment. This transaction was additionally notable for the following reasons: • Strong Investor Support for a new Sponsor, Trigger and Peril: Transaction was placed with 23 investors including a broad range of investors types • Remarkable Execution: The transaction's final spread was 10% below the low end of the initial price guidance in addition to the transaction upsizing from $125M to $200M • This sort of structure is easily replicable and highly relevant to NFIP and other governmental entities with a concentration of exposure to storm surge risk. Where the tidal gauge network is less robust or where exposures differ significantly from MTA's there are other methods of parametric trigger design that could be explored.

It should be noted that MTA turned to the capital markets due to a precipitous drop in supply of traditional indemnity-based flood protections after Superstorm Sandy. Thomas F. Prendergast, MTA Chairman and CEO said of the issuance:

> *"In the aftermath of Superstorm Sandy, the traditional avenues we use for insurance and reinsurance contracted dramatically, making it exceedingly difficult for the MTA to obtain insurance. We appreciate the contributions of all of our business partners. This strengthens our position with regard to future interactions with the traditional reinsurance market. We anticipate that this deal represents the start of a long-term alternative reinsurance option that diversifies MTA's risk management strategy."*

It is notable that MTA used a parametric trigger to obtain extra capacity. Sandy, like many other recent catastrophic industry loss events, revealed flaws in current underwriting and modeling techniques causing insurers and reinsurers to rethink their capacity allocations accordingly. For flood risk – both storm surge and inland flood – the market for private indemnity risk transfer was constrained even before Sandy by a general lack of robust commercial modeling techniques. While all three of the main commercial vendors have active storm surge models for the US Eastern and Gulf coasts, in accordance with our market research these are by comparison to other US catastrophe models not very well studied or understood by the market at large. Moreover, there are no commercial inland flood models available for the US at present[81]. This is understandable considering the dearth of flood-specific or flood-driven secondary risk transfer transactions in the market today.

For these reasons, since the peril of flood is not well understood by all markets, capacity for indemnity solutions may be constrained for any new issuer entering the market such as NFIP. Parametric solutions on the other hand rely upon the assessment of an objective hazard measurement (e.g. coastal or riverine water level for instance) and are relatively easy for risk transfer counterparties to underwrite. Therefore, NFIP may wish to consider using a combination of indemnity and parametric solutions to maximize allocations of capacity from the marketplace at large to support the transfer of its catastrophe risk.

Parametric solutions however are not an ideal risk transfer solution insofar as they subject the issuer to basis risk, or the risk of mismatch between actual loss experience and a parametric payout. While there are various statistical techniques which can be used to minimize basis risk, structuring parametric solutions relies fundamentally upon a correlation analysis between historical or expected loss activity and the parameter in question. In the instance of MTA the linkage between storm surge height as measured by stations along the New York metropolitan coastline was strong enough to warrant the purchase of a large bond, though parametric solutions are not always suitable.

Basis risk financing mechanisms are also sometimes available. Though usually these only exist for perils which can be modeled with some degree of certainty. Since US flood risk remains a relatively new peril for the global reinsurance market and commercial models are still coming online, implementing a parametric risk transfer solution with an attendant basis risk transfer mechanism would likely be difficult.

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[81] For the purposes of the FIRS project AIR Worldwide will be running its inland flood model prior to its commercial release.

For the ILS industry the issue of storm surge and wind risk correlation does not seem to be an issue. Nephila, the largest and oldest ILS investment fund, is actively looking to increase its US wind risk and offered $1 billion in capacity to support the Florida Hurricane Catastrophe Fund (FHCF) if it were to purchase reinsurance for its catastrophic risk[82].

C. Capital Markets

The global capital markets are vast accounting for over $200 trillion in debt and equity value. The main means by which capital markets investors access the (re)insurance market and underwrite catastrophe risk is via ILS which have been covered in depth in previous sections of this report. There are other pockets of the capital markets focused on weather risk and creative modes of catastrophe-linked contingent capital which warrant coverage here as well.

1. Weather Derivatives/Index-Based Insurance

Weather derivatives are a relatively new phenomenon. The birth of the modern weather derivative marketplace is dated back to 1997 when the first US transactions took place. Since then the weather trading industry has expanded significantly.

At first the market was dominated by the energy sector though it has gradually gained traction in a variety of other sectors, including agriculture, construction, transportation and entertainment. In recent years the exchange trading of weather risk has risen significantly and attained a critical mass on the Chicago Mercantile Exchange (CME), the main marketplace for weather trading. Over this time period the weather market has emerged as an important contributor to the management of corporate and public entity risk.

Today the business of weather has two main facets:

1. The management of the financial consequences of adverse weather for those with natural exposure to weather;
2. Commercial trading of weather risk, both in its own right and in conjunction with a variety of commodities[83].

For the purposes of this study we are mainly concerned with facet #1 above. In this context, weather derivatives function effectively the same way as parametric (re)insurance transactions – an objective parameter is correlated with a financial consequence, sensitivities are tested and triggers are structured accordingly. The main differences between the weather derivative marketplace and the parametric (re)insurance market are the perils covered and the market structure.

Whereas (re)insurance markets center on acute catastrophic perils such as hurricanes and earthquakes, weather markets center on acute or chronic weather phenomenon such as temperature and precipitation (both rainfall and snowfall). Weather derivative contracts are typically structured to guard against adverse seasonal fluctuations in weather. The most common products traded on the CME weather exchange are cooling degree day contracts in the summer and heating degree day contracts in the winter (CDDs and HDDs respectively). These hedges can be used by

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[82] http://www.trading-risk.com/nephila-offered-1bn-line-to-florida-cat-fund

[83] WRMA.org

energy utilities to guard against lower than anticipated demand (e.g. a warm winter for instance) which would otherwise have an adverse impact on their revenue.

Other products traded on weather exchanges include daily, seasonal or annual rainfall/snowfall. These are most pertinent to organizations with rainfall dependency such as water utilities or agriculture producers. Most often these are also structured to guard against seasonal fluctuations (e.g. drought risk) though contracts can be structured to guard against acute (or extreme short-term) precipitation risk which can be a cause of localized flooding (more on this later in this section).

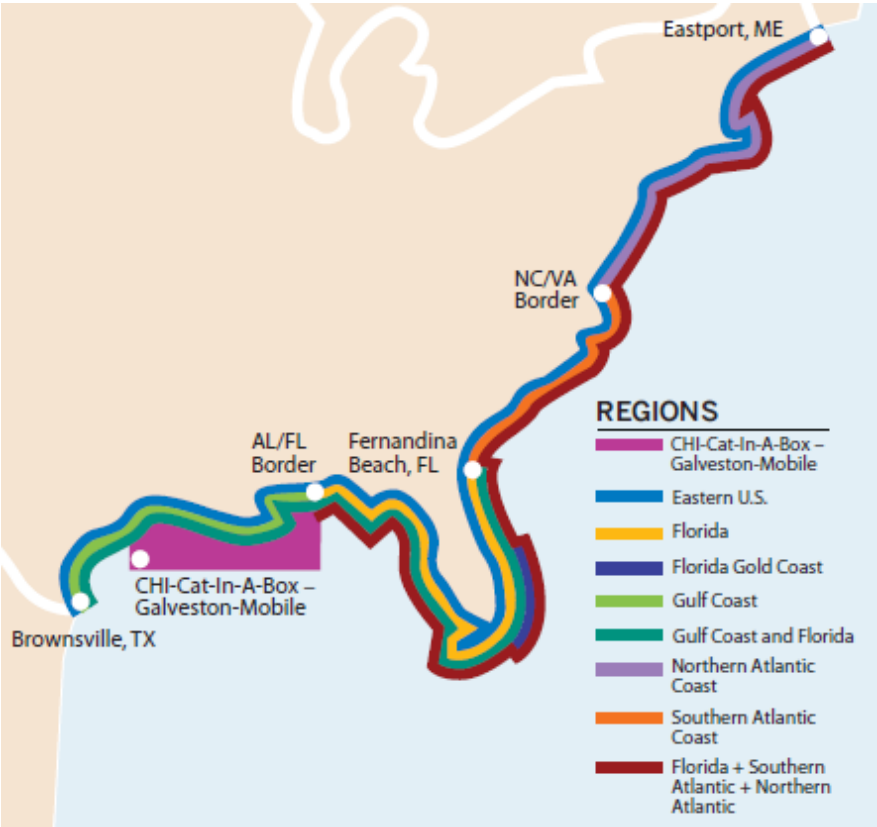
CME weather futures and options on futures are standardized contracts traded publicly on the open market in an electronic auction-like environment, with continuous negotiation of prices and complete price transparency. However, not all weather derivatives are traded on exchanges. Over the Counter (OTC) weather derivatives are privately negotiated, individualized agreements made between two parties. While OTC derivatives are sometimes "cleared" on exchanges they are not exchange traded per se.

The primary benefit of buying an exchange-traded or OTC cleared product is the management of credit risk. Futures and options contracts traded through an exchange are generally cleared, settled and *guaranteed* – the same holds true for any cleared OTC products. The guarantee function of an exchange is important since it effectively removes credit risk from transactions. Buyers of derivatives thus do not need to evaluate the credit of each potential counterparty or limit themselves to a selected set of counterparties.

Interestingly, CME in 2007 ventured into the US hurricane market developing a hurricane index and launching a catastrophe derivative platform (note the distinction between weather and catastrophe). The CME Hurricane Index (CHI) was designed as an improvement upon the Saffir Simpson Hurricane Scale (SSHS) which, for the purposes of estimating financial losses, has certain shortcomings. The CHI attempts to take into consideration losses from storm surge by inputting factors like storm width into index calculation since storms with a wider area have the potential to create greater damage, all else being equal[84]. This represents yet another area of reinsurance and capital markets convergence. While trading in catastrophe derivatives has yet to take off *en masse* the concept is certainly valuable and potentially relevant to NFIP.

[84] For more details on the CHI, see CME white paper: A DETAILED OVERVIEW OF THE CME HURRICANE INDEX™ (CHI™).

Figure 39: CME Hurricane Index (CHI), Binary Hurricane Option Regions



In all, weather or catastrophe derivatives have interesting potential for financing flood risk. To the extent certain weather or catastrophe events – such as extensive short-term rainfall or a landfalling hurricane – can be linked to the incidence of major flood losses weather or catastrophe derivatives could play a role in any NFIP disaster risk financing or privatization program. The major shortcoming of this approach is that none of the indices traded on CME are flood-specific. Meaning any attempt to protect against flood losses involves fitting a second order correlation (e.g. heavy rainfall → flood → loss) which is inherently weaker than a first order correlation (e.g. flood → loss).

It would be possible for NFIP to develop a bespoke OTC derivative transaction which uses measurement techniques or indices not found on CME. In the context of derivatives, OTC markets are generally less transparent, less liquid and operate with fewer rules than do exchanges, though if a prospective hedge buyer has a complex risk management problem a bespoke OTC product may be the only or most viable solution. All this being said it is unclear what the advantages of purchasing an OTC derivative versus a parametric collateralized ILS product like a catastrophe bond would be since both approaches would be largely similar in form and function.

As a corollary to the weather derivative markets a fledgling market for index-based weather insurance has begun to form in the US building on many examples of such schemes from throughout the developing world (see Other section for commentary related to index-based microinsurance). The most prominent example of an index insurance provider in the US is the Climate Corporation an organization which recently sold to Monsanto for nearly $1 billion. In addition to offering Federal Crop Insurance coverage, Climate Corporation has developed a state-of-the-art, technology-driven weather index insurance platform. Its flagship such product is called Total Weather Insurance (TWI) which by the company's own description "is the only full-season

insurance program that enables [farmers] to protect…potential profits by insuring against adverse weather events that can cause yield shortfalls, even when [farmers] fully utilize Federal crop insurance."

While Climate Corporation is operating exclusively in the agriculture insurance market today, their high-caliber technology and granular, multivariate approach to weather risk modeling could lend itself well to other sectors or perils including flood risk financing. Irrespective of the sophistication of a given modeling technique or the granularity of data used, any parametric product – whether styled as a derivative, insurance or a bond – entails some degree of basis risk. Basis risk is most tolerable when the parametric product is used to protect against a key, readily identifiable risk.

According to the industry sources circa 2012 about $12 billion of risk is transferred annually in the weather derivatives market[85]. This makes the weather derivative marketplace about 3-4% the size of the property catastrophe reinsurance market when measured against limit. Though as in the catastrophe reinsurance market, weather derivatives are beset by a similar troubling dichotomy: a dearth of demand and a surfeit of supply.

Weather market participants are optimistic that this will change soon. To paraphrase from a recent report by Allianz[86], current estimates indicate over 30% of US gross domestic product (GDP) is directly or indirectly affected by weather and climate ($5.7 trillion of $15.7 trillion). Many industries are as, or even more, sensitive to variance in weather patterns as they are to interest rate or foreign exchange movements. Despite this known interrelationship weather is often used as a convenient excuse by businesses for poor financial outcomes. This is increasingly less accepted by shareholders/stakeholders. Assuming this assessment of weather market dynamics is correct and pressure is building behind improved weather risk management and increased use of weather hedging techniques we could see an uptick in demand for derivatives and index-based insurance; though it remains to be seen whether or not this viewpoint will prevail.

2. Contingent Capital

Another alternative form of potential capital to support flood risk financing can be found in the form of contingent capital. Two types of contingent capital arrangements will be discussed here – contingent convertible bonds (or CoCos) and contingent credit.

CoCos – which might also be referred to as contingent equity – are debt securities convertible into equity if a pre-specified trigger event occurs. CoCos have been particularly discussed in the context of crisis management in the banking industry though they have also been emerging as an alternative way for insurers to shore up their solvency in the face of Solvency II and other changing regulatory requirements. CoCos start out as debt and, in the event certain pre-specified trigger criteria are met, convert into equity improving the issuer's liquidity ratios and general financial standing. CoCos are usually issued with very long tenors (e.g. as long as 30 years) and can trigger based off of financial metrics (e.g. solvency ratio) or catastrophe events (e.g. FL hurricane causing $XX industry loss).

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[85] WRMA Weather Markets Webinar 1.0; History, Acronyms and Terminology and Overview; Peter Brewer, Cumulus Fahrenheit Fund; March, 2012.

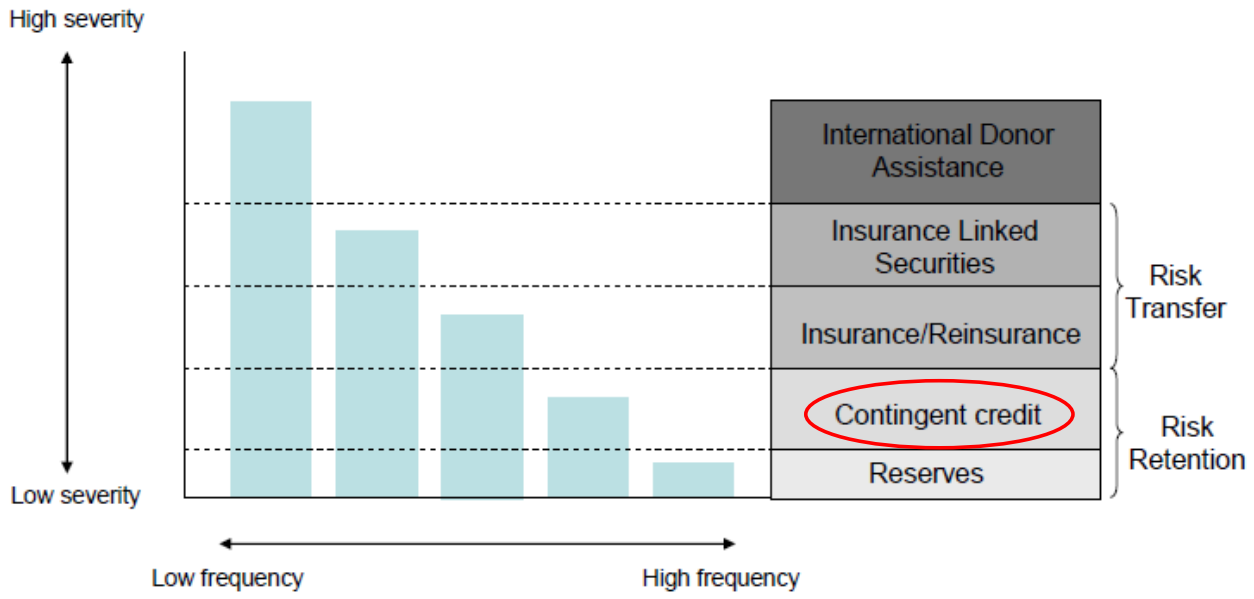
[86] Allianz Global Corporate and Specialty; The Weather Business: How companies can protect against increasing weather volatility; 2013.

Past notable (re)insurance company sponsors of CoCos include Swiss Re, Allianz and SCOR[87]. While these securities serve a very compelling purpose in the private (re)insurance market it is unclear how they might be applied to NFIP since the organization technically does not have any tradable equity.

Contingent credit arrangements on the other hand would perhaps be of more relevance to NFIP. This is a form of *ex ante* financing which is advocated by the World Bank in the context of sovereign disaster risk management. Contingent credit agreements act like any other line of credit where the terms of said credit facility including the interest rate, maturity and usage criteria are all pre-agreed though access to the credit limit is governed by the occurrence of an external event, usually a natural catastrophe. For the World Bank's catastrophe contingent credit products, front-end and renewal fees are charged to keep the line open. The specific triggers used to unlock credit access can either be financial metrics (e.g. value of loss incurred) or a soft trigger, such as the declaration of a state of emergency by the relevant government.

According to the World Bank, contingent credit increases the ability of governments to self-insure by relaxing their short-term liquidity constraints after large loss events. In many situations, contingent credit is most effectively used to facilitate risk retention for middle layers, with reserves used for bottom layers and risk transfer (e.g. reinsurance and ILS) for top layers (and in the context of small developing countries, international development assistance at the extreme tail)[88]. A layered graphic showing an idealized sovereign disaster risk financing program appears in Figure 40.

Figure 40: Risk Layering and Disaster Risk Financing Strategy for International Sovereign Entities[89]



[87] For details on some of these past transactions visit www.artemis.bm and search "contingent capital".

[88] World Bank; Policy Research Paper Disaster Risk Financing and Contingent Credit: A Dynamic Analysis; Daniel Clarke and Olivier Mahul; June, 2011.

[89] Ibid – while this graphic was developed with small developing world countries in mind the concepts it espouses regarding the efficiency/affectivity of certain disaster risk transfer arrangements versus others is more or less universally relevant.

The World Bank's contingent credit facility could serve as a useful model for potential future US Treasury lending to support NFIP operations so long as such an arrangement is implemented in the context of a holistic risk modeling and financing program.

D. Other

Under the category of "other" a variety of interesting topics will be covered including microinsurance and community level insurance programs (in this section community level insurances are also referred to variously as meso-level or group insurances). These segments of the global risk transfer industry, though relatively small are hotbeds of innovation and could serve as solid reference points for similar innovation around flood risk financing in the US.

Microinsurance – insurance for financially excluded, usually low-income populations – is growing fast. Latest global estimates place the total number of lives covered at 500 million in 2011 – this represents 300% growth since 2009[90].

Microinsurance product development is beset by a variety of challenges. For insurance companies to access the low-income marketplace entirely new business models are required so as to streamline distribution and attendant administrative processes without unduly compromising product and service quality. For instance, simply downscaling existing homeowners coverage for low-income consumers will not work since the expense of administering such a product, burdened by the need for individualized loss assessments and expensive overheads, would likely exceed the available premium. Such an innovation imperative erects a significant barrier to market entry – this is particularly true for natural catastrophe risk.

Index-based or parametric products represent an extremely promising avenue for the implementation of effective and efficient catastrophe-risk-transfer mechanisms in low income communities. These mechanisms are useful mainly due to their ability to streamline program administration and lower associated expenses. Since index insurance payouts are priced and trigger based upon an objective parameter, they do not require any of the detailed underwriting and loss adjustment processes used for traditional indemnity products.

However, as catastrophe events are often highly localized and the capacity of local markets to withstand risk varies, index-based products which function at the micro level can prove rather difficult and expensive to design. The implementation and/or expansion of index-based microinsurance programs also remain hampered by a number of other external gating factors. These include data shortage, model development complexity, and a dearth of technical capacity, all of which lead to diminished or nonexistent financial capacity for risk transfer.

Despite these challenges and with the assistance of aid organizations a number of innovative index-based microinsurance project have been launched in recent years. Reinsurance companies, having a lot of the expertise needed to analyze and interpret catastrophe information, are often involved in product development initiatives in this space. Also, due to the difficulty of distributing individual products to farmers in remote villages or individuals lacking bank accounts, index insurance products are most often delivered through an institutional delivery channel.

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[90] Lloyds estimated 135 million covered lives in 2009; ILO estimated 500 million covered lives in 2011

Delivery channels can take many shapes. The most common delivery channel type is a microfinance institution (MFI), though mobile phone operators, retail chains and utilities have also been used. Products can be distributed through these delivery channels on either a voluntary or mandatory basis or somewhere in between (e.g. "negative option" where the coverage is automatically included but can be excluded by the consumer).

Mandatory distribution functions similarly to the lender-placed market in the US in that a microlender requires its borrowers to retain a certain type/amount of insurance. Though usually in the microinsurance context the insurance is automatically loan-linked and not force placed depending on local regulations. Products which cover the interests of the lender against default (and sometimes the interests of the borrower) are occasionally referred to as meso-level products.

The following are examples of microinsurance programs covering flood risk:

- Jakarta Flood: Munich Re launched this program, touted as the world's first index-based microinsurance flood cover in Jakarta, Indonesia. The coverage design in this context was very simple: consumers could buy as many IDR50,000 (US$4.80) insurance cards as they wanted during the dry season months of May to October. If, during the following rainy season, the water level at the Manggarai flood gate on the Ciliwung River reached 950cm, each card could have been exchanged for a one-off payment of IDR250,000 (US$24). This scheme is no longer in force.
- MiCRO: MiCRO is the world's first parametric catastrophe microinsurance company. It launched in 2010 with a pilot project involving Fonkoze, Haiti's leading MFI. MiCRO provided Fonkoze and its borrowers with index-based portfolio protection against EQ, wind and excess rainfall. This last peril was used as a proxy for localized rain-induced flooding which is common in Haiti given the deforestation problem in the country. This program is still active.

In the US tribal insurance market, since 2002 AMERIND has offered a flood insurance endorsement to its standard policy, limited to Housing and Urban Development (HUD)-assisted Indian housing. Through a members-only risk pool, the flood endorsement provides flood coverage to about 56,000 structures on tribal lands and charges a universal rate of $10 per structure per year. AMERIND has a coverage limit of $15,000 for each covered structure[91].

E. Industry Capacity Assessment

(Re)Insurance capacity for US flood risk is ultimately a function of profit potential over time. The core questions which private (re)insurers ask before underwriting a piece of business are will the premium be sufficient to cover anticipated losses and how does the addition of new business influence the company's risk profile? Answering these questions is not straightforward given the manifold factors which influence the pricing, capacity and returns of disaster risk financing markets. Indeed the various steps needed to unlock primary or secondary market capacity require more attention and will be covered in detail in subsequent deliverables under the FIRS project (e.g. the Privatization Study).

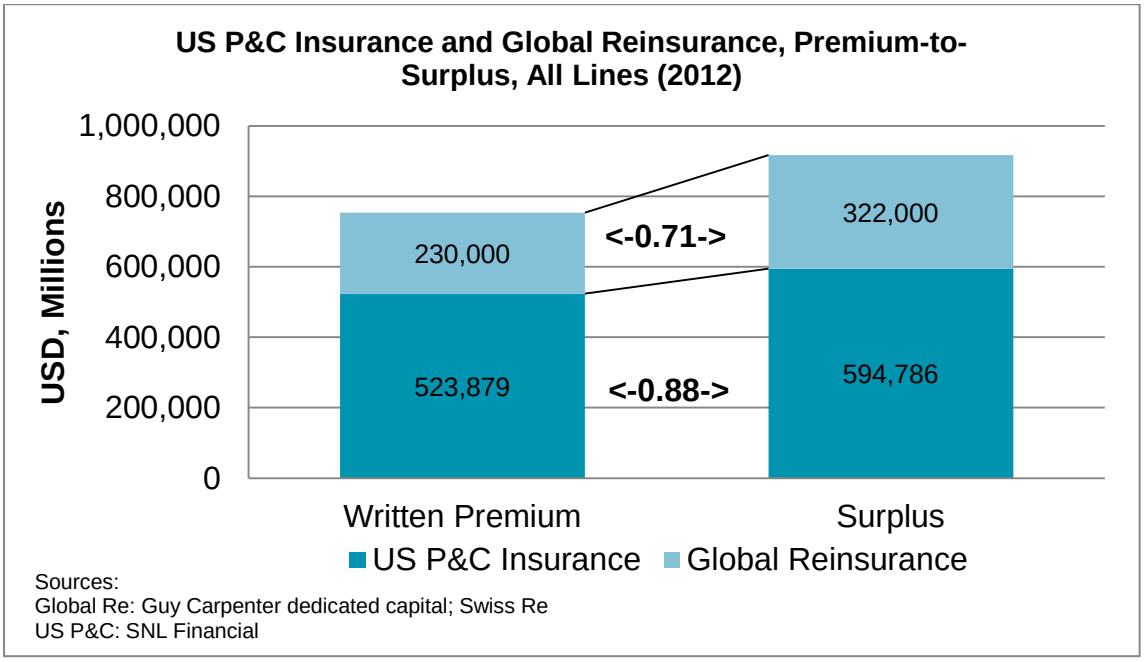
For the purposes of this Current Market Assessment, while we include commentary below on the primary insurance market's ability to assume more catastrophe risk, practically speaking the US

[91] For a more comprehensive treatment of AMERIND's flood product see: GAO; Participation of Indian Tribes in Federal and Private Programs; Jan, 2012.

insurance market will not be in a position to enter the flood insurance business in any significant way without first having some assurance as to the availability of related reinsurance capacity to address tail risk. Therefore, while we will start this section with some observations around the primary insurance industry's ability to take on flood insurance risk, most of our focus will be on the reinsurance sector and top-down capacity development.

Since capacity is ultimately a function of capital, in order to assess the private (re)insurance market's aggregate *capacity* to assume US flood risk we first need to understand its *capital* base in relation to the risk presently underwritten. Figure 41 shows gross domestic P&C insurer and global reinsurer premium and capital levels. Premium-to-surplus ratios are shown between the two towers. To reemphasize commentary above, both the US P&C Insurance and the Global Reinsurance markets are very well capitalized from a historical perspective both posting record capital-to-surplus ratios recently (see Historic Market Assessment for more detail). Based upon this relatively simple measure of underwriting leverage both market segments should have ample balance sheet room and appetite for new catastrophe risk.

Figure 41: US Property & Casualty Insurer and Global Reinsurer Industry Gross-Written-Premium-to-Surplus Ratios, All Lines (2012)



As previously emphasized, the global reinsurance industry relies upon probabilistic catastrophe models to conduct natural disaster risk assessments which often underpin their underwriting decisions. To gain a better sense of loss potential for this Current Market Assessment, AIR Worldwide ran exclusively for this project its proprietary storm surge model against its proprietary Industry Exposure Database (IED) and produced a set of aggregate (as opposed to occurrence based) industry storm surge modeled loss results split between residential and commercial structures. Table 14 summarizes the results of this analysis which are pertinent to (re)insurance industry capacity assessment.

In short, AIR's analysis suggests the national probable maximum insurable (meaning both insured and uninsured) losses for storm surge events on an annualized basis are roughly **$38.6 billion** at

the 1% return period (100 year loss level) and **$59.5 billion** at the 0.4% return period (250 year loss level) for all property types. Looking at residential business only, loss estimates suggests **$28.9 billion** and **$45.2 billion** losses at the 1/100 year and 1/250 year intervals respectively. These results further suggest that **residential risk accounts for roughly 75% of overall US storm surge risk**[92]. This last finding is consistent with prior indications that flood risk financing in the US is mainly a residential issue as opposed to a commercial one.

While these numbers do not take into consideration the significant potential for catastrophic losses from inland flood events, this is not to suggest that inland flood exposure does not pose a significant challenge. While most individual inland events do not present the loss potential of a Hurricane Katrina or Hurricane Sandy, there are inland event scenarios that carry significant loss potential and inland flooding on an aggregated basis carries significant risk. However, as history has shown the NFIP's portfolio, when one considers the potential need to borrow from the Treasury and rely on tax payers to cover unfunded catastrophic exposure, is most vulnerable to large occurrence losses from wind-driven storm surge events. As a result, and assuming this is the initial challenge FEMA attempts to address from a reinsurance perspective, reinsurance underwriters will focus on loss potential from storm surge when analyzing the NFIP's portfolio. Insurers will also focus on this exposure element at least preliminarily given concerns around management of aggregate coastal exposures. An assessment of private market flood risk financing capacity must therefore be considered in the context of this peril. Moreover, given the fact that Gulf and East Coast wind represents the (re)insurance sector's largest catastrophe exposure by most measures, the correlation between the perils of wind and coastal flood must be taken into account when considering the extent to which the sector can potentially support the NFIP (as an aside, one potential benefit from inland flood from the insurance industries perspective is that this exposure will not correlate with the industries hurricane exposure to the same extent).

[92] Return periods are not additive and should not be averaged. Expected Value (EV) metrics on the other hand are additive. 75% is the ratio of the EV for residential storm surge to the overall EV. Commercial risk accounts for the remaining 25%. See Appendix for details.

Table 14: AIR Worldwide Industry Insurable Storm Surge Aggregate Modeled Loss Results; Industry and Residential Only[93]

State	Total All LOB					Residential				
	Avg Ann Loss	Stan. Dev. of AAL	2.00%	1.00%	0.40%	Avg Ann Loss	Stan. Dev. of AAL	2.00%	1.00%	0.40%
US	3,550	8,178	27,173	38,556	59,486	2,554	5,998	19,801	28,931	45,227
AL	45	345	586	1,244	2,411	26	183	355	776	1,412
CT	32	307	347	858	1,747	25	230	283	681	1,423
DE	4	120	0	0	24	4	107	0	0	21
FL	1,480	6,394	16,859	30,152	53,648	1,063	4,655	11,821	21,518	40,341
GA	33	479	109	629	1,808	25	365	86	525	1,363
LA	513	2,374	8,227	11,919	16,801	329	1,601	5,363	8,331	11,500
MA	83	657	1,104	2,561	4,836	70	547	958	2,177	4,076
MD	5	148	0	0	27	3	102	0	0	18
ME	13	175	7	193	982	10	138	6	150	751
MS	17	161	187	477	995	8	85	60	205	534
NC	321	1,172	4,220	5,931	8,131	256	922	3,376	4,726	6,264
NH	1	10	0	9	52	1	9	0	7	45
NJ	94	1,325	101	1,404	5,728	77	1,068	88	1,165	4,798
NY	184	2,342	1,002	4,003	11,714	149	1,821	859	3,441	9,453
RI	61	534	766	1,951	3,276	44	385	570	1,378	2,291
SC	320	1,549	4,794	6,923	11,378	248	1,175	3,643	5,425	8,787
TX	337	1,591	5,698	9,003	13,002	212	995	3,579	5,704	7,953
VA	6	187	0	12	61	5	142	0	9	47

*** %'s = Mean value at Return Period Thresholds (2% = 50 year; 1% = 100 Year; 0.4% = 250 Year)

To understand the implications of these model numbers it is useful to assess if the (re)insurance industry could tolerate a 1/250 year loss given two hypothetical scenarios: 1) all residential properties exposed to storm surge are required to purchase flood insurance from the private market

[93] See AIR Industry Storm Surge Modeling Methodology section in appendix for commercial loss results and a list of key terms and modeling assumptions.

and; 2) all residential properties exposed to storm surge are required to purchase flood insurance from either the NFIP or the private market.

In scenario #1 the (re)insurance industry would suffer a $45 billion loss with no uninsured component. While this would certainly be a significant loss event it would be much smaller than Hurricane Katrina in terms of economic impact ($125 billion[94]) and about the same size as Meteorological Event Sandy ($50 billion[95]). The private insured loss would be roughly equivalent to the private insured loss from Katrina ($48.7 billion[96]).

In scenario #2 it is first necessary to establish the portion of industry loss that would be covered by the NFIP prior to making any capacity assessments. In the absence of a detailed coastal take-up rate analysis, for simplicity's sake let's assume the NFIP insures roughly half of the residences exposed to US storm surge risk weighted evenly in accordance with IED building density patterns. This would allow for a simple 50% prorating of the residential loss figures in Table 12, making NFIP's 1/250 loss to storm surge $22.6 billion. The privately insured component of a 1/250 year loss would then also be $22.6 billion. To provide some context, the total insured loss in scenario #2 would be roughly equivalent to the insured loss from Meteorological Event Sandy ($18.8 billion[97])[98].

On their own these industry storm surge loss events do not seem to cause any immediate concern in terms of market capacity or risk tolerance. A $45 billion or $22.6 billion insured loss would exhaust up to 75% of a full year's combined earnings for the US P&C Insurance segment and the Global Reinsurance segment which together account for an approximate annual net income of $60 billion[99]. Stated otherwise, of the $916 billion in capital held by US P&C insurers and global reinsurers a $45 billion or $22.6 billion insured loss event would be equivalent to only about 5% to 2.5% of total combined capital. Based on these measures a standalone storm surge loss even with 100% market penetration would not be a "capital event" for the industry meaning it would not cause any depletion in industry surplus by itself. To provide some historical context, while hurricanes Katrina and Sandy were two of the most costly hurricane events in US history and both resulted in some impact on reinsurance pricing and capacity (see Historical Market Assessment for more details), neither led to significant (re)insurance company impairments. Furthermore the (re)insurance industry certainly demonstrated its resilience to these events by bolstering capital levels significantly in the months and years since.

However, when these residential storm surge losses are combined with simultaneous residential and commercial wind losses the impact on the industry could become much larger pushing the private market's exposure to a single storm quite high. To put into frame the impact of a large wind

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[94] EM-DAT, International Disaster Database.

[95] EM-DAT, International Disaster Database

[96] PCS; Insurance Information Institute inflation adjustments to 2012 dollars using CPI. Excludes NFIP's losses.

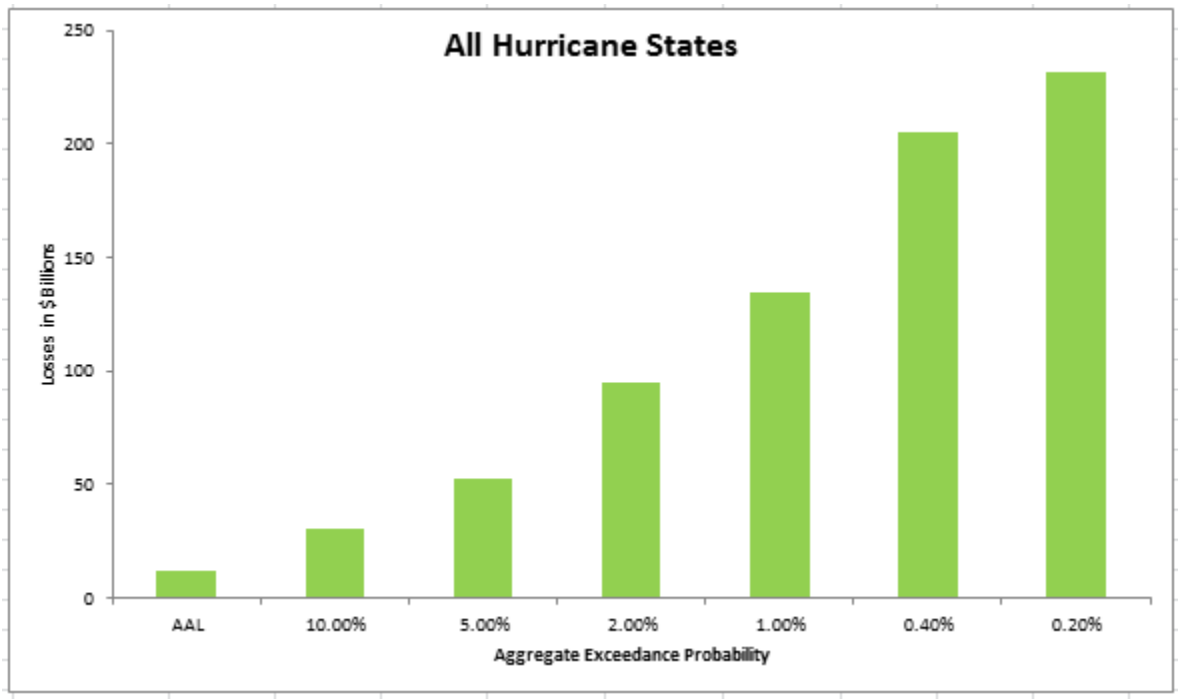
[97] PCS; Insurance Information Institute inflation adjustments to 2012 dollars using CPI. Excludes NFIP's losses.

[98] This scenario is purely illustrative. The authors recognize that in any situation where the NFIP and the private market are both insuring flood risk, the NFIP is likely to write some of the more risky properties (not unlike a state residual property market) making a prorata adjustment of the sort here envisioned impractical. In this scenario we also assume that NFIP does not purchase reinsurance for its portfolio, though this would increase the private market's exposure to storm surge.

[99] The US P&C Insurance segment posted a net income of $29.75 billion in 2012 (close to the five-year average for the segment of $27 billion) and the Global Reinsurance industry posted $31 billion in net income in 2013.

event on the industry, Figure 42 shows an industry loss analysis conducted by AIR for the peril of hurricane[100]. According to this analysis a 1/250 year industry wind event would result in a ~$200 billion insured loss. Combine this with the 1/250 year storm surge loss assumed in scenario #2 and the total industry insured loss would exceed $220 billion for one event[101]. Such a loss year would wipe out nearly 4 years of combined earnings for the US P&C Insurance and Global Reinsurance segments eroding capital by as much as $160 billion or about 17.5%.

Figure 42: Modeled Industry Insured Hurricane Losses



As a benchmark for this figure, many insurers manage their portfolios to a 1/100 year net loss (after the application of reinsurance) of 10-15% of surplus meaning a larger surplus loss would be expected from a 1/250 year event. Allowing for the iniquities in the comparison, a 17.5% loss of combined (re)insurer surplus from a $220 billion event would fall within an acceptable range in accordance with such a basic insurance company risk management principal. However, if the loss were to be unevenly distributed (e.g. borne more heavily by certain classes of (re)insurer than others) it could nonetheless cause several company insolvencies and generate a large adverse impact on available post-event capital therefore skewing the market for catastrophe risk transfer (e.g. causing a marked increase in price and a decrease in capacity).

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[100] AIR Worldwide; results show aggregate insured industry losses from v16 of CATRADER (10k standard catalog, including demand surge and a 10% loading for storm surge spillover).

[101] The authors recognize that adding return period figures is not a statistically valid method of assessing combined loss probability. We also recognize that there is an element of overlap in the industry hurricane and storm surge numbers since a small amount of storm surge spillover (10%) is presumed in AIR's hurricane model. In total the combined amount cited here represents a loss amount which is likely higher than the actual combined HU+SS 1/250 year loss. However, for the purposes of this economic analysis and in the absence of a combined industry HU+SS loss curve, this estimation method should suffice for hypothetical demonstrative purposes.

While these combined loss numbers are significant, the impact of new storm surge risk on the wind risk already being written by the industry would be somewhat negligible meaning the addition of this risk would not make a huge impact on the industry's loss position given the size of wind risk by comparison. Again using scenario #2 as an example, a 1/250 residential storm surge loss year combined with a 1/250 wind loss year would only increase total losses incurred by about 11%. This is a meaningful amount though it should not change the dynamics of the reinsurance market unduly since most underwriters should already be comfortable with the concept of 9-figure industry loss events.

From the NFIP's perspective, it should be a positive that storm surge loss potential is relatively negligible by comparison to wind loss potential as it bodes well for private market capacity provision, especially from the reinsurance market. This will be covered in more detail in the following sections.

1. US Insurance

As per Figure 41, the US P&C Insurance market is currently writing premium (all lines) at a ratio of 0.88 to surplus. This in and of itself is an indication of the market's ability to take on new business. As a benchmark, some state regulators impose a maximum allowable premium-to-surplus ratio of 3.00. If we take this as the ceiling and presume NFIP's portfolio is worth something like $5 billion dollars in gross premium on an open market basis[102], writing the entire portfolio would barely increase this metric. Even if measured against HO+FO premium which accounted for $82 billion in premium in 2012, an additional $5 billion would only represent 6% growth in the premium base.

Looking at the primary market a bit further, altogether primary market capital (again, some portion of which is allocated to non-property lines) supports about $64 trillion of insured exposure of which about 16% is on the Eastern and Gulf Coasts (Figure 43). This 16% figure ($10.6 trillion[103] of exposure) is important since it contributes most heavily to insurer exposure to catastrophic loss given the regular incidence of US landfalling hurricanes and the standard coverage of wind risk by most HO+FO and Commercial property policies. Delving into this coastal exposure a bit further, NY and FL are clearly the largest contributors representing collectively over 50% of total US coastal hurricane-exposed risk (Figure 44).

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[102] Estimate reflects rough adjustment for subsidized business only. According to NFIP's Actuarial Rate Review from 2011; ~22% of NFIP's policies receive a ~55% subsidy. Presuming equal pricing across all policies this means a 12.1% portfolio premium subsidy. However, pre-FIRM subsidized properties are not weighted equally. To quote from the Rate Review: "To give a sense of the impact eliminating the subsidy would have on the program as whole, increasing the premium for subsidized policyholders while leaving the remaining policyholders unchanged would cause the aggregate premium for the entire NFIP to increase on the order of 50% to 75%." With earned premium of $3.349 billion in 2012 eliminating subsidies would increase program premium by 50% to just over $5 billion. This estimate does not account for BW-12 rate adjustments or any pending map changes which may cause fluctuation in both risk-based and subsidized rates. It also does not account for private market loadings which may be generally higher than those used by NFIP.

[103] Ibid, __

Figure 43: Total Insured Value of Properties Nationwide, Coastal vs. Non-Coastal

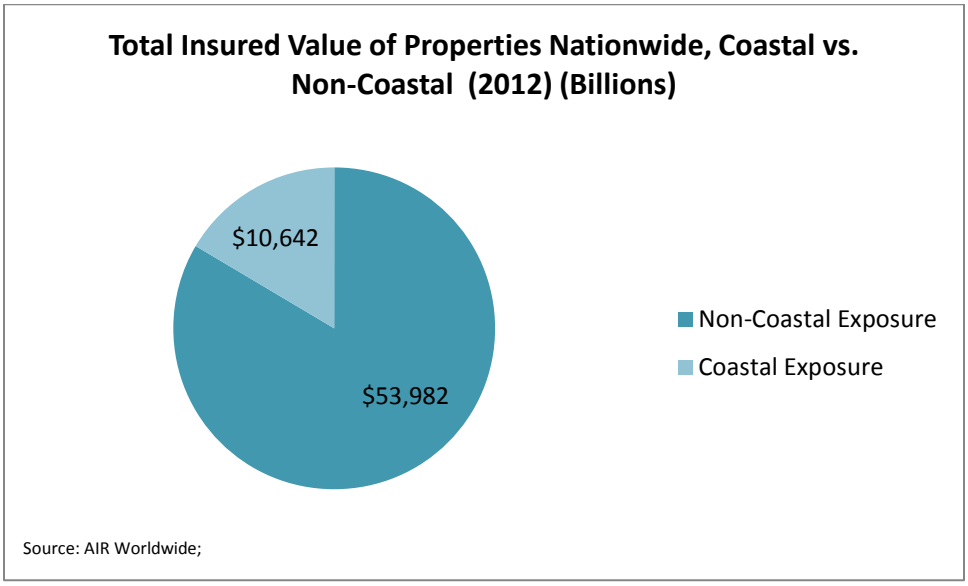
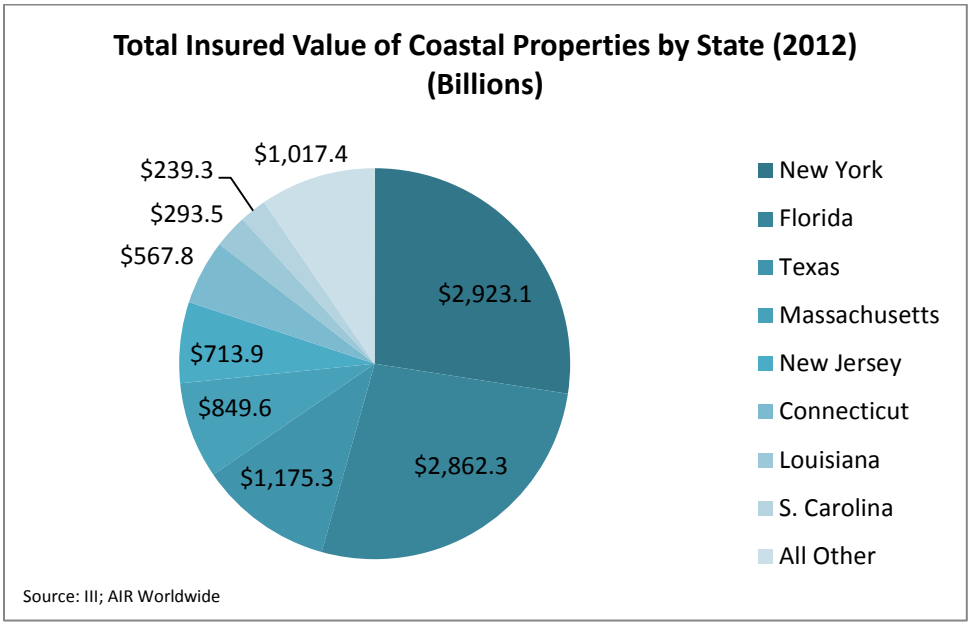


Figure 44: Total Insured Value of Coastal Properties



From the perspective of exposure the primary insurance industry's ability to assume flood risk seems less certain. The main reason is that exposure concentration represents a potential challenge for the primary insurance market which is already heavily exposed to hurricane risk in coastal jurisdictions. Without adequate and cost-effective reinsurance protection to guard against catastrophic floods few insurers are likely to be interested or able to take on significant amounts of flood exposure since most have limited catastrophe diversification potential. For this reason an assessment of the reinsurance industry's appetite and capacity for flood risk is needed before we can make a full determination of the primary market's accordant appetite and capacity.

2. Global Reinsurance

Amidst observable trends across the reinsurance sector including greater and growing interest from capital market investors, low current premium-to-surplus levels, continuing share repurchase programs, etc. reinsurers are finding it challenging to put all of their capital to work. While we are not there yet, we can foresee a future state where the buyer's demand for limit rather than available market capacity is the only constraint on maximum capacity available per program.

Today, given the dynamics touched on above and earlier in the report, we believe it possible, with appropriate lead time, to build a single reinsurance program that provides **$7.5 to $10 billion of vertical event capacity**. As comfort with NFIP's business increases and understanding of the organization's exposure profile and supporting risk analytics including catastrophe modeling increases, we believe available reinsurance capacity could grow to $12.5 to $15 billion in relatively short order. These estimates contemplate indemnity coverage only and are based on conversations with prospective NFIP flood reinsurance counterparties to date, proprietary market data and desk research (see Appendix – Market Interviews for more details on capacity determination). By way of basic background, currently the largest reinsurance program placed internationally exceeds $7 billion in total limit. Beyond this program, there are only a handful of others where the total limit purchased exceeds $4 billion.

As we work through the modeling exercises being conducted under Section C, and begin to construct the cost-benefit analysis called for under the Reinsurance Study, we will provide further insights into the state of large international catastrophe programs that are supported by private reinsurers and capital markets. Attracting meaningful capacity to help the NFIP manage its exposure will be possible as the supporting analytics and tools that enable capital providers to understand the risk become available. We will address how to strategically structure such a program against NFIP's risk appetite, and how to begin the process of building market support. As a start to this process we have included in the Appendix a Reinsurance 101 section and a Reinsurance Placement Process section for your reference.

3. Capital Markets

While some non-ILS capital markets products like CoCos and weather derivatives represent very intriguing possible sources of flood risk financing capacity for the NFIP, by and large they are not presently equipped to address flood risk per se. Whilst an OTC derivative could be structured to address NFIP's flood risk in a manner similar to that used by MTA with MetroCat, the advantages of using a derivative platform for this sort of deal versus a typical ILS product (e.g. a catastrophe bond) are unclear. Until technology and flood modeling capabilities improve and become more readily available exotic risk transfer instruments may not be of any near-term use to NFIP. Nevertheless innovations in the capital markets should continue to be monitored as they may provide inspiration for alternative flood risk financing methods in the future.

HISTORIC MARKET ASSESSMENT

1 PREFACE

For the sake of convenience, FEMA's preliminary guidance as presented in the Flood Insurance Risk Study (FIRS) project Request for Quotes (RFQ) and carried forward into the Consultant's Performance Work Statement (PWS) is restated in Table 1 with respect to the Historic Market Assessment section of the Reinsurance Study.

Table 15: National Flood Insurance Program Flood Insurance Risk Study; Reinsurance Study; Historic Market Assessment Description

NFIP FIRS Reinsurance Study Historic Market Assessment Description
The Contractor shall perform an assessment of the historical capacities of the private sector insurance, reinsurance, capital and financial markets in assuming property and casualty insurance risks, in particular the risk of flooding in the United States. The assessment shall include the following: a) An analysis of the variability of the private sector markets' capacities and pricing levels both year by year and over the period of at least two complete property and casualty insurance market *cycles*. b) Informed by the historical assessment, an analysis of the capability of the private sector markets to provide a *significant, reliable, comprehensive and continuous* source of flood insurance coverage throughout the United States currently and in the future.

Based on the above this analysis will outline the past dynamics of various private risk transfer markets[104] with a specific view towards determining the potential impact of market cycles on their future capacity to finance US flood risk.

Managing growth and maintaining underwriting discipline across market cycles is one of the biggest challenges for (re)insurers everywhere. Such market cycles are often described as having "soft" and "hard" periods. Soft markets are characterized by consistent premium rate reductions and broadening coverage provisions whereas hard markets are characterized by consistent premium rate increases and narrowing coverage provisions. Fundamentally these ebbs and flows in market cycles are caused by changes in market supply and demand. (Re)Insurance supply is influenced by (re)insurer capacity which is a function of available underwriting capital. For example industry capital levels can be influenced positively by operating profits or increased investment from third-parties or negatively by operating losses or significant shifts in the industry's understanding of a given risk. (Re)Insurance demand on the other hand is influenced by macroeconomic conditions, regulatory policy and a litany of consumer-driven behavioral considerations.

[104] Note: per common practice the term "markets" herein is used variously to refer to both marketplaces (e.g. the reinsurance market) as well as risk-bearing entities individually (e.g. XYZ Re is a market for flood risk).

Each of the two major sections of this report covering the US P&C market and the Global Reinsurance market respectively is divided into Underwriting, Asset, Capacity and Pricing subsections. The residual property and ILS segments (distinctive and influential components of the major markets addressed herein) are given separate consideration. The report concludes with a general discussion around the causes and effects of market cycles.

2 MARKET LANDSCAPE

A. US Insurance

1. Property & Casualty Market

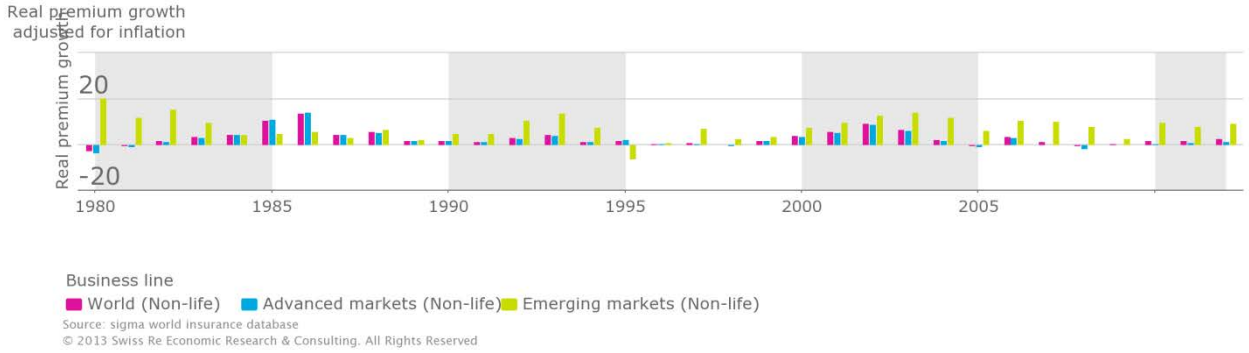
Underwriting

The US Property and Casualty (P&C) insurance market is a key component of global non-life insurance market dynamics. Worldwide non-life insurance premiums amounted to nearly $2 trillion. Approximately 70% of this premium was concentrated in North America and Western Europe. The US alone, the world's largest P&C insurance market, had a 35% share of the global non-life sector in terms of premium volume. The next two largest jurisdictions, Japan and Germany had a 6.5% and 6.3% share of the global market respectively[105].

While the current global non-life insurance market is heavily weighted toward major developed markets in terms of premium volume, real premium growth rates have stagnated in advanced economies in recent years. This in turn has drawn the attention of many insurers to emerging markets where premium growth rates have been higher especially throughout the global financial crisis.

Figure 45 shows real premium growth rates split between emerging and advanced economies from 1980 to 2012. Premium growth in emerging markets has exceeded premium growth in advanced economies for all but four of the last 32 years. This is broadly a consequence of relatively sluggish GDP growth in advanced economies versus emerging markets (again, especially in recent years) since insurance premium growth tends to correlate broadly with economic activity[106].

Figure 45: Non-Life Real Premium Growth Rates – Advanced vs. Emerging Economies – 1980-2012

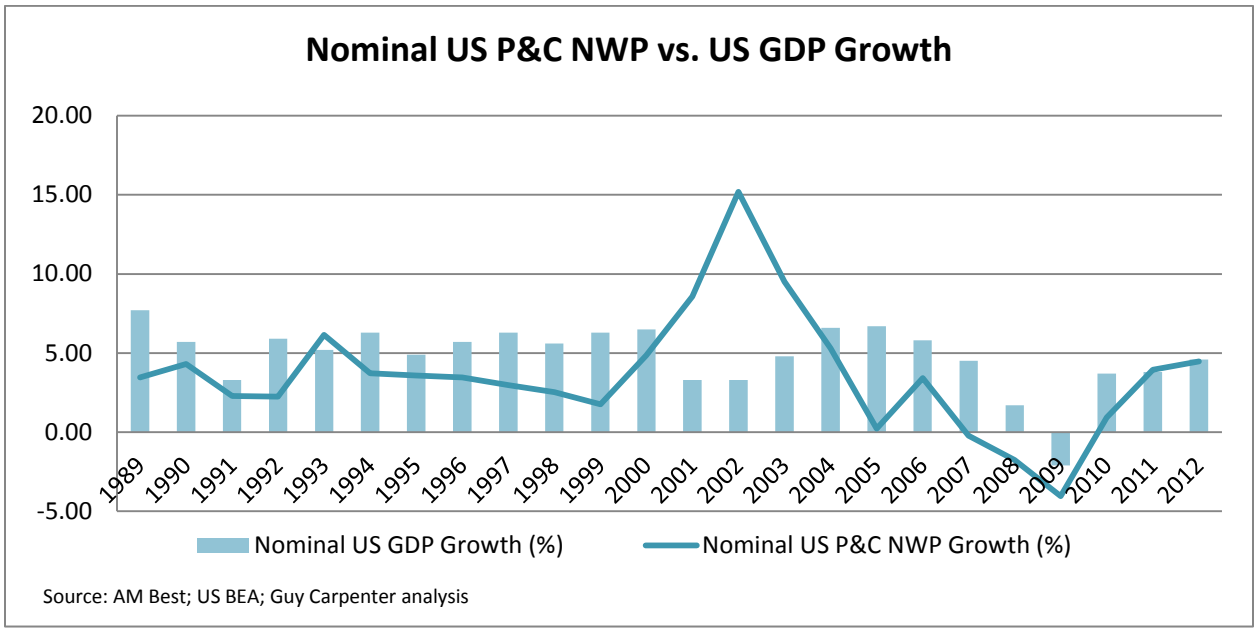


[105] Swiss Re Sigma No 3/2013; *World insurance in 2012: Progressing on the long and winding road to recovery.*

[106] While the correlative relationship between insurance premium and economic activity in a given market is generally accepted, there is an increasing body of literature on the causal relationship between insurance usage and economic development. For a good non-technical summary of the relationship between insurance and economic development see Zurich's White Paper: What is the Role of Insurance in Economic Development?

Figure 46 demonstrates the general correlation between nominal Gross Domestic Product (GDP) growth and nominal US P&C industry Direct Written Premium (DWP) growth over the 15 years ending 2012. While the link is not one-to-one and the factors influencing premium growth are manifold (e.g. the increase in premiums in 2002 can be largely attributed to sharp increases in pricing of many P&C insurance lines after 9/11), growth rates (or rates of decline) track generally with economic output as measured by GDP.

Figure 46: Nominal US Property & Casualty Net Written Premium vs. Nominal US Gross Domestic Product Growth Rates – 1989-2012

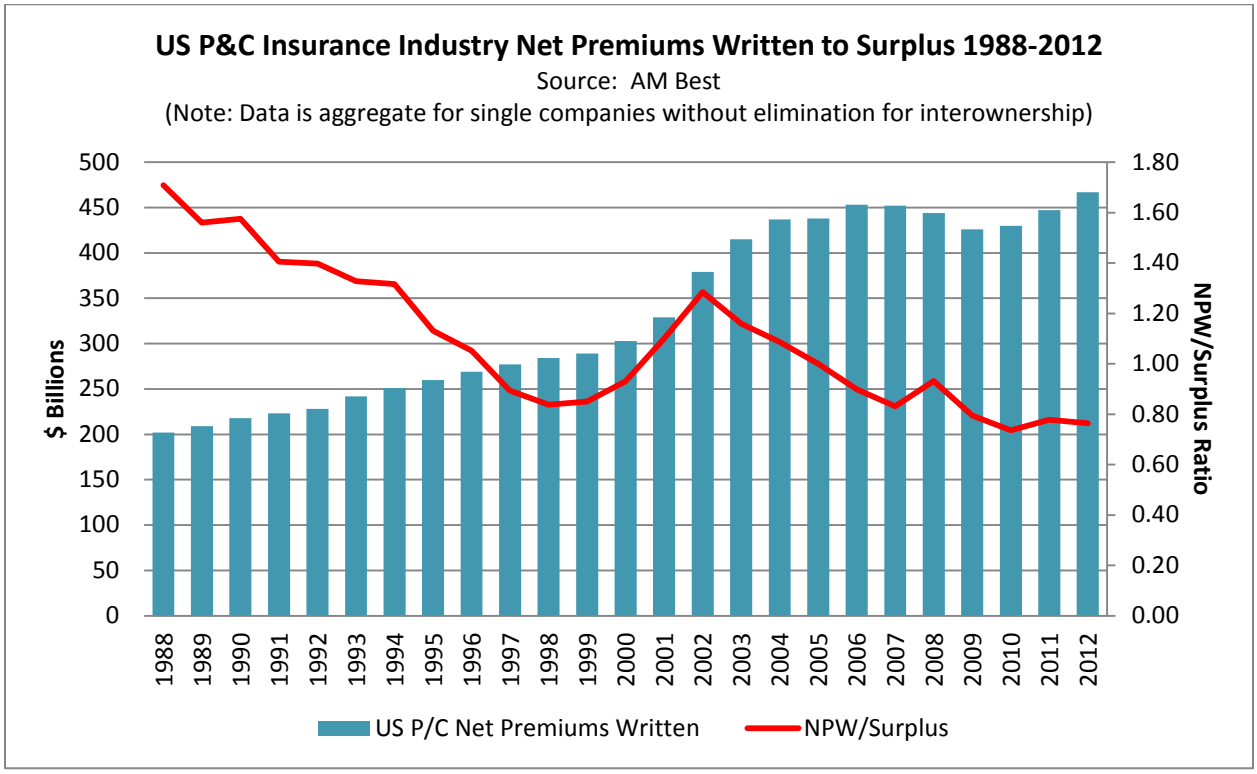


The decline in aggregate Net Written Premiums (NWP) written by the US P&C industry from 2007 through 2009 was the first time aggregate NWP values had declined in recent history. The causes of this decline were linked primarily to the economic fallout associated with the global economic crisis which incited a reduction in economic activity and an accordant decrease in demand for insurance. Premium rates also suffered as the crisis coincided with, and was more firmly succeeded by, a period of abundant P&C underwriting capital coupled with an influx of alternative capital through insurance linked securities (ILS)[107] products.

While NWP levels have since recovered to above pre-crisis levels, growth and capital deployment remain challenging. Underwriting leverage as measured by NPW-to-policyholder-surplus stood at 0.76 in 2012, the lowest level for the US P&C industry since at least the mid-1980s (see Figure 47). Taking NPW as a reasonably stable measure of risk levels over time, the US P&C industry's claims-paying capacity is now higher than it has ever been. At the same time the industry wrestled with a host of challenging "emerging risks" (e.g. terrorism) which it figured out how to underwrite and price despite obvious difficulties associated with risk assessment.

[107] While ILS capital remains focused primarily on the secondary market it has knock-on effects in the primary market – for more on this phenomenon see the Global Reinsurance section of this report.

Figure 47: US Property & Casualty Insurance Industry Net Premium Written to Policyholder Surplus – 1988-2012



Despite the ability of the US P&C industry to take on more risk, growth remains tenuous with domestic P&C insurers struggling to build revenues organically even as the US economy shows evidence of recovery following the latest recession. With growth opportunities limited and interest rates at all-time lows (see next section – Asset) the relative focus of US P&C insurers has shifted to underwriting profitability. While the US P&C combined ratio has fluctuated significantly over the past 30 years (Figure 48), 2004, 2006 and 2007 were the first years for the industry to post a combined ratio below 100% since 1978[108]. Some of the very low combined ratio experience in 2006 and 2007 can be attributed to property rate hardening as a result of hurricanes Katrina, Rita and Wilma, though this likely only intensified a trend which began after the World Trade Center attacks in 2001. Overall it is safe to say that US P&C insurers have become more focused on underwriting results the past 10 years.

Spikes in historical P&C underwriting losses are often the result of catastrophes affecting the Property segment in particular. However, market cycles prior to Hurricane Andrew in 1992 are more indicative of major shifts in the investment environment as opposed to natural hazards. Both types of historical market cycles are relevant to the current US P&C insurance market as the economy sits on the precipice of a potentially significant upward correction in the interest rate environment and as coastal exposure to natural catastrophes (in particular hurricanes) continues to increase at significant rates. A selection of events adversely impacting historical US P&C underwriting profitability is included in Table 16.

[108] At the time of writing the US P&C combined ratio for the full year 2013 appears as though it will be below 100% as well (AM Best).

Figure 48: US Property & Casualty Insurance Industry Combined Ratio 1970-2012

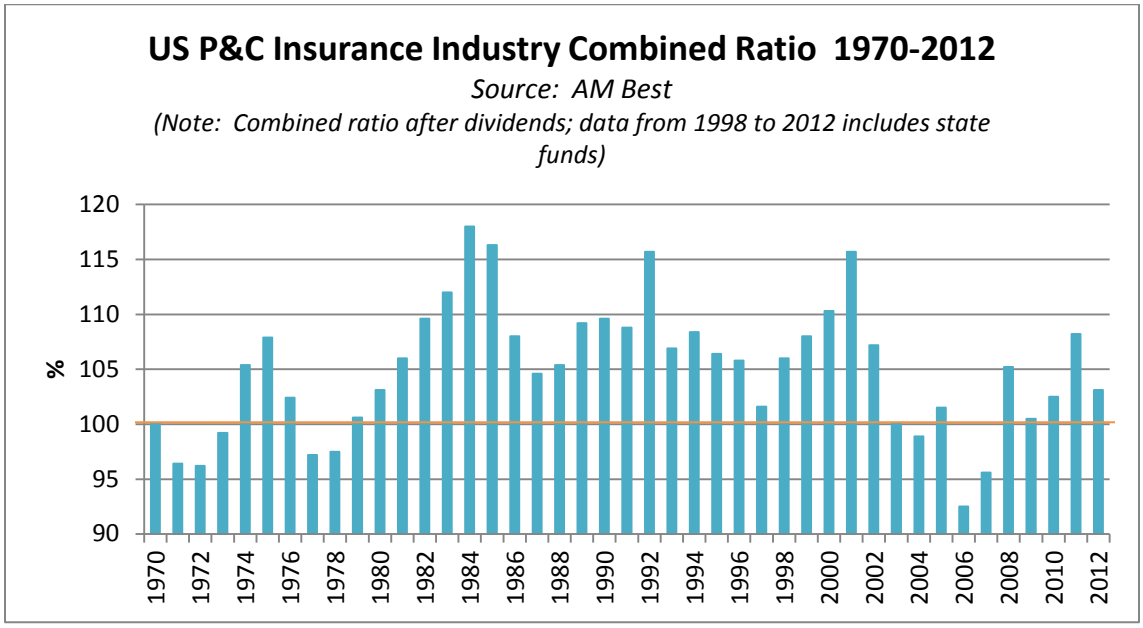


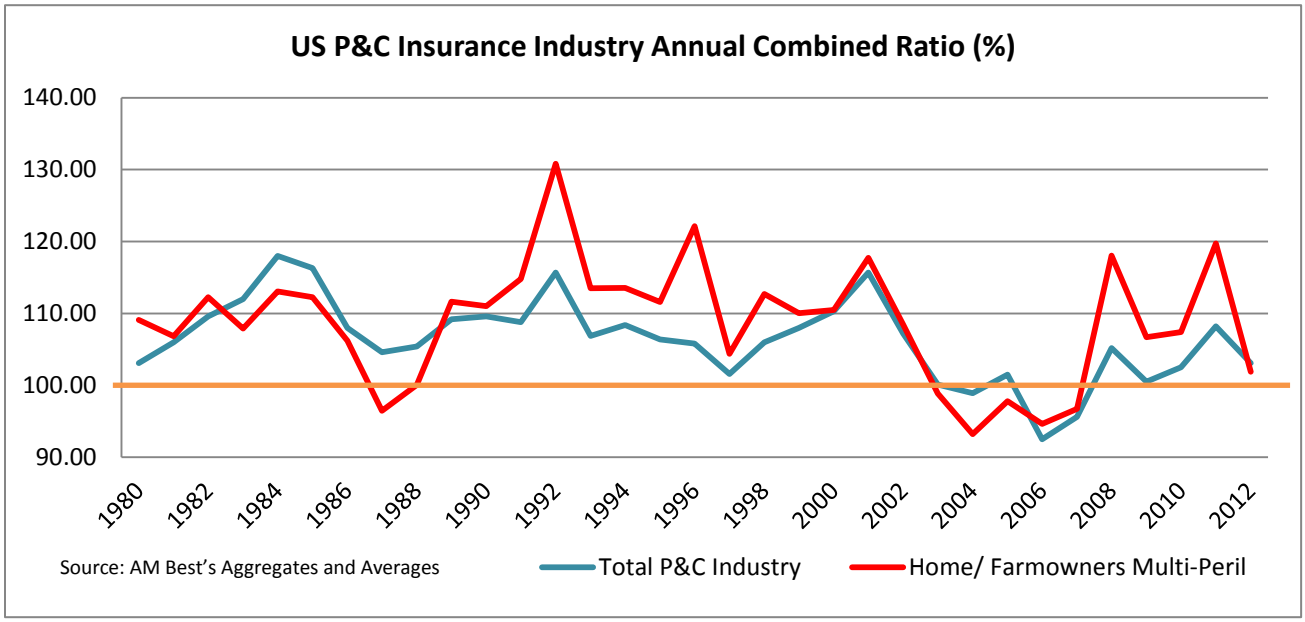
Table 16: Major Contributing Causes of Significant Historical Combined Ratio Increases in the US Property & Casualty Insurance Market

Major Contributing Causes of Major Historical Combined Ratio Increases in the US Property & Casualty Insurance Market
• **Mid 1980s**: Historically high interest rates encouraged "cash flow underwriting"[109] until premium rate decreases eventually outpaced interest rate increases resulting in a market correction. This is also often referred to as the "liability crisis". • **1992**: Hurricane Andrew • **1994**: Northridge Earthquake • **2001**: World Trade Center attacks • **2005**: Hurricanes Katrina, Rita, Wilma • **2008**: Hurricanes Gustav and Ike • **2011**: Record-breaking tornado season; Hurricane Irene • **2012**: Superstorm Sandy

[109] "Cash flow underwriting" refers to a phenomenon where insurers compromise their underwriting returns in favor of investment returns. To explain further, when interest rates are high or stock prices rise, insurers have an incentive to pile up as much cash as possible to invest. This is sometimes achieved by selling coverage at low rates to gain market share. Insurers can rationalize this strategy if they are confident that investment profits will more than cover any underwriting losses. When financial markets cool off, reduced investment profits often require insurers to make underwriting adjustments such as increasing premiums or restricting coverage. If these underwriting adjustments do not happen quickly or significantly enough to match interest rate declines the market can sometimes suffer an operating loss as happened in 1984/85 (see US P&C Capacity section and section on Market Cycles for more details). Cash flow underwriting is related to "float" which references the interest income insurers earn on reserves before paying for claims.

Delving into the underlying causes of underwriting profitability a bit further it is useful to look at the Homeowners+Farmowners (HO+FO) segment which is of most relevance to NFIP. As is evident from historical underwriting experience, the HO+FO line has largely underperformed the broader P&C industry in terms of underwriting returns. This relationship is most notable in the 90's and the last 5 years, though overall the combined ratio for HO+FO business has only fallen below 100% in 5 of last 32 years (Figure 49).

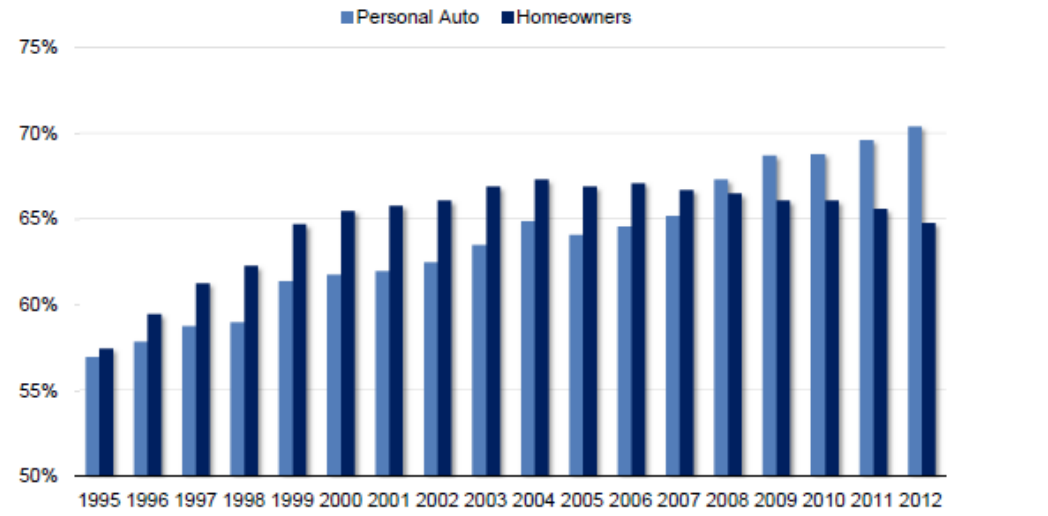
Figure 49: Homeowners+Farmowners Combined Ratio vs. Total US Property & Casualty Industry Combined Ratio 1980-2012



Catastrophe events in the 2005 hurricane season caused many of the leading HO writers to reexamine their property exposure footprints especially in catastrophe prone coastal areas. In addition to loss activity, changes in US P&C property catastrophe portfolio management were reinforced by reinsurers looking to manage their exposure aggregates, increased scrutiny from rating agencies as respects catastrophe risk and new versions of hurricane models which incorporated revisions to underpinning model science after a series of unique large loss events such as Hurricanes Ike and Katrina. As a result US P&C insurers started to shed some of their HO market share making 2004 the peak of HO market concentration.

This runs contrary to the Personal Auto segment which is showing increasing dominance by the top 10 writers (Figure 50). This strategic withdrawal of major carriers from the HO+FO business in terms of top-line volume is a result of many coincident trends: HO+FO business has historically been something of an underwriting "loss-leader" for many major personal lines carriers and negative results have often been driven by catastrophes; with interest rates at all-time lows underwriting performance of individual business lines is being increasingly emphasized (see Asset Trends section for more detail); etc.

Figure 50: Historic Market Share of Top 10 Personal Auto and Homeowners Insurers

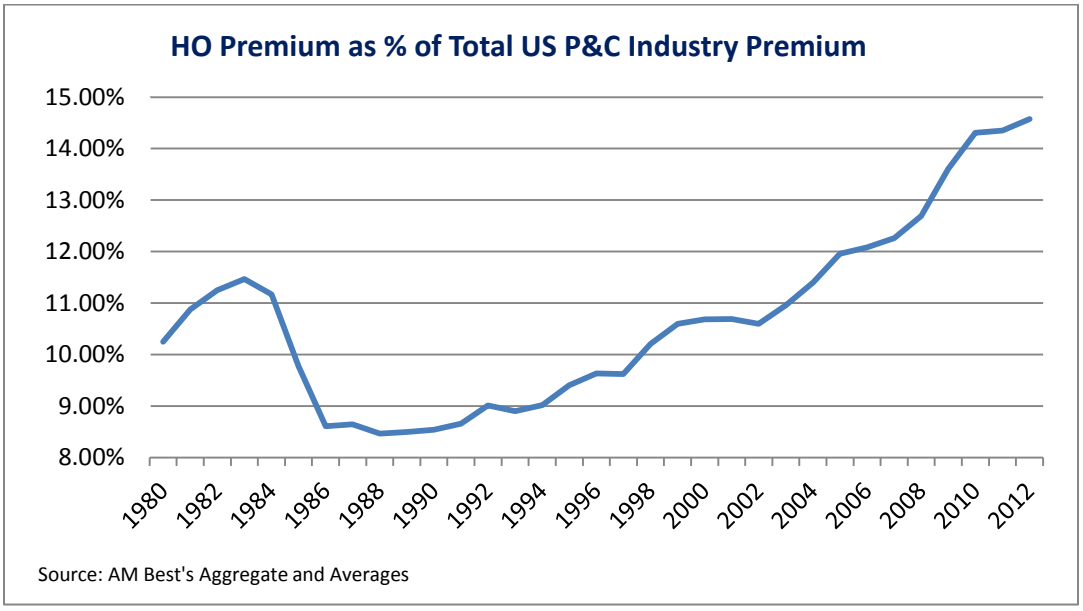


The homeowners line followed a path similar to personal auto until catastrophe events in 2004-2005 led many large national insurers to de-risk the homeowners portfolio

Data source: ©A.M. Best Company—used by permission, Conning analysis

However, in the broader personal lines market this trend of deleveraging from HO business has not been witnessed. To the contrary, HO business has become an increasingly large portion of the total P&C industry in terms of premium volume since the liability crisis in the mid-80s which saw large premium increases in other lines of business (Figure 51). This is likely a function of the re-underwriting of the industry HO book which has taken place in recent years (see Pricing section for more detail) though also simply a function of increasing property values.

Figure 51: Homeowners Premium as % of Total US Property & Casualty Industry Premium



While the scientific debate over the effects of global warming on the frequency and severity of hurricanes remains inconclusive, there is no question that the significant increase in the number and value of exposed properties will continue to contribute to increasing hurricane losses for insurers. According to a series of reports produced by AIR Worldwide over the past decade concerning the growth of US coastal property exposure[110], from 2004 to 2007 the insured value of properties in coastal areas of the US had risen at a compound annual growth rate (CAGR) of about 7%. For the period 2007 to 2012 the CAGR in insured values in coastal regions fell to just under 4% largely as a result of the economic crisis (Table 17). Once the economy recovers the growth in coastal exposure is expected to reaccelerate and, at a historical rate of 7%, the total values insured would double every decade. Presuming this trend continues the industry's exposure to property catastrophe risk will also increase (barring of course the introduction of any additional exclusionary underwriting techniques such as higher wind deductibles). Rapid exposure growth coupled with concerns around the impact of climate change on extreme weather volatility creates ample uncertainty for many insurers operating in the US property marketplace and may in part further explain the deceleration of market share growth by the top 10 largest HO carriers as exhibited in Figure 51. It may also explain the significant growth of residual property insurers over the past decade which is discussed in more detail in a subsequent section of this report.

Table 17: Coastal Insured Commercial and Residential Property Values Over Time

State	Estimated Value of Insured Coastal Property (Commercial and Residential, USD Billions)[111]			Annual Growth Rate	
	2004	2007	2012	2004-2007	2007-2012
Alabama	76	93	118	6.8%	5.0%
Connecticut	405	480	568	5.8%	3.4%
Delaware	47	61	82	9.2%	6.2%
Florida	1,937	2,459	2,862	8.3%	3.1%
Georgia	73	86	107	5.5%	4.5%
Louisiana	209	224	294	2.3%	5.5%
Maine	117	147	165	7.9%	2.3%
Maryland	12	15	17	7.2%	3.0%
Massachusetts	662	773	850	5.3%	1.9%
Mississippi	45	52	61	5.0%	3.2%
New Hampshire	46	56	64	6.8%	2.8%
New Jersey	506	636	714	7.9%	2.4%
New York	1,902	2,379	2,923	7.7%	4.2%
North Carolina	105	133	164	8.0%	4.2%
Rhode Island	44	54	58	7.3%	1.5%
South Carolina	149	192	239	8.8%	4.5%
Texas	740	895	1,175	6.5%	5.6%

[110] Source: AIR Worldwide; The Coastline at Risk: 2013 Update to the Estimated Insured Value of U.S. Coastal Properties

[111] Insured value is an estimate of the cost of replacing structures and their contents, including additional living expenses and business interruption coverage, for all residential and commercial property in the state that is insured or can be insured.

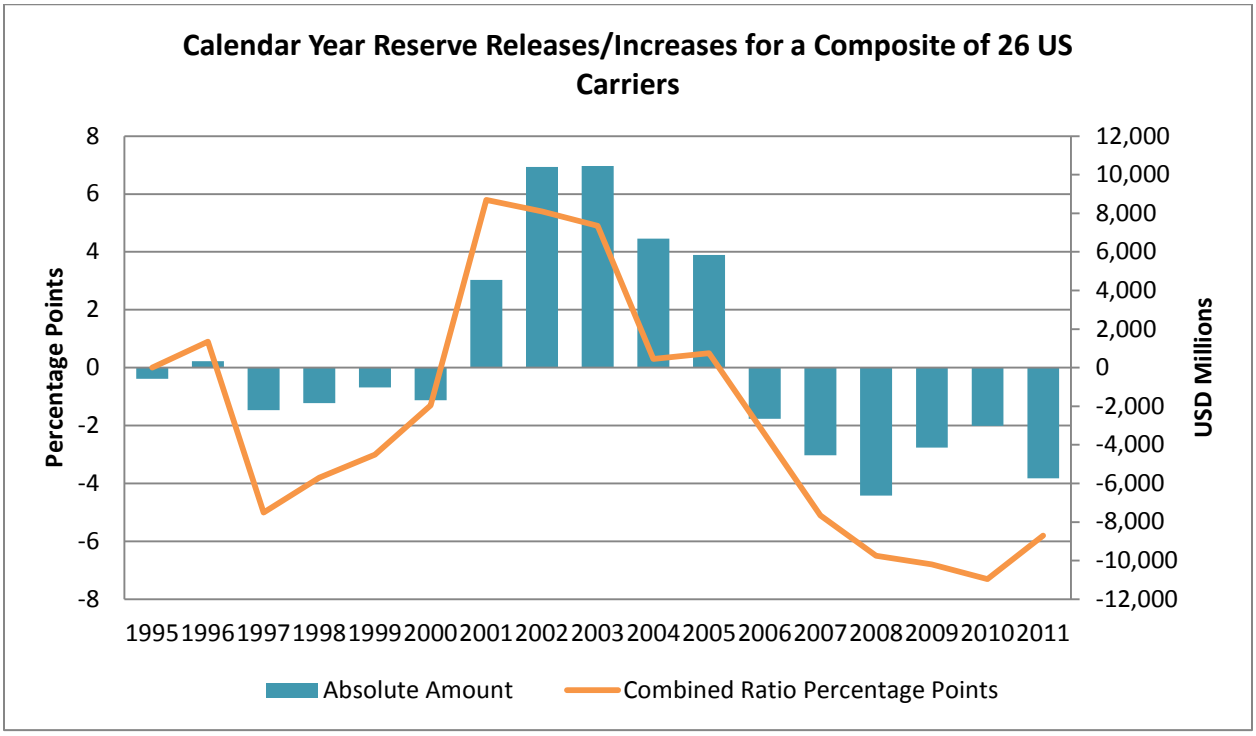
State	Estimated Value of Insured Coastal Property (Commercial and Residential, USD Billions)[112]			Annual Growth Rate	
	2004	2007	2012	2004-2007	2007-2012
Virginia	130	159	182	7.0%	2.8%
All Above States (Coastal Only)	7,204	8,891	10,642	7.3%	3.7%
Total U.S. (Coastal and Non-Coastal)	43,656	53,495	64,624	7.0%	3.9%

Another important factor influencing underwriting results is loss reserves. The requirement to set aside reserves for all incurred but unpaid claims may perhaps be one of the most challenging estimates insurers have to make. While this is predominantly an issue for long-tail casualty lines of business, many major P&C insurers in the US are diversified, most HO+FO policies include personal liability coverage and many large property loss events (e.g. hurricanes) can take many years to settle issues related to causation (e.g. wind vs. flood). This makes casualty reserve redundancy or deficiency a potential issue for diversified property insurers as well. In 2011 the insurance industry benefitted from additional reserve releases in line with a calendar year trend that started in 2005. But many sources believe that the releases of the last half-decade or so will soon begin to taper (Figure 52)[113].

[112] Insured value is an estimate of the cost of replacing structures and their contents, including additional living expenses and business interruption coverage, for all residential and commercial property in the state that is insured or can be insured.

[113] Source: Guy Carpenter, insurance company reports

Figure 52: Calendar Year Reserve Releases/Increases for Insurer Composite

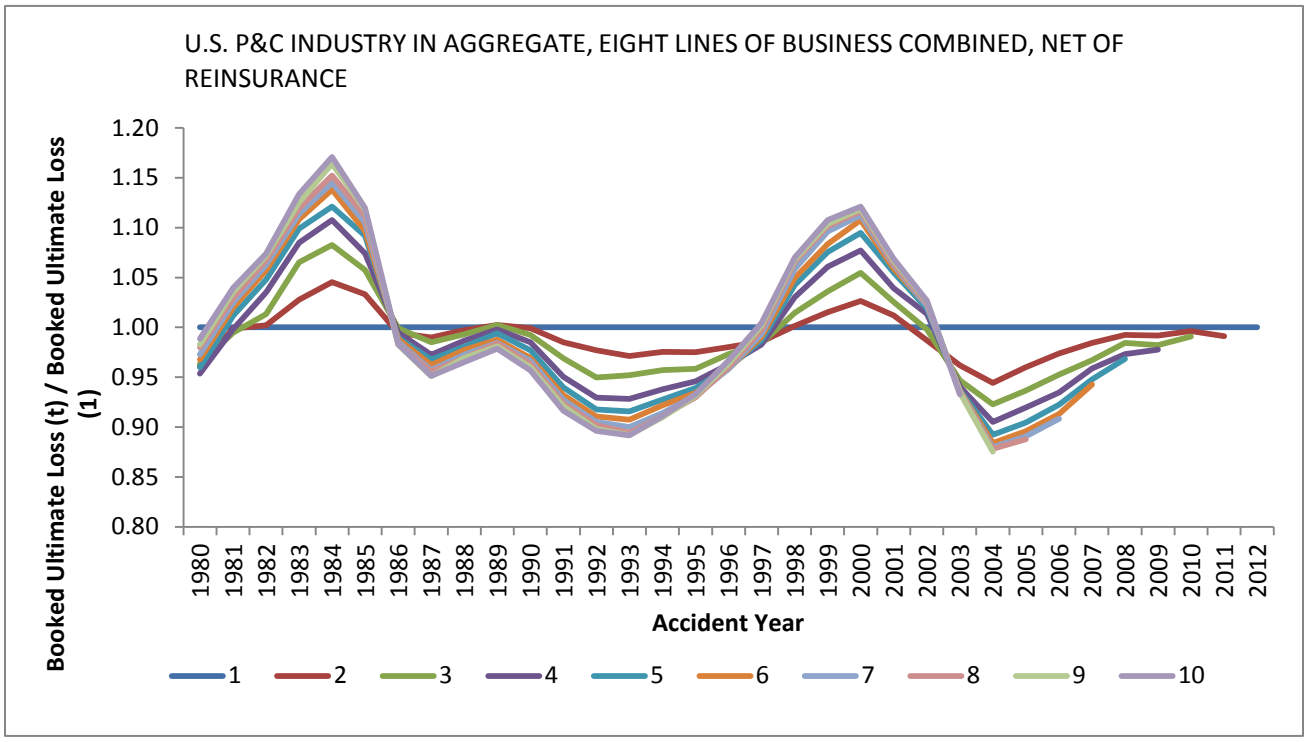


While calendar year results tend to be the focal point of discussion when analyzing P&C insurer underwriting performance, accident year loss development warrants attention as well. Guy Carpenter along with sister company Oliver Wyman has started looking at the reserve cycle in a different light: by studying the booked ultimate loss by accident year over time. Accident year is typically chosen to analyze loss reserve activity since the estimate of the ultimate loss for a given accident year ideally would not change over time if the initial estimate was correct. Usually however estimates of ultimate loss for any given accident year will change over time and, when analyzing the US P&C industry data, cycles sometimes form as specific accident years are re-estimated intermittently.

In Figure 53 below, the reserving cycle demonstrates the impact of these re-estimates, where every line is the booked ultimate loss of a given loss year at successively older evaluations, indexed to the initial booked ultimate loss at 12 months of development. For example, after ten years of re-estimates, the booked ultimate loss for accident year 2000 was 12 percent higher than the initial estimate of the booked ultimate loss made in December 2000[114].

[114] GC Analytics & Oliver Wyman, 2013 GC Insurance Risk Benchmarks

Figure 53: US Property & Casualty Reserve Cycle For Eight Major Lines of Business[115] – 1980-2012



Guy Carpenter's analysis in Figure 53 reveals two clear trends:

1. Those accident years that start to go bad, keep getting worse (and vice-versa)
2. A series of good accident years has in the past been followed by a series of bad accident years, exhibiting a cyclical trend.

These trends provide insight into the drivers and misconceptions of the cycle. For example, there appears to be no "cheating" phase, where insurers purportedly look to authorize unwarranted reserve releases now in order to obtain a short-term boost to profitability metrics. Some suspect this activity is motivated and exacerbated by low investment returns and sluggish economic growth – conditions which fairly describe the current state of the US P&C marketplace. However, analysis shows that reserves are not generally lowered more than they should be in any given year. Instead, analysis shows that the industry eventually shifts to the right number over time.

[115] Includes Commercial Auto Liability, Commercial Multi-Peril, General Liability, Homeowners, Medical Professional Liability, Private Passenger Auto, Products Liability, and Workers Compensation.

Figure 54: US Homeowners Reserve Cycle – 1980-2011

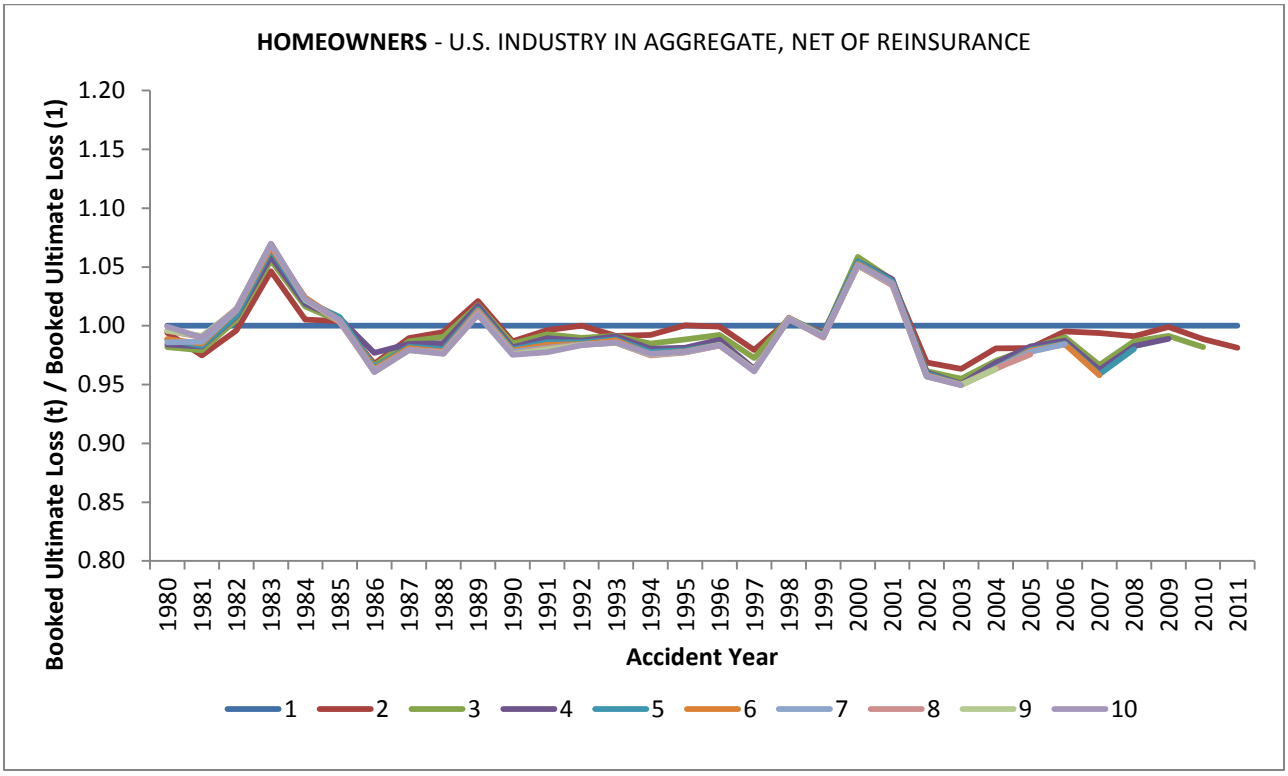


Figure 54 above illustrates the reserve cycle for the HO line of business. It can be seen that the aggregate correlation is less prevalent for Homeowners and other short-tailed property lines than long-tailed casualty lines which can skew the average with heavy redundancies. There is less potential for deficiency in HO claim reserving due to the potential aptitude for carriers to estimate and settle claims in an efficient timeframe.

The possible development of reserve deficiencies in particular is likely to become a more apparent issue over the next five years. Based on the multiline cycles exhibited in Figure 53, it appears as though a decade-long period of accident year reserve redundancies may be coming to an end. With reserve releases progressively dwindling, the industry's ability to boost future underwriting profitability through the realization of prior-year redundancies should diminish.[116]

With the US economy projected to grow at a faster rate in 2014 than in recent years the US P&C industry is increasingly optimistic about its domestic growth prospects. However, given the market conditions of the last 5 or so years and the relatively limited domestic growth options realized during that timeframe, ambitious US underwriters are focusing on untapped, underserved and, in some cases, heretofore largely unrecognized opportunities. One area of particular interest in the US insurance market is catastrophe exposed property where current penetration levels are limited

[116] Citi Research, US P&C Insurance Initiation

overall and pricing arbitrage opportunities versus dominant public sector insurers – like Citizens in Florida and NFIP nationwide – are plentiful (see Residual Market and Global Reinsurance sections for more details).

Given the general recent movement of major US P&C insurers away from catastrophe-exposed HO business together with the recent and increasing availability of cost-effective catastrophe reinsurance capacity (see Global Reinsurance section for details), conditions should be ripe for new market entrants looking to compete for existing HO business with more expense-efficient business models and fewer legacy concerns. Additionally with increasing primary capital levels relative to underwriting risk and related pressure from shareholders to put capital to use (see US P&C Capacity section for details), existing players are also poised for additional primary risk assumption.

With respect to flood in particular, existing HO carriers have the added advantage of established distribution channels and an understanding of or involvement with flood risk underwriting either via their participation in the WYO program or as private flood carriers. For those carriers participating in the WYO program, growth of the WYO business has tapered off since 2010 (Figure 55). While this is in large part due to State Farm's exit from the WYO program in 2011 and the subsequent assumption of the company's business by NFIP Direct, the size of the overall WYO market for primary carriers is presently in flux. It is still too early to tell with any certainty which way the overall written premium for the WYO program will trend as a result of the Biggert-Waters Act (B-W) as subsequently modified by the Homeowners Flood Insurance Affordability Act (HFIAA). On the side of growth, with the increase in non-compliance penalties it's possible that banks will increase enforcement of flood coverage for borrowers, preventing lapses and increasing the take-up of flood insurance in SFHAs. In addition, new maps could actually increase the number of people in SFHAs overall, further expanding the WYO pie. The big driver that potentially could lower WYO DWP is if rate increases implemented by B-W (and not entirely eliminated by the HFIAA) are offset by an increase in NFIP policyholders lapsing and/or seeking rate relief from the private flood market. Any increase in private flood policy issuance is of course largely conditional upon private flood policies being accepted by banks at large as being "at least as broad" as a NFIP SFIP in order to qualify under the MPR[117].

Given all of the factors above, over the short term an increase in WYO premium would be reasonable to expect especially if most preliminary rate increases are retained within the program. Though as rate increases are implemented, compound interest starts to take effect and private carriers begin to offer more compelling alternatives, the WYO program could start to see some significant policyholder attrition over the medium term. Practically speaking, to take advantage of this likely shift in the WYO program existing carriers could enter or expand their presence in the private flood insurance market in many ways such as by adding new perils to existing exclusionary policies (e.g. flood endorsement to the standard HO form) or offering standalone named-peril covers[118].

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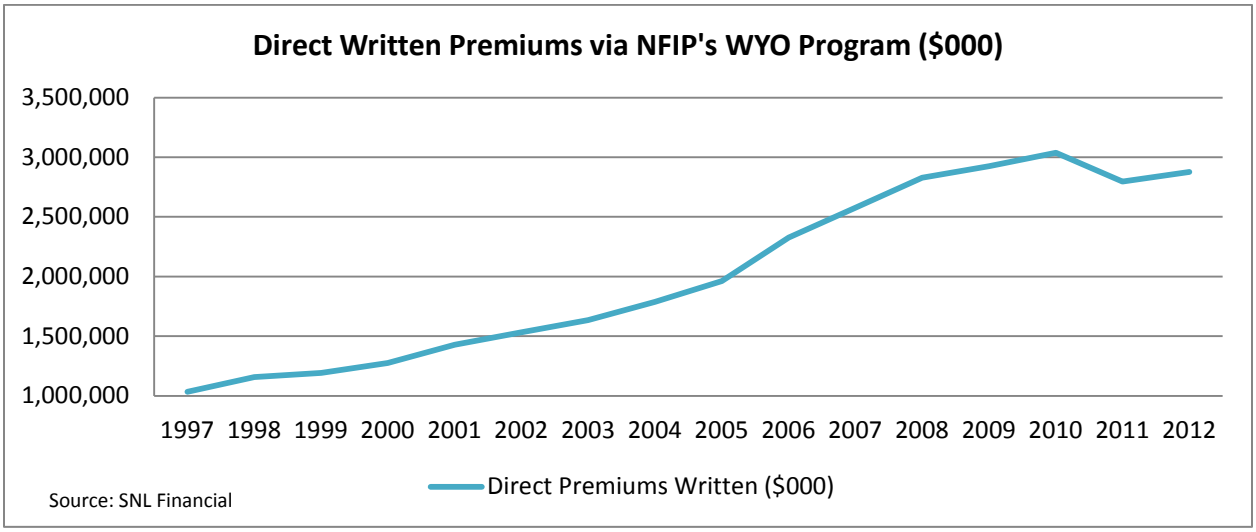
[117] §4012a. of the National Flood Insurance Act as amended; Flood insurance purchase and compliance requirements and escrow accounts. As of this writing, a determination as to what qualifies a private flood policy for acceptance under the MPR is still being made by federal banking regulators as part of the federal rulemaking process.

[118] Any such policies would of course need to be issued in compliance with the terms of Article XIII – Restriction on Other Flood Insurance in the FEMA Federal Insurance Administration, Financial Assistance/Subsidy Arrangement relative to the NFIP WYO program.

Figure 55: Direct Written Premium via the National Flood Insurance Program's Write-Your-Own Program – 1997-2012

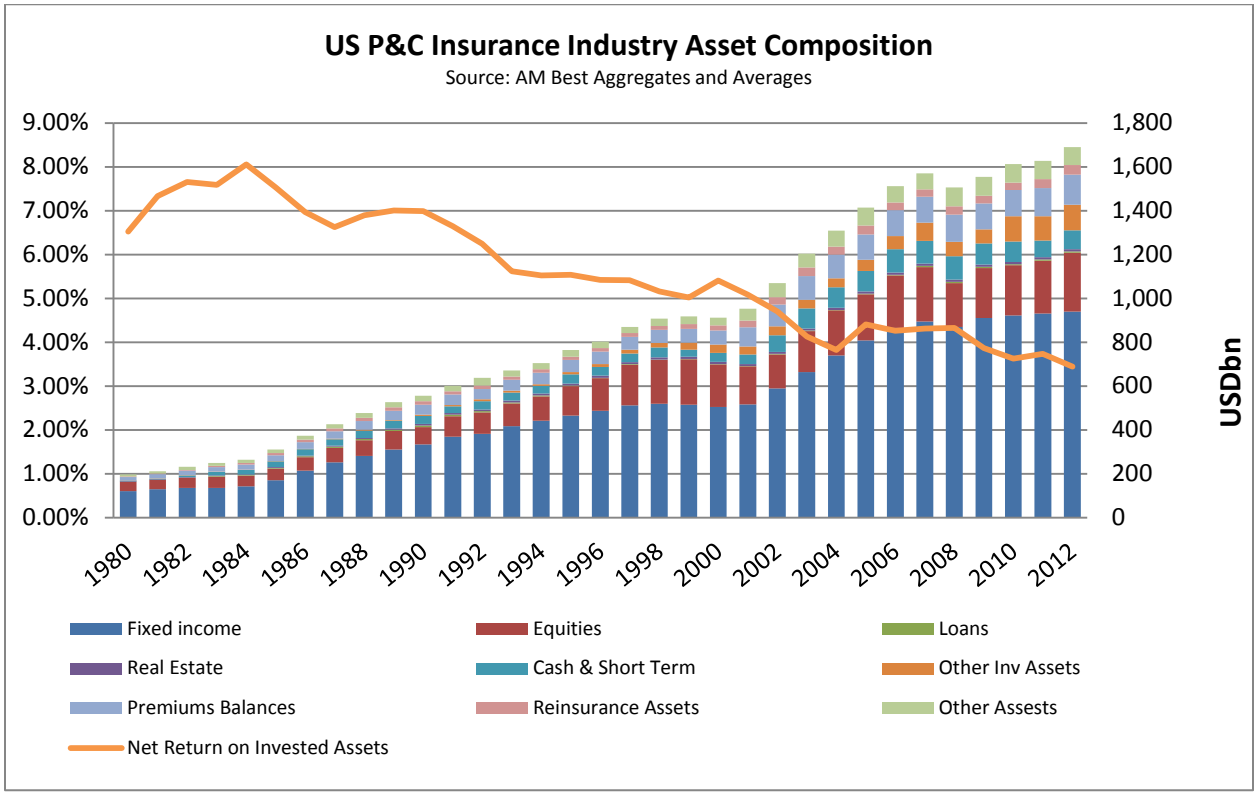


Regardless of the manner in which new business might be written, from an underwriting perspective the US P&C industry should be eager to entertain novel exposures given the ample room it has for increased underwriting leverage so long as the new risk can be adequately underwritten and priced (an important caveat in the context of flood, a complex peril to evaluate). This being said there are notable adverse underwriting trends facing the industry which may offset companies' tolerance for new (especially volatile) risk. These include the relentless increase in catastrophe exposed property values, a possible shift in the volatility of extreme weather as a result of climate change and the current apparent inflection point in the casualty accident year reserving cycle.

Asset

The US P&C insurance industry controlled nearly $1.7 trillion of assets in 2012 – equivalent to ~10% of US GDP for the same year – making it a very influential class of investor. However, since insurers are in the business of taking risks on the liability side of their balance sheets their investment profiles remain relatively conservative both as a practical consideration and, in some cases, by virtue of regulatory mandates. Overall, in 2012 only about 16% of US P&C insurer assets were invested in equities compared to about 60% in fixed income securities, mainly bonds. These proportions have remained largely consistent over time (see Figure 56).

Figure 56: US Property & Casualty Insurance Industry Asset Composition – 1908-2012



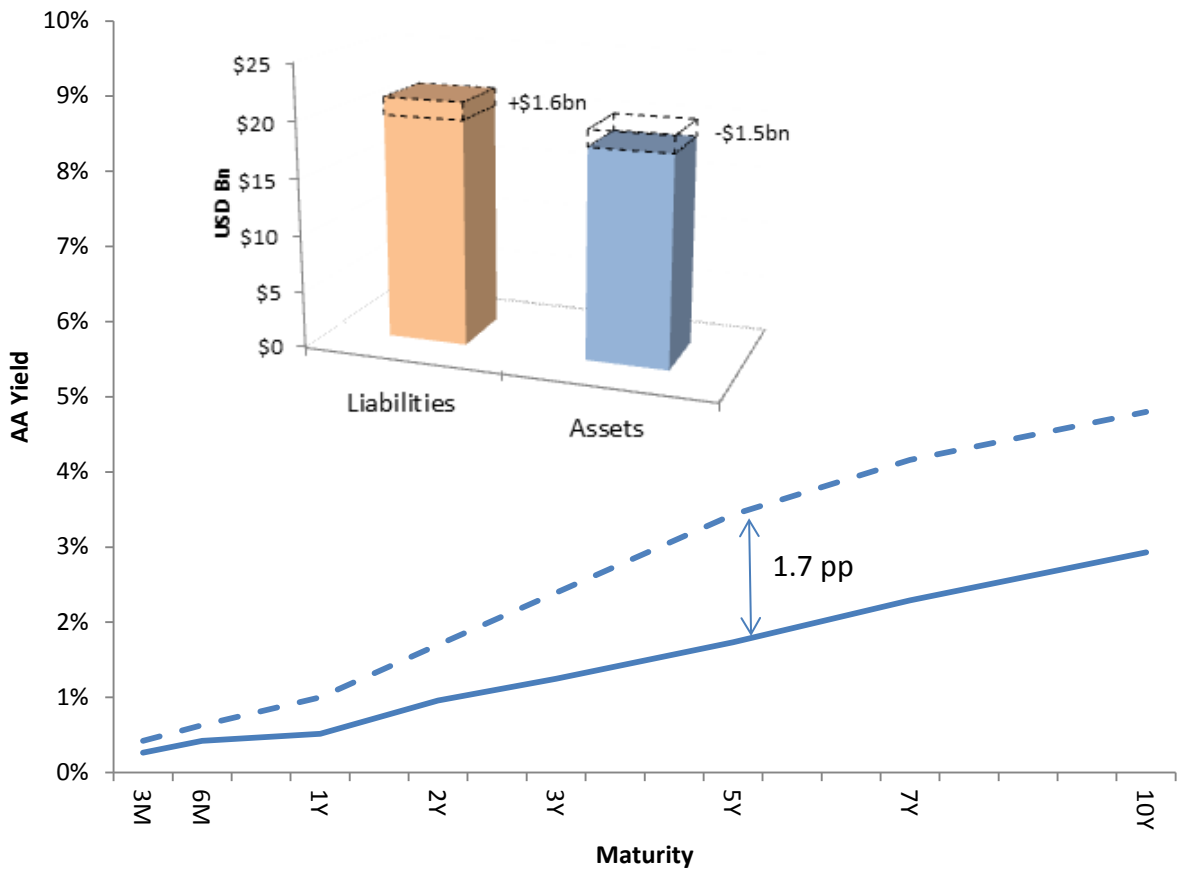
Despite this relatively conservative investment philosophy P&C insurers have potentially significant exposures to losses in their investment portfolios. Such losses – whether realized or unrealized – can result in overall capital depletion resulting in shifts in underwriting practices (e.g. market hardening). Of specific concern are short-term interest rate fluctuations which can result in significant mark-to-market losses or systemic defaults which can result in both mark-to-market losses and complete write downs of securities (note the 4% decline in total industry assets under management in 2008 at the peak of the financial crisis). Alternatively, large returns can have a dilutive effect, increasing capital levels and equally influencing underwriting practices (e.g. market softening).

To understand the industry's exposure to such risks it is first important to better understand the underlying composition of some of its assets. Focusing in specifically on the P&C industry's bond portfolio (by far its largest exposure to loss) and using the 2012 year as an example, of the bonds held most are AAA rated (~75%) though a good portion are BBB or "high yield" (~25%). In terms of maturity, nearly 60% of the industry's held bonds are less than 5 years in duration, 27% are in the 5-10 year range and the remainder are long-dated with maturities over 10 years. The overall average maturity for the industry's total bond portfolio (long and short-term) is 6.3 years. The largest type of bond held by insurers is municipal at 35% of the total followed closely by corporate debt at 30% and US Government debt at about 11% (the remainder being largely held in structured deals such as mortgage backed securities or MBS)[119].

[119] Source: Conning; Property & Casualty Investment Profile 2013 Edition; AM Best Data

To demonstrate the potential adverse balance sheet impact of an increase in interest rates, see Figure 57. This shows a hypothetical scenario in which a rapid, unexpected and sustained 1.5 percentage point increase in inflation expectations is accompanied by a 1.7 percentage point rise in yields on a five-year duration, average AA-rated bond portfolio. In the example shown the increase in inflation expectations coincides with a $1.6 billion increase in reserves as claims costs escalate. At the same time, the increase in prevailing market interest rates leads to a $1.5 billion decline in the value of the bond portfolio. The total combined effect is a $3.1 billion shortfall. P&C insurance carriers with conservative investment allocations and low equity gearing are relatively unhedged against inflation and interest rate risk[120].

Figure 57: Insurer Balance Sheets and Interest Rate Sensitivity



Whether this risk will come to pass and whether today's quantitative easing will lead to unexpected inflation remains uncertain. Looking at past asset-side events which have had a negative balance sheet impact, in 2008 the US P&C industry took a $67 billion hit to surplus – equivalent to a 12% year-on-year drop – the majority of which was due to unrealized losses on securities such as MBS (see Capacity section for details). While this was the result of the global financial crisis the worst of which is hopefully behind us, there remain other concerns around general asset class devaluation.

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[120] Source: Guy Carpenter & Company, LLC; Overcoming Key Risks on the Road to Profitable Growth: Mid-Year Market Overview; Sept, 2012.

More recently some attention has been paid to the industry's exposure to ailing municipal debt sparked by the City of Detroit's bankruptcy and other prominent municipal debt downgrades.

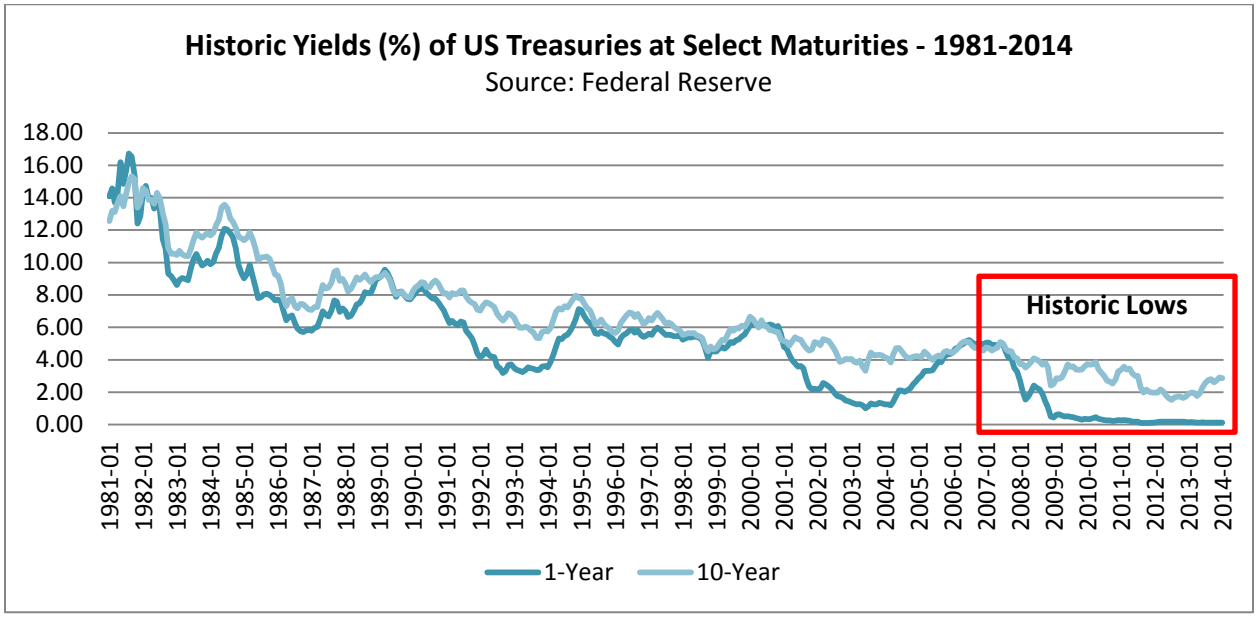
So far this decline in municipal debt quality has had a minimal impact on US P&C insurer balance sheets mostly because the industry's exposure to any one municipality remains fairly limited. Though a more systemic issue resulting in a wholesale decline in the quality or default of municipal debt issuances could cause disruption in the US P&C insurance sector considering the industry's significant municipal debt holdings (in excess of $320 billion in 2012). Possibly to hedge against this potential risk the US P&C insurance industry has been diminishing its overall exposure to municipal debt in recent years. The share of the industry's total bond exposure classified as municipal is down to 35% in 2012 from 42% in 2007[121].

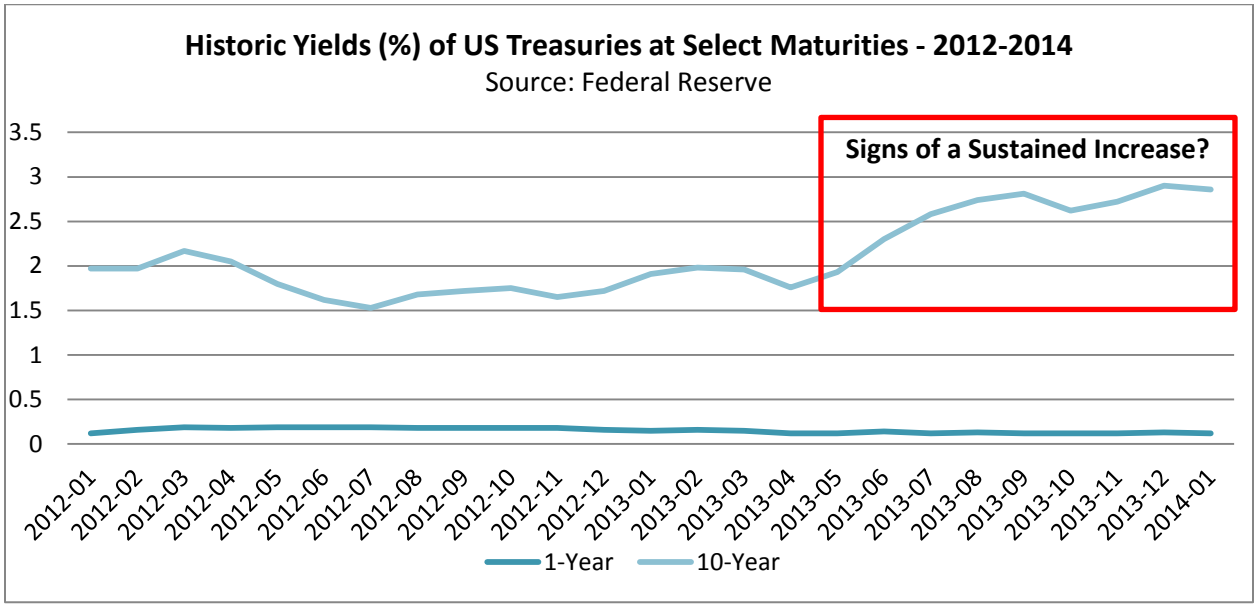
Another asset-side risk which US P&C insurers are grappling with is the general decline in investment yields. In looking again at Figure 56, the trend in the industry's net investment return as a percentage of invested assets has steadily declined over time from a peak of 8% in 1984 to below 3.5% in 2012. This decline in investment income has coincided with a period of significant asset growth which has in turn served to increase the absolute value of investment returns over the same time period. Nevertheless, the persistent low-yield environment places increasing amounts of pressure on US P&C insurers to build and/or maintain underwriting returns to offset relative capital inefficiency on the asset side.

It is possible to track the overall decline in insurer investment returns by looking at the yields on US Treasury's since the early 1980s (Figure 58a). Yields on US Government debt which serve as a benchmark for the overall bond market have been at historic lows the past several years. Very recently – over the last six months – the yields on 10-year treasury notes have started to inch upwards (Figure 58b). Whether or not this is a sign of impending inflation or some other fundamental shift in the investment landscape remains to be seen.

[121] Ibid. 14; SNL Financial

Figure 58: Historic Yields in US Treasuries at Select Maturities – 1981-2014 and 2012-2014





Capacity

To restate prior assertions, the US P&C industry's capacity to underwrite business is ultimately a function of available underwriting capital. As discussed in the Underwriting and Asset sections above, various factors can influence the industry's level of underwriting capital. Looking at factors influencing industry operating income in more detail, the upshot of the various underwriting and asset trends discussed previously become clear in terms of their net impact.

The US P&C industry showed record profitability in 2006 and 2007 – two of only a handful of years where the industry experienced both an underwriting and investment gain (Figure 59). This was largely the result of improved underwriting post-Katrina and favorable reserve releases which contributed to significant improvements in the industry's overall combined ratio (Figure 49). These record returns in turn fueled the steep pre-crisis growth in industry surplus. Record levels of policy holder's surplus in 2007 enabled the sector to weather the market downturn and global financial crisis in 2008 relatively well. Since then the industry's capital levels have rebounded reaching the highest point in history in 2012 (Figure 60).

Figure 59: US Property & Casualty Insurance Industry Sources of Operating Income 1970-2012

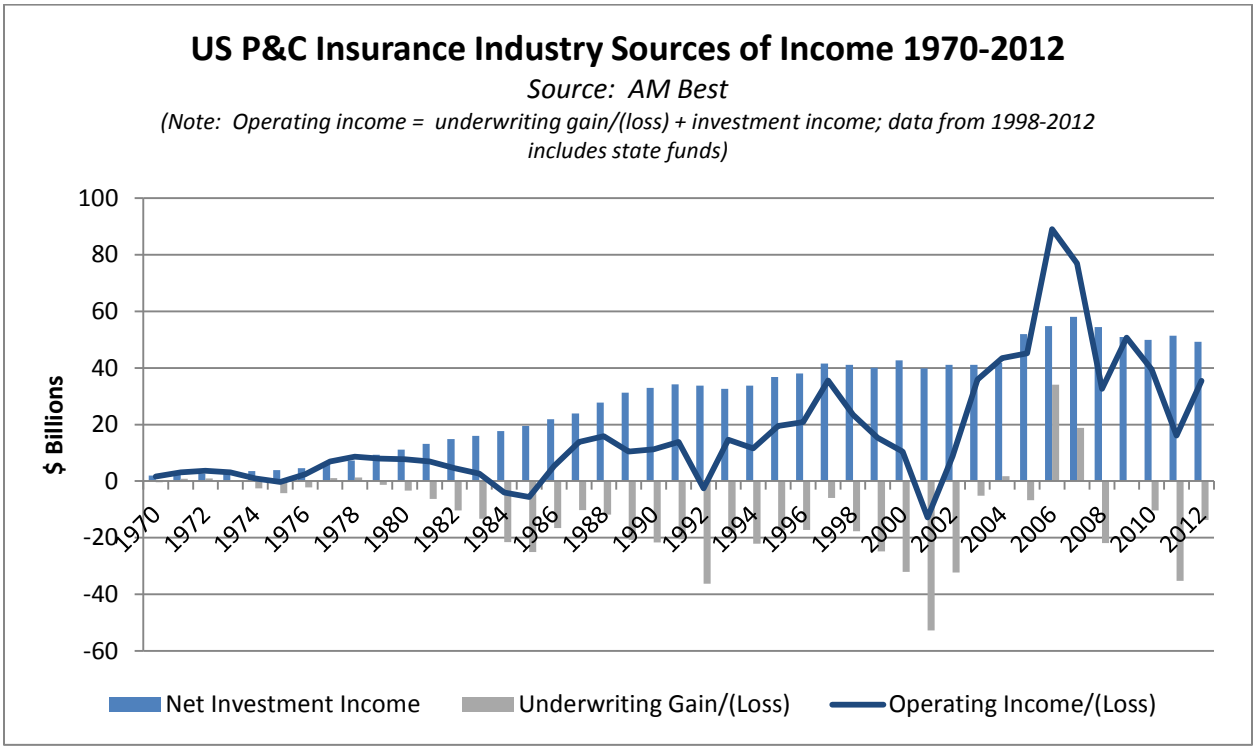
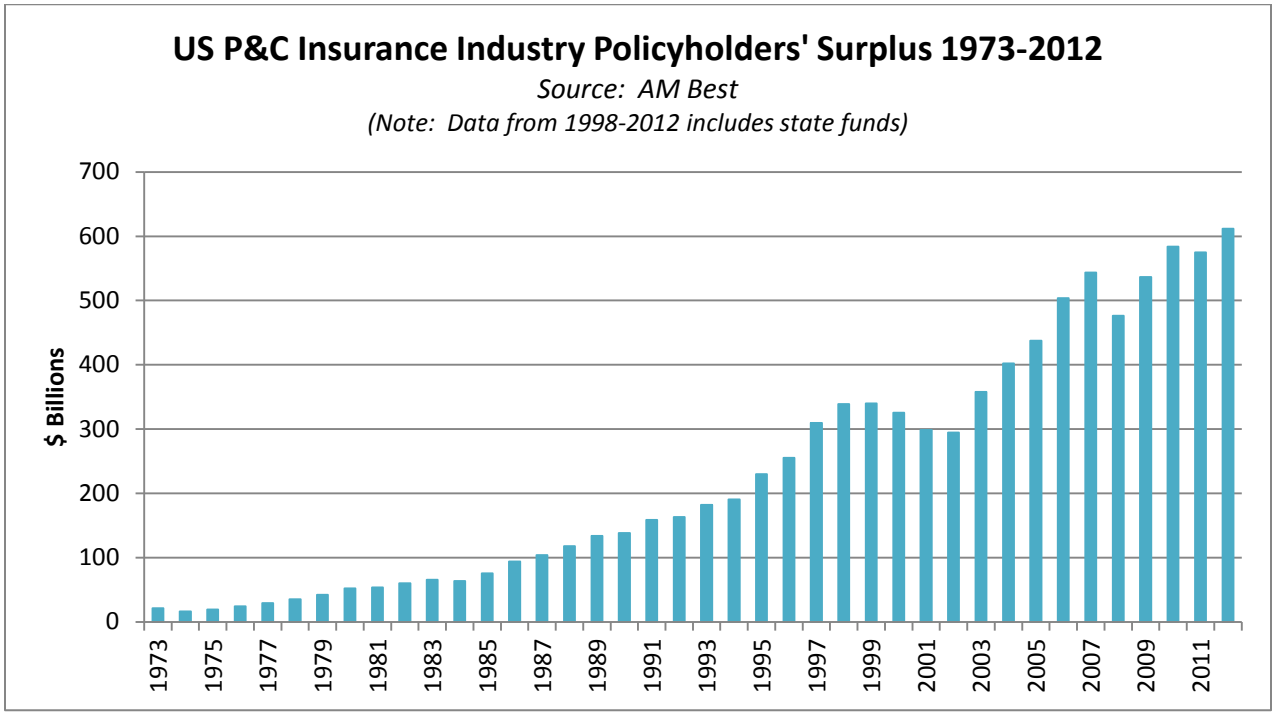


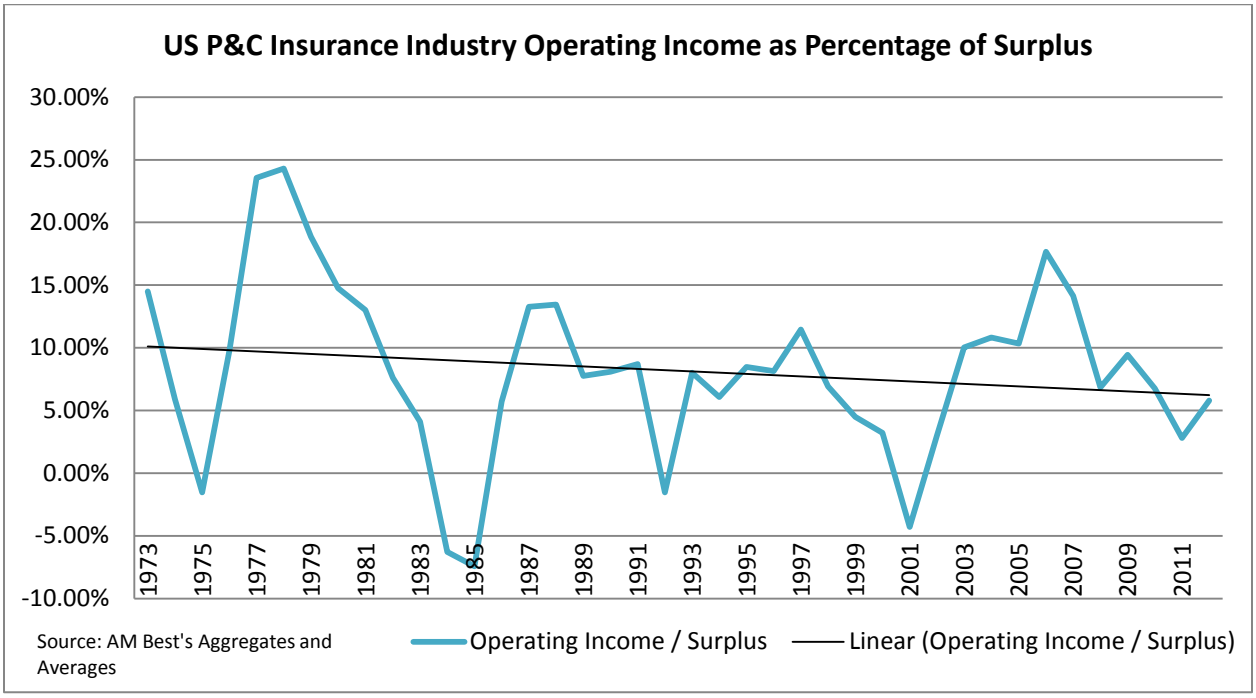
Figure 60: US Property & Casualty Insurance Industry Policyholder's Surplus 1973-2012



By this basic measure the US P&C industry has never been stronger financially. Though given the dilutive nature of excess capital on various return metrics which are used by financial markets to ascertain company value, dividends and share repurchases are increasing in response to pressure from shareholders. Though unprecedented in dollar terms, relative to industry surplus[122] 2006 and 2007 did not represent the industry's best performing years on record (Figure 61). While above trend, the returns posted were lower than those experienced in the late-70s and on par with other historical peaks. At present industry returns against surplus are declining overall (see trend line in Figure 61) indicating pressure on sources of income production on both sides of P&C insurer balance sheets and relatively fewer productive uses for increasing amounts of held risk capital.

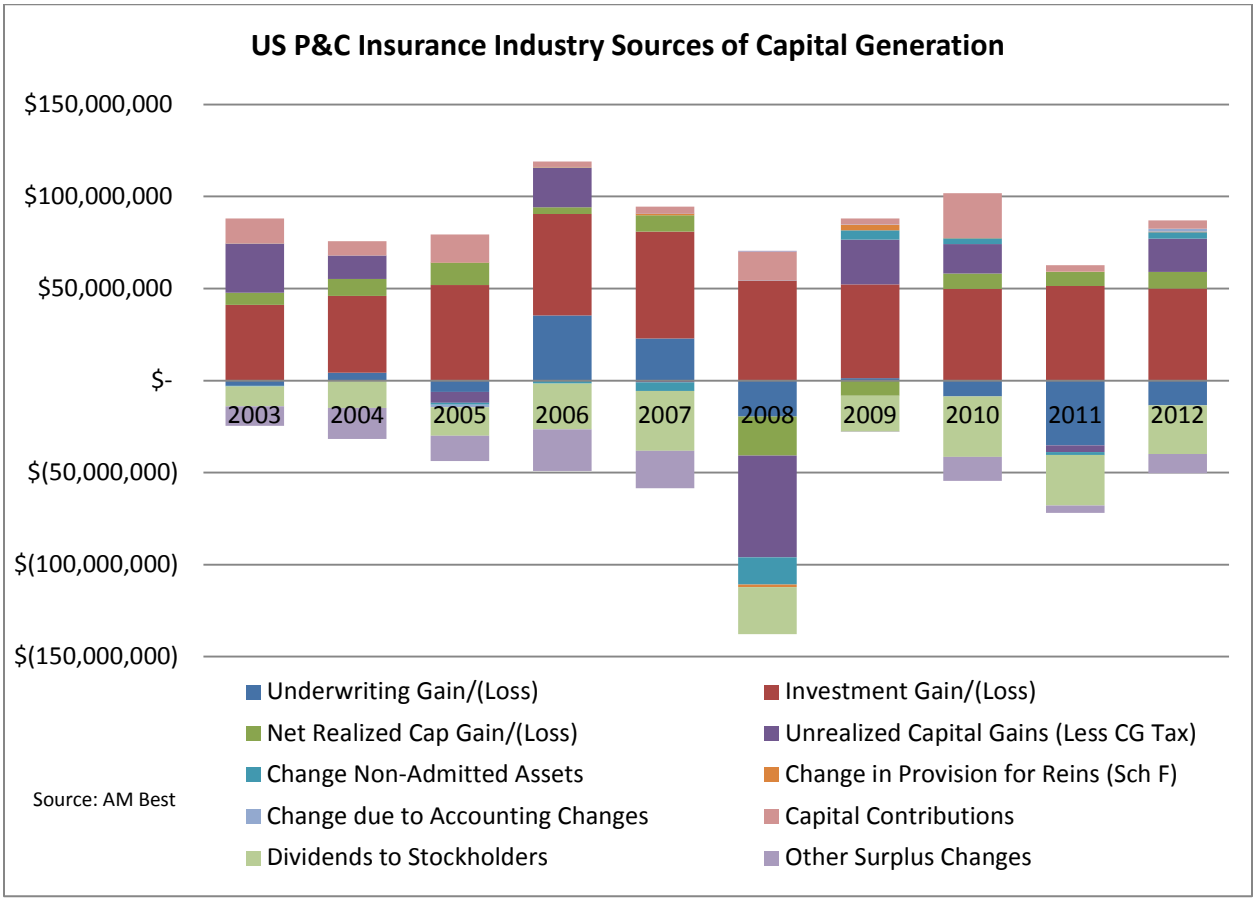
[122] Taken at the end of the period in question, not averaged.

Figure 61: US Property & Casualty Insurance Industry Operating Income / Surplus – 1973-2012



To get a unified view of the market's susceptibility to capital (and therefore capacity) fluctuations, it is useful to look at all of the various liability- and asset-side sources of US P&C insurance industry net capital generation together. Figure 62 shows the influences of various factors on insurer capital over time. The solid underwriting results in 2003 through 2007 (much improved from prior years) allowed for a significant rise in industry surplus during those years. Distress in the financial markets caused a decline in industry surplus in 2008 mostly due to unrealized capital gains (losses), though this decline was recuperated and eventually exceeded by rebounding financial markets, increases in unrealized gains and third-party capital contributions (notably in 2010).

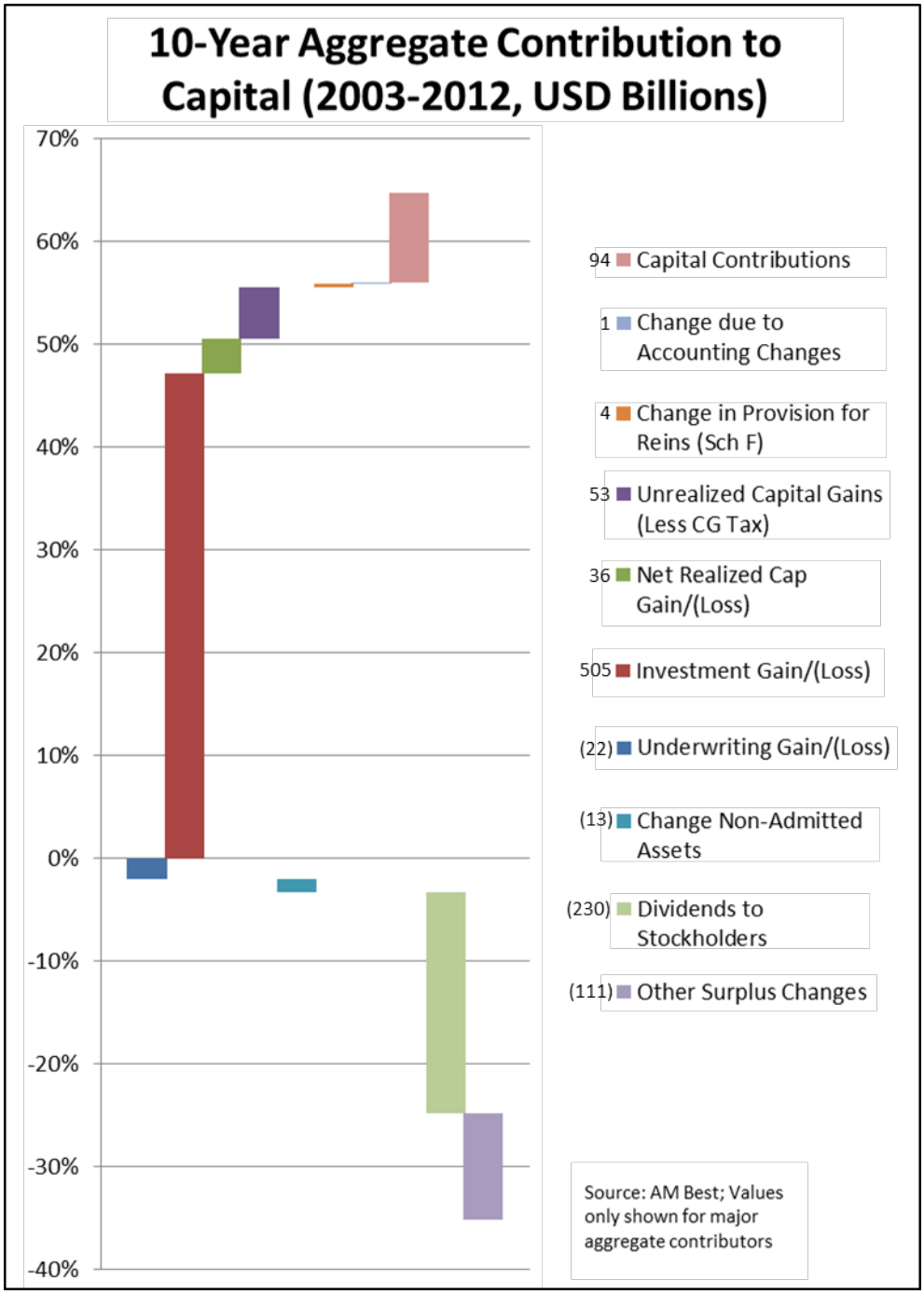
Figure 62: US Property & Casualty Insurance Industry Sources of Capital Generation 2003-2012



Overall the industry has added $316 billion to surplus over the past 10 years. The biggest net influence on the industry's capital position has been investment income which totaled $505 billion over the time frame whereas underwriting income was more or less a net zero. Dividends to stockholders were partially offset by additional capital contributions (Figure 63). This aggregate result clearly demonstrates the importance of the broader financial markets to insurance company performance and their influence on broad-based underwriting market cycles.

The industry has earned an average of about $50 billion in investment income in the ten year period ending December, 2012. In order to offset this amount, the industry would have to produce a combined ratio of about 111%, assuming stable earned premium levels and no realized or unrealized gains (losses). The industry US P&C industry has exceeded 111% combined ratio twice in recent history – in 1992 as a result of Hurricane Andrew and in 2001 as a result of the World Trade Center attacks. A future sizable catastrophe loss could similarly take capacity out of the insurance industry.

Figure 63: 10-Year Aggregate Contributions to Capital Generation 2003-2012



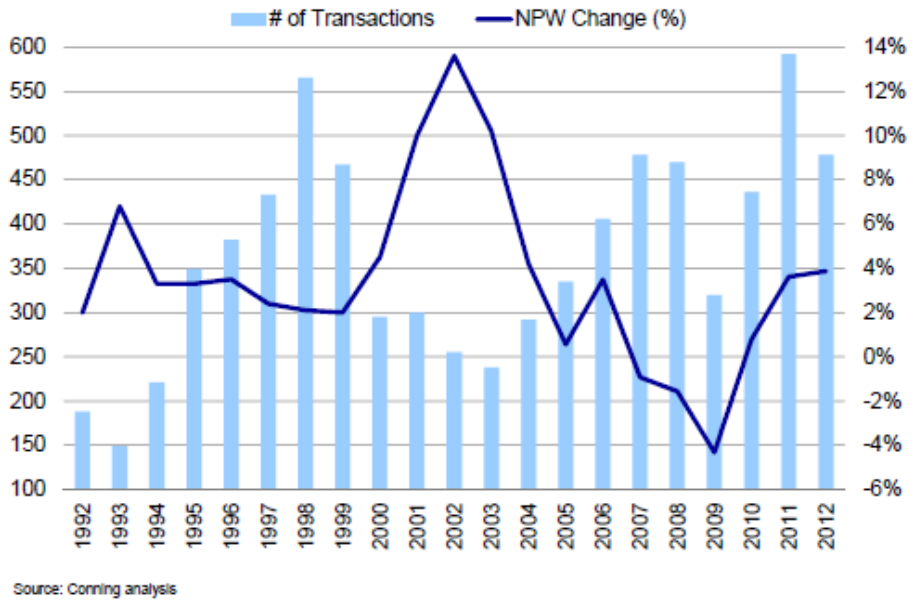
Excluding the possibility of such a catastrophic loss scenario, the biggest problem the industry is facing at the moment is excess capital. When a carrier is overcapitalized, it has at its disposal a number of strategic options:

- Hold on to capital
- Return capital to shareholders through share repurchases or dividend payments Grow organically (write more premium in existing lines or in new lines or regions)

- Grow inorganically (make acquisitions)

Each of these strategies has merits and drawbacks, and a combination of several is certainly plausible. In the recent past, for US domiciled P&C insurers with domestic top-line growth aspirations prospects have been relatively limited. This has led to an increased focus on profitability through improved expense and rate management and inorganic growth through acquisition. As can be seen in Figure 64, mergers and acquisitions (M&A) tend to be used in the US insurance market as a soft market growth strategy. As premium levels rise through rate increases and/or insured exposure growth (as in the period 2000-2004) M&A activity tends to decline and vice versa (as in the period 2005-2011)[123].

Figure 64: US Insurer Mergers and Acquisitions and the Underwriting Cycle



Recently share repurchases have also been common. Share repurchases improve insurer returns on equity and involve little risk by comparison to other strategies discussed herein perhaps explaining their recent and increasing popularity.

Organic growth on the other hand is much harder to engender given the commodity-like nature of most US P&C insurance lines. The easiest way for insurers to grow premiums is simply by lowering rates to attract new customers. Unfortunately, losses do not respond to changes in price, so underwriting margins can deteriorate materially if a company adopts too aggressive a pricing strategy. In some instances, a company may make a conscious decision to allow underwriting margins to deteriorate in the short term in order to gain market share (this is referred to as “cash flow” underwriting and is discussed in the primary Underwriting section). If a company sets its sights on entering a new line of business it can develop or hire the talent and build the infrastructure needed to compete. Organic growth could be a good strategy for the use of excess capital though it is typically much harder to implement successfully and sustainably versus the other strategies

[123] Conning; Strategic Study: Global Insurance Mergers & Acquisitions in 2012—Fragmented Patterns in an Uncertain Environment; April, 2013.

mentioned above given competitive market pressures and the uncertainty associated with new-new business[124].

Pricing

Assessing the value and meaning of insurance rate changes is a complex exercise since rates respond to the multifarious factors discussed above. So as to distill related analysis, rather than review a measure of ensemble P&C market rate changes altogether it is more instructive to review individual lines or classes of business. For the purposes of this report we will focus on the Homeowners and, to a lesser extent, the Commercial primary property markets.

According to Citi's insurance equity research team, despite rate increases in recent years the homeowners segment is still short on rate. This is due primarily to past catastrophic losses being much higher than expected, especially those in 2011 and 2012. To illustrate, if we assume the industry's combined ratio improves by 400 basis points during 2013, in large part due to a big decline in catastrophe costs, the industry would still post an underwriting loss of $21 billion since 2010.[125] If the HO industry expects to turn an underwriting profit in the long term, losses can only be counterbalanced by more rate. Citi's expectation is that competitive conditions will result in a flattening of rate increases in the future. Figure 65 illustrates HO rate movements over time (including several annual projections) against loss trends.

Figure 65: US Homeowners Insurance Rates – 1999-2018E

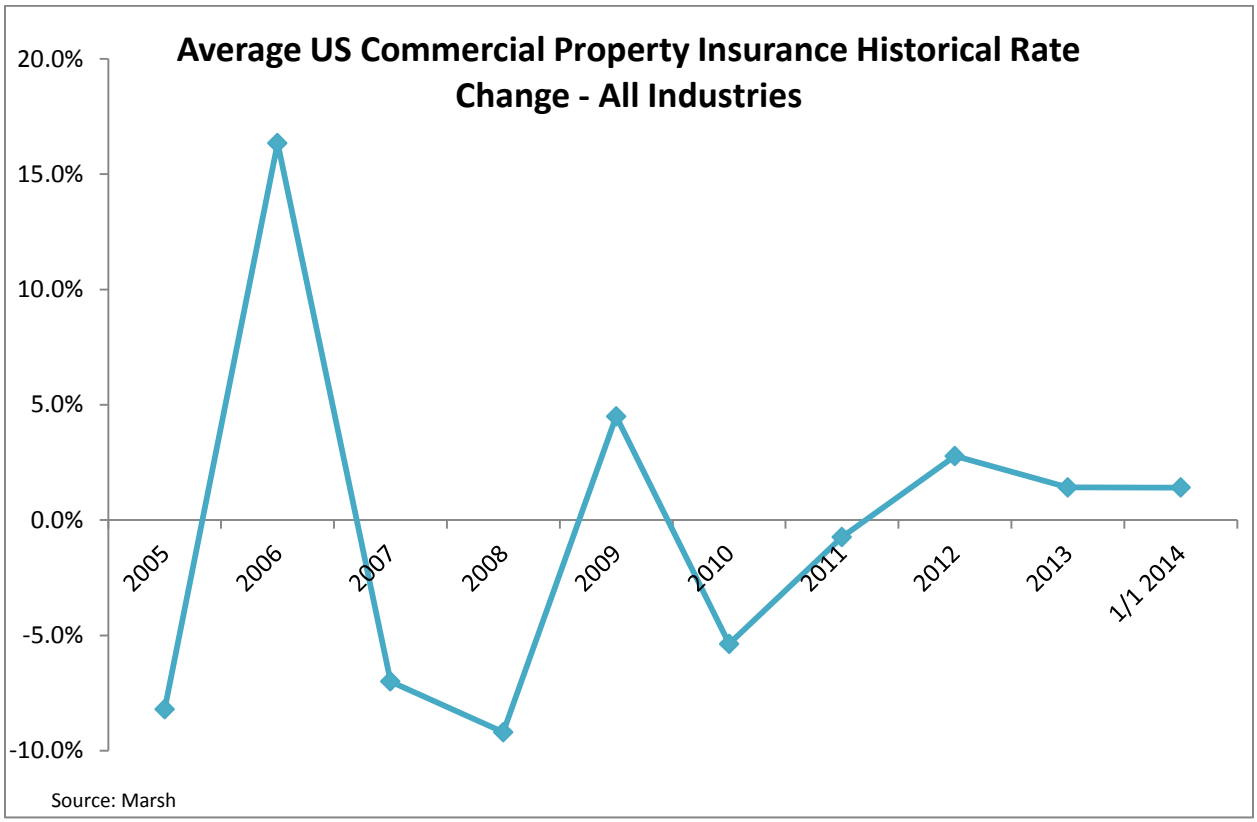
Source: Fast Track Monitoring System, MarketScout via Bloomberg and Citi Research

[124] Bank of America Merrill Lynch; P/C Insurance Primer; Less upbeat on the stocks; Valuation sensitivity key; Feb, 2014

[125] Citi Research, P&C Insurance Broker Initiation

On the commercial property side, 36% of companies experienced rate decreases at renewal in the fourth quarter of 2013[126]. The number of companies that had a rate increase in this quarter was 44% though most rate increases were in the 1-10% range. 20% of companies experienced no rate change at renewal. Overall in 2013 US commercial property insurance prices stabilized as a significant surplus of capital among insurers and reinsurers kept competition high (Figure 66). This trend of rate stabilization is expected to continue in the commercial property segment in 2014 so long as capacity stays plentiful and catastrophe losses remain relatively low.

Figure 66: Average US Commercial Property Insurance Historical Rate Change - All Industries – 2005-2014



All of this commentary aside, it should be noted that even under the best of circumstances frictions exist within the pricing landscape which slow the speed of primary rate changes and can impede the achievement of rate adequacy. For admitted carriers rate filings and coverage changes need to be targeted so as to avoid losing market share. Once filings have been crafted and submitted they take time to run through the regulatory approval process. Once approved (or filed, depending on the state's rules) implementing rate changes takes yet more time. With this in mind a lag should generally be expected between insurer intention and realization as respects any sort of pricing increase.

[126] Marsh, Inc.

2. Residual Market

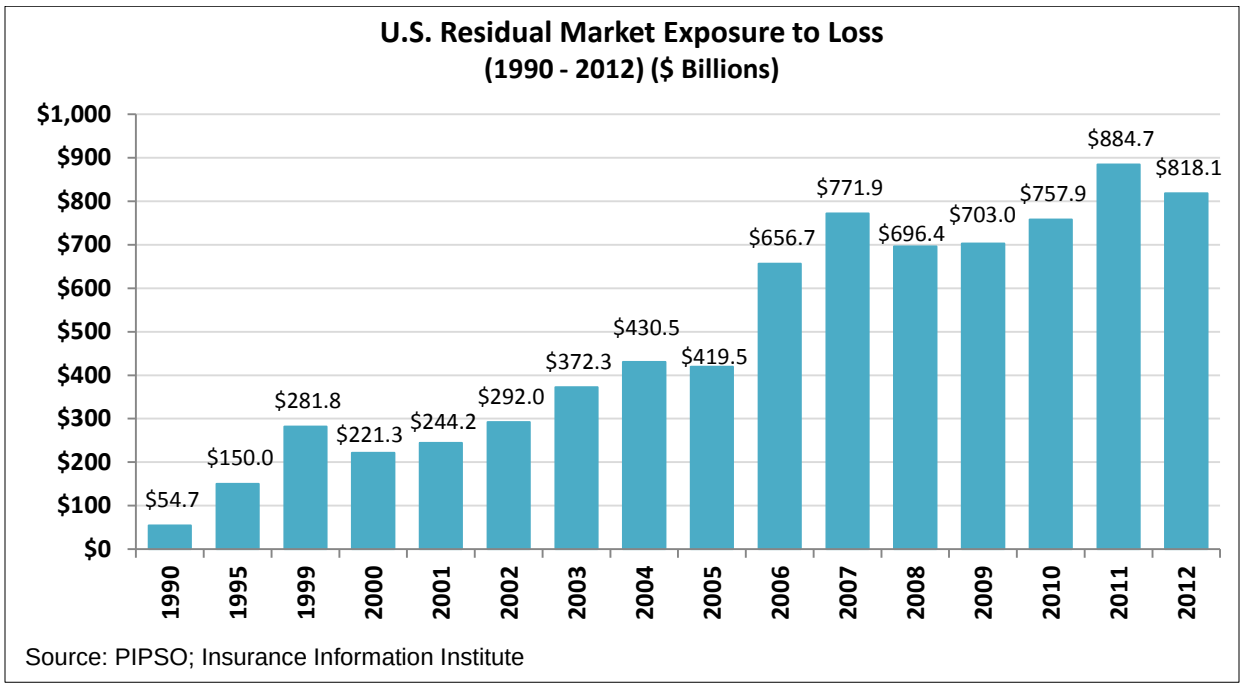
The residual market was created over 40 years ago in order to provide a supplemental outlet for those unable to attain coverage through the traditional private insurance sector. In the past two decades residual market plans have been experiencing exponential growth; this has been putting a lot of strain on individual programs and is calling into question their future sustainability.

Initially there was a clear divide between private and residual markets. Residual markets had their separate niche, taking upon unfavorable risk and ideally charging higher rates than the private market. Over time this distinction has been blurred. The Insurance Information Institute (III) claims that these markets of last resort have become the markets of first choice for many. This is largely due to change in state laws which removed provisions requiring residual market property insurers to charge rates which are uncompetitive with the private market. These legislative changes put a lot of pricing pressure on the private market challenging their ability to underwrite and appropriately price risk. This became a large contributing factor for applicant rejection in the private market sparking an abundance of demand for the residual markets.

Three predominant types of residual market mechanisms exist, Fair Access to Insurance Requirements (FAIR) Plans, Beach and Windstorm Plans, as well as hybrid plans such as Florida Citizens Property Insurance Company (CPIC) and Louisiana Citizens Property Insurance Corporation (Louisiana Citizens). FAIR Plans were initially established in the late 1960s to offer urban property coverage. Beach and Windstorm Plans were initially established around the same time to provide coverage for coastal wind-only risks. Both FAIR plans and Beach and Windstorm Plans have evolved from their initial agenda blurring their prior distinction. At present, FAIR Plans have been providing coverage for both urban communities as well as coastal communities that don't have Beach and Windstorm plans. Additionally FAIR Plans and Beach and Windstorm plans have merged in two states (FL and LA Citizens) creating hybrid plans which provide state-wide coverage. The type of coverage typically provided has also evolved from "bare bones" property to providing full homeowners coverage. The shift in coverage combined with private market competition has led to the overall growth of state residual property insurance markets.

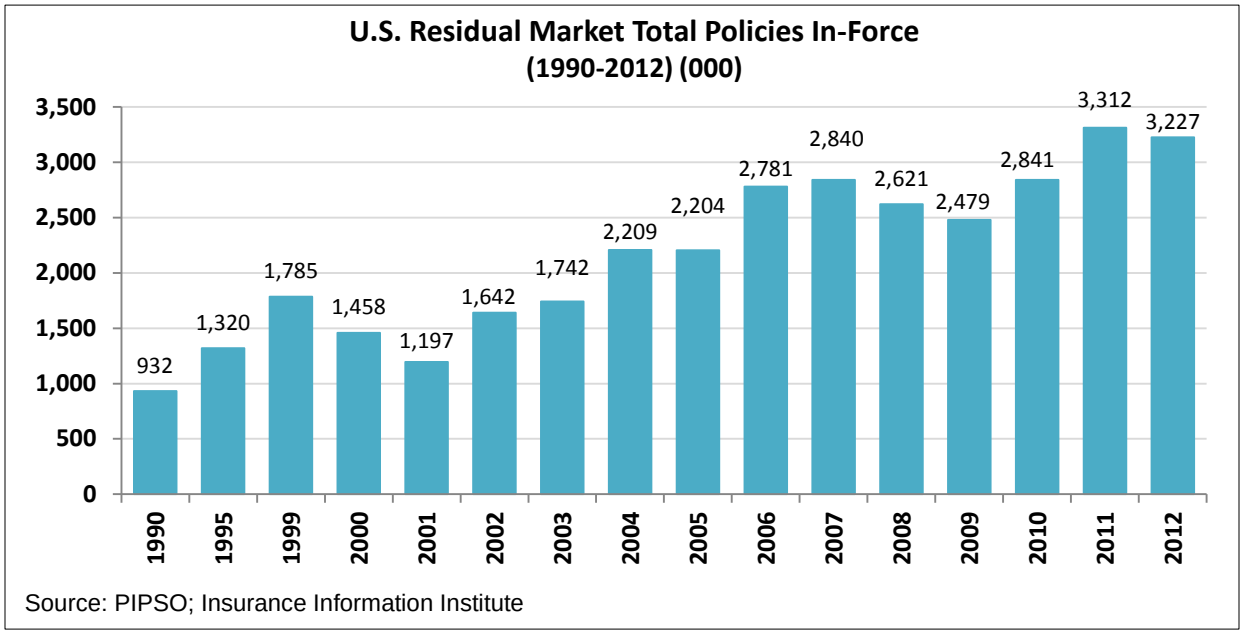
To be more specific, the demand for residual market coverage has been increasing at considerable rates for the past two decades. According to the Insurance Research Council (IRC), US residual market growth averaged close to 18 percent per annum for the years 1990 to 2007. Hurricane Andrew in 1992 was the major event that initially sparked the drastic increase in size of the residual market. This trend was promulgated further by various Florida Hurricanes (e.g. Hurricanes Katrina, Rita and Wilma 2005). The steep growth rate has seen the US residual property market's exposure grow from $54.7 billion in 1990 to over $800 billion in 2012, even after the market's exposure dipped in 2012 from its peak of $884.7 billion in 2011 (Figure 67).

Figure 67: US Residual Market Exposure to Loss – 1990-2012



The total number of residual market policies in the same time period more than tripled from nearly 1 million in the early 1990s to over 3.2 million in 2012. Like exposures the number of policies in force peaked in 2011 with 3.3 million (Figure 68). In addition to legislative change the growth in residual market business can also in part be attributed to the growth in coastal exposures (as detailed in the primary Underwriting section above).

Figure 68: US Residual Market Total Policies In-Force – 1990-2012



It is important to note that over 50% of the residual market exposure nationwide is concentrated in Florida. The Florida Citizens plan reached a peak of $511 billion of exposure in 2011 prompting a series of efforts to reduce the size of the company's book of business. The book was down to $429 billion by 2012 equivalent to about 12% of total property exposure in the state[127].

Historically there has been high volatility in the profitability of residual market plans. Looking at FAIR Plans alone[128], which account for a large share of the overall residual market, they have had volatile results in the last 20 years with aggregate operating income ranging between a loss of $1.8 billion in 2005 and a gain of $3.6 billion in 2006. From the period of 1990 to 2005 the plans reported aggregate net operating losses; however from 2006 onwards to 2012 the plans reported operating gains throughout. This more recent surplus can be primarily attributed to relatively calm hurricane seasons compared to those of 2004 and 2005 (Figure 69).

Of the 31 FAIR plans for which data are available, 28 have incurred at least one operating deficit since 1999. Of the six Beach and Windstorm plans for which data are available, all have sustained at least one underwriting loss since 1999. Such volatility in the financial results of the plans raises questions not just about heightened risk in coastal areas and coastal development, but about rate adequacy. This has important implications for the local property insurance markets and state fiscal policy[129].

Despite or perhaps because of headwinds and a variety of unique challenges residual market is often a source of industry innovation in the US and internationally. For a list of innovative/notable residual market transactions refer to Appendix B. Included in this appendix is an overview of the California Earthquake Authority which was excluded from the above since its subject business is only indirectly relevant to NFIP.

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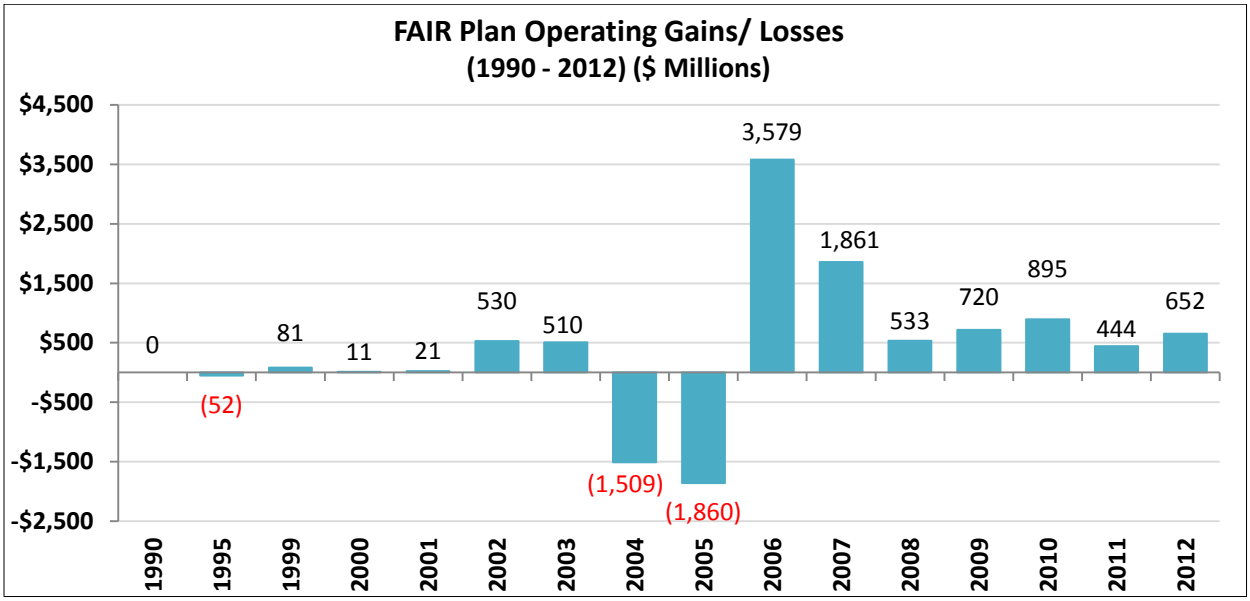
[127] Based on estimates from: AIR Worldwide; The Coastline at Risk: 2013 Update to the Estimated Insured Value of U.S. Coastal Properties. The value of Florida's total property exposure (both commercial and residential) was $3.6 trillion in 2012 of which 79% was coastal.

[128] Including FL and LA Citizens plans, though excluding Louisiana Citizens for 2005-2007. In 2005 LA Citizens reported an operating deficit of $954 million.

[129] http://www.iii.org/assets/docs/pdf/ResidualMarketWhitePaper-2012.pdf

Figure 69: FAIR Plan Operating Gains/Losses 1990-2011



Source: PIPSO; Insurance Information Institute

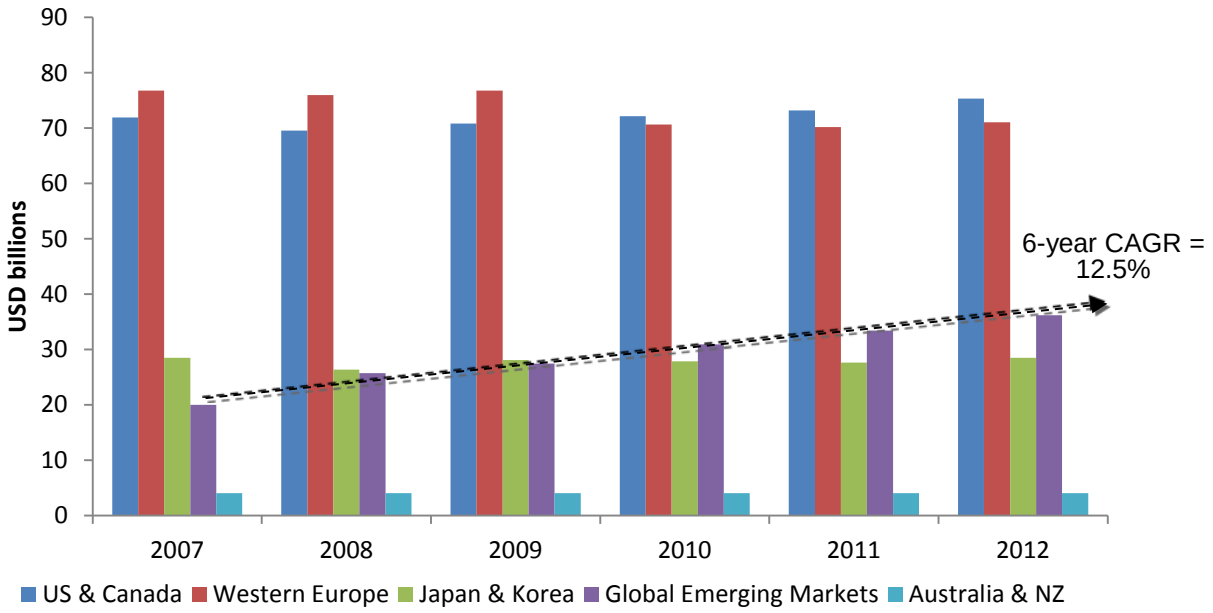
B. Global Reinsurance

1. Traditional

Underwriting

The global reinsurance market has been challenged for premium growth in recent years. As can be seen in Figure 70, growth has been down or stagnant in major developed markets including the US, Canada and Western Europe which together account for the vast majority of global reinsurance premium written. Emerging markets on the other hand have fared much better posting CAGR over the last 6 years of around 12.5%. By this measure growth in reinsurance is even more heavily skewed towards emerging markets than in insurance.

Figure 70: Estimated Reinsurance Premium (Life & Non-Life) Growth by Region



Source: Swiss Re, OECD, Bloomberg, Conning & Co., Standard & Poor's, Guy Carpenter estimates

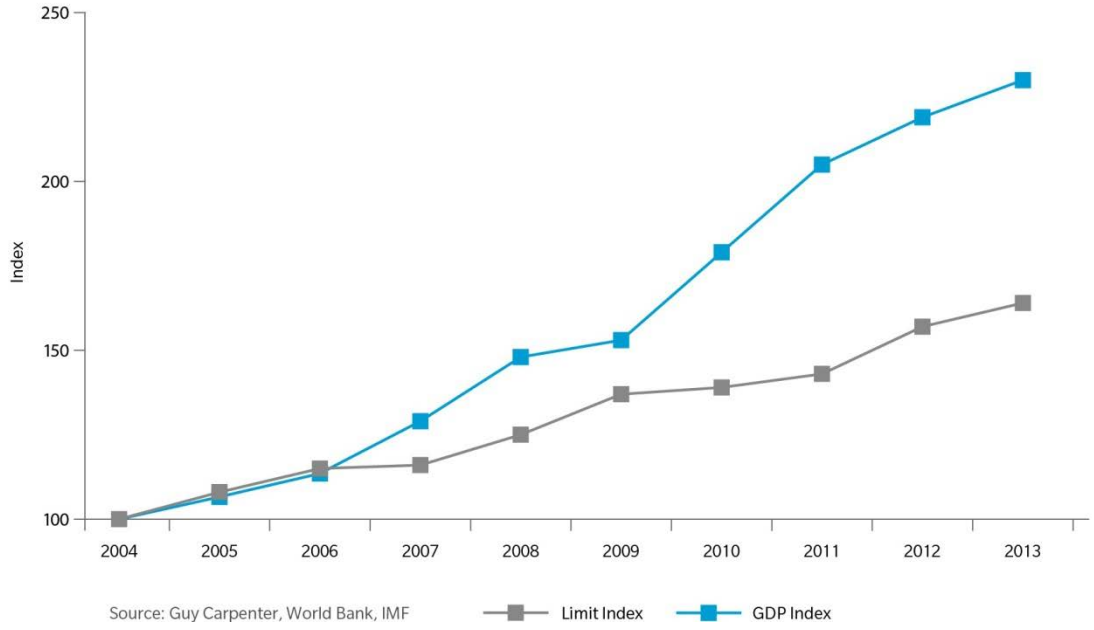
But even in emerging markets competition is steep and growth has not quite been sufficient to produce meaningful premium increases on a global basis. Though as the trend line in Figure 70 indicates, emerging markets will inevitably become a more important part of global reinsurance portfolio over time[130].

Interestingly, growth in reinsurance does not appear to be pacing growth in economic development in emerging markets. This perhaps implies both cheap rates as a result of the aforementioned competition and a relative underutilization of insurance by low-income consumers which make up

[130] Fitch; 2014; Global Reinsurance Guide 2014

the majority of emerging markets population. Figure 71 demonstrates this point for the Asia-Pacific region charting the widening gap in the growth of reinsurance catastrophe limit against GDP since 2006. Stronger rates of expected future economic growth in such emerging markets mean the gap between economic growth and reinsurance usage has the potential to increase further.

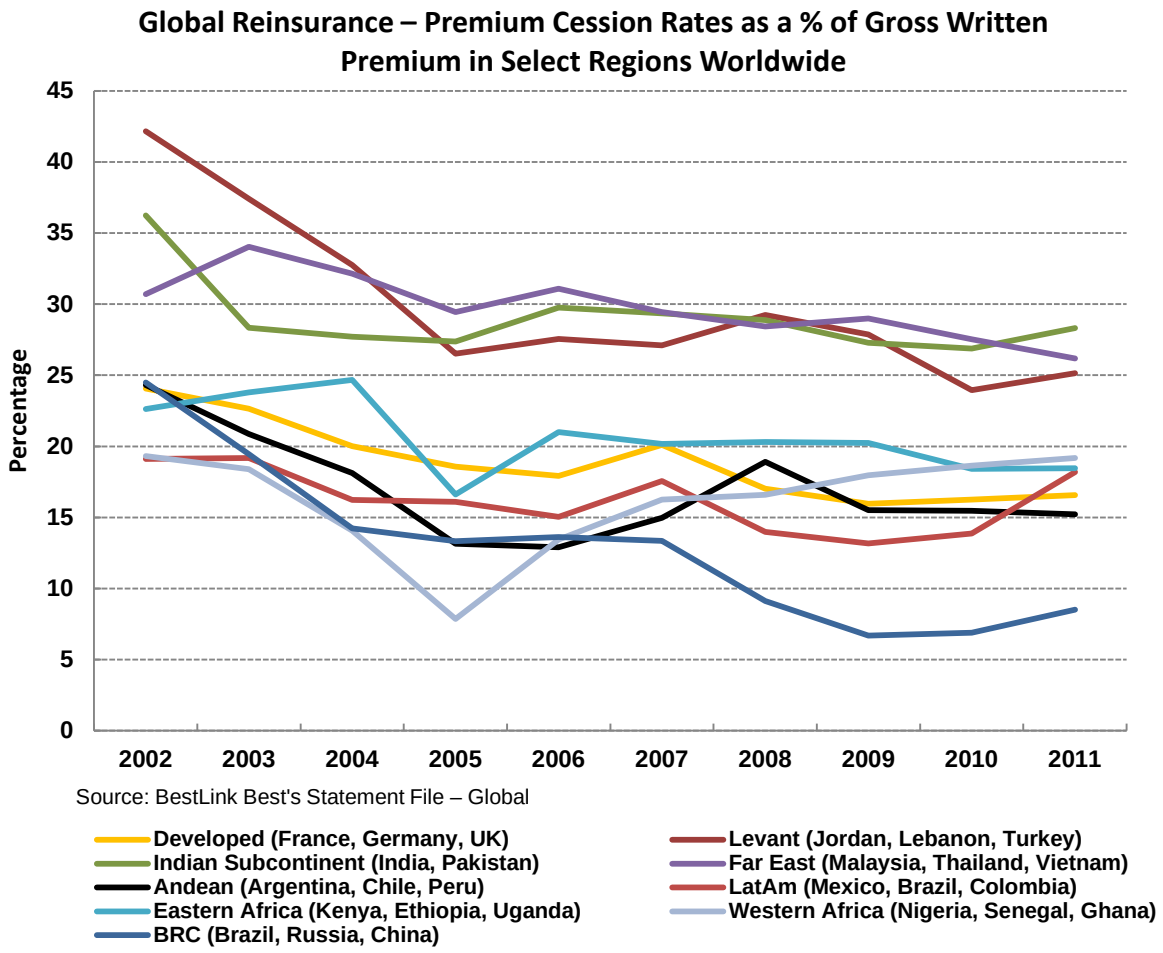
Figure 71: Increasing Gap between GDP Growth and Reinsurance Limit in Asia Pacific – 2004-2013



Reinsurance purchasing/demand trends are another factor influencing the market's ability to grow. Record levels of primary insurance market capital are driving increased consolidation in reinsurance buying on a global basis. The retaining of additional risk by major primary insurers in developed markets is one of the main drivers of stagnant premium growth there. Figure 72 charts the change in primary insurer cession rates[131] in regions around the world. Altogether this shows an overall downward trend in reinsurance cessions worldwide over the ten year period ending in 2011 the last year complete data are available for some markets.

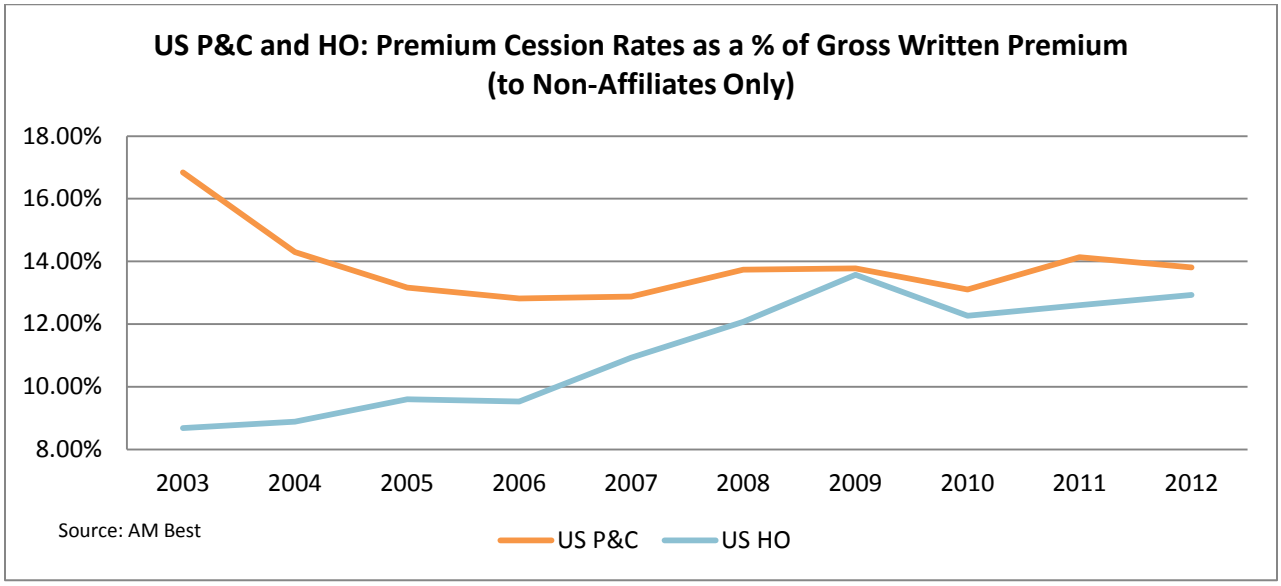
[131] Cessions Rate is the estimated amount of catastrophe reinsurance ceded by insurers to the reinsurance market as measured by purchased reinsurance limit.

Figure 72: Global Reinsurance Premium Cession Rates in Select Regions Worldwide – 2002-2011



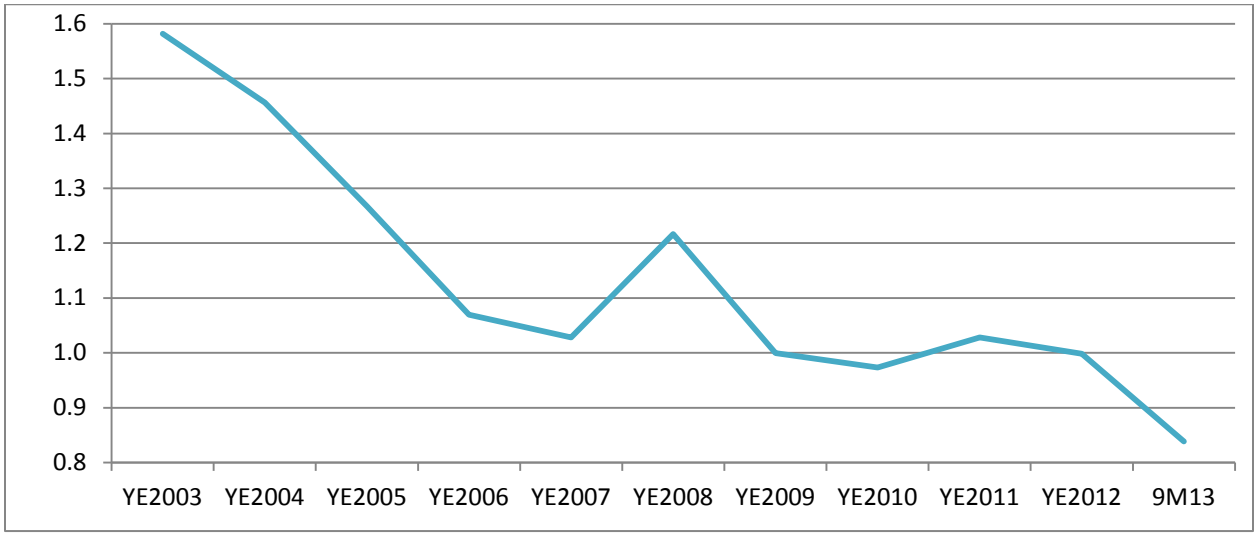
Despite this global trend, cession rates (premium ceded to reinsurers as a percentage of gross premium written) in the US HO market have actually been increasing in recent years (Figure 73). The reasons why US HO is bucking the global trend relate to the increased awareness of catastrophe risk affecting the business after the 2005 hurricanes and the increased concentration of HO exposures in catastrophe exposed areas, namely the US coastlines. Regardless of cause, the implications of this contrary development are potentially many, though in short the importance of US HO business to reinsurers in terms of top- and bottom-line performance appears to be increasing. Adding the peril of flood to the mix of US HO business would change the risk profile of the line somewhat substantially and would likely result in further increases in US HO cession rates at least in the short term. This in part explains why reinsurers in particular appear to be quite interested in the prospect of the privatization of NFIP.

Figure 73: US Property & Casualty Industry and Homeowners Cession Rates – 2003-2012



Another meaningful underwriting metric is the ratio of net premiums written to total shareholders' funds which recently hit a low for Guy Carpenter's Global Reinsurance Composite[132] (Figure 74). This tracks very closely with a similar decline in the NPW/Surplus ratio for primary US P&C insurers over the same time period. Since the US P&C insurance and global reinsurance markets are deeply intertwined this relationship is somewhat unsurprising, though not all of the factors that influence insurance supply and demand influence reinsurance and vice versa.

Figure 74: Guy Carpenter Global Reinsurance Composite: Ratio of Net Premiums Written / Shareholders' Funds

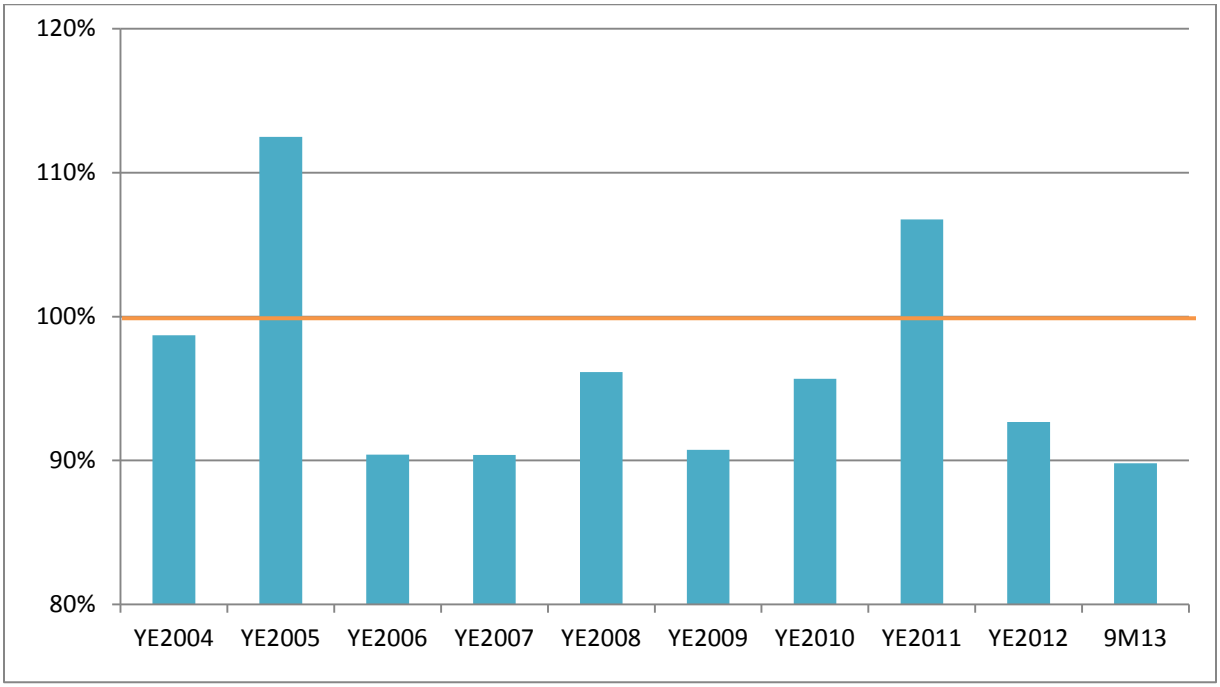


Specifically reinsurers are highly susceptible to primary insurer purchasing habits as indicated above. Reinsurers tend also to have much broader multinational footprints than most US P&C

[132] Guy Carpenter's global reinsurance composite includes the top 28 largest global reinsures.

insurers making them more highly exposed to international loss activity (and more diversified against US loss activity). Reinsurers, especially those focused on non-life business, are also more focused on the assumption and management of catastrophe risk.

Figure 75: Guy Carpenter Global Reinsurance Composite Combined Ratio



Looking at the combined ratio for the Guy Carpenter composite (Figure 75), the impact of international catastrophe loss activity on reinsurer underwriting profitability is apparent. While posting a gain in most of the last ten years, reinsurers suffered large net underwriting losses in 2005 (several landfalling US hurricanes) and in 2011 (the worst year for global economic catastrophe losses on record).

Given the susceptibility of their balance sheets to catastrophe risk, reinsurers closely track global catastrophe loss trends. Worldwide between 1970 and 2012 fully 70% of total direct economic losses from natural catastrophes were uninsured[133] and the gap between economic and insured catastrophe losses continues to widen (see Figure 76). There is even some evidence that direct economic catastrophe loss numbers are consistently and significantly underreported, meaning uninsured losses from catastrophes are actually magnitudes higher than shown herein[134].

The chart below further illustrates the rising level of insured losses from global natural catastrophes over the last 40 years. The steady growth in gross losses is due to a combination of factors including increasing insurance penetration and population growth/building density particularly in coastal regions as mentioned in the primary Underwriting section herein. Four of the five largest

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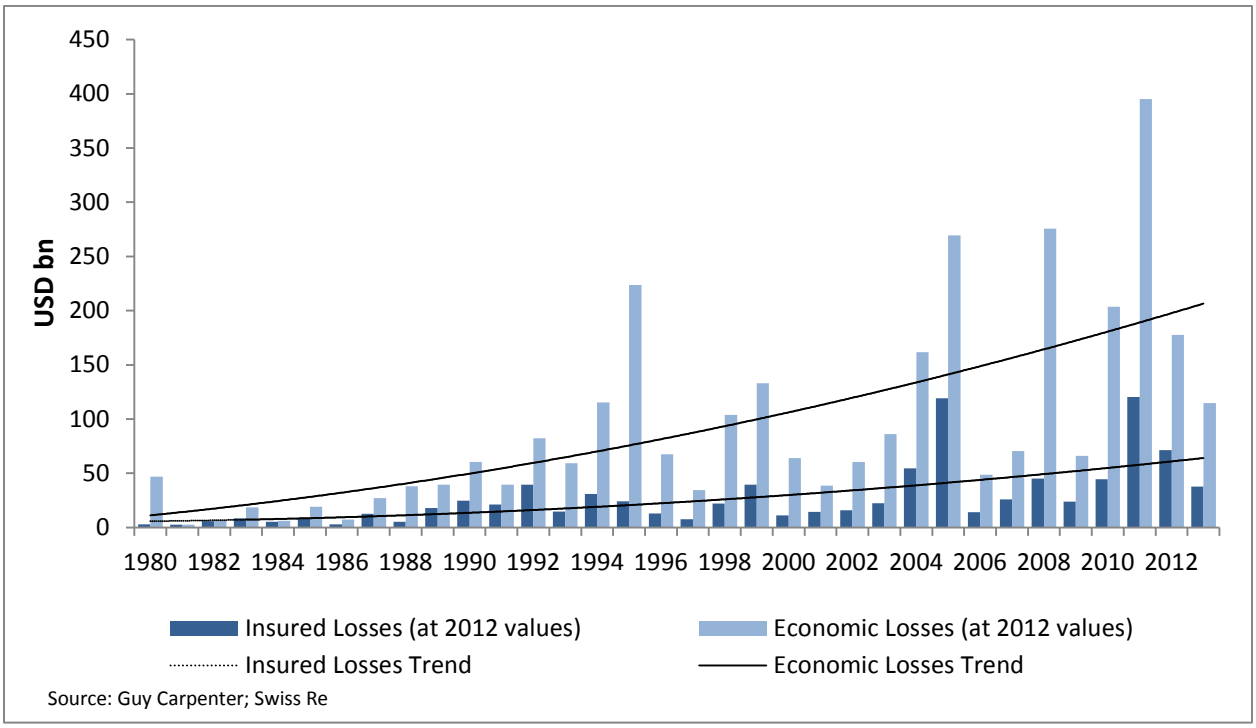
[133] http://www.gccapitalideas.com/2013/09/07/gc-videocast-rendez-vous-press-briefing-2013-richard-booth-opportunities-for-growth/

[134] Global Assessment Report on Disaster Risk Reduction 2013: From Shared Risk to Shared Value: the Business Case for Disaster Risk Reduction; Introduction to Part I.

catastrophe loss years on record have occurred within the last eight years. 2011 in particular was the worst on record, with devastating earthquakes occurring in Japan and New Zealand, unprecedented floods in Thailand and Australia and a record breaking tornado season in the US.

Figure 76: The Gap in Economic and Insured Catastrophe Losses Worldwide Continues to Widen



The current and increasing lack of catastrophe insurance usage is often thought of as an issue exclusive to emerging markets. While the gap is indeed more pronounced in low- or middle-income countries there remains a significant problem of un(der)insurance in developed markets as well (see Figure 77). Even in the most developed insurance market in the world uninsured risks still abound. For example, for the five largest hurricane losses to impact the US in the last decade uninsured economic losses amounted to over $126B – more than 50% of the total economic losses recorded for those events (Figure 78).

Figure 77: Economic and Insured Losses in Advanced and Emerging Economies

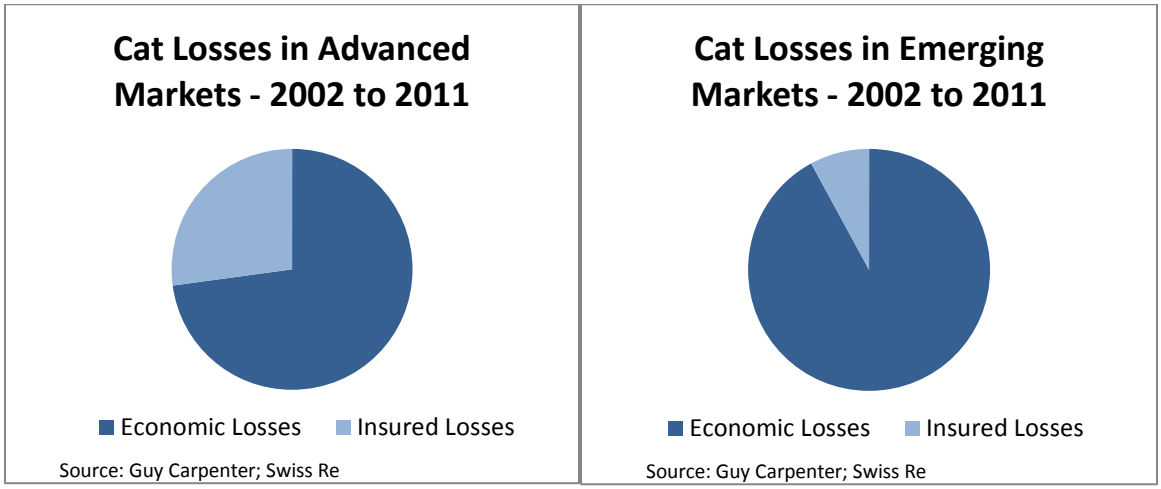
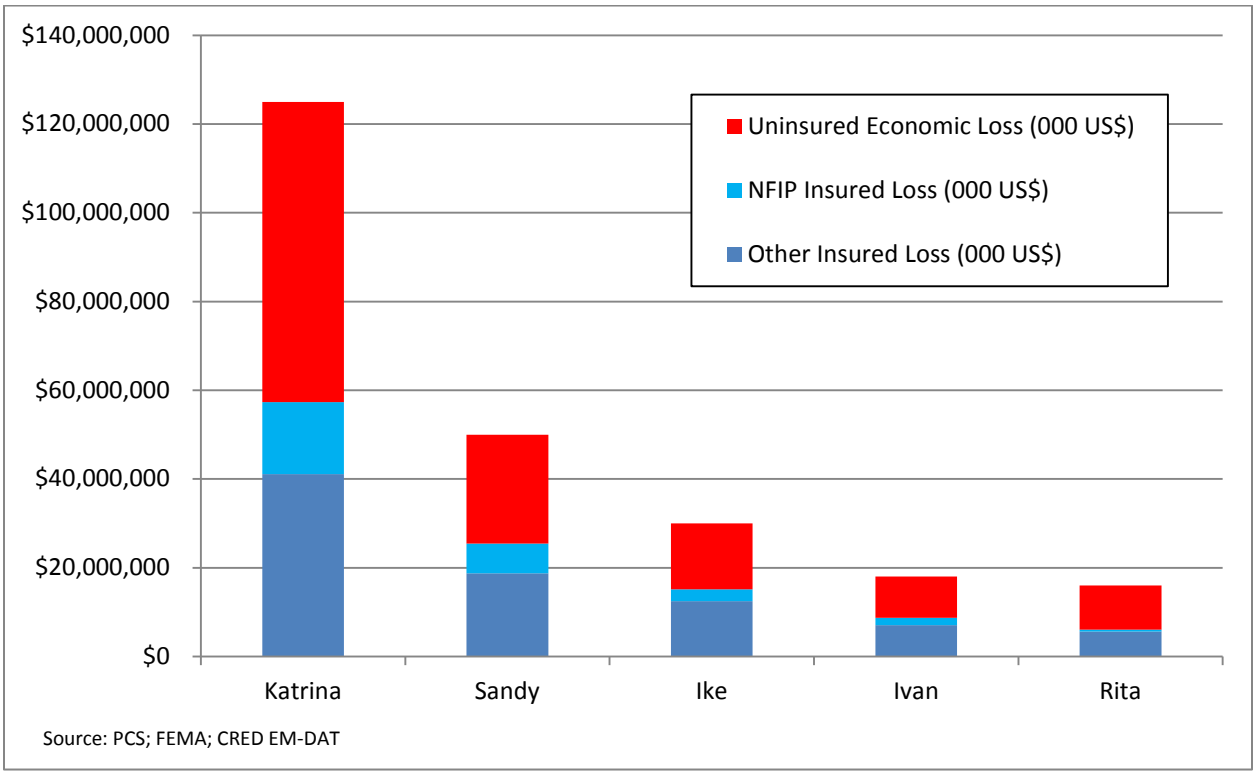


Figure 78: Insured and Uninsured Losses from Top Five Largest US Hurricane Losses



Therefore, despite the common view that catastrophe risk demand is being satisfied by (re)insurers, it is clear that many territories lack available and affordable insurance cover. Indeed, the disparity between economic and insured losses is likely to increase in the future unless carriers create products that better meet the needs of policyholders. Herein lays an opportunity for reinsurers in conjunction with their primary underwriting partners to design and offer competitive and compelling products which address customer concerns. With the recognition of opportunity in the catastrophe markets an increasing number of reinsurers and alternative risk transfer solution providers are turning their attention to growth opportunities in developed economies. As such, the US flood

insurance market which is by and large untapped by private carriers – and therefore largely off-limits to reinsurers since NFIP does not currently buy – is often at or near the top of reinsurers' business development agendas.

To give a sense of the current importance of reinsurance to the US catastrophe insurance market Table 18 below shows the portion of the insured loss that was reinsured as a result of the ten most costly hurricanes in the US. Reinsurers have paid 20-50% of the insured loss amounts for each of these events. Hurricane Andrew sits at the lower end of this range and served as the proximate cause for the bankruptcy of as many as 11 insurers. This event served as a wake-up call to the insurance industry and caused a paradigm shift in the way insurers managed catastrophe risk and purchased reinsurance. The figures in Table 18 exemplify this shift as most subsequent events (including several smaller) had much higher reinsured loss percentages.

All of this being considered, when it comes to the possible addition of new catastrophe risk such as flood into the primary US insurance market, reinsurers will undoubtedly have a very influential seat at the table during any related negotiations.

Table 18: The Ten Most Costly Hurricanes in the United States

Rank (1)	Date	Location	Hurricane	Estimated Insured Losses (millions of $ when occurred) (2)	In 2012 dollars (3)	% Reinsured (4)
1	Aug. 25-30, 2005	AL, FL, GA, LA, MS, TN	Hurricane Katrina	$41,100	$47,424	***46.0%***
2	Aug. 24-26, 1992	FL, LA	Hurricane Andrew	15,500	23,349	***19.1%***
3	Oct. 28-31, 2012	CT, DC, DE, MA, MD, ME, NC, NH, NJ, NY, OH, PA, RI, VA, VT, WV	Hurricane Sandy	18,750	18,750	***27-53%***
4	Sep. 12-14, 2008	AR, IL, IN, KY, LA, MO, OH, PA, TX	Hurricane Ike	12,500	13,283	***47.9%***
5	Oct. 24, 2005	FL	Hurricane Wilma	10,300	11,885	***29.8%***
6	Aug. 13-14, 2004	FL, NC, SC	Hurricane Charley	7,475	8,912	***21.4%***
7	Sep. 15-21, 2004	AL, DE, FL, GA, LA, MD, MS, NC, NJ, NY, OH, PA, TN, VA, WV	Hurricane Ivan	7,110	8,476	***21.4%***
8	Sep. 17-22, 1989	GA, NC, PR, SC, U.S. Virgin Islands, VA	Hurricane Hugo	4,195	6,957	***35.3%***
9	Sep. 20-26, 2005	AL, AR, FL, LA, MS, TN, TX	Hurricane Rita	5,627	6,493	***36.4%***
10	Sep. 3-9, 2004	FL, GA, NC, NY, SC	Hurricane Frances	4,595	5,478	***28.2%***

(1) Includes hurricanes occurring through 2013; ranking based on estimated insured losses; historical events like the 1928 Florida Hurricane (a.k.a. the Okeechobee hurricane) are not included since they did not cause much loss at the time, though if they were to occur today they might have a comparatively significant impact.
(2) Property coverage only. Excludes flood damage covered by the federally administered National Flood Insurance Program.
(3) Adjusted for inflation through 2012 by ISO using the GDP implicit price deflator.
(4) Losses as of Mar 31, 2011 with the exception of Hurricane Sandy; III presentation: Japan, Global Catastrophe Losses Trends and the Impacts on Insurance & Reinsurance Markets

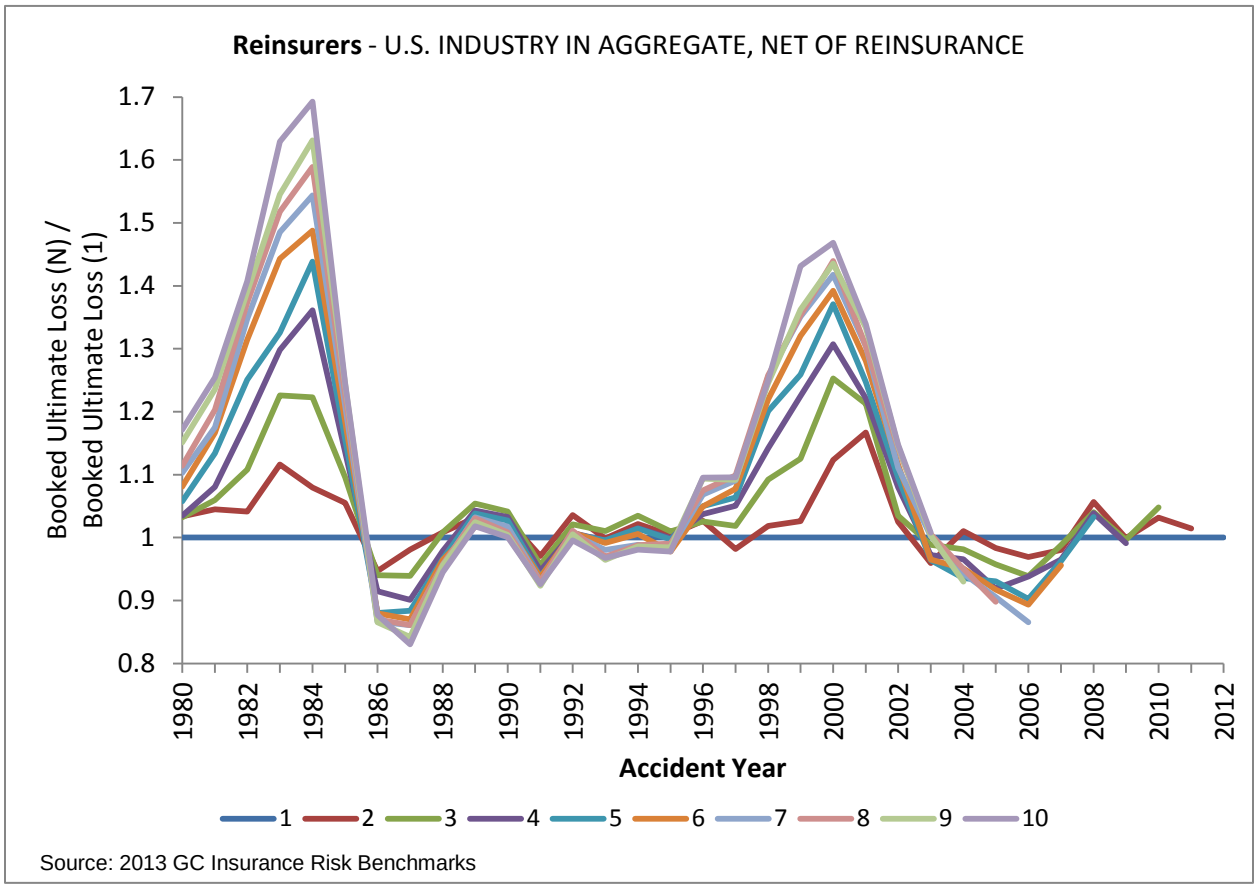
Source: III; The Property Claim Services (PCS) unit of ISO, a Verisk Analytics company; Guy Carpenter analysis

Another factor influencing reinsurance underwriting results is loss reserves. In order to have an apples-to-apples comparison between the P&C and reinsurance industry reserve cycles, Guy Carpenter has examined the US reinsurance sector using similar metrics, notably studying the booked ultimate loss by accident year. As with insurance reserves, the estimate of ultimate loss for a given accident year ideally should not change over time if the initial estimate was correct. Nonetheless, when analyzing reinsurance-specific data, a cycle forms as a specific accident year is re-estimated intermittently.

In Figure 79 below, shows the US P&C industry accident year net of reinsurance reserve development. For each accident year, the initially booked reserve estimate is represented by the horizontal line at 1. Using 1982 as an example, we can see our initial ultimate loss estimate was significantly under-reserved and was adjusted incrementally upwards in each 12 month evaluation thereafter. Graphically, this is the industry wrestling with a developing tide of asbestos related liabilities. Conversely, accident year 2003 represented a period of marginal reserve redundancy. In this cycle, the industry was overly conservative with its initial reserve pick, and through a series of reserve releases, managed its way back to an efficient reserving.[135]

[135] GC Analytics & Oliver Wyman, 2013 GC Insurance Risk Benchmarks

Figure 79: US Reinsurer Reserve Cycle– 1980-2012



The reason for such volatility and severity in comparison to the primary US P&C industry reserve cycle is that reinsurers are vulnerable to much larger and more volatile risks. When purchasing reinsurance, the primary carrier's goal is to set their reinsurance structure at an optimum level where cost versus benefit strategically makes sense. Often this takes the form of excess of loss reinsurance where an insurance company retains the first $X of loss and places a reinsurance treaty to cover $Y in excess thereof. In this capacity, reinsurers are thus susceptible to only the most unexpected and severe losses affecting the insurer.

As shown in Figure 79 above, the years that initially trend poorly are exhibiting something of a whiplash effect in later years. This reverberation has to do in part with the lack of clarity and speed of information transfer from primary to reinsurance underwriters. This issue brings forth a time lag, taking longer for reinsurers to realize the true loss, handcuffing their ability to release reserves when experiencing a poor underwriting year.

Reverting back to the reinsurance example above, once the insurer exhausts its retention the responsibility for reserving the loss is now shifted to the reinsurer up to the limit of its excess treaty. A loss affecting a reinsurer may take years to come to fruition. This causes an initial reserve deficiency to result in a significant year-over-year spike.

In sum the global reinsurance market is battling with a variety of dominant underwriting trends including the following:

- Primary market – demand decreasing:
    - Global insurance premium growth is being driven by emerging markets
    - In emerging markets catastrophe reinsurance purchasing is not pacing economic growth
    - Primary insurers are having difficulty growing especially in developed markets
    - Primary insurers are stockpiling more capital and thus retaining more risk causing cession rates worldwide to decline
    - Insurance penetration in most catastrophe insurance markets worldwide remains relatively suppressed
- Secondary market – supply increasing:
    - Available reinsurance capital is increasing significantly due to:
        - Good financial results over the last several years by reinsurers
        - The ongoing influx of alternative capital in the catastrophe risk arena
    - The industry has fared very well financially even after historically large and active catastrophe loss years

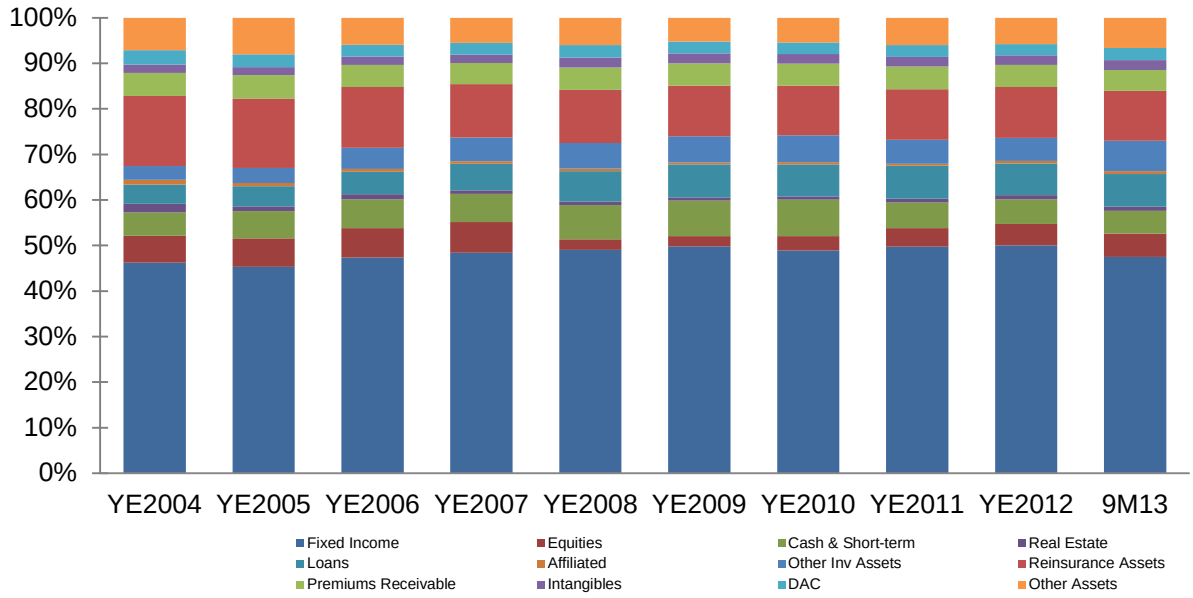
The upshot of all these moving parts is that demand for reinsurance is decreasing and supply is increasing simultaneously creating a very cedant-friendly market environment. In situations where demand exceeds supply of capacity, reinsurers need to ration available capacity and allocate to maximize return. When supply exceeds demand as in the current environment, capacity utilization is critical and marginal return pricing becomes the norm. For many reinsurers building relationships helps to buffer the peaks and troughs.

Reinsurers will be challenged going forward to maintain risk-appropriate rates and market share simultaneously. Market participants with the most efficient business model or attractive product offering will be best positioned to compete in this highly competitive environment. Those reinsurers looking to grow their business will need to do so in increasingly creative ways. This may entail partnering with insurers, public entities and/or regulators to generate new markets and mechanisms by which to transfer heretofore un(der)(re)insured risk into the private market.

Asset

Much like primary insurers, reinsurers' investment portfolios are generally made up of fixed income securities (Figure 80). Since reinsurer asset composition and therefore risk profile is very similar to insurer asset composition, please refer to the primary Asset Trends section for related details. In short, reinsurer performance is highly susceptible to swift interest rate fluctuations and to the ongoing low-interest rate environment.

Figure 80: Asset Composition of Guy Carpenter Global Reinsurance Composite



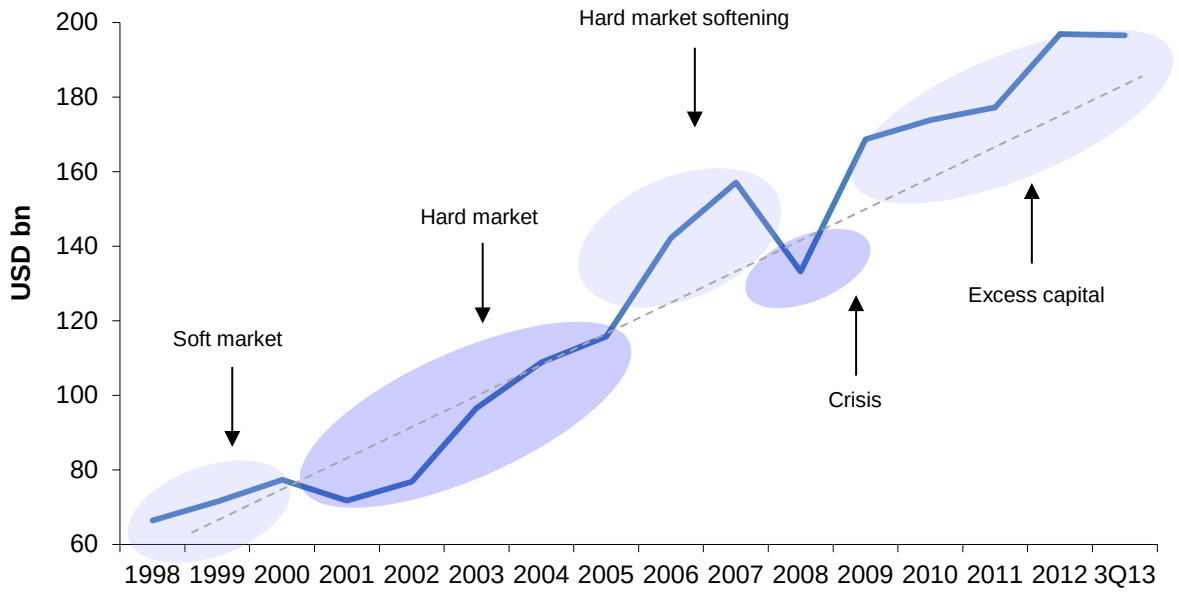
Specific to the reinsurance industry, the combination of interest rate risk and catastrophe underwriting risk could cause some unique problems. While some may contend that mark-to-market losses due to interest rate spikes are not particularly relevant since insurers generally intend to hold their bonds to maturity minimizing capital impairment over time. However, if the reinsurance industry were to experience a very large catastrophic loss, it would need to sell some of its current investment positions at the going rate to bolster liquidity. If interest rates go up pursuant to a really big underwriting loss, this might require reinsurers to sell assets at a discount. Granted this would have to be a really extreme event, but reinsurers are in a sector of extreme tail risk with global exposures so it is not unthinkable.

Capacity

There are a variety of interrelated factors that influence reinsurance market capacity. Capacity is mainly a function of capital, though also a function of the riskiness of business assumed. At present there is an abundance of capital in the reinsurance sector. While some would argue that the reinsurance market has assumed more risk relative to its capital since the turn of the century this is difficult to quantify. Traditional reinsurance capital on the other hand has grown significantly as can be seen from Guy Carpenter's Global Reinsurance Composite (Figure 81)[136]. Note the clear upward trend (dotted line in graphic) which also indicates roughly the incidence of hard and soft points in the reinsurance underwriting cycle – when the industry's capital position falls below the dotted line rates rose and vice versa.

[136] Please note: Guy Carpenter's Global Reinsurance Composite is an index based upon a limited selection of leading global reinsurers. The absolute capital numbers referenced in this index therefore will not match the overall industry dedicated capital estimate also produced by Guy Carpenter and referenced elsewhere in this reinsurance study which is intended to be comprehensive.

Figure 81: Long Term Evolution of Reinsurance Capital – Guy Carpenter Global Reinsurance Composite[137]



Traditional reinsurance capital has grown to recent historical high levels after dropping in 2008 due to the investment and accounting losses suffered during the global financial crisis. Even with the gating influence of the financial crisis, the sector has been in a sustained period of excess capital in recent years. This is in part because reinsurers have had a good deal of recent success as indicated by their overall operating profitability over the past decade (Figure 38). In the late 1990s, the reinsurance sector suffered poor results due to adverse loss-reserve development from poor underwriting of casualty lines during that time period. From this point on reinsurers worked hard to improve their balance sheets and largely succeeded in so doing.

Despite challenges to premium growth, a low interest rate environment and declining reserve releases the global reinsurance industry has managed to maintain profitability over the past decade avoiding a net income loss even in years with significant catastrophic loss activity or during the financial crisis (see years 2005, 2008 and 2011 in Figure 82). The profitability of the reinsurance sector reached record highs in 2006 and 2007 and has been in the double-digit range for six of the last nine and a half years.

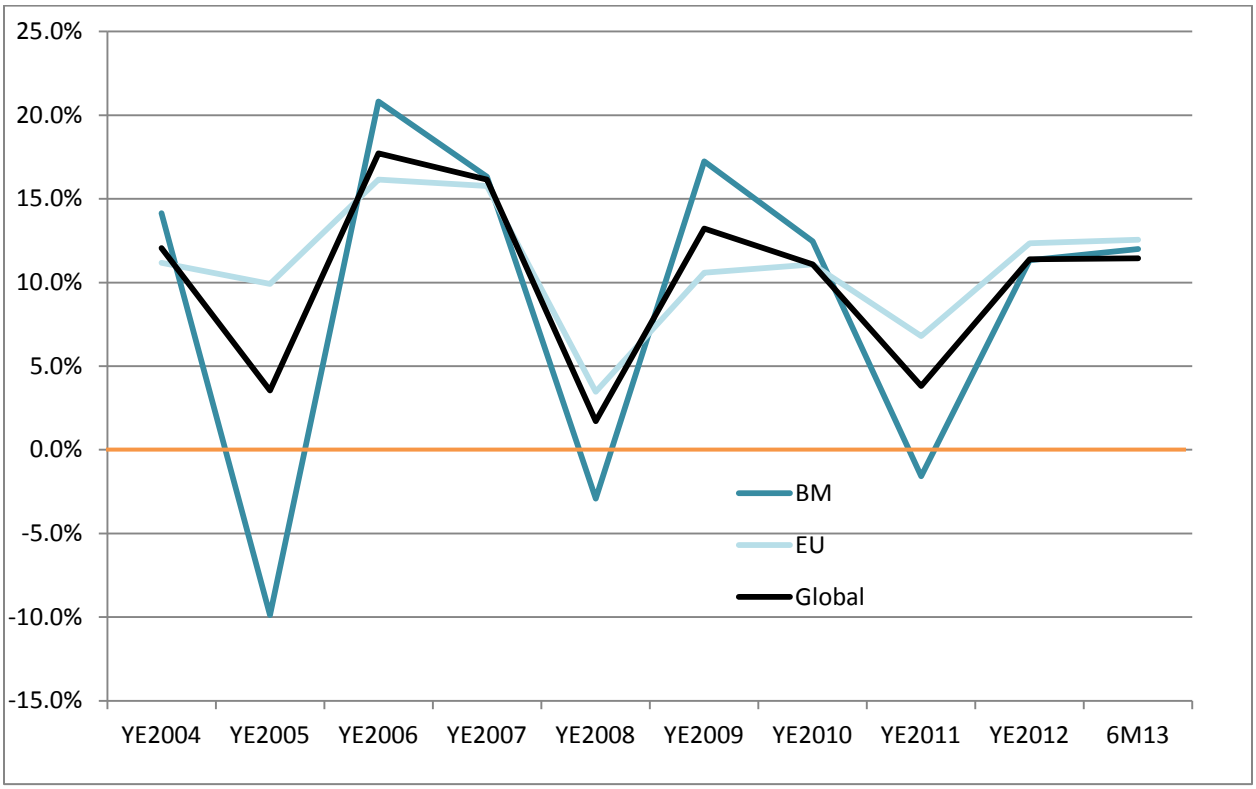
Looking at the results for Bermudian and European reinsurers separately a few interesting differences arise. Bermuda market reinsurers tend to exhibit more volatile earnings than all reinsurers taken together as they consistently post a Return on Average Equity (ROAE) which is higher than the global composite in good years and lower in bad years. The opposite is true for European reinsurers. The reason for this is most likely the focus of the Bermuda market on more

[137] Guy Carpenter Global Reinsurance Composite is an amalgamation of key leading reinsurance groups, not every reinsurer is represented. It is designed to provide directional advice as to the capital position of the reinsurance marketplace.

volatile lines of business, most notably property catastrophe. This in turn makes their risk-return profile more volatile than large European reinsurers for instance which tend to have much more diversified portfolios writing a combination of Life and many lines of Non-Life business.

Overall the reinsurance industry has performed remarkably well in the past decade. Such strong earnings illustrate the strength and resiliency of the sector. Though entering 2014 reinsurers face significant margin pressure from all sides which will impact on their ability to deploy capital and maintain earnings. Whether or not reinsurers will be able to maintain their historical performance in light of these headwinds remains to be seen.

Figure 82: Guy Carpenter Global and Regional Reinsurance Composite Return on Average Equity



With stable operating performance and an ongoing influx of new capital into the sector (see ILS section for more details) the current period of excess capital is not likely to end soon (of course barring a very large catastrophic loss year). When a reinsurer is overcapitalized, it has at its disposal the same strategic options as an insurer:

- Hold on to capital
- Return capital to shareholders
- Grow organically (write more premium in existing lines or in new lines or regions)
- Grow inorganically (make acquisitions)

Returning capital to shareholders has been popular in recent years reaching a peak of nearly 7% of shareholders' funds in 2007 (Figure 83). Though barring a few notable large deals, inorganic growth through M&A has been sparing in recent years possibly due to a lack of clear synergetic or opportunities or undervalued targets (Table 19). This leaves organic growth as an option though as

already discussed in this section and others above, new premium income is not easy to come by due to a confluence of trends affecting underwriting.

Figure 83: GC Global Reinsurer Composite – Stock Repurchases as a Percentage of Shareholder's Funds

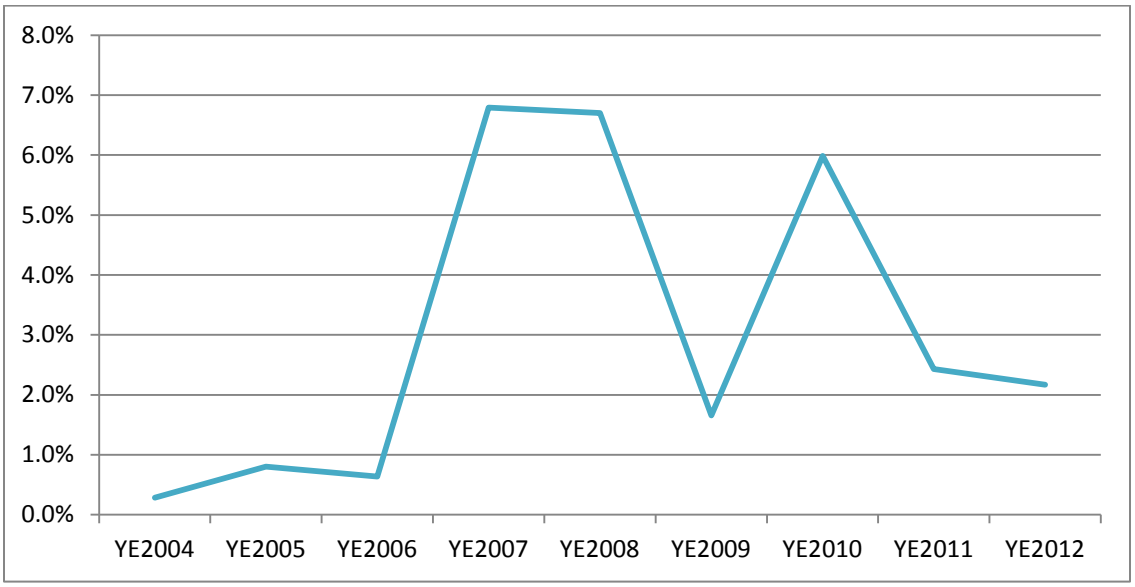


Table 19: Reinsurer Mergers and Acquisitions – 2011-2013

Buyer -> Target Company : ~Transaction Value (USD millions)
2013 Transactions
Enstar -> Arden Re : $80
2012 Transactions
Markel -> Alterra : $3,130
Validus Holdings -> Flagstone Reinsurance Holdings : $623
CNA -> Hardy : $227
Canopius -> Omega : N/A
Goldman Sachs -> Ariel Re : N/A
Arch Capital Group -> Ariel Re (credit & surety business) : N/A
2011 Transactions
Alleghany Corporation -> Transatlantic Re : $3,427
Ramius Enterprises -> Bel Re : $293
Catalina Holdings -> Glacier Re : N/A
Source: Public filings, Conning analysis

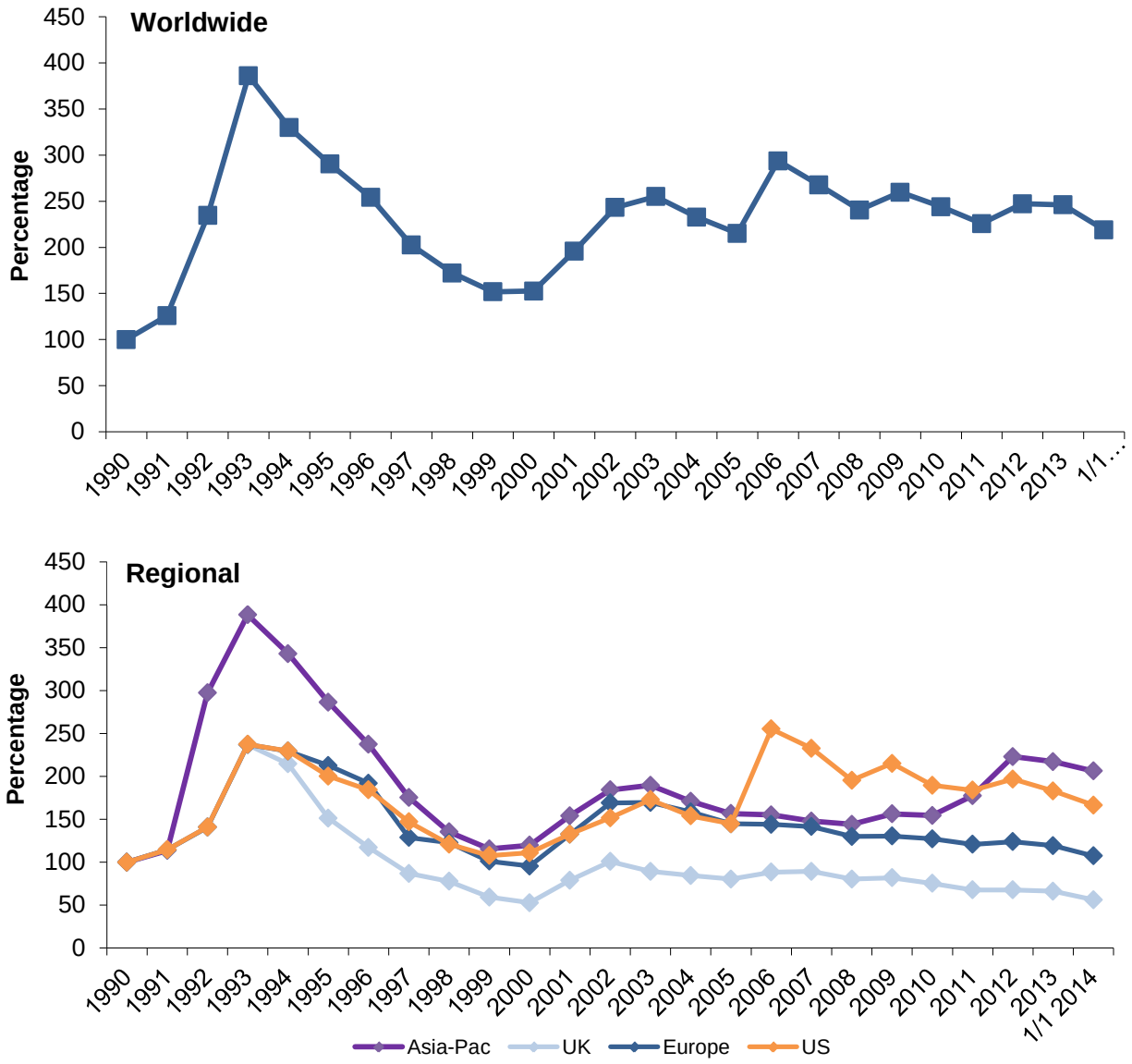
Pricing

Rates generally increase after a major catastrophe as capital is drained from the market. Capital flowing into the market then causes prices to level off (supply/demand). Hurricanes Andrew and Katrina are both examples of this market swing, where prices rise significantly after the event but then level off due to new capital flowing into the market trying to capture increased rates. Figure 84 shows the impact of these two events on global property catastrophe reinsurance market pricing in the years following 1992 and 2005 respectively.

At January 1, 2014 GC's property catastrophe reinsurance rate online (ROL)[138] index fell by 11%. Much of this was driven by a decline in US property catastrophe pricing (discussed further below). While Germany and Canada experienced rate increases for select programs after being impacted by heavy flood and storm losses during 2013, catastrophe pricing fell overall in Continental Europe. The Asia Pacific region also saw pricing fall while considerable softening was experienced in the United Kingdom. Over time reinsurance rates in the UK and Europe have been less volatile than in the US.

[138] Guy Carpenter tracks the ROL for all of its Property

Figure 84: Guy Carpenter Worldwide and Regional Property Catastrophe Reinsurance Rate On Line Indices (ROL is reinsurance premium paid as a percentage of reinsurance limit purchased)



The main pricing drivers throughout 2013 were the rising supply from traditional carriers and alternative markets on top of an already abundant capital base and low catastrophe loss experience. As discussed earlier, the increased competition between capital providers pushed reinsurance pricing lower, particularly for peak risks in the United States. Although the impression was less noticeable in other regions and lines, the January 1, 2014 renewal showed that competition has trickled into other non-property market segments.

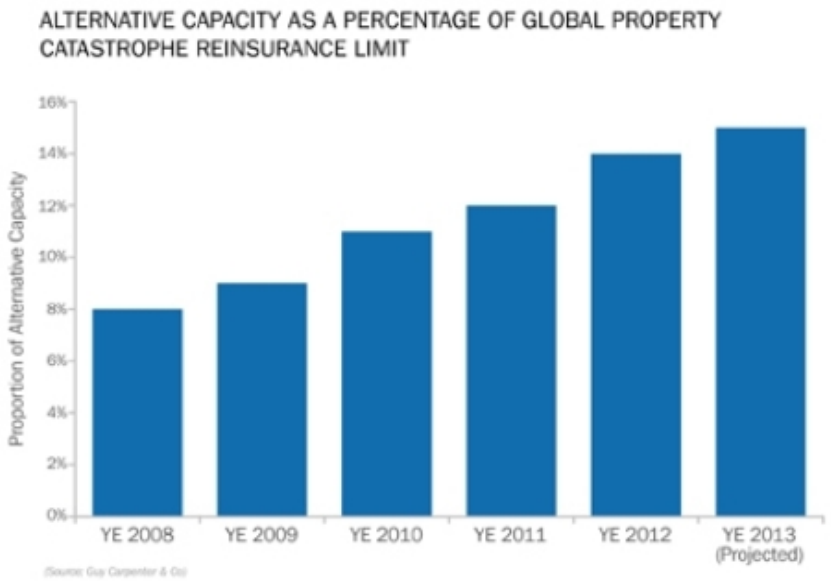
In the US, the January 1, 2014 renewals displayed a continuation of price softening, more than expected in large part due to the effect of the capital markets capacity, specifically 144A catastrophe bonds. Alternative market capacity was mostly used on residual markets and for Florida placements. Almost 90% of placements were shopped to alternative markets in some fashion with 50% of those binding some limit. In total, 18% of total limit was bound with alternative

markets, not including cat bond placements. Other than residual market placements, the majority of alternative capacity was used to complete supplemental coverages, many of which were new placements.

2. Insurance Linked Securities

As discussed in the CMA, insurance-linked securities (ILS) are investments where performance and risk of loss are typically tied to underlying insurance risk. An ILS can relate to life or non-life risks, though the majority is non-life. As of year-end 2013 the ILS market represented nearly 15% of all catastrophe reinsurance purchases[139]. Cat bonds and collateralized reinsurance make up the majority of insurance-linked securities purchases today with ILWs and retrocession rounding out the remainder. This sector has grown significantly in absolute size and influence over the last several years (see Figure 86) and is expected to continue growing into the foreseeable future.

Figure 85: Alternative Capacity as a Percentage of Global Property Catastrophe Reinsurance Limit



As investor capital continues to pour into the reinsurance sector it is having a tangible impact on traditional reinsurers' operations. Reinsurers have had to alter their business model in response to the challenge, leading to more favorable terms and conditions for cedants, as well as better pricing, program structures, early signing discounts and many multi-year deals. Pricing expectations of traditional reinsurance products have deviated from expectations as a result of the availability of alternatives provided by insurance-linked securities.[140]

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[139] GC Securities

[140] Guy Carpenter; 2014; Capacity: Evolution, Innovation and Opportunity

The history of ILS can be dated back to 1992 when Hurricane Andrew devastated Florida, causing $15.5 billion in insured losses.[141] Two years later, the Northridge earthquake caused $49.3 billion in economic losses near Los Angeles, California. As a result, insurers and reinsurers began seeking alternatives to fund losses of magnitude.

Five years later, a solution was developed. On behalf of USAA, Residential Re sold the first single peril cat bond to capital markets, providing coverage against catastrophic hurricane loss with limits of $480 million. Since then, nearly $45 billion of cat bonds have been issued, protecting over 70 insurers, reinsurers, governments and corporations from a multitude of risks.

From 2001 until 2006, the ILS market began rapidly expanding to fill the gap left in reinsurance capacity as a result of the 2001 terrorist attacks at the World Trade Center and Hurricanes Katrina, Wilma, and Rita in 2005. Although Hurricane Katrina briefly tempered the growth of the market, the market surged forward again soon after. As insurance-linked securities do not rely on economic factors to generate returns, they provide a valuable asset to help diversify investment portfolios. Even throughout the financial crisis of 2008, investor appetite for cat bonds has remained strong and has risen to record levels during the past two years.

This can be attributed to the fact that 144A cat bonds have averaged an 8.6% return on investment since 2003[142] in part due to the favorable loss history of the class – since market inception (circa 1997), 14 catastrophe bonds have caused a loss of principal to cat bond investors[143]. Investors' principal losses have been the result of natural peril events, non-natural peril events (e.g. credit insurance or other liability losses) and collateral failures during 2008 as a result of the financial crisis and the collapse of Lehman Brothers. These collateral failures resulted from the investment of the cat bond proceeds in Total Return Swaps ("TRS"), which were the predominant collateral solution prior to the financial crisis. Under this collateral solution, the Total Return Swap provider would receive the proceeds from the sale of the cat bond notes, investing it in eligible investments, and in return pay the Issuer a fixed quarterly floating rate (LIBOR) payment and the full principal amount at redemption. Several cat bonds that held TRS's with Lehman Brothers suffered losses as a result of its bankruptcy and subsequent failure to repay the entire principal amount. To mitigate collateral credit risk following the financial crisis, cat bond proceeds are typically invested in US treasury money market funds and AAA-rated debt issued by international development banks such as the International Bank for Reconstruction and Development and the European Bank for Reconstruction and Development. In sum investors have suffered over $1B of principal losses from 144A cat bonds alone (so excluding private issuances); of which ~$800M resulted in claims payments to the cedants who sought protection via the catastrophe bonds. See Table 20 for details.

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[141] Swiss Re; 2012; What are Insurance Linked Securities (ILS), and Why Should they be Considered?

[142] Swiss Re Global Cat Bond Total Return Index; Artemis.bm

[143] GC Securities; As of YE2013

Table 20: Detailed Listing of Historical 144A Catastrophe Bond Losses

Transaction	Sponsor	Year Triggered	Peril(s) Covered	Loss Event(s)	Original Principal Amount ($M)	Estimated Loss to Notes ($M)	Estimated % Loss to Notes	Arbitration / Litigation
Kelvin Re	Koch Energy	1999	US Extreme Weather	Warm Winter	21.61	2.48	11.48%	None
Georgetown Re	St. Paul Re	2001	US Multiperil	9/11; World Trade Center	24.00	0.54	2.25%	None
KAMP Re	Zurich American	2005	US Hurricane and Earthquake	Hurricane Katrina	190.00	144.00	75.79%	None
Avalon Re C	Oil Casualty Insurance	2007	General Liability	Hurricane Katrina,; Buncefield Explosion; NY Steampipe Burst	135.00	12.69	9.40%	Arbitration led by investors
Ajax Re	Aspen Insurance	2008	California Earthquake	Collateral loss due to Lehman Brothers Bankruptcy	100.00	88.00	88.00%	None
Carillon A-1	Munich Re	2008	US Hurricane	Collateral loss due to Lehman Brothers Bankruptcy	51.00	36.00	70.59%	None
Newton Re 2008 A-1	Catlin	2008	US/EU/Japan Multiperil	Collateral loss due to Lehman Brothers Bankruptcy	150.00	21.00	14.00%	None

Table 21: Detailed Listing of Historical 144A Catastrophe Bond Losses (cont'd)

Transaction	Sponsor	Year Triggered	Peril(s) Covered	Loss Event(s)	Original Principal Amount ($M)	Estimated Loss to Notes ($M)	Estimated % Loss to Notes	Arbitration / Litigation
Willow 2007-1 B	Allstate Insurance	2008	US Hurricane	Collateral loss due to Lehman Brothers Bankruptcy	250.00	45.00	18.00%	None
Crystal Credit B	Swiss Re	2008	Credit Reinsurance	Financial Crisis	118.87	63.00	53.00%	None
Crystal Credit C	Swiss Re	2008	Credit Reinsurance	Financial Crisis	93.00	93.00	100.00%	None
Nelson Re Series 2008-1 Notes Class G	Glacier Re	2008 (first claim submitted in 2011)	US Hurricane and Earthquake	Hurricane Ike	67.50	0%	0%	Arbitration led by Glacier Re
Mariah Re Class 2010-I	American Family Insurance	2011	US Severe Convective Storm	2011 US Tornados	100.00	100.00	100.00%	Litigation led by Liquidator
Mariah Re Class 2010-2	American Family Insurance	2011	US Severe Convective Storm	2011 US Tornados	100.00	100.00	100.00%	None
Muteki	Zenkyoren	2011	Tohoku Earthquake	Tohoku Earthquake	300.00	300.00	100.00%	None

Table 22: Detailed Listing of Historical 144A Catastrophe Bond Losses (cont'd)

Summary		
Loss Type	**144A Cat Bond Principal ($) Loss Total ($M)**	**% of Total**
Nat Cat Losses	$646	64.28%
Non-Nat Cat Losses	$169	16.83%
Collateral Losses	$190	18.89%
TOTAL	**$1,006**	**100.00%**

As noted in the rightmost column in Table 20 catastrophe bonds, like many other forms of legal contract, are sometimes disputed either via arbitration or in court. Of the instances cited above disputes have not centered around whether losses should have been paid but rather on issues related to the magnitude of losses or premium. The exception to this rule was Mariah Re where the dispute centered around the design of the industry-loss trigger structure which utilized qualitative descriptions of areas affected to determine which factors (Metro or non-Metro factor e.g. urban area affected or non-urban area affected) to apply to the PCS reported state loss.

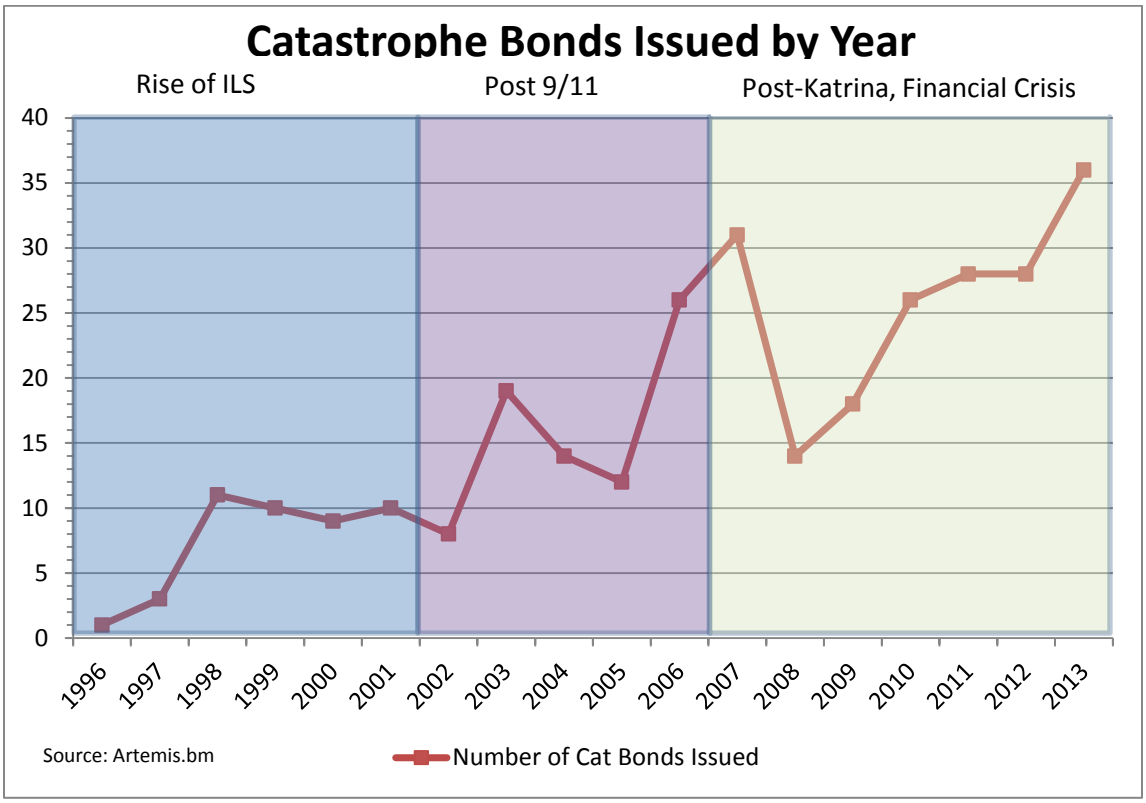
This dispute history is instructive. Insofar as catastrophe bond losses are determined via indemnity reinsurance contracts the form and function of arbitration or litigation arising out of such agreements should be substantially similar to any such action arising out of traditional reinsurance agreements, keeping aside the additional compliance burden affiliated with 144A issuances in particular. On the other hand, if a catastrophe bond is settled based upon a non-indemnity trigger (e.g. a parametric index or an industry loss warranty) the loss settlement procedure should be clearly prescribed and objective limiting the chance for dispute amongst parties by comparison to indemnity-based bonds. However, if a non-indemnity trigger is unclear in design (as in the case of Mariah Re) or if there is a problem with the data provider/calculation agent named in the bond (e.g. PCS does not provide a loss estimate or its methods are questioned) relatively new areas for dispute could arise between sponsors and investors.

In the timeframe since 1996 there have been three predominant phases in the development of the current ILS market. The first was the advent and popularization of the catastrophe bond in the mid-to-late 1990s. The second occurred after the terrorist attacks of September 11, 2001 and the consequential market capacity shortage[144]. The third occurred after Hurricane Katrina. Figure 86

[144] The 9/11 event is referenced here in relation to its indirect impact on the issuance of bonds covering other perils rather than terrorism. While terrorism risk represented around 7% of the total catastrophe bond limit outstanding in 2013, this

demonstrates the steady growth in the number of cat bonds issued throughout the three main aforementioned phases of market development. Figure 87[145] demonstrates the growth in volume over a similar timeframe. Arguably the market is now entering a fourth phase characterized by an overabundance of capital and increasingly competitive cat bond pricing which should lead to increased issuance. During these phases the cat bond market has seen a variety of innovative transactions a few of which have addressed the peril of flood. For a survey of innovative ILS transactions see Appendix A.

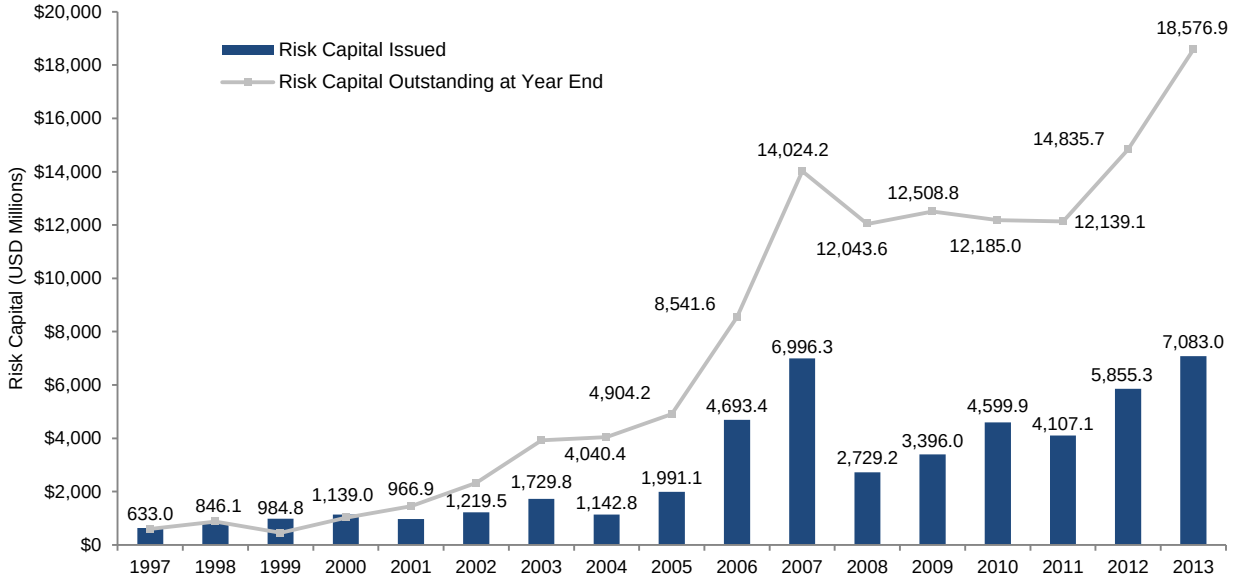
Figure 86: Number of 144A Catastrophe Bonds Issued by Year



percentage has not grown much since the first cat bond to cover terrorism risk – Golden Goal Finance, Ltd. – was brought to market in 2003. Golden Goal provided terrorism cancellation coverage to FIFA for the 2006 World Cup. Source: Testimony of Dr. John Seo; Subcommittee on Housing and Insurance, Committee on Financial Services, United States House of Representatives; November, 2013.

[145] Source: GC Securities

Figure 87: Catastrophe Bond Issuance and Capital Outstanding – 1997 to 2013



As catastrophe bonds became increasingly popular around the turn of the century, other forms of ILS began gaining traction as well. Although sidecars have existed since the early 1990s, the first modern sidecars came into existence in the wake of Hurricane Katrina, helping to satisfy regulatory concerns over the financial stability of sidecar sponsors. A sidecar's appeal lies in the potentially higher returns they afford without the risk of funding pre-existing liabilities, the costs of starting a new company, or the risks associated with founding a new company. Given their impermanent nature, sidecars provide a greater degree of flexibility than other forms of ILS.

The market for sidecars has been generally more transient as capital interests ebb and flow opportunistically to offset the effects of constrained capacity during periods of market stress. Over time, sidecars have experienced a healthy degree of growth as investors search for high-yield assets and reinsurers strive to expand their capacity. Sidecars are expected to represent an increasing and significant fraction of insurance-linked securities moving into the future.[146]

The concept of collateralized reinsurance is one of the oldest forms of alternative risk transfer. However, not until 2005 did collateralized reinsurance make a significant impact in the ILS space. In recent years, collateralized reinsurance has become an attractive alternative to cat bonds, as it is faster to assemble a program and more economical to launch, offering investors needs for both diversification and for returns.[147]

Industry loss warranties have existed since the 1980s, representing a small but influential consideration for reinsurers and their pricing strategies. As the market's capacity waned post-Hurricane Katrina, ILWs have grown in volume though represent a relatively significant portion of

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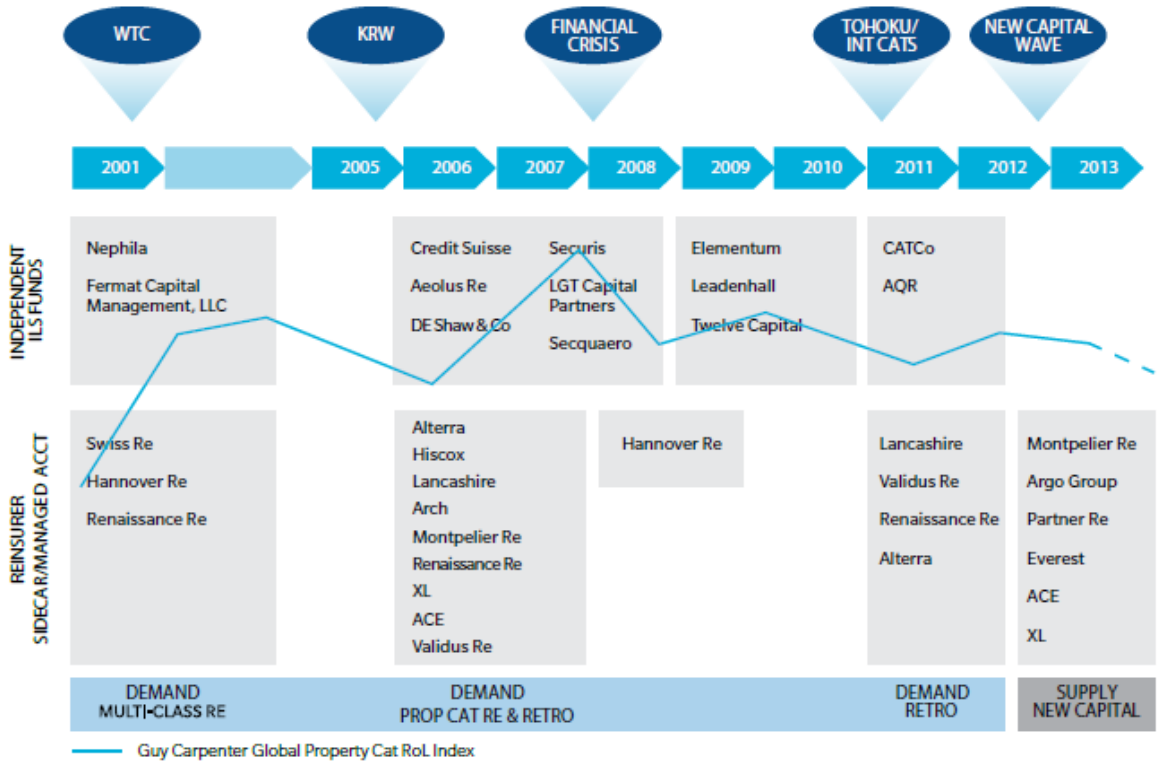
[146] NAIC; 2014; Insurance-Linked Securities: Catastrophe Bonds, Sidecars and Life Insurance Securitization

[147] Risk.Net; 2013; ILS investors fuel collateralized reinsurance growth

overall ILS market[148]. Overall the development of alternative capacity in the reinsurance market is tracked in Figure 88.

Figure 88: Alternative Capacity Development – 2001- 6M2013

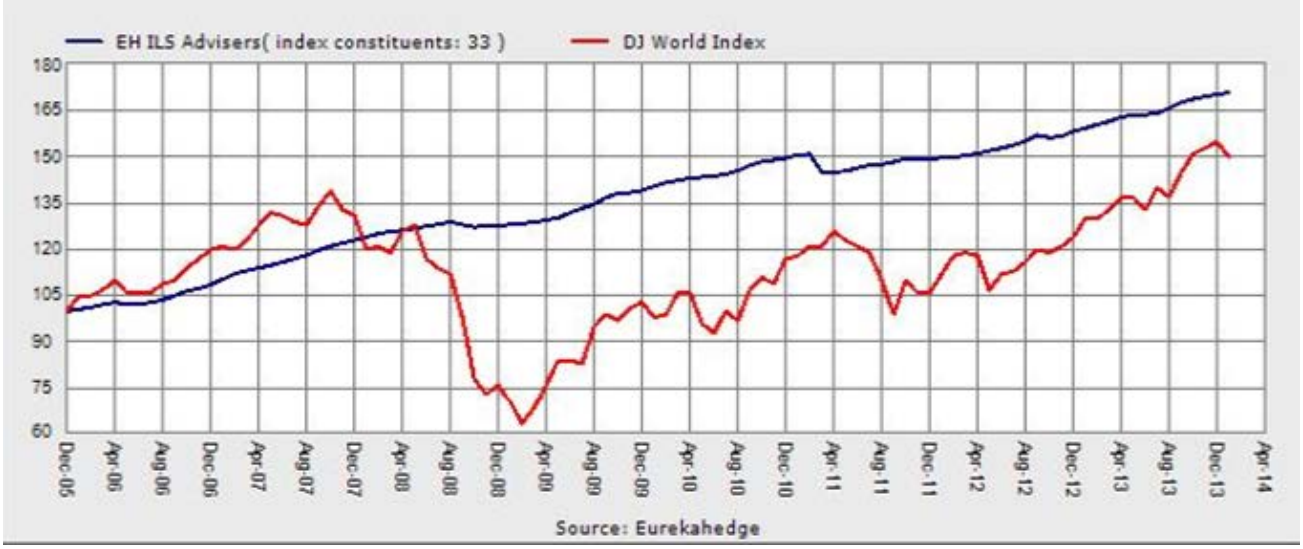


By September 2013, nearly $10 billion of new capital had entered the market in the form of insurance-linked securities, driving capacity to $45 billion, or roughly 14% of global cat limits purchased.[149] Pension funds, once a smaller player in the ILS space, have become increasingly relevant since 2005. It can be expected that their interest and subsequent investments in the space will continue to grow as confidence builds within the sector. This increasingly stable institutional money is widely expected to remain a long term participant in the ILS space, even in the face of large losses. This is in large part due to the risk-return profile of ILS funds which is largely uncorrelated with broader financial markets and has produced consistent returns over the past decade (see Figure 89).

[148] Please note that some cat bonds use ILW triggers but are not classified as ILWs. Some traditional reinsurance agreements will also sometimes incorporate secondary ILW triggers as a means of further sheltering a reinsurer from loss.

[149] Guy Carpenter; 2013; Capital Stewardship: Charting the Course to Profitable Growth

Figure 89: Eurahedge ILS Advisers Index Against Dow Jones World Index – 2005-2014



Although the market has experienced significant change over the last decade, dedicated ILS funds have historically shown a strong preference for single peril bonds.[150] These single peril bonds and peak risks remain desirable to institutional investors as loss data remains more reliable, readily available, and there are advanced modeling techniques to better gauge the risks. Despite the overall decline in prices during the last decade, investor demand remains strong.

C. Other

The following includes a survey of past/current microinsurance or weather derivative programs/products which may be relevant to the peril of flood.

<u>Bangladesh Issues First Flood Cover through Oxfam and Swiss Re</u>

In 2013, Bangladesh launched its first flood coverage which aims to provide protection for over 1,600 impoverished families in 14 villages along the Sirajganj River. It is a unique blend of alternative risk transfer and index-based microinsurance and a good example of the power of public-private relationships.[151]

The program relies on a parametric, flood-based trigger. Payments may not correlate to actual losses sustained but instead will be driven by a water level threshold. The threshold is based on the number of flood days sustained in a region. In the event that flood levels exceed the threshold for a period of 11 days or longer, payments will be issued.[152] The rationale for using a parametric trigger is a combination of the rapid payment it affords and a general lack of flood loss data for the region which could otherwise enable the development of indemnity protection.[153] Roughly USD$104 will be

[150] Guy Carpenter; 2014; GC Securities: ILS Market Update

[151] Swiss Re, 2013; Swiss Re Supports Flood Insurance for River Basin Residents in Bangladesh

[152] Asia Insurance Review, 2013; Bangladesh: Country's First Flood Cover Launched

[153] Artemis, 2013; New Parametric Flood Index-Insurance Pilot Launched in Bangladesh

paid per household in the event of loss, with the intent of making mobile payment available to further expedite payments. As the program develops, it is expected that it will be spread across the country with the continued support of the government, national and international organizations[154].

Munich Re Jakarta Flood Microinsurance Program

Touted as the world's first flood microinsurance program, Munich Re teamed up with Indonesian insurer Asuransi Wahana Tata and and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ) to bring this innovative product to the Indonesian market. The product offers index-based flood insurance to low-income families in the Indonesian capital of Jakarta. There is no lengthy policy document – rather the insured receives a protection card. One card costs 50,000 Indonesian rupiahs and guarantees a one off payment of 250,000 should the waters rise above 950cm at the Manggarai Water Gate in Jakarta[155]. This program ran for a short time but was subsequently discontinued due to low demand for coverage.

CME Group Weather Derivatives – Monthly and Seasonal Rainfall

CME Group offers a variety of exchange traded and OTC cleared weather derivatives products. Included in its products suite are a variety of precipitation based derivatives including for monthly and seasonal rainfall[156]. Exchange traded products come in a variety of future/option forms and are triggered based off of rainfall measurements procured from well-monitored weather stations in the following ten US cities:

- Chicago O'Hare International Airport
- Dallas-Fort Worth International Airport
- Des Moines International Airport
- Detroit Metro Airport
- Jacksonville International Airport
- Kansas City International Airport
- Los Angeles Downtown USC Campus
- New York LaGuardia Airport
- Portland International Airport
- Raleigh/Durham International Airport

While location-specific rainfall is not the only cause of flooding, rainfall hedges can be used to at least partially protect against the peril of flood. In addition to CME in the US, a number of international microinsurance programs rely on rainfall triggers to simulate flood (see Microinsurance Catastrophe Risk Organisation, SCC[157] for a prominent example).

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[154] Oxfam Blogs, 2013; Flood Insurance for River Basin People

[155] Financial Times, 2009; Munich Re Pilots Jakarta Flood Policy

[156] Some snowfall products are also offered.

[157] www.microcatrisk.com

D. Market Cycles

When the concept of a market cycle is mentioned it is important to distinguish exactly what is being discussed. Generally a reference to a (re)insurance market cycle refers to the underwriting cycle typified by a fluctuation in the pricing of a given product. However, any price change is comprised of and informed by a variety of "sub cycles" in other aspects of the business all of which interact to determine market supply and demand which in turn determine price. Some of these cycles correlate closely with shifts in the pricing cycle; others are counter-cyclical or are sometimes effectively offset by competing trends.

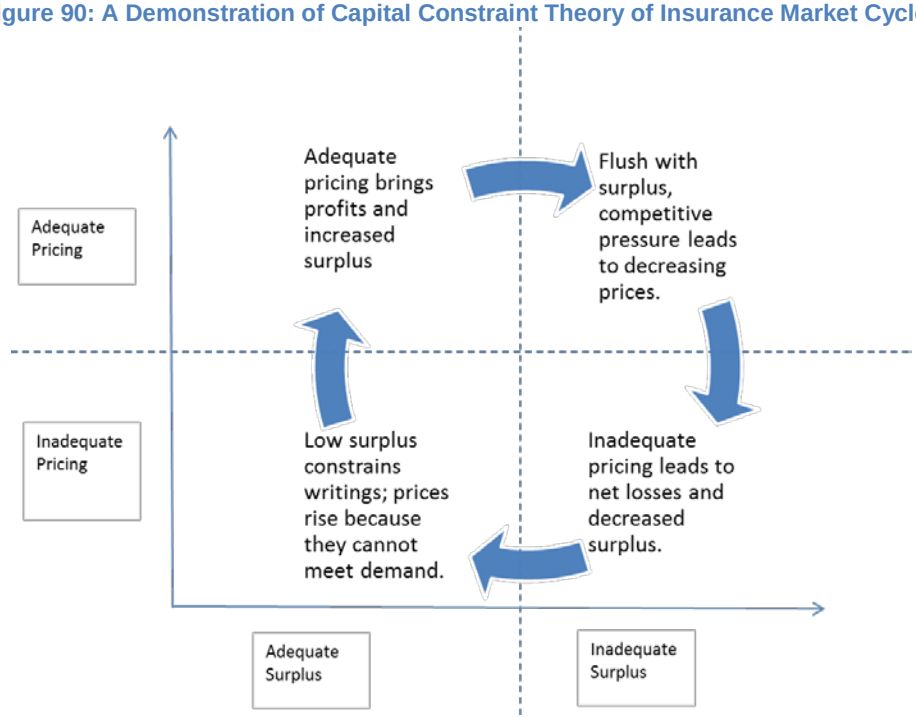
In short, pricing cycles in (re)insurance can be caused by any one or a combination of the following factors:

- **Underwriting Losses**: Underwriting losses can be caused by catastrophe losses, systemic casualty losses or an unexpected acceleration in attritional claims costs before coupled with premium rate stagnation or decline. Underwriting losses can also result from reserve fluctuations.
- **Asset Losses**: Asset losses can come in the form of realized or unrealized investment losses as may occur from a stock market crash or a major reversal in the bond market.
- **Investor Action**: This can take the form of new market entrants which serve to increase supply or intra-industry consolidation which can serve to diminish industry capital if one insurer buys a competitor at a price above book value. Returning capital to shareholders also takes capital out of the industry.

A theory of the insurance cycle worth mentioning is "capital constraint theory" which focuses on the relationship between pricing and surplus which tracks the reasonably close linkage between an industry's surplus and pricing changes. The theory posits that time lags in reporting and emergence of losses interfere with the ability of firms to anticipate changes or make quick alterations. The result of this time lag is a cycle illustrated in Figure 90[158].

[158] Shaun S. Wang*, John A. Major, Charles H. Pan, Jessica W.K. Leong ; U.S. Property-Casualty: Underwriting Cycle Modeling and Risk Benchmarks; 2010

Figure 90: A Demonstration of Capital Constraint Theory of Insurance Market Cycles



There are several other compelling underwriting cycle theories including:

- **Competition**: Not all competitors have the same view of the future, with a "winner's curse" phenomenon pushing the group towards lower rates, even if all participants are behaving rationally (and they may not be).
- **Capital Shocks**: Since insurance needs capital to support it, any shock that reduces capital will reduce capacity and therefore raise prices as supply becomes constricted.
- **Economic Linkages**: Profitability for an insurer is linked to investment income, and cost of capital is linked to the wider economy. Expected losses in some lines of business are affected by inflation, economic growth, or unemployment. Therefore, cycles in the economy result in cycles in insurance.

All of these theories present a plausible explanation for the underlying causality behind insurance market underwriting cycles; though in reality all of the above have a variable and sometimes concurrent impact[159]. There have been attempts to build unified underwriting cycle models but none have been validated or adopted at large by the broader risk and financial modeling community. This may be due to the variable impact of cycles and underlying causes on different lines of business and in different regions.

Other, more colloquial methods of describing the underwriting cycle have also been posited, such as the clock illustrated in (Figure 91) which was first devised by Paul Ingrey, a former Chairman of Arch Capital Group. This graphic emphasizes the more human or psychological elements which can lead to cyclical market behavior. While it is impossible to know where exactly we are in the cycle or how long the current phase will last – only hindsight will tell – a survey of recent headlines

[159] Ibid.

might lead to the conclusion that the time in the reinsurance market is presently 3:30 and the dark hours of 6:00 through 9:00 are nigh.

Putting these theories aside, historically the underwriting cycles exhibited in the insurance and reinsurance markets have been closely linked. Looking at the US commercial property insurance and global property catastrophe reinsurance markets in particular, the linkage has been very tight since 2005 (Figure 92). However, in recent years the two markets have begun to decouple. This may be the result of the significant amount of external capital which is primarily entering the reinsurance industry causing reinsurance rates to decline more precipitously than insurance rates. This decoupling may diminish as reinsurance rate decreases start to "trickle down" into the primary market over time though it is difficult to tell at this stage.

Figure 91: The (Re)Insurance Underwriting Cycle Clock

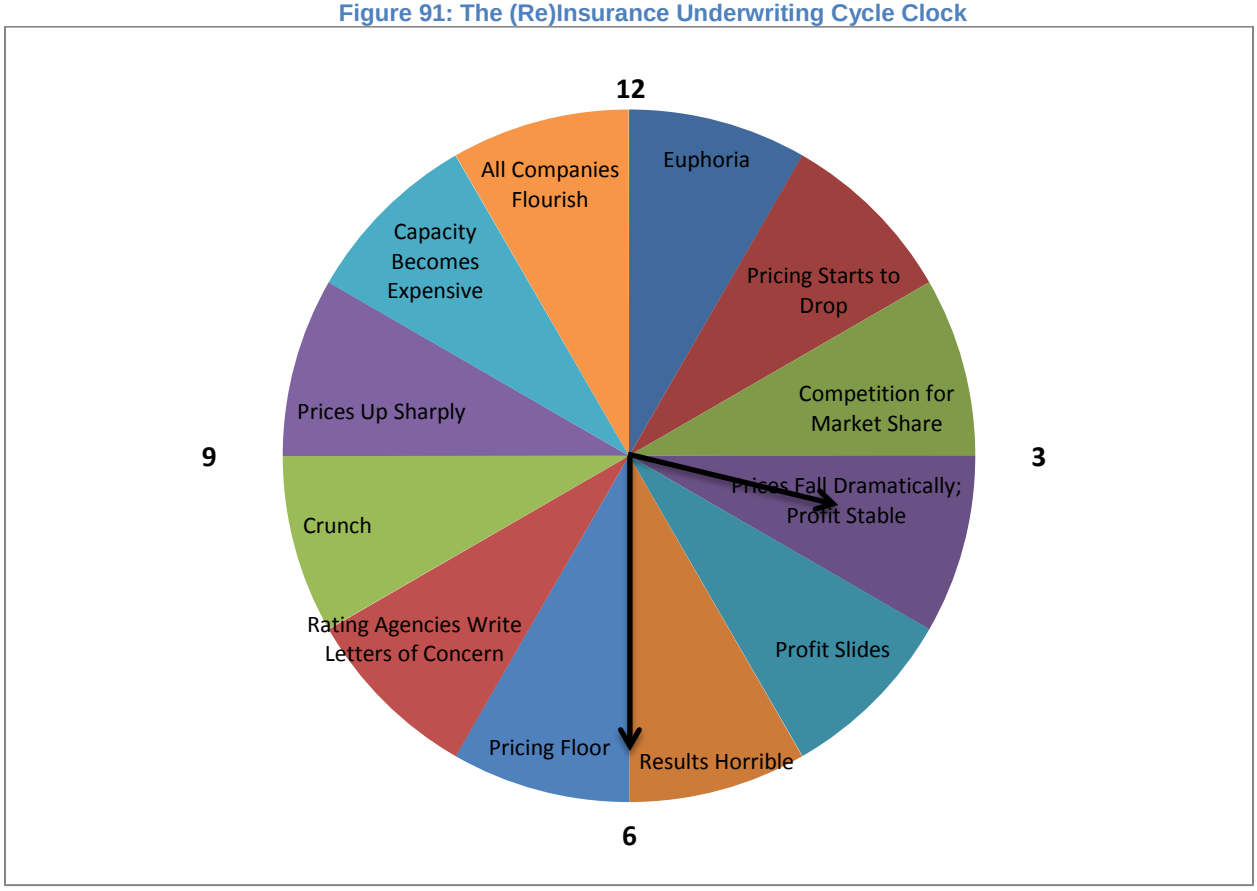
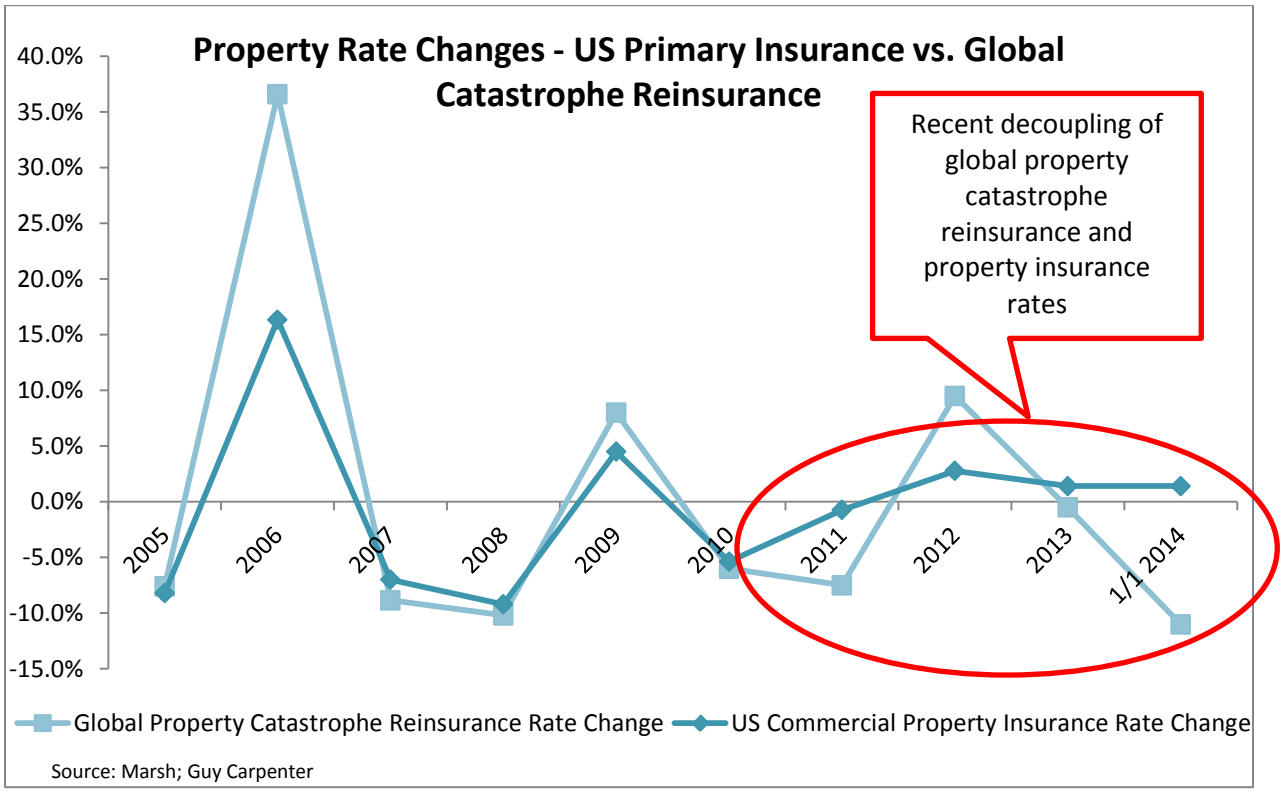


Figure 92: US Commercial Property Insurance vs. Global Property Catastrophe Reinsurance Rate Changes – 2005-1/1/2014

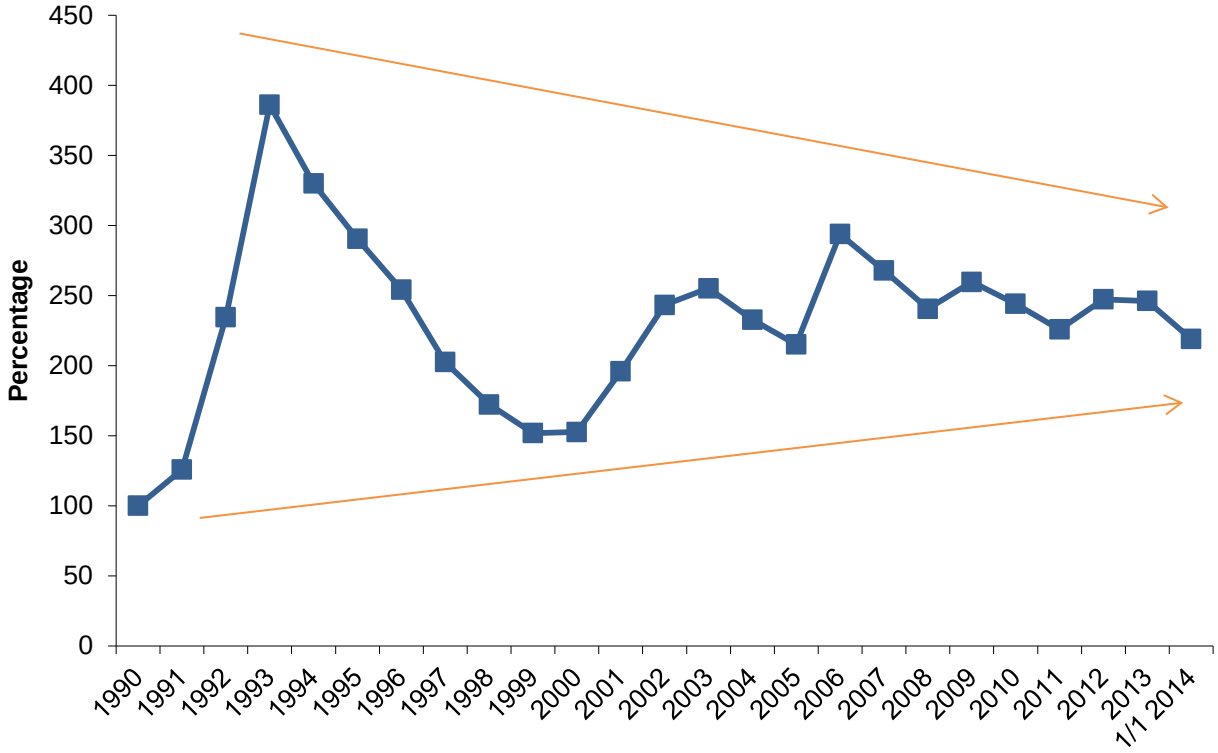


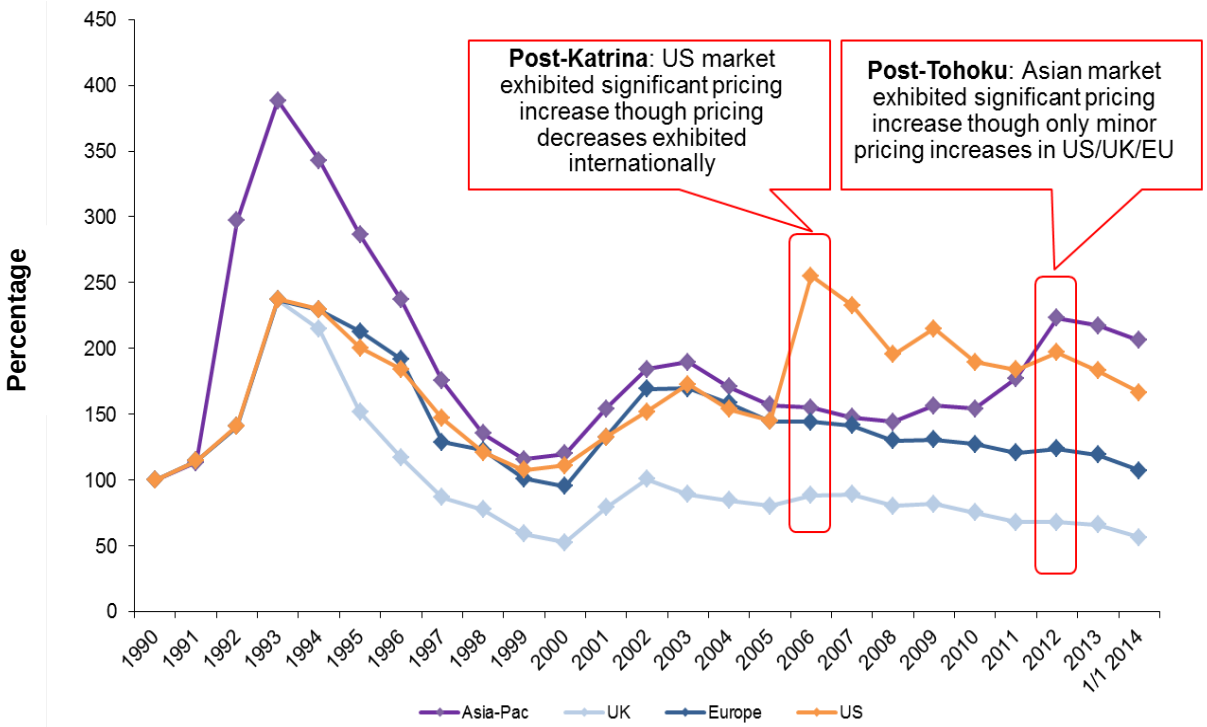
Looking a bit closer at the Global Reinsurance market, pricing cycles have started to exhibit less volatility in recent years. According to the Guy Carpenter Global Rate on Line index (cited originally herein as Figure 84 though recast in Figure 93), since the drastic pricing increase post-Hurricane Andrew in 1993 the range of global market pricing has remained within an increasingly narrow band even through such landmark events as Hurricane Katrina and the worst economic catastrophe loss year on record in 2011 (Figure 76). The reasons for this narrowing are manifold, though relate in part to the historically high levels of industry capital and the expansion and diversification over time of reinsurance business worldwide[160].

It is reasonable to expect this narrowing trend to continue since, even in the event of a historically large industry loss (e.g. category 5 hurricane hitting Miami), the amount of excess capital currently in the industry and the speed with which new capital can now be mobilized to take advantage of rising rates post catastrophe thanks to the advent of the sidecar, the growing number of nimble ILS funds, etc. any hard market is likely to be regionally contained and short in duration. This is demonstrated by looking at the second graphic in Figure 48 which highlights the differing regional impacts of certain market events. For instance, Hurricane Katrina caused a marked uptick in global property catastrophe prices though upon further inspection all of this upward rate movement was contained within the US market. In 2011 a similar dynamic played out with large losses in Asia (e.g. the Tohoku earthquake and tsunami) and the US (a very active tornado season) resulting in regional rate rises whereas the UK and EU markets remained more or less flat.

[160] Per Figure 70, the portion of global reinsurance premium written in developing markets has grown rapidly over the past decade.

Figure 93: Guy Carpenter Global and Regional Property Catastrophe Reinsurance Rate On Line Indices with Market Cycle Commentary (ROL is reinsurance premium paid as a percentage of reinsurance limit purchased)





It is difficult to predict with any certainty what sort of loss event might precipitate a large-scale or long-term shift in reinsurance market pricing. Though it is easy to imagine a plausible scenario – a category 5 hurricane hitting Florida, a 9.0 earthquake near a populated area (e.g. Tokyo), the emergence of a new large meteorological event type (e.g. “Superstorm” Sandy) or the confluence of two separate loss events such as an asset crisis coupled with a large natural catastrophe. Some have hypothesized – and our calculations in the Current Market Assessment would corroborate – that the (re)insurance industry can withstand a $100B event without suffering any capital deterioration.

Hurricanes Andrew and Katrina, which caused the largest and longest historical shifts in global and US reinsurance pricing, both surprised the market insofar as they represented losses of a magnitude and dimension previously uncontemplated by (or at least inadequately accounted for) by reinsurers. Both of these events prompted the evolution of underwriting and portfolio risk management tools which have since contributed to the strengthening of the market’s foundation in terms of managing acknowledged risks. The market may thus need to be surprised again if we are to see a marked shift in pricing.

The property catastrophe rate increases seen in the US post-Katrina had almost completely eroded as of January 1, 2014 and pricing may soon fall below 2005-levels despite significant catastrophe loss activity in the meantime. This amounts to a relatively steady decline over a 10-year period. Eventually another large loss will occur which registers as a “capital event” for reinsurers, causing bankruptcies and/or a reexamination of underwriting procedures. Whether or not the price increase is as steep and persists for as long after the “next Katrina” will depend on the size of the loss and the amount of capital available to backfill for losses. As mentioned above, the size and duration of any future pricing shift caused by this event (or series of events) is likely to be attenuated by the amount of capital waiting in the wings to enter the market when pricing conditions harden.

COST BENEFIT ANALYSIS

1 PREFACE

For the sake of convenience, FEMA's preliminary guidance as presented in the Flood Insurance Risk Study (FIRS) project Request for Quotes (RFQ) and carried forward into the Consultant's Performance Work Statement (PWS) is restated in the Box 1 with respect to the Cost-Benefit Analysis section of the Reinsurance Study.

Table 23: National Flood Insurance Program Flood Insurance Risk Study; Reinsurance Study; Cost-Benefit Analysis Description

NFIP FIRS Reinsurance Study Cost Benefit Analysis Description
Cost-benefit analysis of the impact upon the NFIP of utilizing the NFIP's reinsurance authority under current law. In performing the cost-benefit analysis the Contractor shall include the following analyses: a) Using the information from the research above, an analysis of the costs and benefits under a number of different scenarios including a stable insurance environment as well as a number of volatile environments. b) An analysis of whether the financial markets can be expected to provide enough capacity to meaningfully lessen the financial consequences of the NFIP's flood claims volatility and the need for the NFIP to borrow from the US Treasury. Such analysis should also demonstrate that it takes into account the current and anticipated future levels of subsidized premiums charged by the NFIP.

Based on the above this analysis will include commentary on the expected future development of past trends impacting the underwriting cycle of the global reinsurance market. While there is significant uncertainty involved in the projection of diverse financial indicators ranging from GDP to the influx of ILS investor capital, we will attempt to distill the most likely outcome for each variable based upon recent occurrences and market knowledge. From this subcomponent analysis we will outline three separate market scenarios which would have a diverse impact on NFIP's cost of reinsurance.

For the purposes of demonstrating market trend dynamics under the specified scenarios utilized within this report, we have modelled potential reinsurance solutions around four high-level program structures. From the outset it is important to understand that we have employed credible, but future visions of what an NFIP reinsurance program might look like. In reality, it will take time for any such reinsurance program to be realized. For the purposes of this report, we disregard certain short-term challenges either associated with the private sector's ability and appetite to provide the required capacity or the NFIP's current financial resource available to pay for it. However, we do utilize structures that we believe should be achievable under the right circumstances in the foreseeable future. Following the scenario outline around these structures, we provide initial thoughts on how

the NFIP could utilize reinsurance over the short term to begin the process of building toward a more complete program in subsequent years.

2 TREND PROJECTION

A. US Insurance

1. Property & Casualty Market

Underwriting

The short-term outlook for the US P&C market is for moderate premium growth and deteriorating combined ratios. Premium growth is likely to continue to be sluggish reflecting relatively low GDP increases and further dampened by negative loss cost trends (e.g. medical inflation and Consumer Price Index (CPI)). Modest improvement in the industry expense ratio is possible with expenses growing slightly slower than premiums. Factoring in an historical average level of catastrophe losses, combined ratios will approach 100%.

It is likely that the current and most recent accident years are far less profitable than initially reported. With prior year reserve redundancies drying up, less redundancy cushion in recent years and recent declining loss trends factoring into current pricing, as loss costs revert to more normal levels underwriting results are likely to deteriorate. The degree of underwriting result deterioration will depend on how long it takes to recognize the loss cost inflection point, factor new trends into pricing and the magnitude of increase needed to support adequate loss reserves.

It is reasonable to expect underwriting leverage (e.g. premium-to-surplus) to rise, while the ratio of reserves-to-surplus continues to fall. This will place increasing pressure on industry ROEs which overall will likely continue to fall due to accumulating industry surplus, slow premium growth and poor prospects for investment income. All of these trends combined will redouble the industry's recent focus on underwriting profitability, which will become more of a challenge as rates continue to move downward in many classes of business reflecting reinsurance rate decreases among other factors, and could lead to a rash of industry consolidation.

Asset

Overall yields continue to fall as maturing investments put on the books multiple years ago are reinvested at lower yields. Insurers may respond with some shift in asset allocation to take more risk (e.g. lower credit quality investments or less liquid securities) to improve total return. In addition, with deteriorating underwriting conditions and the low interest rate environment persisting, insurer investment profiles may change in favor of more exotic, speculative securities as the risk-reward opportunity becomes more attractive relative to underwriting returns. Already the insurance industry has shown a modest uptick in high-yield investments and a big migration out of NAIC-1 bonds – A, or AAA securities – into NAIC-2 bonds – BBB[161]. The threat of a short-term spike in interest rates is likely to loom for some time.

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[161] SNL Financial; Insurers turn to diversification, emerging markets to remedy interest rate pressures, PIMCO says; July 29, 2014 interview with David Braun.

Capacity

Compounding surplus accumulation, plentiful low-cost reinsurance, access to new alternative capital sources and strong investor appetite for the (re)insurance asset class creates an abundance of available capacity for all lines of business in all regions. The largest impediment to the supply of capacity matching market needs will be rate adequacy and regulatory environments, excepting of course the potential for a “mega-cat” which could change the landscape dramatically.

Within the US P&C market capacity tends to ebb and flow between the standard/admitted and E&S markets. The ongoing flow to standard lines will continue unless a significant loss creates capacity rationing amongst admitted writers. Sufficient capacity exists within the E&S sector to respond to a market shift providing of course that rate adequacy exists. A strengthening US Dollar may have a marginal impact on Lloyd’s capacity creating an ephemeral capacity crunch which would be resolved as excess capacity responds but potentially causing short-term disruption as pricing and coverage terms take time to adjust

Price

Insurers’ quarterly reports and several pricing surveys indicate moderating price increases across almost all lines. Smaller and midsized accounts are seeing somewhat greater increases than large or jumbo accounts. Personal lines pricing will be less volatile than commercial pricing but rate adequacy in the commercial sector will be more robust with less rate regulation. With medical and hospital costs outstripping CPI, reserve adequacy will come into greater focus and eventually create pressure for corrective rate action. As low loss cost trends and savings in reinsurance costs become fully factored into pricing levels, many segments of the US P&C insurance market are likely to see rate reductions though these eventually will bottom out and stabilize.

The dominant trend in the US P&C Insurance market is the sector’s steadily increasing asset base over the last 30+ years. This larger denominator, combined with the aftereffects of the financial crisis (stagnant economic growth and low interest rates) have resulted in steady declines for the overall industry in relative measures of underwriting leverage, investment income and operating profitability. If these trends continue as they seem poised to for the near term US P&C insurers will see increasing pressure to grow.

Mergers, acquisitions and other means of inorganic growth or capital management actions (e.g. share buybacks) should become more common over coming years as organic growth opportunities dwindle. All of these factors combined pose a threat to the industry’s underwriting discipline. Faced with pressure from shareholders, some insurers may be tempted to cut rates to below sustainable levels so as to maintain or grow market share; others may feel pressured to post unwarranted reserve releases so as to boost calendar year loss ratios. Elevated loss activity could result in an uptick in company insolvencies.

2. Residual Market

With excess private market capacity and increasing competition for new business, the historical growth of the residual market is likely to stabilize and maybe even decline in coming years. A decline is further likely since Florida Citizens, which represents the plurality of US residual property insurance market business, is focusing on depopulating its risk profile. The biggest impediments to

this indicated potential shift in US property exposure toward the private market would be inadequate residual market rate levels and/or regulatory barriers to private market involvement (e.g. prohibitions on nonadmitted policy issuance, admitted market rate and form freedom, etc.)

In 2014, Florida Citizens was able to lower its total policy count below the one million mark for the first time since 2006. Florida Citizens attributes this success to experiencing nearly a decade of storm-free years, enabling the State's private insurance market to rebound as new investors and companies look to increase their market share in the state. These depopulation efforts have led to a shift of nearly half-a-million policies from Citizens to the private market. Simultaneously, softening reinsurance market conditions have allowed Citizens to transfer more risk to the secondary private market.

Conversely, others uphold that coverage sold by Citizens remains heavily underpriced and caution that a major storm opens the potential for both Citizens and the Florida Hurricane Catastrophe Fund to levy billions of dollars in post-hurricane assessments on nearly every policy in the state. Even though certain states are attempting to lessen the size of their plans, the fact of the matter is many markets of last resort remain the market of first choice for many vulnerable, high risk coastal properties.[162]

B. Global Reinsurance

1. Traditional

Underwriting

The global reinsurance sector faces many of the same pressures as the US P&C insurance sector. However, in addition to these, the sector must also contend with a shift in its operating model and capital structure. This shift is being driven by an ongoing influx of external capital from capital market investors such as pension funds who have entered certain segments of the market. Thus far these investors have focused on property catastrophe lines of business though they have now begun to seek returns in other lines of business as well – Watford Re[163] provides such an example. This trend is discussed in more detail in the Asset and Insurance Linked Securities sections of this report.

Traditional multiline reinsurers, under pressure from sharply falling rates in property (catastrophe) reinsurance, will begin to favor low-catastrophe exposed property and liability lines in addition to Life and Health. This shift will continue to influence the competitive environment across the reinsurance sector. Global players that span both reinsurance and insurance will likely increase emphasis on their insurance businesses where they possess greater control over pricing and distribution.

In addition to a change in strategy around lines of business, global reinsurers will look to foster a dual geographic focus on emerging markets (specifically Asia and Latin America) positioning for

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[162] Source: http://www.iii.org/sites/default/files/docs/pdf/paper_residualmarketupdate_2014.pdf

[163] Watford Re provides highly-rated and stable capacity with a broad mandate to underwrite risk across the reinsurance sectors. Watford Re will be primarily focused on medium and longer tail lines of Liability Reinsurance where Watford Re's higher investment yields can generate better-priced solutions for brokers and their clients. Source: www.watfordre.com.

long-term strategic growth and mature markets (US/Canada and Europe) to underpin profitability. Establishing a presence in emerging markets will require significant capital investment including the prospect of marginal underwriting returns in the medium term.

Asset

Global reinsurers face the same challenges in the investment environment as insurers but with less regulation, more freedom from internal governance and greater choice in investment strategy. Increasingly, reinsurers will forge closer strategic alliances with global investment houses, in some cases as part of a supply-of-capital relationship. Reinsurers will exercise a more active strategic investment approach where return on investment is fundamental to the overall enterprise value thesis – Third Point Re[164] provides an example. The trend toward global reinsurers acting as risk transformers feeding various sources of capital will continue even at the expense of their traditional business. Reinsurers pursuing this strategy believe that this trend is supported by knowledgeable and sophisticated investors and that the trend is here to stay. As a result, they have made a conscious decision to support these developments even at the potential expense of 'cannibalizing' some of their traditional business. Fundamentally they acknowledge that traditional reinsurance is simply one form of capital management and that they need to be involved where alternative approaches are unlocking new sources of efficient capital.

Capacity

Despite reinsurers attempting to harness alternative capital sources, the influx of new, independently managed, alternative capital is likely to continue. This capacity will continue to have a strong US catastrophe focus and will increase market share of the US cat business through both direct transactions and support provided behind traditional (re)insurers. New entrants to the reinsurance marketplace will possibly include more reinsurers launched by "hedge funds " targeting long-tail, low volatility business hoping to leverage investment return by investing the reinsurance "float". Leading global reinsurers will attempt to differentiate with the use of "mega capacity" meaning the ability to complete large transactions at differential terms, rather than open market syndicated terms, is likely to become more common.

Price

Property pricing will bottom out but not recover with continued downward pressure on property catastrophe which will spill over into other lines as competition intensifies. The recent influx of alternative capacity into the catastrophe bond market lowered catastrophe bond spreads somewhat precipitously, though this rate softening is likely to stabilize as the market reaches a minimum multiple of expected loss. The minimum pricing level for catastrophe bonds will further serve to establish a (likely lower) benchmark for the pricing of traditional catastrophe reinsurance. Though this ILS market minimum may rise over time as interest rates increase apace investor's cost of capital and return expectations. The current buyer's market for reinsurance with the flow of new capital into the reinsurance industry and the creation of new reinsurance vehicles expanding the

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[164] Third Point Re is a Bermuda-based specialty property and casualty reinsurer with an investment-forward business model. Third Point Re focuses its reinsurance underwriting on lines of business that have historically demonstrated more stable return characteristics, such as limited catastrophe exposed property, auto, workers compensation and certain segments of crop. These lines of business are often characterized as having exposure to higher frequency and lower severity claims activity. Substantially all of the reinsurer's investable assets are managed by the "hedge fund" Third Point LLC.

choice for buyers is likely to continue, acting as a counterweight against rate hardening for reinsurers.

Given the underwriting pressures outlined above significant consolidation is likely within the reinsurance sector. It will be challenging for smaller/niche players to exercise underwriting discipline and maintain market relevance. With increasing competition it will be difficult to maintain existing client relationships and forge new business opportunities. Faced with dwindling portfolios and high capital levels (despite repeated stock buyback programs) niche reinsurers will need to consider strategic options to provide stockholder value including a possible merger or sales process.

In addition to all of the market forces discussed herein, reinsurers and insurers alike will need to contend with a changing climate. Evidence of the potential and actual impact of climate change on (re)insurance industry operations is growing, though arguably the largest factor – of special relevance to NFIP – is the expected change in Sea Level Rise (SLR). According to a recent Guy Carpenter report[165]:

> *"The single greatest threat posed by global warming is the rise in sea levels, which are expected to increase coastal flood frequency and severity from tropical cyclones, extratropical cyclones and tsunami events. According to the IPCC, a sea-level rise of at least one to two feet can be expected by the end of the century, though a wide range of sea-level rise scenarios exist."*

Assuming the sea level in the Atlantic rises by 10 inches (0.25 meters) by 2050[166], Swiss Re's proprietary storm surge model suggests that the probability of insured extreme flood losses occurring will almost double (time goes on and SLR occurs.

Figure 94)[167]. This is a significant impact which will require regular adjustments in coastal property underwriting and pricing as time goes on and SLR occurs.

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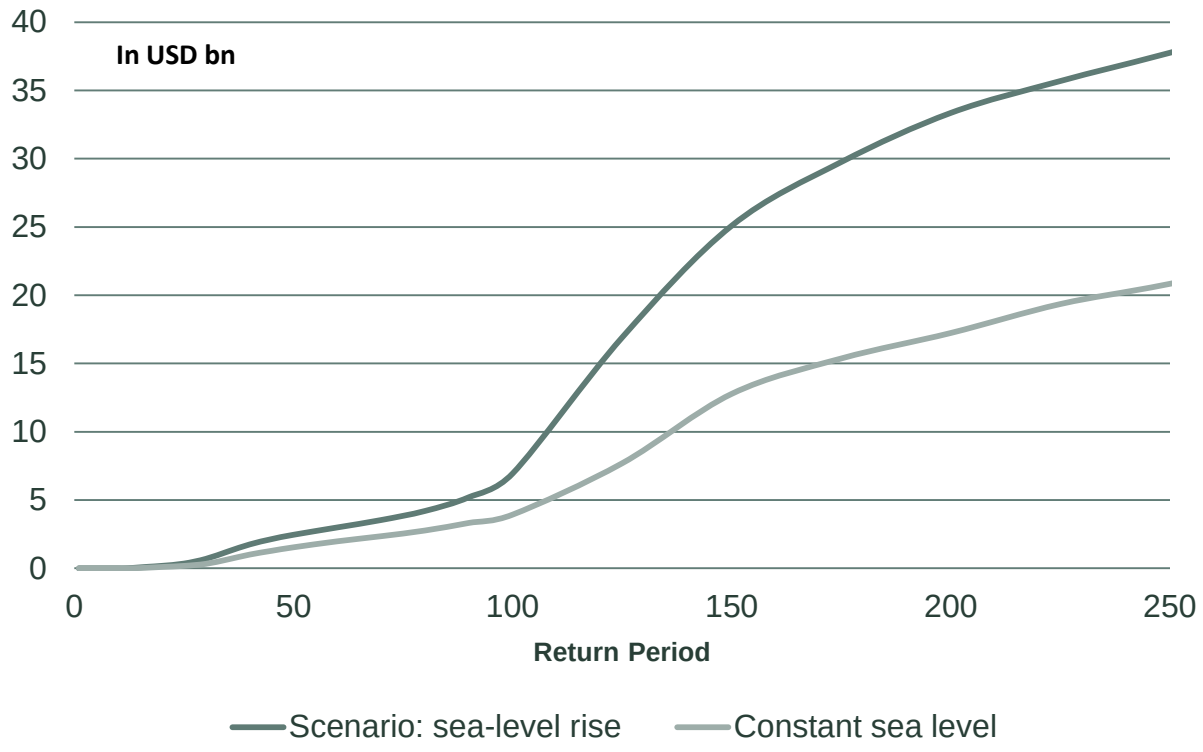
[165] http://www.gccapitalideas.com/2013/09/02/rising-sea-levels-ranked-as-the-greatest-climate-change-threat/

[166] This lies within the range provided by a recent study conducted for the State of New York: Horton, R. et al. (2011): Climate risks. In "Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaption: Technical Report", Rosenzweig, C. et al. (Eds). New York State Energy Research and Development Authority, pp. 15–48.

[167] Swiss Re estimates show insured market losses excluding NFIP for the North East region. As NFIP is excluded these results are strongly driven by Commercial/Industrial flood exposure with a significant Business Interruption impact. The underlying portfolio is Swiss Re's market portfolio for the Northeast Region (mainly New York and New Jersey).

Figure 94: Industry Insured Losses Reached or Exceeded for a Given Return Period in a Scenario with Sea Levels Rising by 10 Inches above Current Sea Levels (Source: Swiss Re, Sigma 2, 2013)



The Swiss Re result, however, predominantly contemplates the impact of SLR on commercial/industrial risk which represents the vast majority of private insurance flood limits written in the US Northeast. Similar dynamics are corroborated by the analysis underpinning the RiskyBusiness.org report[168] on the economic impacts of climate change released in 2014 which casts the net a bit wider. This report addresses total commercial *and* residential economic exposure to property damage and business interruption attributable to SLR as a result of coastal storm surge related to hurricanes and Nor'easters. Averaged over two decade intervals, likely SLR-driven *increases* in average annual coastal storm damage, in line with "Representative Concentration Pathway" (RCP) 8.5[169], are: $2 to $3.6 billion on average by 2020-2039; $5.7 to $12 billion on average by 2040-2059 and; $18 to $28 billion on average by 2080-2099. These increases are above a current roughly $27 billion in average annual average commercial and residential property damage and business interruption costs along the East Coast and Gulf of Mexico, with roughly half of that occurring in Florida.

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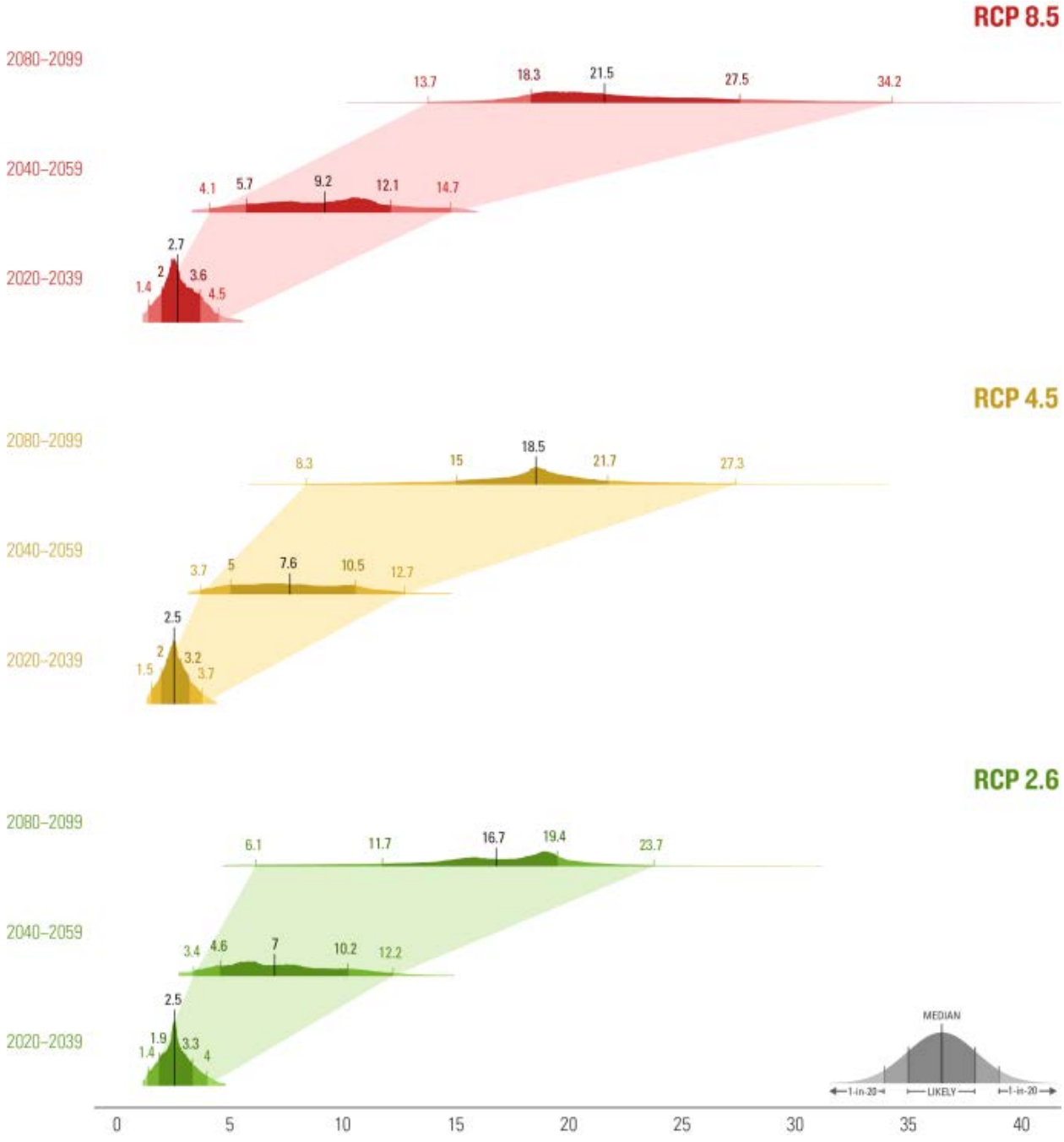
[168] Rhodium Group; American Climate Prospectus: Economic Risks in the United States: Prepared as input to the Risky Business Project; June 2014.

[169] A broadly accepted set of global concentration pathways was recently developed by the Integrated Assessment Modeling Consortium (IAMC) and used in the Intergovernmental Panel on Climate Change (IPCC)'s Fifth Assessment Report (AR5). At the high end of the range, RCP 8.5 represents a continuation of recent global emissions growth rates, with atmospheric concentrations of CO2 reaching 940 ppm by 2100 and 2000 ppm by 2200.

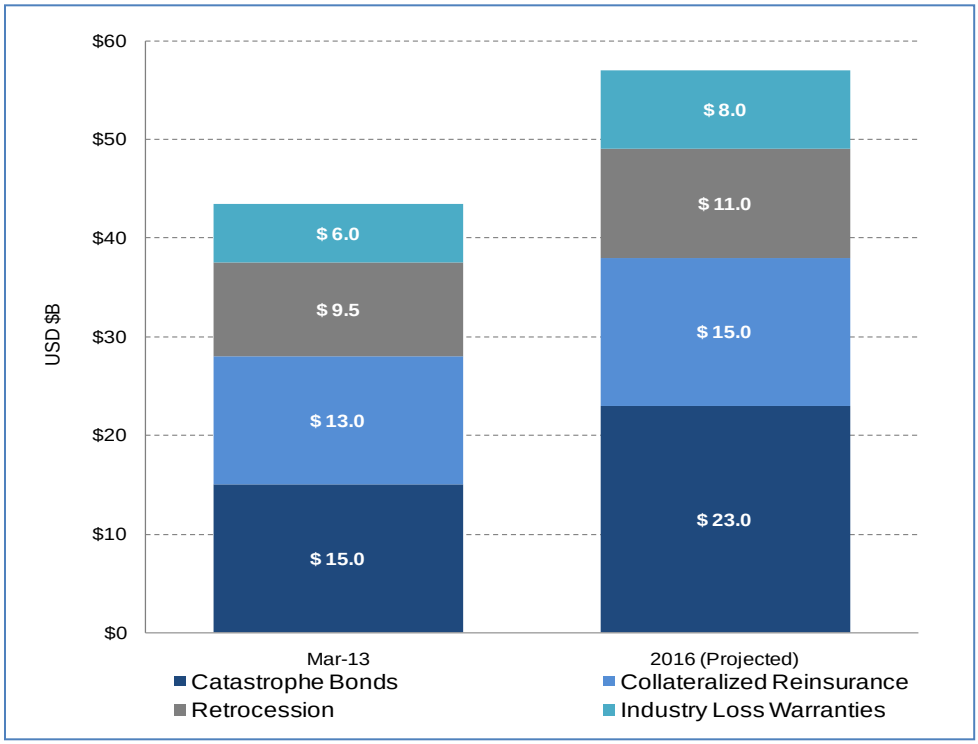
Figure 95: Increase in Expected Annual Property Losses as a Result of SLR Under Three Climate Change Scenarios Assuming No Change in Hurricane Activity (Source: American Climate Prospectus)



2. Insurance Linked Securities

Overall industry consensus points to a near-term increase in the size and relevance of the ILS market. According to GC Securities, by 2016 the amount of alternative catastrophe limit issued is likely to approach $60B up from just over $40B in early 2013 (Figure 96). Others are projecting even starker increases over the long term. For instance BNY Mellon has estimated that ILS in force could grow to $150B by 2018, with the cat bond share of that total volume worth up to $50B[170].

Figure 96: Projected Growth of Alternative Property Catastrophe Limit (Source: Guy Carpenter)



As ILS funds and deal structures become more commonplace convergence and competition between traditional reinsurers and alternative capacity providers will continue. It should be reasonable to expect the line between what constitutes a reinsurer and an ILS fund to blur increasingly with many organizations managing both types of capital already. As alternative capital figures out how to access lines of business beyond property catastrophe more market disruption in favor of cedants should be expected. Ultimately the most efficient business model/capital form should prevail in each market segment where competition/collaboration exists.

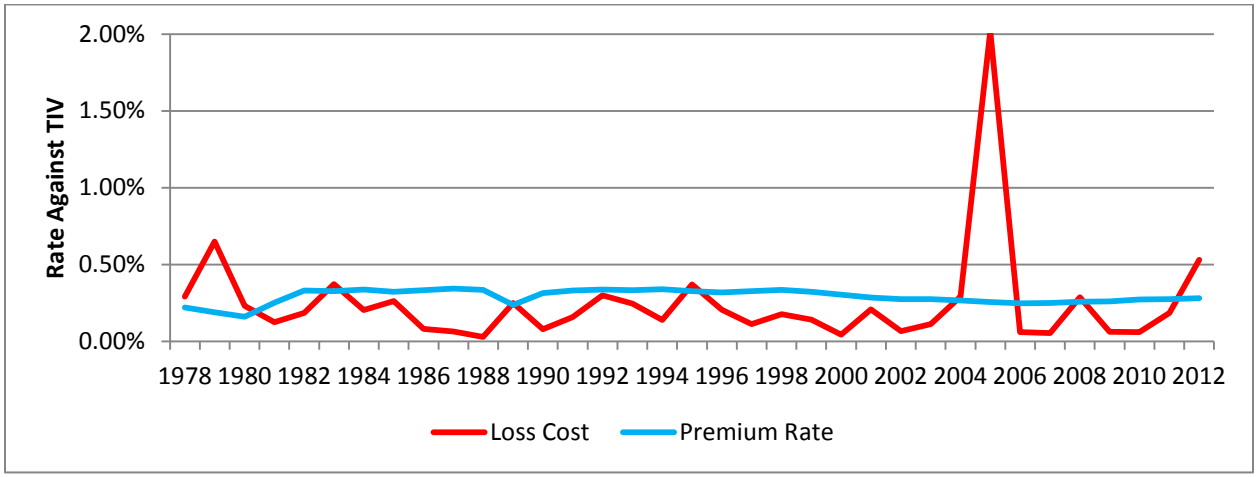
[170] Source: BNY Mellon; The Disaster Gap: How Insurers and the Capital Markets can Harness Big Data to Close the Gap; October, 2013. BNY's definition of ILS includes catastrophe bonds, collateralized reinsurance, industry loss warranties (ILWs) and sidecars and so differs slightly from the definition employed by GC Securities for its estimate (replace sidecars for retrocession).

3 NFIP PRO FORMA RISK FINANCING PROGRAM

A. Historical Context

In the past NFIP has financed its risk primarily through annual premiums. Overall premium rates as a percentage of exposure written have been essentially flat since program inception, though exposure-equivalent losses (a.k.a. loss costs) have exhibited significant volatility over time (Figure 97). While loss volatility was most heavily pronounced in 2005 (Katrina) and 2012/13 (Sandy), year-to-year changes in experience were common up until then as well. Going forward exposure-relative premium rates should increase slowly by virtue of legislative changes enacted by BW12 and HFIAA14, though loss volatility – primarily a function of the weather and other factors outside of congressional control – should be expected to continue.

Figure 97: NFIP's Historical Premiums and Losses as a Percentage of Total Insured Value



As a strategy, risk financing through premiums alone worked fairly well through 2003 when the program's cumulative loss ratio hovered in the low-50s (Figure 98). Some borrowing was needed before then to support claims payment though these amounts were repaid in full at two prior occasions: once through a congressional appropriation (1985) and later through accumulated program earnings (2002/03). Losses from the 2004 hurricane season prompted NFIP to borrow $300 million from the US Treasury in 2005 in order to pay claims. NFIP was in the process of repaying this initial debt when hurricanes Katrina, Rita and Wilma occurred prompting an additional $16.6B in borrowing. This was followed by Meteorological Event Sandy in 2012 which raised the programs total outstanding debt to $24B (Figure 99).[171]

[171] All claims data cited in this section come from FEMA's 2012 FY NFIP Report to Congress Draft as of Sept 2013; Additional premium, TIV and claim/PIF count info sourced from: http://www.fema.gov/statistics-calendar-year

Figure 98: NFIP's Total Premium and Loss by Year and Cumulative Loss Ratio

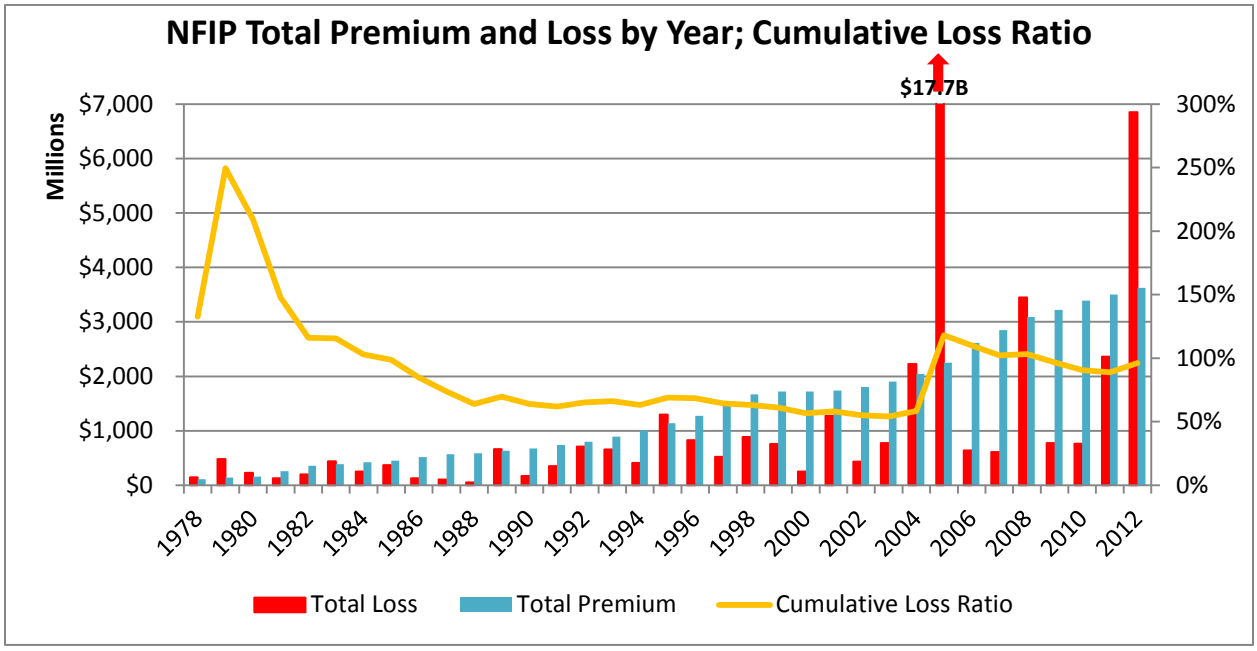
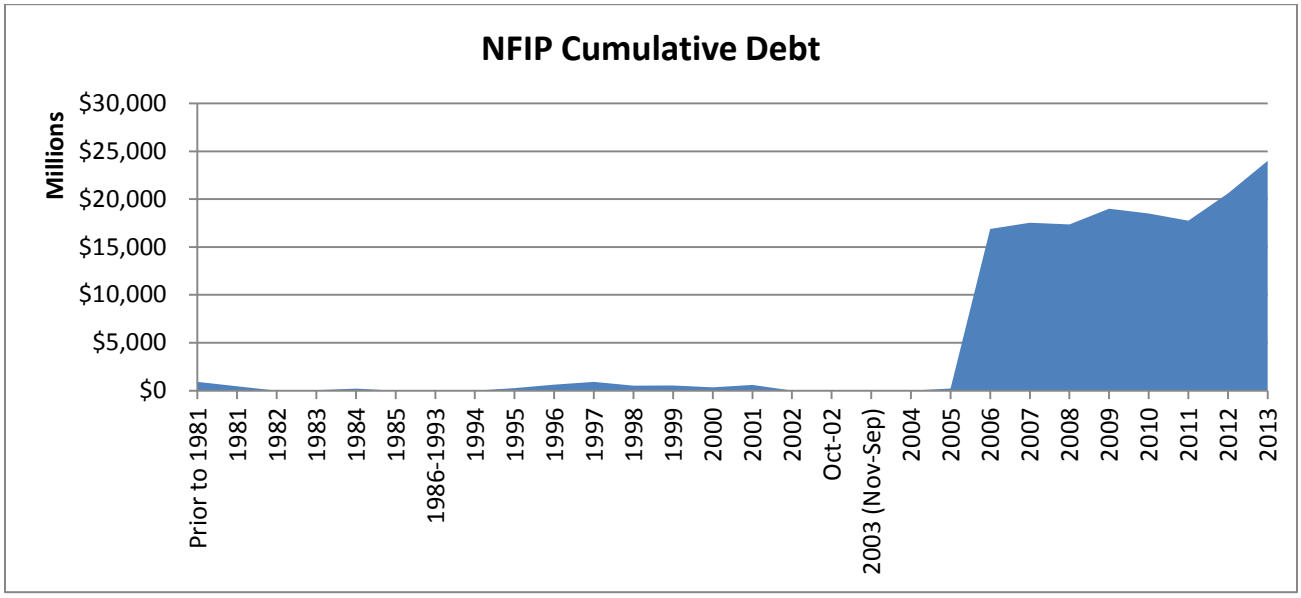


Figure 99: NFIP's Cumulative Debt Burden since Program Inception

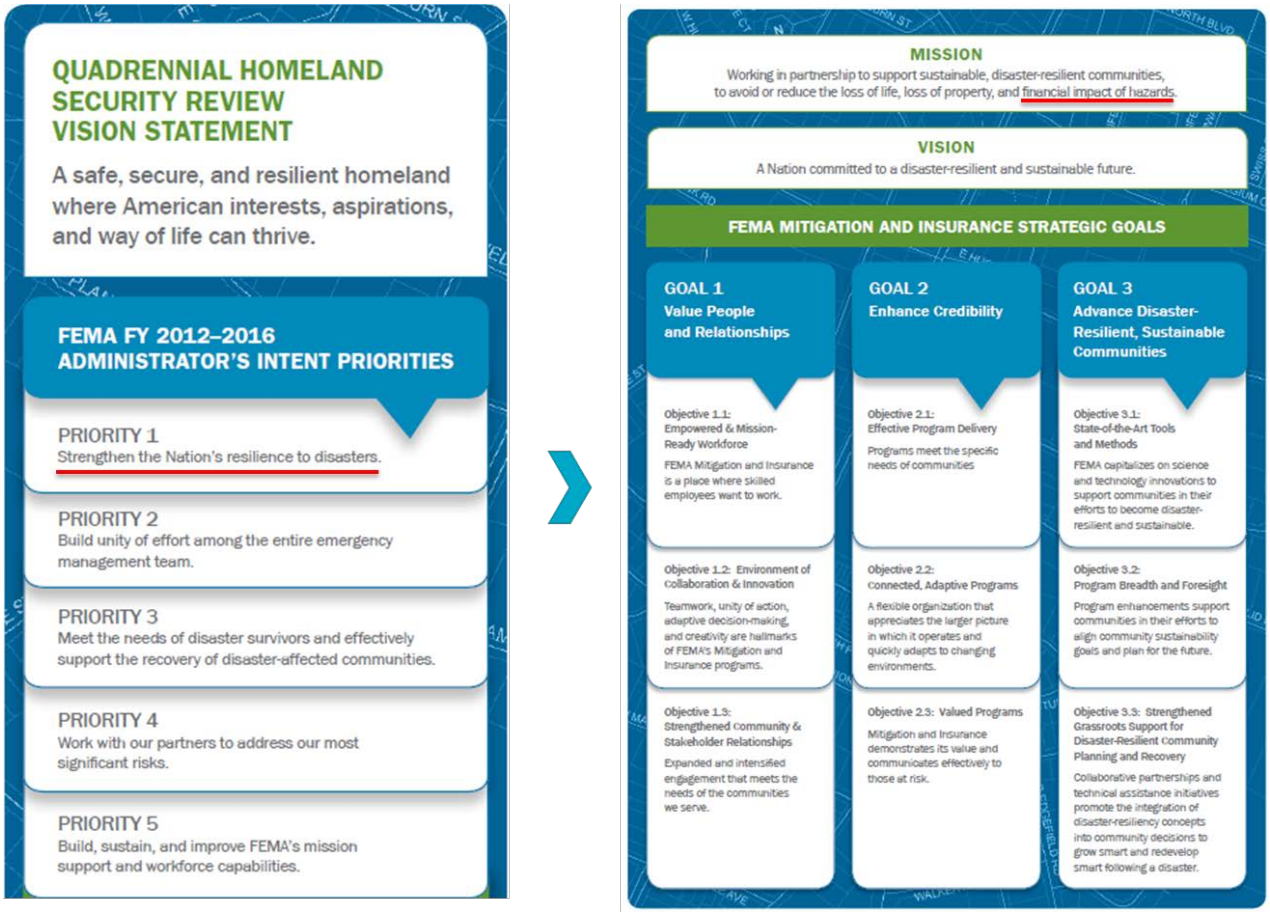


The National Flood Insurance Fund (NFIF), though available to support NFIP financial obligations since program inception, have run a balance at or near zero for most of the program's history. The same holds true for the related Reserve Fund which was created by BW12. In sum, NFIP historically has financed its risk through some combination of annual premium earnings and debt from the US Treasury.

B. Risk Appetite

Any decision to purchase reinsurance should support the cedant's risk appetite which itself should be grounded in the organization's mission, vision and goals. Ideally it should also be motivated by a risk management philosophy which is supported by senior management and pervades the organization's activities. NFIP itself does not appear to have an explicit mission and vision, though the Federal Insurance and Mitigation Administration (FIMA), of which NFIP is a key part, does. FIMA's guiding precepts as established by its Administration are outlined in Figure 100. The aspects of the precepts with potential direct relevance to the financial soundness of NFIP have been underlined[172].

Figure 100: FEMA Administrator's Intent Priorities Influence FIMA's Mission, Vision and Strategic Goals



Based upon a reading of these precepts, the fiscal sustainability of NFIP does not appear to be an explicit goal of FEMA or FIMA Administration. Congress has taken a similarly light touch with respect to the "financial soundness" of the NFIP. This exact phrase is referenced only twice in NFIA68 as amended: once in the Congressional Findings related to §4011, "Authorization to establish and carry out program" and a second time in §4017a, "Reserve Fund" (see Table 22).

[172] FEMA Mitigation and Insurance Strategic Plan 2012–2014; September, 2011

Table 24: National Flood Insurance Act as Amended; §4017a "Reserve Fund" Excerpt

National Flood Insurance Act as Amended; §4017a "Reserve Fund" Excerpt
(b) Reserve ratio Subject to the phase-in requirements under subsection (d), the Reserve Fund shall maintain a balance equal to— (1) 1 percent of the sum of the total potential loss exposure of all outstanding flood insurance policies in force in the prior fiscal year; or (2) such higher percentage as the Administrator determines to be appropriate, taking into consideration any circumstance that may raise a significant risk of substantial future losses to the Reserve Fund… (e) Limitation on reserve ratio In any given fiscal year, if the Administrator determines that the reserve ratio required under subsection (b) cannot be achieved, the Administrator shall submit, on a calendar quarterly basis, a report to Congress that— (1) describes and details the specific concerns of the Administrator regarding the consequences of the reserve ratio not being achieved; (2) demonstrates how such consequences would harm the long-term ***financial soundness*** of the flood insurance program; and (3) indicates the maximum attainable reserve ratio for that particular fiscal year.

It could be implied from all of the above that the financial soundness of the NFIP is a prerequisite to the fulfillment of NFIP's purpose/mission. For instance, maintaining the ability to pay all valid claims on a long-term basis without having to borrow additional funds from the US Treasury may be essential to enhancing the credibility of the program (Figure 100: FEMA Administrator's Intent Priorities Influence FIMA's Mission, Vision and Strategic Goals, FIMA Goal 2) and reducing the financial impact of hazards on the Federal Government (and by extension the US taxpayer, per FIMA Mission). However, these conclusions would be derivative and difficult to reconcile with many prior decisions made by Congress such as to subsidize flood insurance rates and concerns expressed around the affordability of insurance premiums.

In this environment, lacking further interpretation of Congressional intent around the management of NFIP's finances and insurance obligations, developing a framework around the decision to purchase or not to purchase reinsurance is a challenge. Given various considerations put forth in the related Privatization Study, we do not believe the reinsurance decision should be measured alone and outside of the broader context of any NFIP privatization effort. This being said, as a result of the rigorous approach to risk assessment undertaken as part of the FIRS project, it is possible to outline the comparative strengths and weaknesses of various reinsurance structures against a set of predetermined

quantitative criteria. In turn, this framework may be useful in demonstrating to NFIP's multifaceted stakeholders the merits of pursuing a risk financing strategy that entails the use of reinsurance.

C. Peer Review

In the absence of clear qualitative guidelines, prior to delving deeply into quantitative analysis for risk transfer options it is first useful to look at NFIP's risk financing strategy as compared to some of its 'peers'. While NFIP is certainly a unique entity in many respects it is at least somewhat comparable, in terms of its catastrophic exposure profile and large size, to certain state residual market property insurers such as Florida Citizen Property Corporation (Florida Citizens), North Carolina Joint Underwriting Association/Insurance Underwriting Authority (NCJUA/IUA) and California Earthquake Authority (CEA). As such the risk transfer strategies employed by these programs can provide a reasonable benchmark for FIMA as it contemplates different risk financing solutions for the NFIP.

State residual market property insurers are particular good comparisons insofar as some of them have access to special forms of risk financing similar to NFIP's current legislative borrowing authority such as post event bonding capacity. In addition state residual market property insurers usually enjoy a legal right to assess their insurer members and/or policyholders in the event certain triggers are met (e.g. an annual underwriting loss and/or a complete depletion of surplus). As markets of last resort, often forced to accept "all-comers", they also must manage some of the most exposed properties in their respective markets. As a result, they face the scrutiny of private reinsurance markets regarding the quality and maintenance of underwriting and claims guidelines; those residual markets demonstrating the highest quality processes and procedures typically gain access to preferential reinsurance capacity on a risk-relative basis.

Overall, in comparing NFIP's current[173] total risk financing capacity against its identified state-sponsored peers[174], NFIP is significantly underfunded (see Figure 102). Whereas the three state residual markets included in this comparison finance their risk out to the 1/100 year return period occurrence exceedance probability (OEP) (for hurricane exposed programs)[175] or 1/250 year return period aggregate exceedance probability (AEP) (for CEA)[176] NFIP only has finances sufficient to cover losses out to the 1/16.7 year all perils OEP or the 1/6.2 year all perils AEP (see NFIP Gross Modeled Loss Results section for details). Also of note are the following key differences:

- NFIP's relatively high reliance on *ex post* debt financing as compared to the other insurers featured (see red tranches in Figure 102: NFIP – US Residual Market Risk Financing

[173] Based on remaining borrowing authority as of writing; National Flood Insurance Fund as of 6/12/14 and; Reserve Fund projection as of 9/30/14.

[174] Peer risk financing structures all shown for their 2013 or 2014 accounts.

[175] Major catastrophe model vendors produce both "Long-Term" and "Near-Term" hurricane models. The Long-Term models take the entire historical record into account in their stochastic hazard event sets. The Near-Term models on the other hand use only a limited historical record to inform the development of their stochastic event sets sampling only from years where sea-surface temperatures (SSTs) were high in the Atlantic (as is currently the case on a historical basis). Most coastal residual market property insurers use Long-Term hurricane models including Demand Surge to determine their PML estimates. Some will use a blend of Long-Term and Near-Term results. Vendor usage varies.

[176] CEA uses the following model blend for its earthquake loss estimates: 50% EQE and 25% each for AIR and RMS.

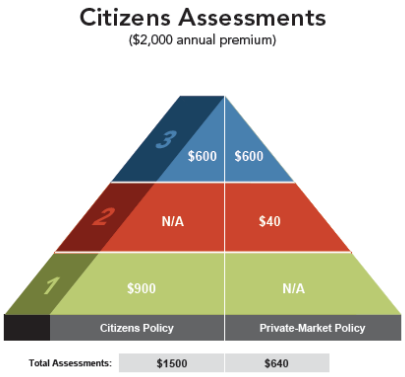
- Figure 102: NFIP – US Residual Market Risk Financing Program Comparison). Debt features only moderately in the other programs surveyed whereas it represents over 80% of NFIP's current risk finance capacity.
- NFIP lacks any policyholder or member assessment capacity whereas most state residual markets rely heavily on assessments as "mezzanine" (as with NCJIUA/JUA) or top-layer (as with Florida Citizens) financing.
- NFIP currently only utilizes two types of risk capital – surplus funds and debt – whereas the other residual markets surveyed access 5-7 different types of risk capital[1].

While many state-sponsored residual market property insurers have access to relatively more funds than NFIP in total, there is some notable differentiation with respect to the prioritization of each funding type across companies. For instance, private reinsurance within Florida Citizen's coverage towers exhausts well below the 1/50 OEP for the coastal account and is not used at all for the Personal and Commercial lines account, whereas NCIUA/JUA and CEA both use private reinsurance much higher up with private coverage exhausting above the 1/100 OEP and exhausting at the 1/250 AEP respectively[2].

While all three of the residual markets surveyed in Figure 102 utilize their own surplus funds to provide first-dollar protection, the types and level of assessments they use varies. Florida Citizens for instance uses a variety of policyholder assessments which can impact both Citizens' policyholders as well as private market policyholders in the state. A more detailed summary of their assessment plan follows[3]:

1. Citizens Policyholder Surcharge
    - One-time assessment
    - Citizens policyholders only
    - Up to 45 percent of premium
2. Regular Assessment
    - One-time assessment
    - Private-market policyholders, including, but not limited to homeowners, auto, and specialty and surplus lines policies
    - Up to 2 percent of the remaining shortfall
3. Emergency Assessment
    - Single- or multiyear assessment
    - Citizens and private-market policyholders
    - Up to 30 percent of premium per year until any remaining deficit is eliminated

Figure 1: Florida Citizen's Assessment Pyramid for a $2,000 Premium Policy

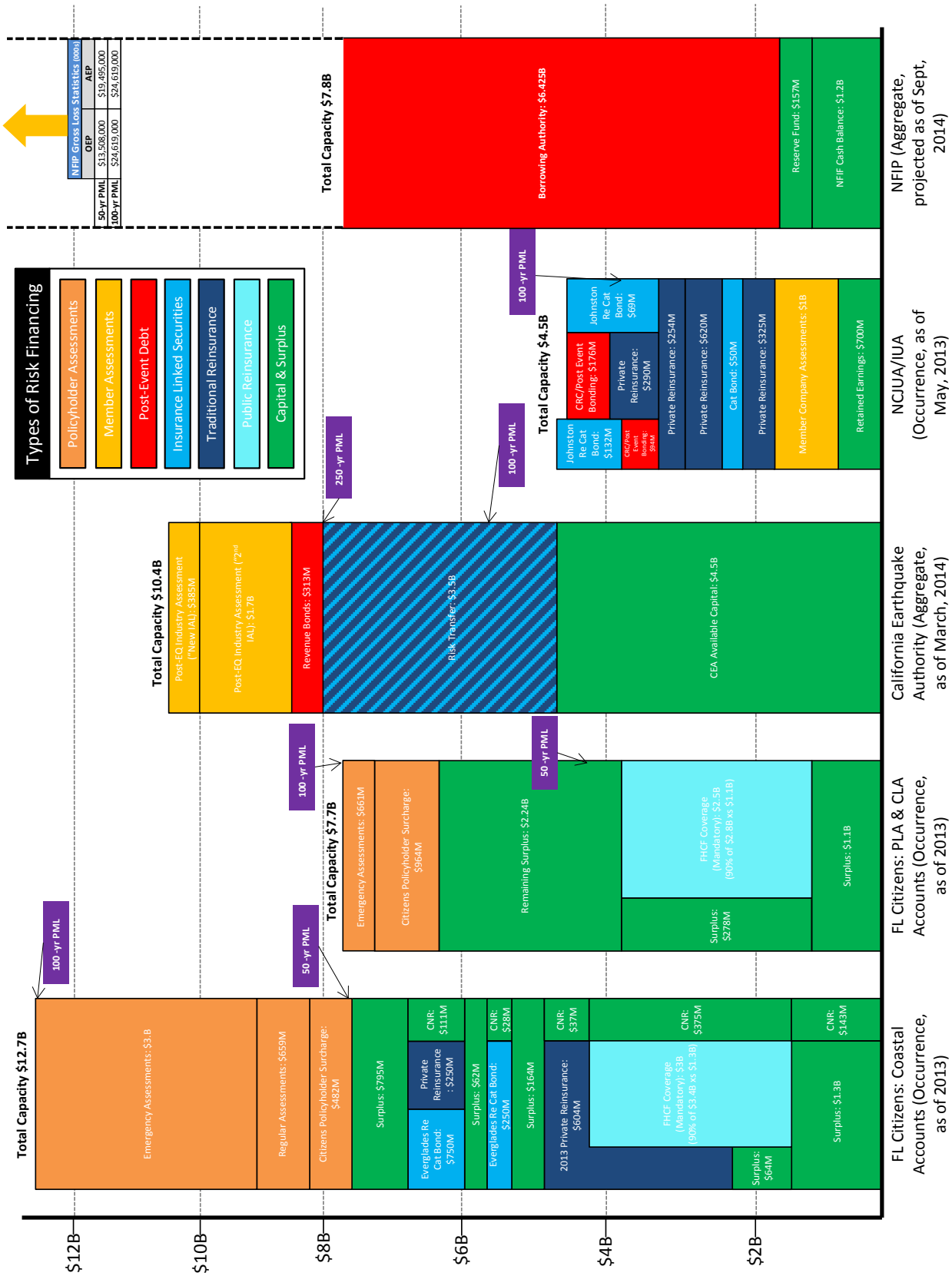


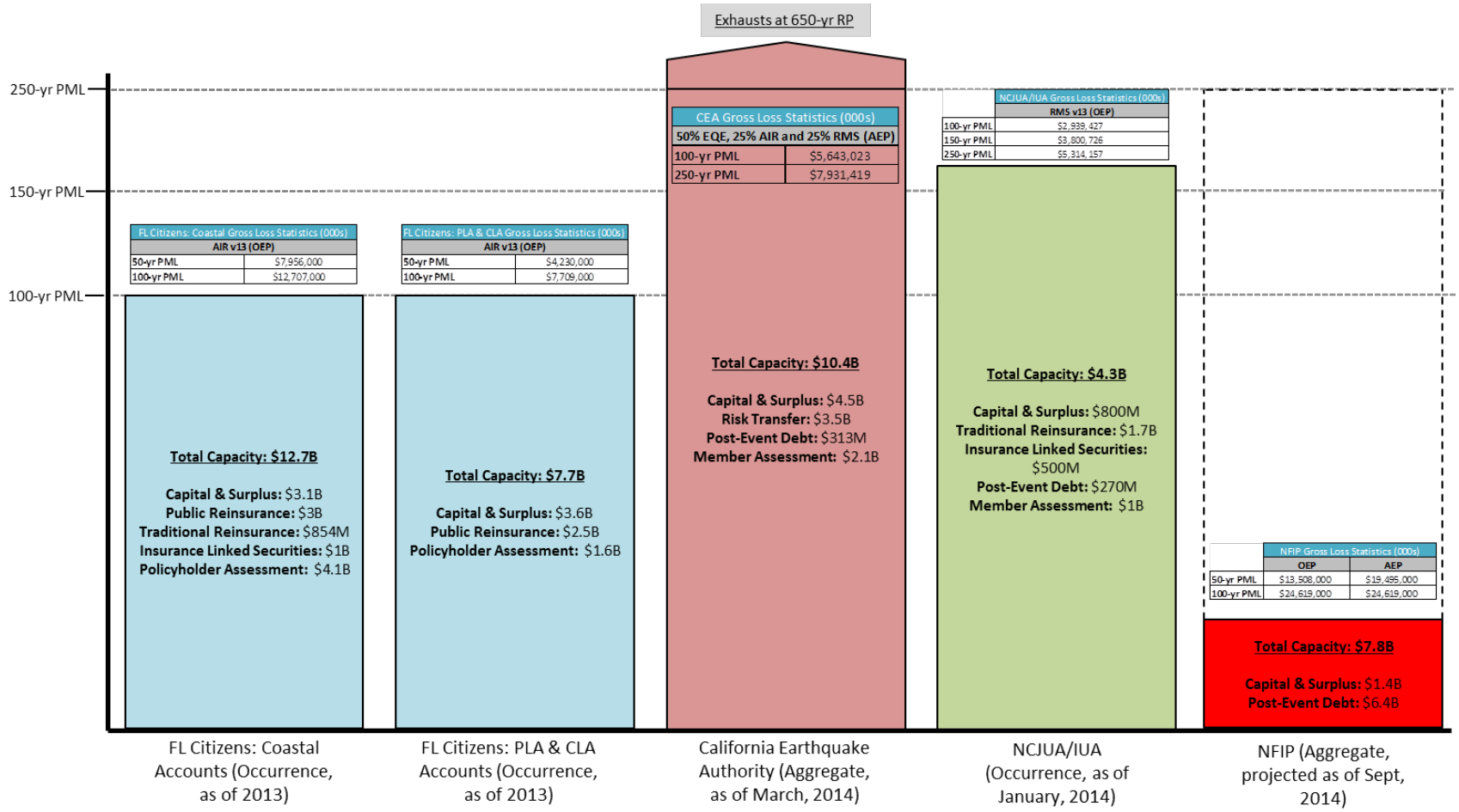
[1] This number varies depending on the granularity of funding source categorization used.

[2] It should be noted that the FHCF (Florida Hurricane Catastrophe Fund) is a state-sponsored reinsurer which itself relies upon a variety of alternative risk financing mechanisms including pre/post-event debt underpinned by its own unique ability to levy assessments. The FHCF is not required to pay its reinsurance claims if for some reason it cannot issue the full amount of its projected post event bonding capacity creating a shortfall. In this instance insurers' recoveries would be prorated. Based on these factors the FHCF deserves special consideration, separate and apart from private reinsurance, as a form of risk financing from the perspective of Florida Citizens. For more details on the FHCF's financial resources and claims settlement procedures: http://www.sbafla.com/fhcf/Portals/5/Advisory%20Council/20140515_FHCF_May2014BondingCapacityFINAL.pdf

[3] Source: www.citizensfla.com

Figure 102: NFIP – US Residual Market Risk Financing Program Comparison – Dollars and Return Periods




Exhausts at 650-yr RP
250-yr PML
150-yr PML
100-yr PML
FL Citizens: Coastal Gross Loss Statistics (000s)
AIR v13 (OEP)
50-yr PML $7,956,000
100-yr PML $12,707,000
FL Citizens: PLA & CLA Gross Loss Statistics (000s)
AIR v13 (OEP)
50-yr PML $4,230,000
100-yr PML $7,709,000
CEA Gross Loss Statistics (000s)
50% EQE, 25% AIR and 25% RMS (AEP)
100-yr PML $5,643,023
250-yr PML $7,931,419
NCJUA/IUA Gross Loss Statistics (000s)
RMS v13 (OEP)
100-yr PML $2,939,427
150-yr PML $3,800,726
250-yr PML $5,314,157
NFIP Gross Loss Statistics (000s)
OEP AEP
50-yr PML $13,508,000 $19,495,000
100-yr PML $24,619,000 $24,619,000
Total Capacity: $12.7B
Capital & Surplus: $3.1B
Public Reinsurance: $3B
Traditional Reinsurance: $854M
Insurance Linked Securities: $1B
Policyholder Assessment: $4.1B
Total Capacity: $7.7B
Capital & Surplus: $3.6B
Public Reinsurance: $2.5B
Policyholder Assessment: $1.6B
Total Capacity: $10.4B
Capital & Surplus: $4.5B
Risk Transfer: $3.5B
Post-Event Debt: $313M
Member Assessment: $2.1B
Total Capacity: $4.3B
Capital & Surplus: $800M
Traditional Reinsurance: $1.7B
Insurance Linked Securities: $500M
Post-Event Debt: $270M
Member Assessment: $1B
Total Capacity: $7.8B
Capital & Surplus: $1.4B
Post-Event Debt: $6.4B
FL Citizens: Coastal Accounts (Occurrence, as of 2013)
FL Citizens: PLA & CLA Accounts (Occurrence, as of 2013)
California Earthquake Authority (Aggregate, as of March, 2014)
NCJUA/IUA (Occurrence, as of January, 2014)
NFIP (Aggregate, projected as of Sept, 2014)

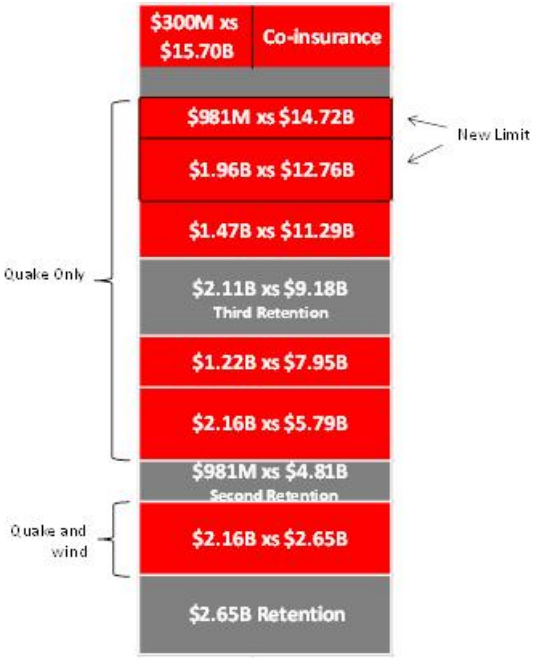
CEA and NCJUA/IUA on the other hand utilize different forms of assessment, whereby insurance company members are required to foot the bill for all or a portion of the underwriting deficits the residual market might accrue. Membership in a residual market can either be mandatory or voluntary. In mandatory states the requirement usually extends to all insurers authorized to write property insurance in the state and assessments are usually levied based upon market share. CEA is one of the few residual markets that make membership voluntary. At present there are 19 participating insurers writing approximately 75% of the residential property insurance sold in California[180].

Residual market membership rules vary, but in general member assessments can either be recoupable through policyholder rate increases or non-recoupable. In recoupable states insurers do not share in profits, but are assessed for losses beyond the residual market's available funds. After such an assessment is levied recoupment may be allowed by insurers via a line-item premium surcharge on renewal policies. In non-recoupable states member companies tend to share in the residual market's profits and losses, though once the residual market exhausts its claims paying capacity, members are required to assume all outstanding liabilities with no specific provisions made for recouping assessed losses through rates.

All of the above being said, it should be noted that many residual markets in the US have benefited from relatively benign loss activity for the past decade plus. For instance no hurricanes have made direct landfall in Florida since 2005 and the State of California has had no major property-damage-causing earthquakes since Northridge in 1994. Residual markets in these states have benefited from Mother Nature's benevolence during this recent time period which has allowed them to build surplus funds and minimize the use of post-event debt and other *ex post* forms of financing available to them.

Extending this peer review beyond US borders, it is useful to look at some of the larger international reinsurance placements for correlates to NFIP. Zenkyoren, the Japanese National Mutual Federation of Agricultural Cooperatives, has been the largest single buyer of catastrophe reinsurance coverage in recent years with a reinsurance treaty sized between $6B and $7B. Zenkyoren's past lost experience (Tohoku earthquake) coupled with a growing portfolio has led to the recent purchase of an additional $3B in protection as shown in the adjacent Figure[181]. This transaction is encouraging for large cedants unsure of global reinsurance market conditions. Zenkyoren was able to significantly increase its coverage at reduced risk-adjusted pricing of around 10% - 12% across its

Figure 103: Zenkyoren's 2014/15 Catastrophe Reinsurance Program Structure



[180] Source: www.earthquakeauthority.com

[181] Source: Insurance Insider; currency converted from JPY to USD as of July 28, 2014.

$10 billion catastrophe reinsurance treaty.[182]

This price reduction has strengthened the belief that property catastrophe renewals in 2014 continue to be driven by buyers. Along with the aforementioned benefits, cedants have been able to issue changes in coverage and lock in multi-year placements allowing companies to better tailor solutions to meet their risk management needs.

Though Zenkyoren was able to utilize savings on its legacy program in order to round out its coverage strategy, the company still pays substantially more than before the program suffered a total loss from the Tohoku earthquake. The Zenkyoren case exhibits that prices have certainly softened in Asia-Pacific and it is expected that renewals for other large Japanese programs will follow this lead.

Allegedly the reinsurer Berkshire Hathaway offered to write the entire additional $3B in limit placed by Zenkyoren this year. Though the mutual declined this offer it illustrates the heightened demand for premiums by even large reinsurance players and their interest to capture market share by leveraging their size and offering mega capacity as mentioned in the Global Reinsurance – Capacity section.[183]

D. NFIP Gross Modeled Loss Results

As part of the FIRS project, AIR Worldwide together with Guy Carpenter conducted a holistic loss modeling analysis on NFIP's in-force portfolio. This analysis utilized probabilistic catastrophe modeling tools where available to assess the risk of loss to NFIP from all manner of flood events including coastal storm surge linked to hurricanes as well as inland riverine flooding. For loss sources that could not be modeled, such as hurricane precipitation and storm surge associated with tropical storms, actuarial techniques were used to fill gaps and estimate loss occurrence frequency and probability.

Losses are presented herein by major peril – bifurcated as A) coastal Hurricane and Tropical Storm (HU/TS) losses[184] and B) Inland Flood losses[185] – and altogether (also referred to as "All Perils")[186]. A great deal of work went into the development of these loss estimates. This work is detailed in the final report associated with section C.2 of the FIRS project[i].

Before presenting results of the ensemble, All Perils loss analysis conducted for NFIP as part of the FIRS project it is first useful to include a primer on the interpretation of such results. Specifically the following output types will be used to explain NFIP's portfolio risk:

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[182] "Zenkyoren Buys $3bn More as Pricing Slides Double Digits." *Insurance Insider*. N.p., n.d. Web. 19 Mar. 2014.

[183] "Zenkyoren Sets the Tone for April Reinsurance Renewal Pricing." Web log post. *Http://www.artemis.bm/blog/2014/03/19/zenkyoren-sets-the-tone-for-april-reinsurance-renewal-pricing/*. N.p., 19 Mar. 2014. Web.

[184] HU/TS as referred to herein includes an assessment of losses caused by Hurricane Storm Surge and Precipitation and Tropical Storm Surge and Precipitation.

[185] Inland Flood as referred to herein includes an assessment of losses caused by meteorological events other than HU/TS including storm surge as a result of Nor'easters.

[186] All modeled loss figures include loss adjustment expenses and other ancillary loss costs. While expenses vary by event type and magnitude overall expenses amount to 4.9% of the All Perils AAL.

- **Occurrence Exceedance Probability (OEP)**: Probability that a single occurrence will exceed a certain threshold.
- **Aggregate Exceedance Probability (AEP)**: Probability that multiple events occurring within a predefined time frame (usually a year) will together exceed a certain threshold.**Return Period**: Points along the exceedance probability curve for an catastrophe analysis are often expressed as Return Period Years. For example, the 1-in-100 year loss is equivalent to 1% chance of exceedance or a 99% chance of non-exceedance. The return period represents the expected length of time between recurrences of two events with similar characteristics. The return period can refer to hazard events (e.g. - hurricanes or floods), or it can refer to specific levels of loss (e.g. a $100 million loss in this territory has a return period of 50 years).
-
- **Average Annual Loss (AAL)**: Long term average or mean loss expected in any one year.
- **Standard Deviation (SD)**: A measure of how spread out from the average or expected value a group of numbers is. Used as a basic measure of the volatility/uncertainty associated with a given distribution.
- **Coefficient of Variation (CV)**: CV = SD/AAL. A normalized measure of volatility/uncertainty which is comparable across different programs/measures.

The key findings of the FIRS loss analysis are presented in Figure 104 and Figure 105. NFIP's 1-in-100 year modeled all perils loss is $24.5B on an annual aggregate basis and $18.2B on an occurrence basis. NFIP's equivalent numbers for the peril of HU/TS only are $21.9B and $18.2B respectively. While the potential for an HU/TS event or loss year as large as $60B exists at the far end of the OEP and AEP distributions, the 1-in-100 year loss is important insofar as it is a reasonable measure of extreme or "tail" risk. It is also often used in the insurance industry to inform regulatory, rating and capital management decisions especially for companies exposed to the peril of hurricane[187].

The OEP values cited above for HU/TS and all perils are the same since the Inland Flood peril has a very limited potential impact above a certain loss threshold. For instance the 1-in-1,000 year Inland Flood loss is just under $10B. Given the HU/TS loss curve crosses $10B at around the 1-in-25 year mark Inland Flood losses will have essentially no impact on all perils losses above that level. Stated otherwise, all perils occurrence losses beyond the $10B level will be caused almost entirely by HU/TS events rather than Inland Flood events.

However, on the AEP curve the differential between HU/TS and All-Perils is much greater owing to the likely frequency of multiple Inland Flood events occurring within a given year. On an aggregated basis Inland Flood has a far greater impact on NFIP's losses than they do on an occurrence basis. This is not to say that a $5.7B 1-in-100 year Inland Flood event is insignificant, but rather to emphasize that HU/TS events are the main driver of extreme volatility in NFIP's portfolio. Tail values though are only one measure of risk. It is also useful to look at the mean and SD of the annual distribution to determine the likelihood of loss on average. Figure 106 shows the mean, SD and CV for the perils of HU/TS and Inland Flood and for the All Perils perspective. According to this analysis NFIP can expect to incur $4.6B of loss and expense annually on average

[187] The 1-in-250 year number is most often used for the peril of earthquake due to the volatility and higher relative uncertainty surrounding this peril. Regionally focused Insurers that lack diversity or greater spread of risk in their portfolios will also manage their risk financing toward this higher threshold. Rating agencies and regulators also contemplate higher risk thresholds above the 1-in-100 year result for a variety of perils where warranted.

over a theoretically infinite timeframe. Of this loss amount about 60% is HU/TS related. While the CV for the All Perils number is around 100% there is significantly more volatility around the portion of loss contributed to by HU/TS allowing for the covariant nature of the peril and uncertainty around its impacts.

Figure 104: NFIP's Gross Ensemble Modeled Loss Results; Occurrence Exceedance Probabilities by Major Peril

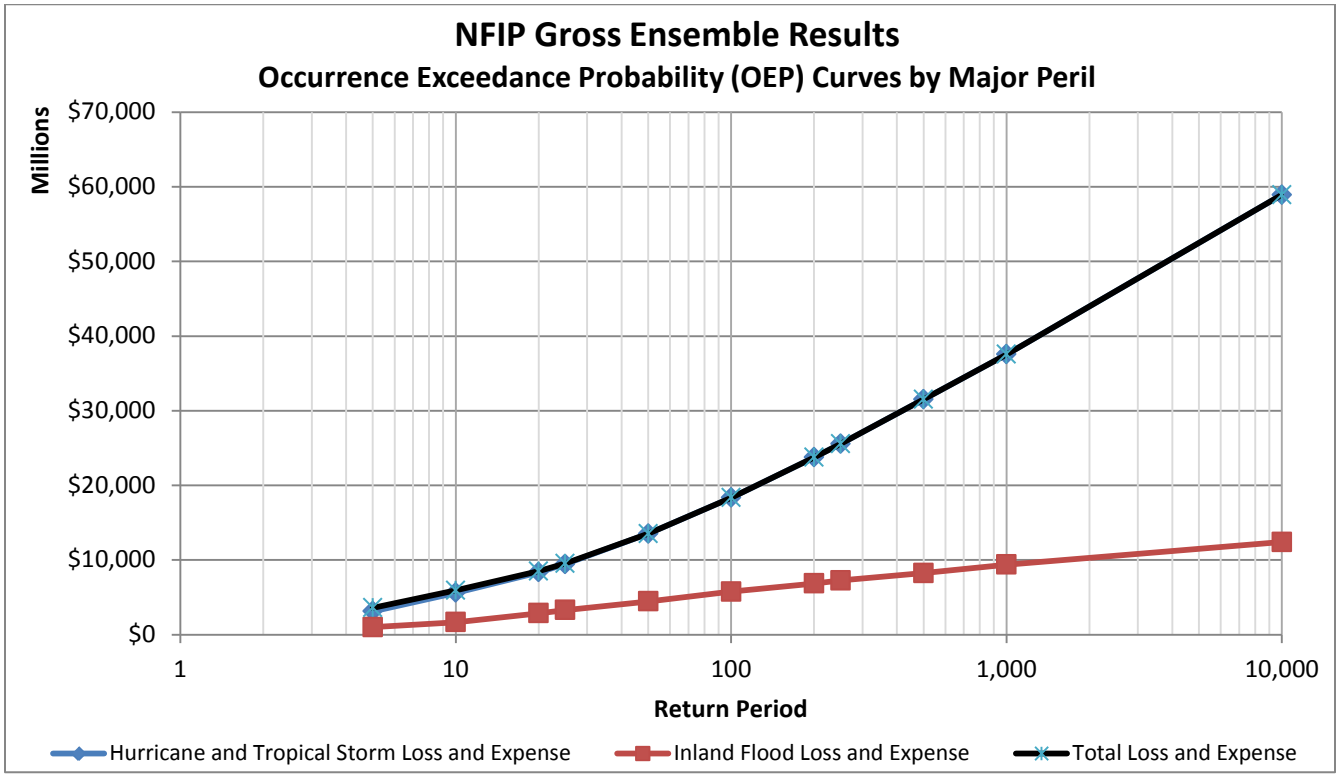

Figure 105: NFIP's Gross Ensemble Modeled Loss Results; Aggregate Exceedance Probabilities by Major Peril

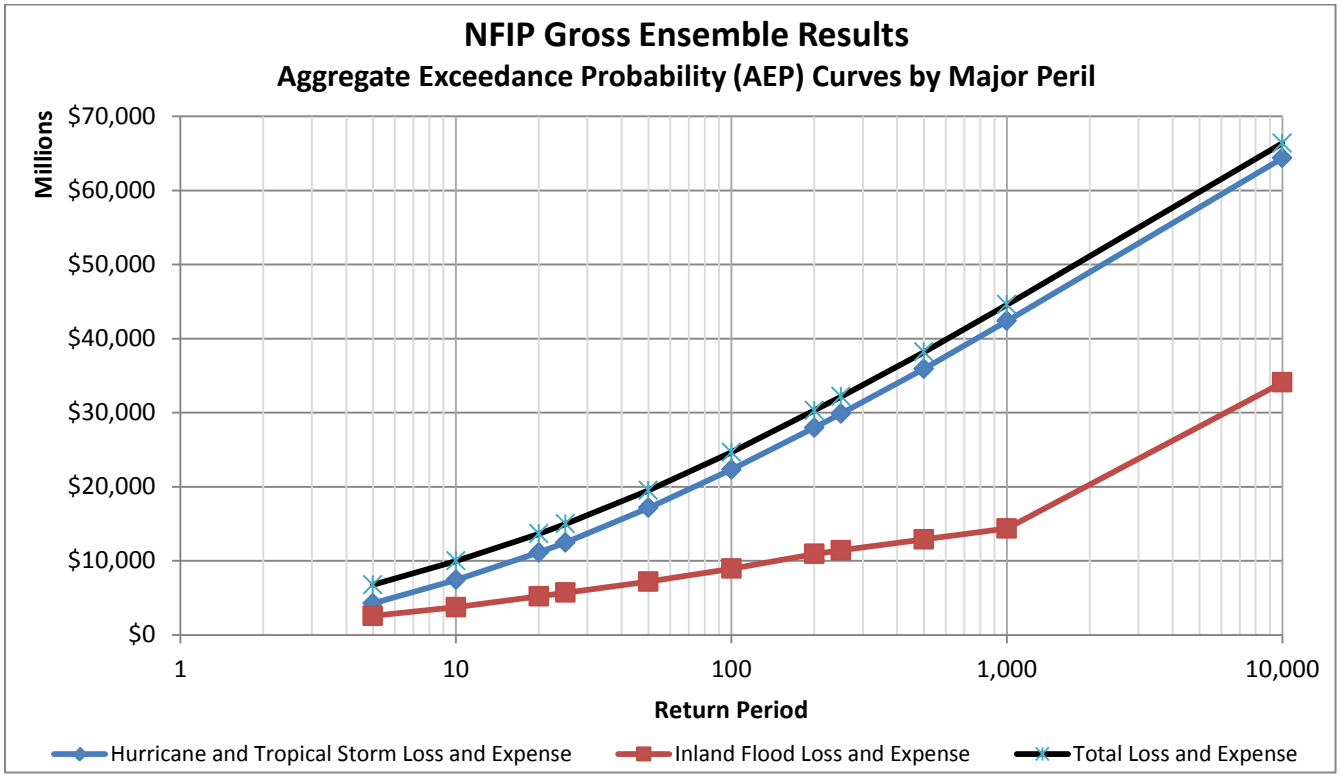

Figure 106: NFIP Gross Ensemble Modeled Loss Results; Mean and Volatility Metrics

Stat	Hurricane-TS Loss and Expense	Inland Loss and Expense	Total Loss and Expense
Mean	2,729	1,910	4,639
StDev	4,639	1,737	4,952
CV	170.0%	90.9%	106.7%

To contextualize these loss numbers it is useful to look at NFIP's historical loss experience for benchmarks. Hurricane Katrina was a $16.2B event for NFIP in actual (2005) dollars and a $29.4B when losses are indexed to 2012 to account for historical exposure growth. Meteorological Event Sandy on the other hand was an $8B event. The "as-if" position of these historical losses on the HU/TS and All Perils loss curves is detailed in Table 23. On an indexed basis Hurricane Katrina is considered to be a 1-in-392 year event. Events the size of Meteorological Event Sandy on the other hand are expected to occur much more frequently (e.g. 1-in-17 years).

Table 25: Historical Large NFIP Event Losses on Modeled Loss Curves

		Return Period			
Event	Loss Amount	HU/TS AEP	HU/TS OEP	All Perils AEP	All Perils OEP
Katrina Actual Loss	16,240,093,653	46.1	75.2	30.5	75.0
Katrina Indexed Loss	29,441,293,745	248.6	392.9	184.0	392.9
Sandy Actual / Indexed Loss	8,019,120,113	12.1	18.5	6.5	17.7

All loss numbers as per AIR Worldwide NFIP Claims Analysis dated June 18, 2014; indexed losses adjusted for exposure as of 2012; AEP Return Periods are provided for reference.

A comprehensive set of gross loss results is useful in helping organizational administration to determine appropriate risk management and financing strategies to meet the organization's operational goals. With the results summarized above for NFIP, the full extent of the program's potential liability is demonstrated and fiscal vulnerabilities of the government program are readily revealed. Without adequate premium (e.g. actuarial rates), cash on hand (e.g. surplus/reserve funds) or rental capital (e.g. in the form of reinsurance) to support average and/or severe claims activity, the only other current recourse for NFIP is *ex post* borrowing from the US Treasury. The full potential extent of this liability can be seen in the tail of the presented loss curves.

E. Reinsurance Decision Tool

Purchasing an appropriate reinsurance program is a multifaceted financial decision involving a variety of organizational functions and priorities, some of which may even conflict. To be made appropriately it requires a robust analytical approach which enables the quantification of the costs and benefits of various program options. For the purposes of this report we have used Guy Carpenter's proprietary Reinsurance Decision Tool (RDT) framework to facilitate the selection of an optimal hypothetical[188] reinsurance program for the NFIP.

The RDT framework is essentially a matrix whereby selected reinsurance structures (along the X-axis) are compared across a set of uniform metrics (along the Y-axis) and relative scores are calculated for each. Since the realm of possible reinsurance structures is potentially endless, to facilitate comparison it is useful to limit optionality to some extent and to only consider programs which could reasonably help the organization to meet its desired goals, whatever they may be.

Table 26: NFIP's Key Criteria for Assessing Reinsurance Options

NFIP's Key Criteria for Assessing Reinsurance Options
Based on conversations with management and published documents we have identified the following as NFIP's core concerns with respect to the potential use of reinsurance: • Minimize the potential for having to increase current borrowing or borrowing authority • Maximize the potential for paying back NFIP's existing debt to the US Treasury

For the X-axis of NFIP's RDT we have devised four relatively straight-forward reinsurance program structures. These structures all center around and attempt to address NFIP's core concerns with respect to the potential use of reinsurance which relate primarily to minimizing the potential for having to increase NFIP's current borrowing from the Treasury or its borrowing authority and to maximizing the potential for paying back NFIP's existing debt to the US Treasury (see Table 24[189]). As noted above, reinsurance buying decisions involve a variety of multifaceted issues and can often conflict which is demonstrated in the NFIP goals listed here. Reinsurance can provide a useful component of risk financing but it does involve cost. While the reinsurance coverage can provide meaningful risk transfer in years of unusually high loss experience thus forestalling the potential need to call on the Treasury to meet its claim obligations, its cost will reduce the NFIP's ability to pay down debt in years of profitable experience. Please note, in keeping with the high-level and hypothetical nature of this exercise, these structures are all presented as single tranches of cover

[188] This RDT exercise will be hypothetical insofar as it does not contemplate: a) NFIP's practical ability to pay for reinsurance or; b) the reinsurance market's practical ability to supply the full capacity envisioned. The structures included in this RDT might otherwise be characterized as "ideal" given available premium dollars and capacity to support. In this sense they provide a sound basis from which to inform a theoretical cost-benefit analysis for NFIP, though we recognize that any actual reinsurance placement by NFIP, if reinsurance is used at all, is likely to be a fraction the size of the options contemplated in initial program years anyway.

[189] NFIP undoubtedly has many multifaceted practical and political concerns ancillary to these core financial issues, though for the purposes of this analysis a deliberate focus has been paid to readily quantifiable financial outcomes.

and do not yet contemplate internal program layering[190]. Some commentary regarding each selected coverage option follows:

- **Option 1 – Aggregate XOL: $16.9B xs $7.8B**
    - This option provides NFIP with protection attaching above its current capital resources inclusive of current additional borrowing authority (as depicted in Figure 102) and providing coverage up to the 1/100 all perils AEP level (as depicted in Figure 105). The drawbacks with this option are that the chosen attachment is quite low (around the 1/6 year AEP) and requires a limit amount which is likely infeasible to place given the capacity available in today's market for any one program. Main advantages include budget certainty, protection against the need for additional borrowing authority out to the 1/100 all perils AEP and avoidance of potentially contentious negotiations with prospective reinsurance industry counterparties around the definition of a loss occurrence or reinstatement terms.
    - **Option 2 – Occurrence XOL: $14.4B xs $3.9B w/ 1 Automatic Reinstatement, 100% as to Time, Prorata as to Amount (a.k.a 1@100%)**[191]This option sets the coverage retention at half NFIP's current capital resources (again, inclusive of current additional borrowing authority) requiring two large catastrophe events and/or particularly adverse non-catastrophe loss experience for NFIP to exceed current borrowing authority. The limit for this option exhausts at the 1/100 all perils OEP level (Figure 104). Drawbacks with this option are essentially the same as with Option 1 above though also include added budget uncertainty since the number of occurrences in any given year is an unknown factor. The main advantage of this program is that it is likely to be relatively less expensive than an equivalent Aggregate XOL adjusting of course for probability of loss.
- **Option 3 – Occurrence XOL: $10.5B xs $7.8B w/ 1@100%**
    - This cover is essentially the same structure as Option 2, except a higher attachment is utilized. This in turn calls for a lower required limit of reinsurance to construct protection around the NFIP's 100 year OEP loss threshold (Higher Attachment + Lower Limit = Lower Cost). Based on our Peer Review capacity may be available in the market to support such a cover now; certainly if the NFIP were to enter the market we believe such capacity could be constructed over the medium-term (3 to 5 years) to supply the full limit. Based upon the modeled loss results surveyed herein coverage attaches around the 1-in-15 year All Perils OEP loss threshold, which would be more in line with the attachment points of many large US cedant reinsurance programs.
- **Option 4 – Occurrence XOL + Aggregate XOL: $14.4B xs $3.9B Occurrence w/ 1@100% coupled with $5.25B xs $3.75B of Aggregate Reinsurance excluding Coverage for Named Storms**
    - This option builds off of the Option 2 by adding a component of Aggregate Cover. The Aggregate coverage is designed to provide additional protection against an undue accumulation of losses from flood events outside of those caused by named events (i.e. inland flooding and Nor'easters). Losses from Tropical Storms and

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[190] Layering has potential implications for reinsurance program marketing (e.g. reinsurers have varying risk appetites and some will not support covers attaching below a certain level for instance) and cost (e.g. reinstatement costs will differ for Occurrence XOL structures based upon the layers used). Efficient program layering can be addressed with some more granular peril- or region-specific analysis of NFIP's gross loss results as needed.

[191] For a detailed explanation of how reinstatements work see Appendix – Reinstatements Explained for reference.

Hurricanes would be excluded from this supplemental protection for two reasons: first, losses from these events would be afforded protection through the Occurrence coverage; second, there would be significant price implications to incorporate such coverage within the Aggregate Cover. The Aggregate XOL attachment and exhaustion points have been set at the 1/10 and 1/100 AEP level respectively for Inland Flood.

With these four structures established we can turn our attention to the Y-axis of the RDT framework. In selecting metrics there are some basic guidelines to follow which are paraphrased as follows:

- Avoid multi-colinearity or the reliance on many different metrics which essentially measure the same thing. For instance Tail Value at Risk (TVaR) @ 90% and Value at Risk (VaR) @ 90% both measure tail risk volatility and will produce different absolute values for each structure. So including only one of these measure is warranted but not both. While including both will likely not change the relative ranking of each structure, it could overemphasize tail volatility reduction at the specified threshold[192]).and;
- Align metrics as closely as possible with the organization's mission, vision, strategic objectives or risk appetite/tolerance statements (for example if an organization's primary goal is to achieve financial sustainability the ability of a reinsurance program to minimize the organization's "risk of ruin" should be emphasized whereas if an organization's primary goal is to provide stable returns to shareholders the ability of a reinsurance program to minimize the volatility around net underwriting results should be emphasized).

All metrics do not have to be dynamic or strictly quantitative. A number of qualitative measures which can be judgmentally assigned a value may also be useful (e.g. "ease of implementation"; "political viability"). Any number of binary "'pass/fail" measures may also be useful so as to immediately diminish the field of potential structure options. Broadly there are three types of metric:

- **Volatility**: Reinsurance is often used as a means of results volatility reduction. Therefore some of the most common metrics used in RDT analyses measure volatility at some level or scale. These measures can be at the tail of the distribution (e.g. TVaR @ 90%), around the mean (e.g. CV of Net Underwriting Result) or somewhere in between (e.g. VaR @ 50%).
- **Budget**: Budget metrics are typically expressed as mean measures of gross or net loss or gain.
- **Cost-Benefit**: Any metrics whereby a relationship or ratio is derived between an upside and a downside measure. Such metrics are typically more complex, are not readily intuitive by just their name and therefore require some degree of additional explanation.

Once metrics have been determined for inclusion in the RDT analysis a relatively simple scoring methodology is used whereby each structure is ranked between 1 and 0 with the best performing option for each category receiving a 1 and the worst a 0. The scores for the programs falling in between the best and the worst are then linearly interpolated based on their relative value as compared to the best and the worst. Once these values have been determined an arithmetic

[192] VaR returns the value of potential loss at the specified point in the reference distribution whereas TVaR returns the average of all values beyond the specified point in the reference distribution. TVaR @ 90% then would show a larger loss number than VaR @ 90%.

average is computed based off all the metric scores for each structure. This arithmetic average can then be supplanted by a weighted average where the weights are selected subjectively by the user.

The metrics selected in consultation with NFIP for this exercise have centered on the same core financial concerns as expressed in Table 24. Again, these include minimizing the potential for having to increase NFIP's current borrowing or borrowing authority and maximizing the potential for paying back NFIP's existing debt to the US Treasury. In looking over NFIP's historical record (see Figure 98) for reference) unmitigated loss volatility primarily as a result of Hurricanes Katrina and Sandy has been the primary driver of NFIP's current debt load and Congress's effort to increase the agency's borrowing authority. One of the main benefits of reinsurance (which are discussed in some detail in the accompanying Current Market Assessment report) is volatility reduction. So understandably some degree of emphasis on this impact is warranted. By the same token, being able to achieve some underwriting income over time is also important so the NFIP can begin to pay off its debt over time. Therefore some emphasis on budget metrics is also warranted.

- **Volatility**
  - **Net Loss and ALAE TVaR 99%**: This metric and its sister VaR @ 99% are industry standards for wind-exposed coastal property insurers and are used as a benchmark for many rating agency and regulatory solvency tests. It measures the average size of NFIP's estimated loss beyond the 1-in-100 year loss threshold on a net basis (after the application of reinsurance).
  - **Net Expected Policyholder Deficit (EPD) @ $7.8B**: EPD is calculated by multiplying TVaR at a specified threshold against the probability of loss at the same threshold. In this case Net EPD @ $7.8B is the product of the following two metrics and is a normalized measure of the tail risk expected from a given distribution accounting for both the frequency and severity of loss.
  - **TVaR of Net Loss @ $7.8B**: The result of this metric answers the question: if NFIP suffers a net loss above $7.8B, how big will this net loss be on average?
  - **Probability Net Loss > $7.8B**: The result of this metric answers the question: how likely is NFIP to suffer a net loss greater than $7.8B?
- **Budget**
  - **Mean Cost of Reinsurance**: The mean cost of reinsurance is a measure of the organization's relative underwriting performance as compared to its bare or unreinsured result. The metric is calculated as the difference between net mean underwriting loss (after reinsurance) and gross mean underwriting loss (before reinsurance). The difference shows on average how much net underwriting benefit the reinsurance program is costing.
  - **Net Mean Loss and ALAE**: This metric gives the average losses expected under each reinsurance option. It is one of the components of the cost of reinsurance metric above though oftentimes produces a notably different result in relative structure ranking.

In selecting the metric weights consideration was again given to NFIP's financial priorities as expressed above. As a guiding principal a 50/50% weight was assigned to the volatility and budget metric categories giving them equal importance. On the volatility side of the ledger, given the focus on minimizing NFIP's chance of having to approach Congress to request additional borrowing authority, Net EPD @ $7.8B has been emphasized heavily (40%). This estimate was rounded out by a 10% weight on Net Loss and ALAE TVaR @ 99% which is a standard (re)insurance industry benchmark often used to evaluate the protection of wind-exposed insurance portfolios. On the budget side ample weight was given to the Mean Cost of Reinsurance (40%) as this serves to

measure the average amount of premium being sent from NFIP into the private reinsurance market after average expected recoveries. This metric also reflects the mean underwriting performance of the portfolio insofar as the more premium ceded the less net premium is available to contribute to growth in surplus funds on average (and vice versa presuming the reinsurance purchased achieves the desired level of risk transfer). The remaining 10% for the budget metrics was allocated to Net Mean Loss and ALAE since it provided a noticeably different relative result versus the Net Cost of Reinsurance and is a solid measure of the average downside reduction achieved through the purchase of reinsurance.

In addition to the selection of structures and metrics and the computation of modeled losses some additional work is required in setting up a RDT analysis. Specifically, in order to measure the various merits/drawbacks of certain structure options it is necessary to first estimate their likely cost in the marketplace. Estimating likely future prices for any given market can be a highly technical and somewhat subjective exercise – this is especially true for the reinsurance market which is subject to the vicissitudes of global underwriting cycles, the interest rate environment and other macroeconomic factors as described in detail in the Current and Historical Market Assessment reports accompanying this document. Uncertainty around price projection is further magnified in this instance by the unique nature and significant size of NFIP – the reinsurance market has not been asked to price primary US flood risk at such large scale before and so its precise reaction to NFIP as a new cedant is difficult to project irrespective of the market factors aforementioned.

In short, technical prices are not the same as market prices and the ceded premium estimates presented herein would need to be market validated before being viewed as firm market pricing. This being said, we have made every effort given our unique access to extensive industry data on property catastrophe reinsurance markets to estimate what the market would charge for the structures envisioned. For a full explanation of our reinsurance cost estimation method see the associated Technical Appendices to Reinsurance Study document[193].

Using all of the inputs described in this report, the RDT framework which we developed in consultation with NFIP is included as Table 25. The central takeaway from this analysis is that Option 1 provides NFIP with optimal protection given its institutional financial priorities as identified in Table 24 and the metric weightings selected. The benefits of this structure are many and are visually represented in Figure 107 where NFIP's gross and net loss perspectives are charted. In short, with a $7.8B aggregate attachment and exhaustion at the 1-in-100 year all perils loss threshold, Congress and the US Treasury are effectively protected against having to increase NFIP's borrowing authority for 99% of possible annual outcomes. This equates to a $16.9B differential at the 1-in-100 year loss level.

Such coverage provides a great deal of political certainty which may well be worth the associated cost in optimal circumstances. However, it is important here again to emphasize that optimal does not necessarily imply practical or even possible. It is also important to emphasize the sensitivity of RDT results to metric weights and the number and type of structure options included.

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Table 27: NFIP Reinsurance Decision Tool Results

Net Mean Underwriting Result

	Gross No Reinsurance	Option 1 - Agg. 16.9B xs 7.8B	Option 2 - Occ. 14.4B xs 3.9B	Option 3 - Occ. 10.5B xs 7.8B	Option 4 - Occ. / Agg (Ex HU/TS) 14.4B xs 3.9B / 5.25B xs 3.75B
Gross Premium	3,500,000,000	3,500,000,000	3,500,000,000	3,500,000,000	3,500,000,000
Ceded Premium	-	2,159,084,307	1,684,784,342	855,478,975	2,194,140,513
Net Premium	**3,500,000,000**	**1,340,915,693**	**1,815,215,658**	**2,644,521,025**	**1,305,859,487**
Gross Losses	4,654,847,585	4,654,847,585	4,654,847,585	4,654,847,585	4,654,847,585
Ceded Losses	-	807,497,531	732,914,057	271,811,644	894,889,320
Net Losses	**4,654,847,585**	**3,847,350,054**	**3,921,933,528**	**4,383,035,941**	**3,759,958,265**
Net Expenses	**1,312,500,000**	**1,312,500,000**	**1,312,500,000**	**1,312,500,000**	**1,312,500,000**
Net Underwriting Result	**(2,467,347,585)**	**(3,818,934,361)**	**(3,419,217,870)**	**(3,051,014,916)**	**(3,766,598,778)**

Results of Metric Calculations

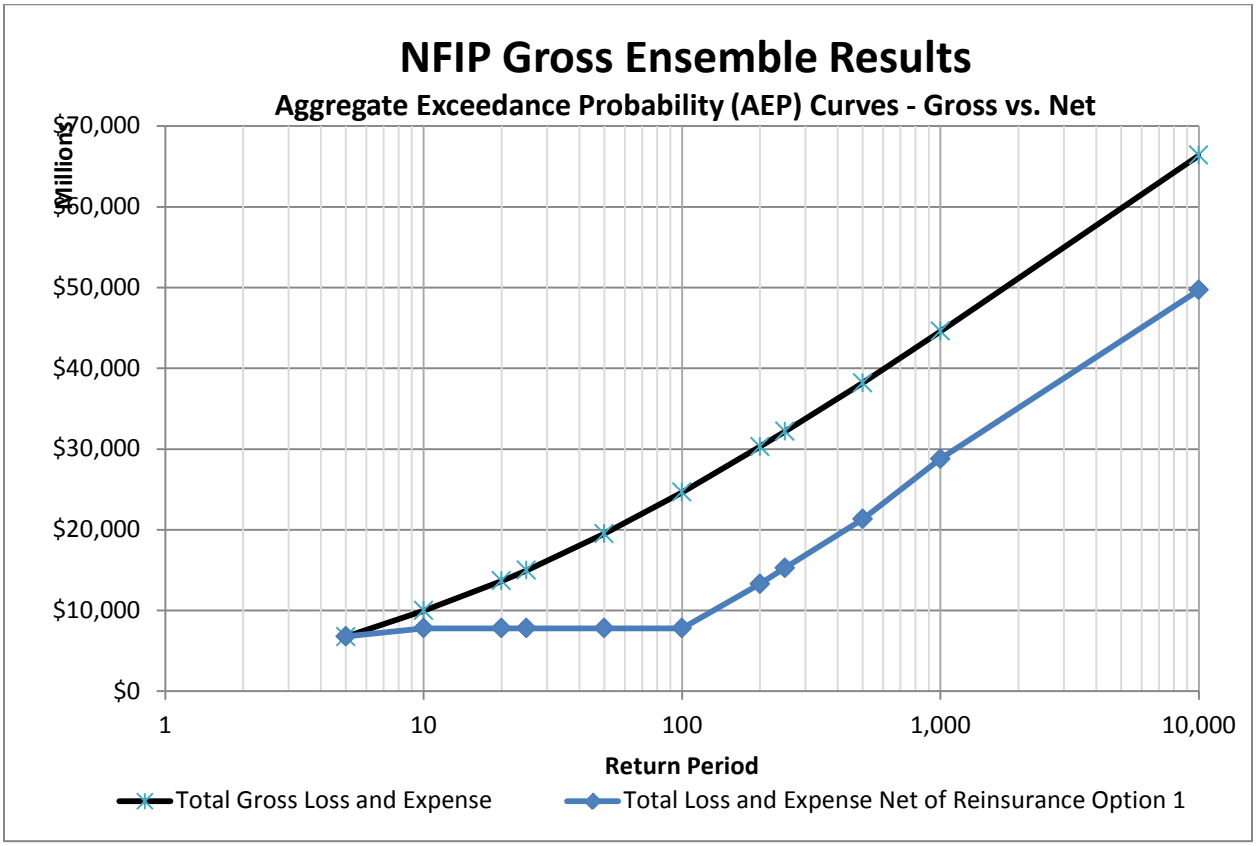
Metric Types: Volatility | Budget

Min/ Max	Metric	Gross No Reinsurance	Option 1 - Agg. 16.9B xs 7.8B	Option 2 - Occ. 14.4B xs 3.9B	Option 3 - Occ. 10.5B xs 7.8B	Option 4 - Occ. / Agg (Ex HU/TS) 14.4B xs 3.9B / 5.25B xs 3.75B
Min	**Net Loss and ALAE TVaR 99.0%**	33,245 M	16,348 M	19,694 M	24,752 M	18,982 M
Min	**Net EPD @ $7.8B**	2,146 M	161 M	1,077 M	1,874 M	866 M
Min	**TVaR of Net Loss @ $7.8B**	13,358 M	16,640 M	10,773 M	11,666 M	10,731 M
Min	**Probability Net Loss > $7.8B**	16.1%	1.0%	10.0%	16.1%	8.1%
Min	**Cost of Reinsurance Mean**	0 M	1,352 M	952 M	584 M	1,299 M
Min	**Net Loss and ALAE Mean**	4,655 M	3,847 M	3,922 M	4,383 M	3,760 M

Scores Based On Calculation Results

Weight	Metric	Gross No Reinsurance	Option 1 - Agg. 16.9B xs 7.8B	Option 2 - Occ. 14.4B xs 3.9B	Option 3 - Occ. 10.5B xs 7.8B	Option 4 - Occ. / Agg (Ex HU/TS) 14.4B xs 3.9B / 5.25B xs 3.75B
10%	**Net Loss and ALAE TVaR 99.0%**	0.00	1.00	0.80	0.50	0.84
40%	**Net EPD @ $7.8B**	0.00	1.00	0.54	0.14	0.64
0%	**TVaR of Net Loss @ $7.8B**	0.56	0.00	0.99	0.84	1.00
0%	**Probability Net Loss > $7.8B**	0.00	1.00	0.40	0.00	0.53
40%	**Cost of Reinsurance Mean**	1.00	0.00	0.30	0.57	0.04
10%	**Net Loss and ALAE Mean**	0.00	0.90	0.82	0.30	1.00
	Overall Score - Unweighted	0.26	0.65	0.64	0.39	0.68
	Overall Score - Weighted	0.40	0.59	0.50	0.36	0.46

Figure 107: Gross vs. Net Loss Curves – NFIP Reinsurance Structure Option 1



With this in mind, Option 1, though most desirable from NFIP's perspective as presented herein, would likely require several years to build up sufficient market capacity to support a full $16.9B of coverage. Currently the largest reinsurance program in the global market is the Zenkyoren program featured in the Peer Review section and it tops out at $10B in limit. Given current market conditions and the appetite of the reinsurance market for new premium and new perils we expect a $16.9B limit should be feasible to place for NFIP at some point in the future though not right away.

There is also the issue of NFIP's ability to pay for reinsurance protection. Currently NFIP's finances do not offer much room for expenditure on any reinsurance whatsoever, much less anywhere near a $2B+ spend – the amount of reinsurance premium potentially required to unlock a full $16.9B in catastrophe reinsurance limit. If NFIP is to enter the reinsurance market with a structure like Option 1 it will likely be only partially placed until NFIP's finances improve and premium rates grow adequately to allow for more reinsurance purchasing.

There are additionally some concerns with relying exclusively on a large Aggregate XOL placement. Aggregate reinsurance transactions, until fairly recently, have been difficult to execute. While such a placement would provide NFIP with ideal protection against both an unexpected frequency and severity of loss activity in any given treaty year, the appetite in the reinsurance market for aggregate protections is somewhat less robust and more fickle compared to its appetite for occurrence covers – the property catastrophe market standard – since balancing the needs of buyer and seller through such transactions has been very challenging historically. Given the current highly competitive market landscape driven by a variety of emerging trends including the influx of alternative capital,

aggregate transactions have been getting done though an occurrence cover might represent a safer play for the NFIP initially.

The principle advantages of occurrence covers center around cost and market support. From a cost perspective, occurrence protection is relatively less expensive than an equivalent amount of Aggregate XOL on a risk relative basis. Occurrence protection is also the basis on which most buyers of reinsurance secure their natural catastrophe protection; as such there will be a greater number of reinsurance providers in a position to allocate capacity, which in certain circumstance can help drive program cost lower through competition. The primary drawback with this option is it does not cover all sources of loss. Losses falling below the program attachment remain the responsibility of the NFIP therefore potential budget uncertainty remains since the number of occurrences in any given year is an unknown factor. All this being said, a more practical (vs. optimal) approach to reinsurance purchasing evaluation for NFIP which takes into consideration factors such as execution risk and the organization's ability to pay might come up with a very different result.

Additionally, shifts in metric weights can change structure scores somewhat substantially. Emphasizing Cost of Reinsurance more heavily than EPD for instance could alter the results so that Option 1 no longer comes out on top. Moreover, leaving the gross perspective (without reinsurance) in the mix of structural comparisons changes the relative scores for each metric since scores are scaled based upon the range of outcomes in the sample set. It stands to reason that excluding the gross perspective would result in greater sensitivity in metric scores across structure options.

Moreover, all of the benefits of purchasing reinsurance are not explicitly tangible or readily measurable financially. Reinsurers and reinsurance service providers such as intermediaries, through their global networks of contacts and their analytical resources can provide cedants with a variety of invaluable though largely intangible benefits such as access to timely and important underwriting or financial management expertise. For instance reinsurers may offer cedants underwriting advice based off their knowledge from related international experience which could yield benefits for both parties. Indeed reinsurers once "on risk" are incentivized to support their clients in improving their underwriting performance given the inherent interest alignment involved in risk transfer. Intermediaries may offer cedants an opportunity cost benefit by diminishing the amount of internal resource required to procure reinsurance and conduct related financial analyses. Such benefits are not readily quantifiable though often factor in to reinsurance purchasing decisions nonetheless.

Similar tools and services could be brought to bear on the privatization efforts the NFIP might elect to pursue (see Privatization Study provided as a component of the FIRS). For example, as the NFIP's flood rates begin to rise, FIMA together with its service providers could construct balanced portfolios of flood risk that could be ceded to willing partners in the private sector. This could help de-populate the NFIP in a similar fashion to the efforts undertaken in Florida by Florida Citizens. By using approaches that look to optimize the economics around a basket of flood policies, the NFIP could cede exposure to the private sector while balancing that objective against the overall financial objectives of the NFIP.

F. As If Historical Analysis

One of the most basic and important tests of a prospective reinsurance program is how it would have performed based on historical loss experience. To do this appropriately it is first necessary to trend and on-level historical losses so that each loss year is comparable and preferably on the same basis as used in any related modeling analysis (in this case, to 2012 values). The analysis of NFIP's historical claims data conducted by AIR Worldwide for the FIRS project developed a granular methodology for assigning individual claims to meteorological events and for trending historical losses at the Zip code level based upon exposure growth. The losses from this AIR analysis were used to inform the as-if analysis in Table 26 also depicted in Figure 108.

Looking at the optimal reinsurance structure selected as a result of NFIP's RDT exercise (Option 1 in Table 25) historical annual aggregate losses would have exceeded the structure's retention four times in the history of NFIP resulting in aggregate payouts of $27B over 35 years or an annual average of $793M. While there is substantial variance around this mean number (a CV of 378%) such analysis provides a useful benchmark against which to measure the results of any modeling exercise since both experience and exposure rating provide valuable tools for risk evaluation and premium pricing in the (re)insurance underwriting discipline. Interestingly, ceded losses for structure Option 1 on a modeled basis (as shown in Table 25) are $807M as compared to $793M – a very close match.

Table 28: As If Historical Reinsurance Analysis Results – Option 1

				Aggregate XOL	
				As If - Actual	As If - Indexed
				$16,900,000,000	$16,900,000,000
				xs	xs
Year	Claim Count	NFIP Actual Loss	NFIP Indexed Loss	$7,800,000,000	$7,800,000,000
1978	32362	$135,317,720	$3,464,904,942	$0	$0
1979	74034	$428,198,978	$7,444,795,888	$0	$0
1980	46028	$210,658,638	$2,744,355,408	$0	$0
1981	25774	$112,331,495	$1,423,251,280	$0	$0
1982	34489	$167,019,474	$2,012,868,593	$0	$0
1983	55484	$392,146,907	$4,303,420,155	$0	$0
1984	31037	$223,461,802	$2,322,438,506	$0	$0
1985	41020	$329,287,342	$3,042,582,115	$0	$0
1986	15837	$121,279,522	$1,007,129,409	$0	$0
1987	16093	$100,775,546	$789,526,012	$0	$0
1988	10635	$52,126,591	$383,495,331	$0	$0
1989	46270	$669,537,086	$3,264,395,015	$0	$0
1990	18507	$176,010,761	$1,065,604,347	$0	$0
1991	35139	$367,414,390	$2,129,570,546	$0	$0
1992	58759	$696,976,125	$3,805,280,549	$0	$0
1993	43860	$657,506,551	$3,173,981,375	$0	$0

Table 29: As If Historical Reinsurance Analysis Results – Option 1 (cont'd)

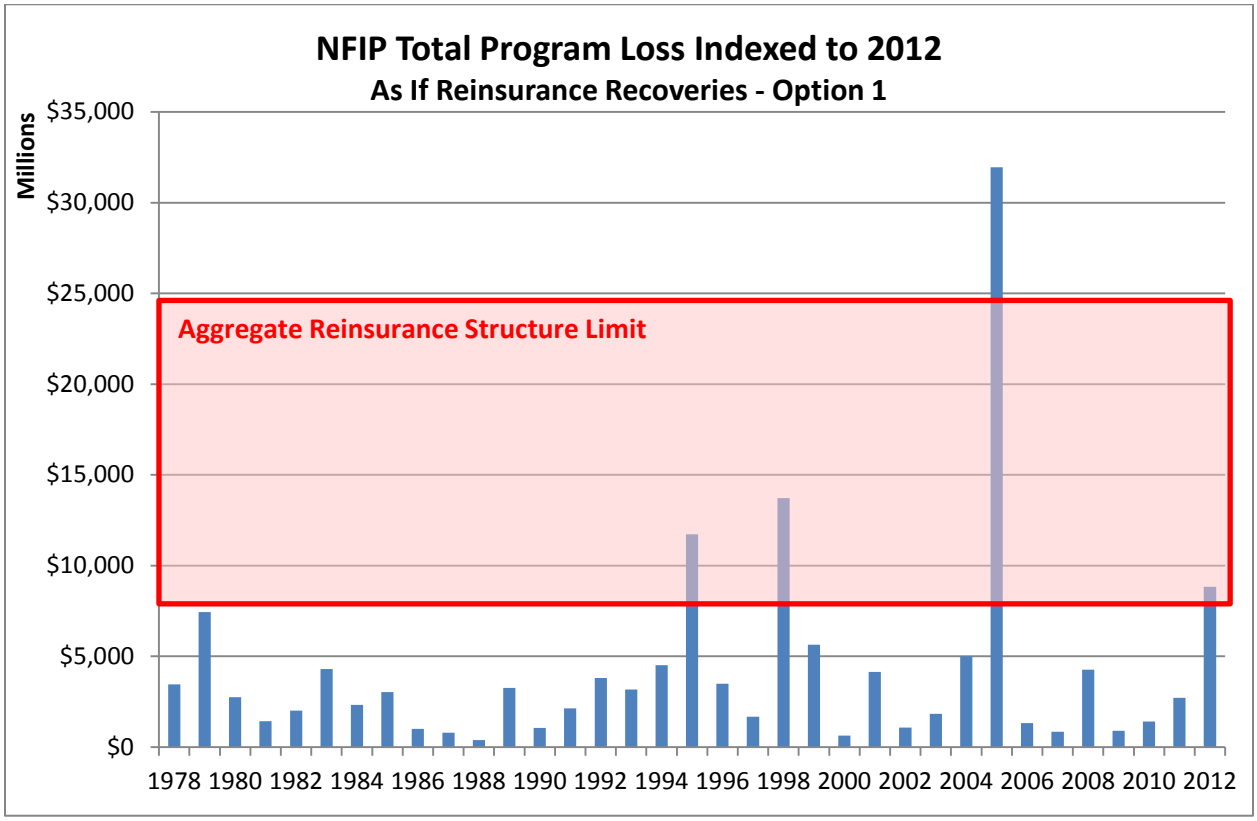
				Aggregate XOL	
				As If - Actual	As If - Indexed
				$16,900,000,000	$16,900,000,000
				xs	xs
Year	Claim Count	NFIP Actual Loss	NFIP Indexed Loss	$7,800,000,000	$7,800,000,000
1994	28058	$416,822,843	$4,512,536,225	$0	$0
1995	77790	$1,312,213,937	$11,724,300,297	$0	$3,924,300,297
1996	64931	$822,027,907	$3,485,840,680	$0	$0
1997	37441	$532,114,661	$1,676,432,925	$0	$0
1998	77477	$886,974,323	$13,716,102,534	$0	$5,916,102,534
1999	66741	$788,316,934	$5,639,932,400	$0	$0
2000	22545	$264,599,043	$636,306,579	$0	$0
2001	52844	$1,310,521,576	$4,141,273,471	$0	$0
2002	33731	$450,869,533	$1,074,585,659	$0	$0
2003	46348	$772,254,049	$1,829,738,419	$0	$0
2004	74098	$2,252,198,794	$5,002,725,806	$0	$0
2005	274450	$17,717,076,562	$31,944,597,875	$9,917,076,562	$16,900,000,000
2006	29030	$657,658,147	$1,315,004,521	$0	$0
2007	27881	$631,193,697	$842,011,365	$0	$0
2008	95075	$3,500,250,318	$4,275,868,891	$0	$0
2009	37004	$799,177,307	$900,990,346	$0	$0
2010	37037	$813,859,980	$1,408,888,802	$0	$0
2011	94728	$2,542,173,776	$2,710,917,107	$0	$0
2012	173662	$8,829,714,658	$8,828,492,909	$1,029,714,658	$1,028,492,909
Grand Total	**1936199**	**$50,140,066,975**	**$148,044,146,283**	**$10,946,791,221**	**$27,768,895,741**

Avg. Annual Loss	***$312,765,463***	***$793,397,021***
StDev	***$1,656,027,446***	***$3,000,173,521***

Notes:

All claim types aggregated by year excluding ALAE, Subrogation, ICC, Special Expense and Pre-Flood Mitigation
NFIP loss indexation methodology was devised by AIR Worldwide as part of the FIRS project (FEMA Claims Analysis, June 18, 2014)
Indexation Method Description: based on the change in total coverage from the claim year to 2012 to account for the increase in exposure. The index was calculated as (Total Coverage 2012)/(Total Coverage Claim Year) for each ZIP Code/occupancy combination within NFIP's detailed exposure data for claims with a date of loss from 1994 to 2012. Detailed exposure data was not available for 1978-1993 periods. Consequently, the exposures index for these years was calculated based on the percent change in total coverage from 2012 to the claim year applied at the national level using data available from the Total Coverage by Calendar Year Report published by FEMA online.

Figure 108: NFIP's "As If" Historical Reinsurance Recoveries for Option 1 – Losses Indexed to 2012 Exposures



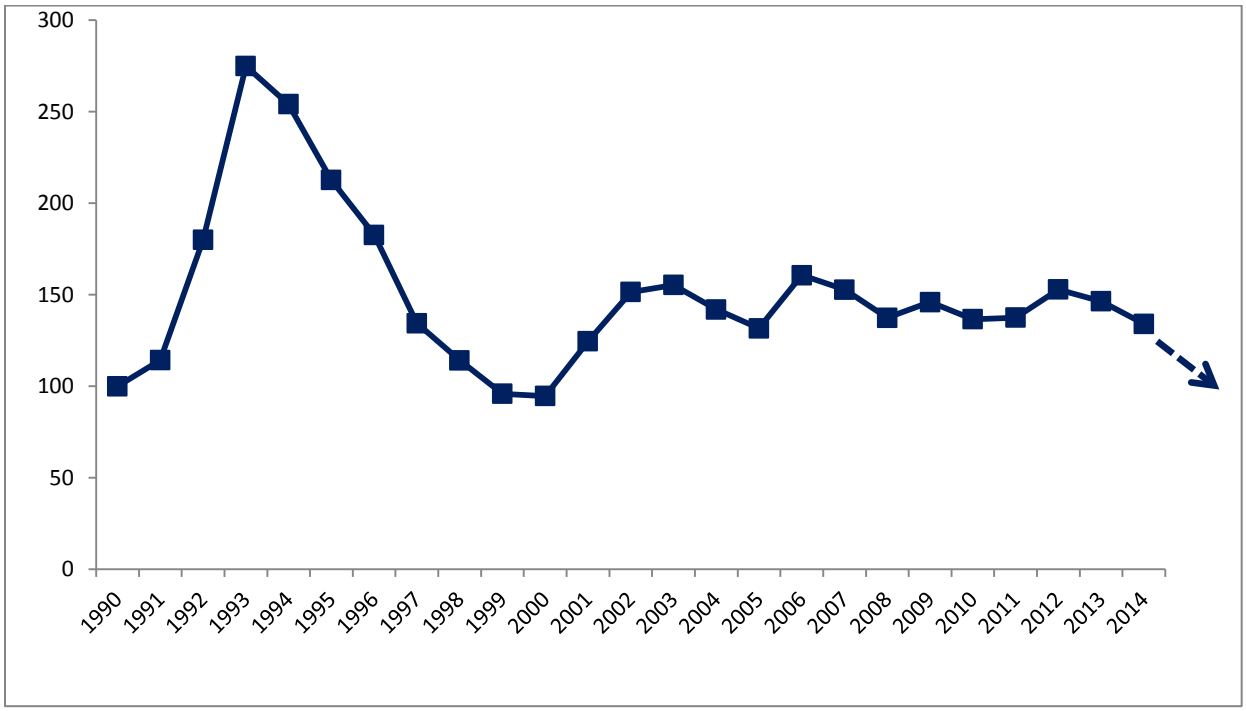
4 REINSURANCE MARKET SCENARIOS

Broadly speaking there are three general directions in which the Global Reinsurance pricing environment can turn going forward – up, down or horizontal. Illustrated below are three projections for movements of the Guy Carpenter Global Property Catastrophe Rate-On-Line Index. Each scenario considers changes in the many variables that can significantly impact reinsurance pricing – the three major variables being interest rates, reserve trends and the severity of natural catastrophes – keeping in mind that there is no formula for predicting any of the three general outcomes. It is also important to acknowledge the many variables which impact reinsurance prices but are driven largely by factors occurring outside of the industry (such as the influx of third-party investor capital) making them hard to predict.

A. Scenario 1 – Decrease

This first scenario should be considered the base case scenario. In order for property catastrophe prices to continue to fall conditions would need to remain reasonably stable as respects the three major variables mentioned above. This translates into a persistent low interest rate environment with the ten year US Treasury rate staying at around 2.5%; relatively stable reserve amounts, meaning no major adverse developments and; natural catastrophes remaining near the historical industry average, or at least relatively light versus industry capital levels.

Figure 109: Scenario 1 – Projected Change in Guy Carpenter's Global Rate on Line Index



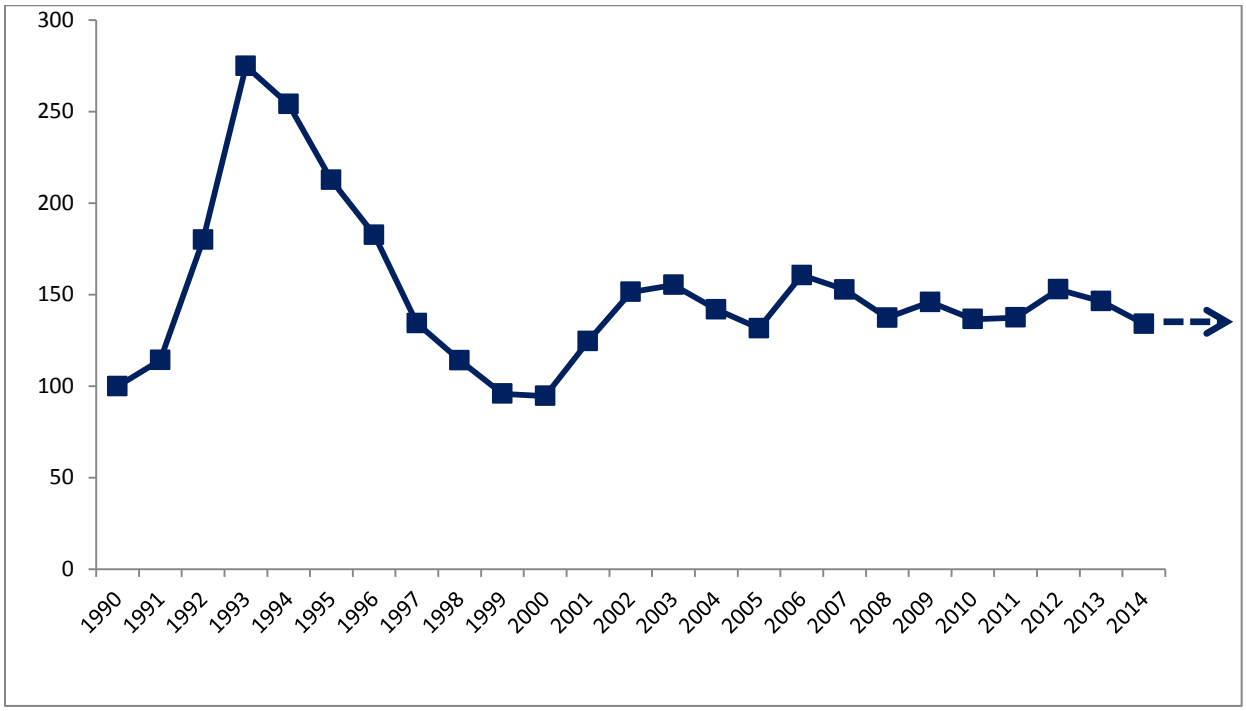
The base case scenario would most likely lead to a continuation of reinsurance property catastrophe rate declines as illustrated in Figure 109. Low interest rates tend to keep (re)insurers' investment income relatively low as much of their assets are invested in fixed income securities. A

low interest rate environment also tends to keep inflation low which can keep loss costs stable. Without any significant loss activity all of these continued economic conditions would keep industry capital buoyant and market conditions soft continuing the downward pricing trend.

B. Scenario 2 – Flat

As mentioned above, even if the conditions typified in Scenario 1 above persist over the long term reinsurance prices at some point should theoretically level off as they begin to reach a technical floor. However, in order for pricing to stabilize in the near term the reinsurance industry would need to hit a few bumps in the road. Specifically a rise in interest rates of approximately 40% or 100 basis points over assumed average interest rates in the base case (Scenario 1) could cause some mitigation of ongoing price declines to occur. Couple this with some adverse reserve development and/or some moderate catastrophe loss activity and pricing could potentially level off enitrely.

Figure 110: Scenario 2 – Projected Change in Guy Carpenter's Global Rate on Line Index

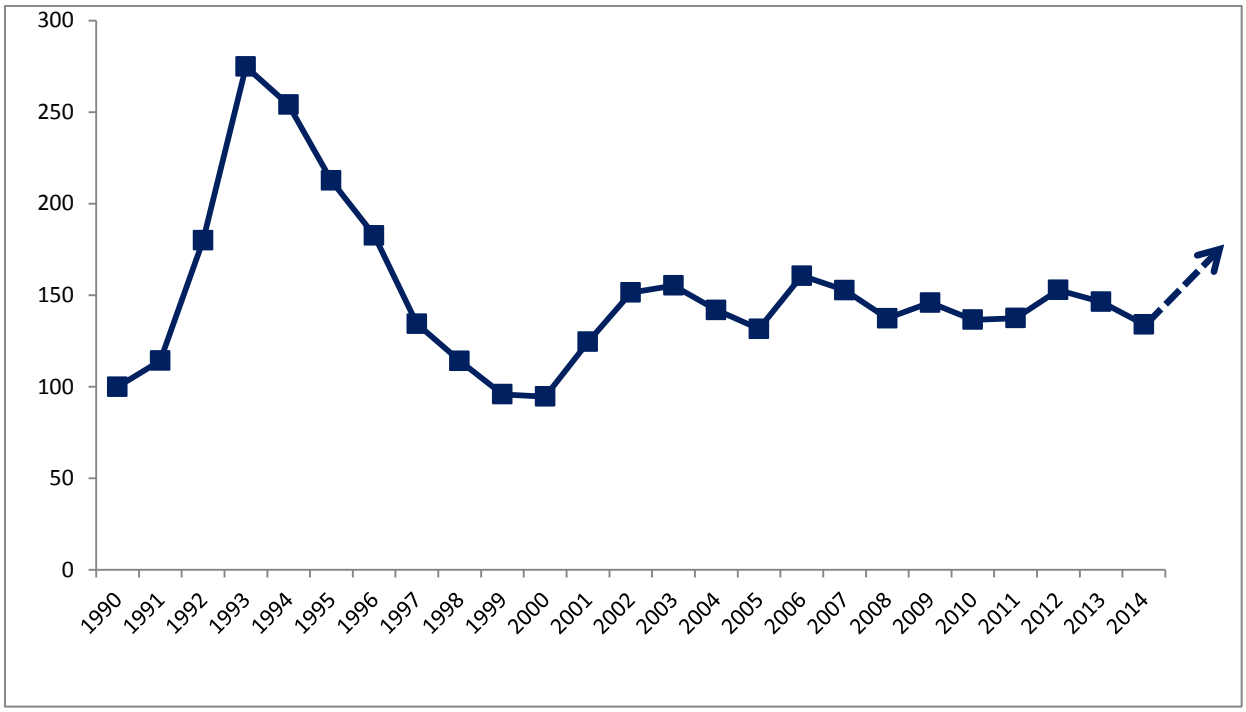


The effects of such conditions are demonstrated in Figure 110. A rise in interest rates and a connected increase in inflation will negatively impact reinsurers' loss costs. In addition adverse reserve development would also negatively impact reinsurers' results by eroding calendar year earnings. On the flip side an increase in interest rates would positively impact the net investment income generated by reinsurers' investment portfolios which would need to be offset at least in part by higher than average catastrophe loss activity in order to put a halt to property catastrophe reinsurance rate declines.

C. Scenario 3 – Increase

Given the analysis of trends impacting the reinsurance industry contained in the Current Market and Historic Market Assessment sections of this Reinsurance Study and general market consensus, it is very clearly going to take a significant event (or a combination of events) to cause any meaningful increase in the property catastrophe rating environment. For instance, more of an interest rate spike than contemplated in Scenario 2 (e.g. ten year US Treasury increases to 4.5% over a short duration) would be needed to cause rates to move in the opposite direction – but this factor on its own is likely insufficient. Similarly reserve development would need to be particularly adverse by most historical measures in order to cause an increase in reinsurance prices by itself. The reinsurance industry's most significant and volatile exposure is on the underwriting side of its balance sheet where catastrophes can cause 12-figure industry insured losses. Indeed many expect a $100B industry insured loss event (almost as much as the industry suffered from multiple catastrophe losses in 2005 and 2011) would be needed to move rates upwards and others have indicated that such a loss coupled with a second factor (e.g. an interest rate spike or adverse reserve development) would need to be added to the mix for this to happen.

Figure 111: Scenario 3 – Projected Change in Guy Carpenter's Global Rate on Line Index



As seen in Figure 111, a large property catastrophe event combined with an interest rate rise could move industry results beyond a reinsurance sector "earnings" event into a "capital" event. Add in rising loss costs due to heightened inflation and this scenario could drain enough capital out of the sector to move property catastrophe rates higher. These rates could then be sustained for several years until the industry builds its capital levels back up, as has been the case in the past, or rates could fall back down more quickly given the change in the capital structure of the industry due to the influx of third-party capital.

While it is difficult to ascribe probabilities to each of the above scenarios, it is safe to say that Scenario 1, where global pricing continues to decline, is the most likely outcome in the next turn of the cycle based on current trends in the Global Reinsurance market especially those affecting the property catastrophe subset thereof. A flattening of current decreases – Scenario 2 – might be expected in the medium term even with the continuation of current trends if one buys into the concept that the market has an intrinsic floor where reinsurers largely begin to hold prices at a certain level. *On the other hand a Scenario 3 outcome – where global prices increase – would likely require a fairly rare event.* For example, based upon AIR's estimation of the private insurance market's exposure to hurricane wind losses cited in the Current Market Assessment, the loss curve crosses the $100B mark at the 1-in-50 year level.

5 REINSURANCE MARKET SCENARIOS – IMPACT ANALYSIS

Generally speaking NFIP's reinsurance pricing could reasonably be expected to follow global pricing trends, at least directionally. However, as pointed out in the Market Cycles section of the Historical Market Assessment, global reinsurance pricing does not necessarily reflect regional reinsurance pricing. Moreover, it is fair to say that regional reinsurance pricing movements vary from cedant-to-cedant depending upon individual account loss experience – both over time and during the prior year – with programs which have been directly impacted by a given catastrophe bearing the brunt of potential increases at renewal.

Therefore while the above global scenarios are instructive, any conclusions we draw therefrom should carry the above subjectivities. Furthermore, NFIP's status as a new buyer of reinsurance with a limited experience base could make it harder for the organization to realize large price decreases in the early years of its reinsurance program should the market environment so dictate. Reinsurers' technical view of US flood risk likely will not have altered in such a short time frame and reinsurers will still be gaining comfort with a program that represents a new large risk on their balance sheets. On the other hand, given the unique nature of NFIP's risk profile, its size and potential buying power the reinsurance market could behave differently providing price decreases in excess of overall market movement to gain a greater share of the program – some of these variables can only be known once NFIP actually enters the market. Regardless, in the following analysis we have attempted to treat NFIP as a "standard" cedant with price movements tracking global fluctuations.

The best way to demonstrate the potential impact of the above three scenarios on NFIP is to use a hypothetical reinsurance program structure. Taking reinsurance program Option 1 – which was identified in Table 25 as the optimal structure given chosen structure options, metrics and weights – with an estimated reinsurance premium of $2.16B we can calculate the impact of price movements more readily and in absolute terms. Since Scenarios 1 and 2 represent the most likely outcomes and would be positive from NFIP's perspective (and therefore not be of great concern from a fiscal management standpoint) *this impact analysis focuses on the less likely downside risk represented by Scenario 3 where the cost of reinsurance would rise.*

While the increase in the GC Global Property Catastrophe ROL Index from 1992 to 1993 was in excess of 60%, the increase in 2006 was about half that and all movements up or down since 2007 have been 1,000 basis points or less in magnitude despite some significant loss activity in that time frame (e.g. Hurricane Ike in 2008 and the worst year for economic catastrophe losses on record, 2011). This tempering of volatility implies a more stable reinsurance pricing environment going forward. However, there are a number of relatively rare occurrences which could foreseeably cause increases in the index in excess of 10% and possibly up to 1993 levels. Such items which could move the index materially have been mentioned previously in this report though warrant repeating. They include:

- **Model Surprise**: Both Hurricanes Andrew and Katrina surprised the industry insofar as they caused losses of a magnitude and type which had not been contemplated by reinsurer risk assessments previously. Hurricane Andrew was a wake-up call for the industry in general alerting reinsurers to the extent of catastrophic risk along the Gulf and East Coasts of the

US and to their deficit up until then in pricing for such catastrophic risk spurring the growth of the modern catastrophe modeling industry. Hurricane Katrina was so devastating for insurers in large part by virtue of levee failures in New Orleans which had not been fully contemplated by catastrophe models previously. Such surprises revealed underlying deficiencies in underwriting approaches and caused many reinsurers to retool their risk assessment methods. Complicating the post Katrina market you saw a shift in focus by rating agencies to monoline catastrophe writers placing the volatility inherent in their business models under greater scrutiny.

- **$100B+ Industry Property Catastrophe Event**: There are many natural occurrences which could potentially cause 12-figure industry losses. The most hotly anticipated of these is a hurricane hitting Florida, specifically a category 4 or 5 centered on the Miami area. Some models even include stochastic events which contemplate a hurricane hitting Miami and continuing up the Eastern Seaboard to make landfall in the New York and New Jersey area such as the 0.01% probability event referenced in the Insurance Linked Securities section of the Current Market Assessment. Other natural and manmade occurrences have similar loss potential such as an earthquake in a populous region or a terrorist attack. However, the pressure on reinsurance prices is so intense right now that any one of these events occurring alone may not be enough to cause significant upward pricing movement. According to S&P it could take two simultaneous "shock scenarios" to turn rates upward again[194] like a large natural catastrophe and a spike in inflation.
- **Economic Catastrophe**: An economic catastrophe like the financial crisis of 2008 could have a marked impact on reinsurer balance sheets especially if it were to cause more widespread defaults on fixed income securities and/or if coupled with adverse catastrophe loss experience. Coming out of the 2008 crisis other economic risks are perhaps of more immediate concern such as a swift and sizable interest rate spike which could cause significant mark-to-market or realized balance sheet losses depending on other industry stresses. Similarly a spike in inflation could cause loss costs to increase necessitating an increase in reserves and forcing a noticeable shift in industry capital ratios.
- **Other**: Some as yet unknown or emerging risk could cause a shift in property catastrophe reinsurance pricing. For instance, risks as exotic as solar storms, cyber warfare or a systemic casualty catastrophe (e.g. asbestos) have all been mooted by industry participants as areas to watch for their potential to cause large (re)insurance losses.

If any of the above were to occur a price increase could reasonably be expected though the magnitude of such an increase of course would depend on the magnitude of the loss. Given historical fluctuations in the GC Global Property Catastrophe ROL Index a reasonable ceiling for a given annual upward change in the index might be 30% considering all of the various market factors currently at play. A 30% hike in the cost of Option 1 would result in a $648M increase in reinsurance premium the following year. This amount of course would be proportionally lessened if NFIP were to purchase less than the full amount of coverage contemplated in Option 1, which is most likely the case in any practical near-term circumstance where NFIP might actually purchase reinsurance protection, though again here we are focused on hypothetical optimum conditions.

While $648M is certainly a significant number it is important to look at it in the context of NFIP's other liabilities. *For instance, a $648M premium increase would equate to just a 1-in-1.4 year loss if placed on NFIP's Gross OEP All Perils loss curve (Figure 104).*

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[194] SNL Financial; S&P says reinsurers need 2 'shock scenarios' to turn pricing; September 9, 2014

NFIP's recent loss experience should also be considered. A 30% premium increase would certainly seem onerous if it were to occur after NFIP's reinsurance program had a clean loss year. Though if reinsurers had just paid a full-limit-loss to NFIP in the prior year (or $16.9B under Option 1), a 30% premium increase might appear less onerous.

A correlated risk to NFIP as a cedant which would arise out of its exposure to the reinsurance pricing cycle would be the potential for capacity deficiency. Capacity for property catastrophe risk has sometimes been tight in years after large scale disasters making it difficult for some reinsurance buyers to complete their desired purchases. In order for such an outcome to take place industry capital would need to be significantly compromised and/or underwriters sufficiently surprised by an event to hold back or remove capacity in certain zones until the outcome of the event and its implications are clear. Even in relatively normal circumstances, some buyers trying to renew their programs during or directly after a large loss might encounter short-term underwriting freezes. Though in either instance the capacity lack would be temporary and the duration of any such future crunch is now expected to be much shorter than in years past given the amount of pension fund capital waiting in the wings and the speed with which such alternative capital can now be mobilized through a variety of alternative risk financing vehicles such as ILS funds, sidecars, etc. (see the Insurance Linked Securities section of the Current Market Assessment for details).

It is also important to note that any individual reinsurance buyer is not necessarily at the whim of the market. There are a variety of mechnisms available to cedants which help them to manage across the cycle and minimize the budgetary risk associated with potential reinsurance price spikes.

- The most basic of these risk management mechnisms is to try and renew any programs outside of peak seasonal risk periods. US hurricane season technically begins June 1st and ends November 30th. Thus to avoid having to renew a hurricane-exposed program with a hurricane loss in progress it is often advisable to set the renewal date outside of this date range (in fact, June 1 is a common renewal date for such programs). Another increasingly common risk management mechanism used by cedants to manage the cycle is the multiyear reinsurance agreement or catastrophe bond. Such arrangements can be made for as many as three years[195] giving buyers some price certainty over that time frame and smoothing out their annual budgets. However, there is some downside associated with multiyear agreements – if the market softens in year two or three the buyer will be unable to realize those potential cost savings.Yet another risk management mechanism available to cedants is the ability to restructure their reinsurance program after a loss. For instance, re-layering a standard occurrence excess of loss program after a loss or converting part of it to an aggregate cover. Such changes make year-over-year comparisons of cost more difficult and can serve to capitalize on changing market dynamics.

[195] Longer tenors are possible though rarely do multiyear catastrophe risk transfer contracts extend beyond three years.

APPENDIX

1 APPENDIX - CURRENT MARKET ASSESSMENT

A. Market Interviews

1. Market List

There are approximately 500 reinsurance companies and Lloyd's syndicates worldwide of which almost 250 accepted some form of catastrophe business in 2013[196]. For the purposes of this Reinsurance Study and elements of the forthcoming Privatization Study we have spoken to a variety of prospective (re)insurance counterparties about their interest in and ability to underwrite US flood risk. These (re)insurers represent a broad swathe of the industry each with a particular expertise and/or perspective we think may be of potential interest or value to FEMA/NFIP.

The list of entities in the following section represents the largest most influential underwriters of reinsurance catastrophe risk across the traditional reinsurance and capital market sectors. To achieve meaningful support on large reinsurance program (e.g. a program structured with over $1 billion of reinsurance limit), some, if not all, of these markets would need to be engaged at some level. By our estimation we believe these markets provide over 50% of the catastrophe risk capacity placed across the globe.

Through our research and market conversations we have gained unique insights into underwriters' current and potential appetite for business, and their ability to provide support behind US primary flood risk. This insight has been incorporated in the main body of this report and will be expanded upon as the FIRS project progresses.

[196] Based on Guy Carpenter Business Intelligence Department data from over 100 (re)insurance groups worldwide.

Table 30: List of Influential Reinsurers and Insurance Linked Securities Funds

Traditional Property Catastrophe Reinsurers				
Company	**Surplus (000) [1)]**	**AM Best Rating**	**AM Best Rating Date**	**Contacted**
Bermuda				
ACE Tempest Reinsurance Ltd.	$10,414,981	A+	12/31/2012	No
Amlin Bermuda, a branch of Amlin AG	$1,625,336	A	12/31/2012	**Yes**
Arch Reinsurance Ltd	$5,511,651	A+	12/31/2012	No
Aspen Bermuda Limited	$2,116,865	A	12/31/2012	**Yes**
AXIS Specialty Limited	$4,491,610	A+	12/31/2012	**Yes**
Catlin Insurance Company Ltd.	$3,456,000	A	12/31/2012	**Yes**
DaVinci Reinsurance Limited (U/W conducted by Ren Re)	$1,498,221	A	12/31/2012	**Yes**
Endurance Specialty Insurance Limited	$3,023,361	A	12/31/2012	No
Hiscox Insurance Company (Bermuda) Limited	$1,018,575	A	12/31/2012	No
Markel Bermuda Limited	$2,107,900	A	12/31/2012	No
Montpelier Reinsurance Ltd	$1,991,700	A	12/31/2012	No
Partner Reinsurance Company Ltd.	$4,056,701	A+	12/31/2012	**Yes**
Renaissance Reinsurance Ltd.	$1,800,000	A+	12/31/2012	**Yes**
Validus Reinsurance, Ltd.	$3,838,200	A	12/31/2012	**Yes**
XL Re Ltd	$4,172,231	A	12/31/2012	**Yes**
US				
Berkshire Hathaway Inc.	$88,175,200	A++	9/20/2013	No
Everest Reinsurance Company	$2,673,100	A+	9/30/2013	No
Odyssey Reinsurance Company	$3,088,760	A	9/30/2013	No
Transatlantic Reinsurance Company	$4,425,100	A	9/30/2013	**Yes**
Europe				
Hannover Re Group	$2,158,235	A+	12/31/2012	No
Munich Reinsurance Group	$23,835,755	A+	12/31/2012	**Yes**
SCOR Group	$2,416,250	A	12/31/2012	No
Swiss Re AG	$13,951,216	A+	12/31/2012	**Yes**
London				
Lloyd's Underwriter Syndicate No. 0033 HIS (Hiscox)	£950,000	A	N/A	**Yes**
Lloyd's Underwriter Syndicate No. 0435 FDY (Faraday)	£325,000	A	N/A	**Yes**
Lloyd's Underwriter Syndicate No. 1414 ASC (Ascot)	£650,000	A	N/A	No
Lloyd's Underwriter Syndicate No. 1910 ARE (Ariel)	£255,000	A	N/A	No
Lloyd's Underwriter Syndicate No. 2001 AML (Amlin)	£1,400,000	A	N/A	**Yes**
Lloyd's Underwriter Syndicate No. 2003 SJC (Catlin)	£1,335,000	A	N/A	**Yes**
Lloyd's Underwriter Syndicate No. 2987 BRT (Brit)	£940,000	A	N/A	No
Lloyd's Underwriter Syndicate No. 4472 LIB (Liberty)	£1,000,000	A	N/A	No

1) For Lloyd's Syndicates, surplus is replaced by stamp capacity; capacity figures based on best advice since Lloyd's ceased disclosing individual syndicate capacity figures in 2008.

ILS Property Catastrophe Markets				
Company	**Est. Capital (000)**	**AM Best Rating**	**AM Best Rating Date**	**Contacted**
Bermuda				
CATCo- Re Ltd	$1,800,000	N/A	N/A	No
DE Shaw	$2,000,000	N/A	N/A	No
Elementum	$1,300,000	N/A	N/A	No
Nephila Capital (Poseidon Re Ltd)	$8,000,000	N/A	N/A	**Yes**
US				
Fermat	$4,000,000	N/A	N/A	**Yes**
Europe				
Credit Suisse Asset Management	$4,000,000	N/A	N/A	No
LGT (formerly Clairden Leu)	$4,000,000	N/A	N/A	No
London				
Pioneer Capital	$1,000,000	N/A	N/A	No
Securis	$2,000,000	N/A	N/A	No

2. Interview Process

Per the Paperwork Reduction Act (PRA), clearance is required from the Office of Management and Budget (OMB) for federally sponsored data collections. PRA clearance is required when standardized data collection from 10 or more respondents is collected in response to a federally sponsored data collection within a 12 month period. As the PRA clearance process can take many months, in lieu of a formal survey we elected to conduct informal interviews of (re)insurance industry participants utilizing publicly available information supplied through FEMA's web-site to inform these conversations.

Guy Carpenter conducted market outreach to a handful of the markets included on the list above. Our intent through these conversations was to build and refine our industry capacity estimates conveyed in this report, to obtain and build greater granularity around some particular issues (outlined below) and to help us generate the most comprehensive study to date for FEMA and the National Flood Insurance Program (NFIP) on the subject of available reinsurance capacity. Through our outreach we have sought to:

1. Obtain expert opinion on how to deal with the challenge of wind and flood correlation (storm surge);
2. Determine how best to mobilize the necessary reinsurance capacity to support US Flood as the NFIP contemplates various potential avenues to privatization and;
3. Collect insights as respects natural catastrophe schemes and Private Public Partnerships (PPP) across the globe.

Our outreach was further organized under a "tiered" approach. Our "tier 1" markets, of which there are 9, are recognized leaders in the sector. They have the ability to commit significant levels of capacity to the NFIP, are well respected for their underwriting expertise and have expressed an active interest in US flood risk either through their own outreach or through internal efforts to understand the peril. Markets agreed to support our outreach efforts in this regard include: *Amlin (Lloyds), Fermat Capital, Hiscox (Lloyds), Munich Re, Nephila Capital, Renaissance Re, Swiss Re, Transatlantic Re, and Validus Re.*

As we built out our FIRS project deliverables, particularly as we constructed the Privatization Study, we conducted a "tier 2" outreach. This involved a second group of reinsurers who also have significant footprints in the reinsurance space. This outreach allowed us to have representation from each of the major sectors in the market represented. Potential reinsurers in this group included: Arch Re, *Aspen Re, AXIS Re, Beazley (Lloyds), Berkshire Hathaway, Catlin (Lloyds), DE Shaw, Odyssey Re, Partner Re, and XL Re.*

Underwriting Criteria

Initial discussions with (re)insurers regarding their US flood appetite and interest yielded the following generalized results:

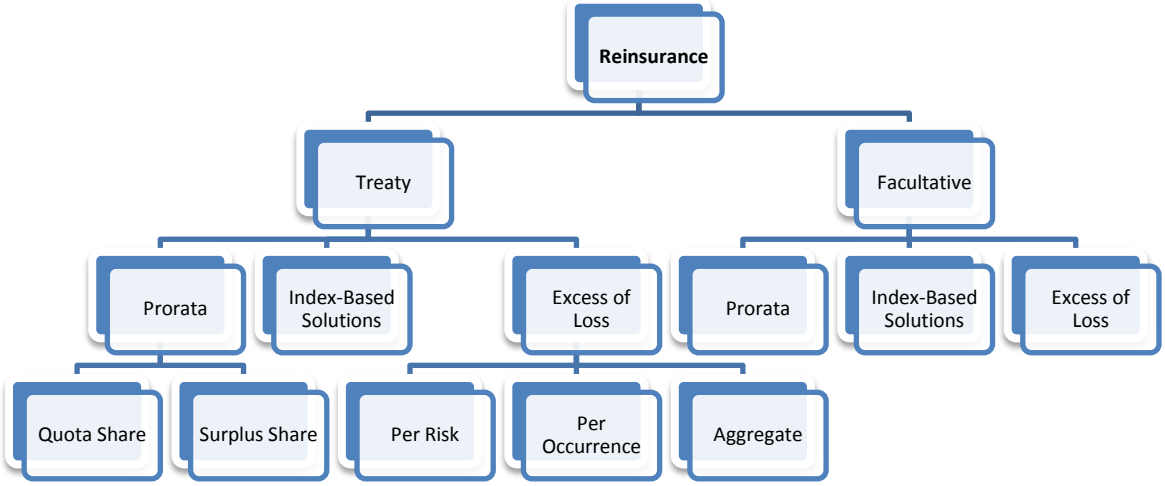
1. Reinsurers are looking for growth opportunities and view US Flood as a good opportunity.
2. Provided pricing is in line, capacity shouldn't be a problem – few mentioned what they might contribute (too early and not enough thinking has been put into it). The closest any one market came to commenting specifically on the correlation between flood & wind was ~25%.
3. FEMA's timing is good given developments with the ILS space.
4. Typical issues and concerns were raised regarding government sponsored deals:
   A. Consistency of purchasing should they enter the market;
   B. Politicians changing the rules post event (political risk) and;
   C. Policy-form differences.
5. The skillset and analytical foundation required for underwriting excess residential or commercial flood risk is significantly different (read, less rigorous) than the process that would need to be followed by the private market to underwrite primary residential or commercial policies exposed first dollar.

B. Reinsurance 101

- To reduce underwriting risk to levels commensurate with their risk appetite, professional insurance companies will purchase any of an array of reinsurance covers.
- The composition of an insurer's reinsurance program will depend on the nature of the company's business, its risk appetite (often described in terms of quantitative and qualitative goals).
- Reinsurance decisions can further be influenced by reinsurer(s)' preferences and specializations, as well as ancillary considerations indirectly related to risk transfer such as access to expertise or underwriting support.
- The most common reinsurance structures used are outlined in Figure 112 below (more sophisticated forms of reinsurance[197] are available but they are highly specialized and largely irrelevant to catastrophe markets).

[197] Among the more complex types of reinsurance transaction which will not be discussed in this paper are Excess Cessions agreements (a hybrid agreement whereby an insurer cedes a portion of its risk excess of a certain limit threshold at a predefined price and receives a ceding commission in return); Loss Portfolio Transfers (used to transfer a book of claims which have already occurred off of an insurers balance sheet protecting against adverse reserve fluctuations – used also to support novation, or the complete transfer of an in force book of business); Block Acquisition Transactions (where the reinsurer advances part of the present value of future profits from a book of long term (usually life) insurance); Structured or Finite reinsurance; Surplus Share reinsurance, etc.

Figure 112: Reinsurance Category Tree



Broadly speaking there are two classes of reinsurance – Treaty and Facultative (or "Fac" for short). Treaty reinsurance is used to protect portfolios of multiple underlying risks, whereas Fac reinsurance is used for single risks which are too large, asymmetrical or heterogeneous to be retained in their entirety by an individual insurer and may fall outside the scope of said insurer's Treaty arrangement(s). This primer will focus on Treaty.

Within the Treaty category, there are three main types of coverage offered. They are described in the following bullets and graphics:

- **Excess of Loss (XOL)**: XOL contracts come in many sub-forms including Per Risk, Per Occurrence and Aggregate (also known as Stop Loss). Per Risk XOL tends to be used to provide protection for "lumpy" or heterogeneous portfolios of risk with some small and some large individual exposures. Per Occurrence reinsurance contracts are best and most often used to protect against catastrophic losses. Aggregate XOL or Stop Loss protections provide protections against adverse experience over a specified timeframe usually a full underwriting year. Excess of Loss coverage is often described as providing purchasers with "vertical" protection – hence coverage above a retention. Insurance companies will sometimes use Occurrence XOL in combination with an Aggregate XOL to protect against a frequency of losses falling within the retention of the occurrence cover.

- **Proportional**: Quota Share (QS) reinsurance is the most common type of proportional reinsurance arrangement though Excess Cessions (a hybrid XOL/QS cover) and Surplus Share arrangements are sometimes used. QS is the simplest form of reinsurance, where a reinsurer agrees to pay a cedant a predefined percentage of every claim in return for the same percentage of premium for the reinsured book of business. To compensate the cedant for its costs of acquiring the business subject to the reinsurance contract, reinsurers will offer cedants a ceding commission in return, usually taken as a percentage of ceded premium. Proportional coverage is described as applying "horizontally" or "sideways", since proportional reinsurers participate in the premium and losses of their underwriting partners starting from the first dollar or the ground-up. Across peak zone catastrophe regions quota share treaties can be structured

with occurrence limitations and/or loss ratio caps which, as the terms imply, limit the amount of catastrophe protection such treaties will provide.

- **Index-Based**: Index-based or non-indemnity reinsurance covers are priced and trigger based upon the incidence of an objective parameter such as rainfall or wind speed. Index-based contracts provide coverage as soon as the index criterion is met and are relatively easy to administer since no loss adjustment is required. Though all index-based solutions involve some level of basis risk – or the risk of mismatch between contract payout and actual losses incurred by the contract's beneficiary.

Figure 113: Illustrative Impact of Excess of Loss Reinsurance on Six Loss Events

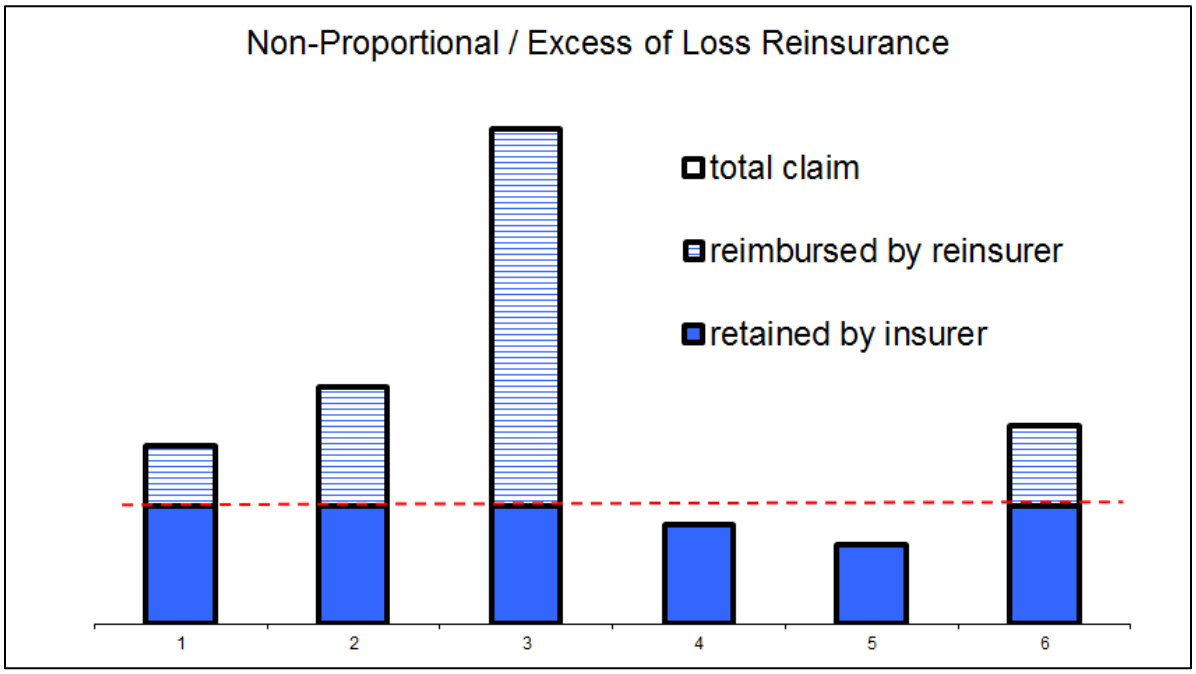


Figure 114: Illustrative Impact of 60% Quota Share Reinsurance Agreement on Six Loss Events

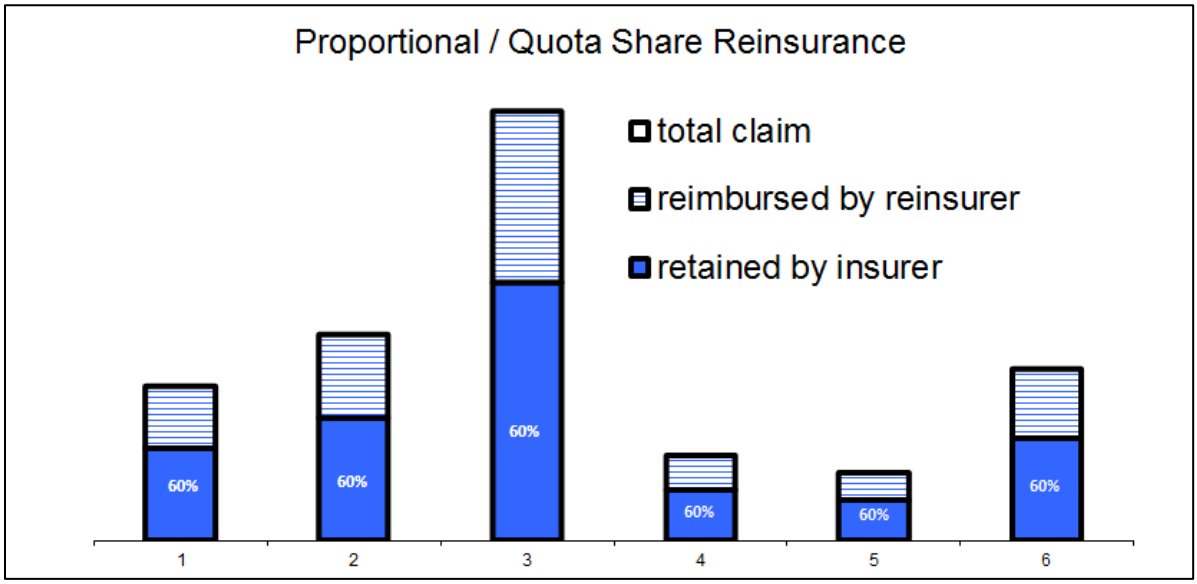
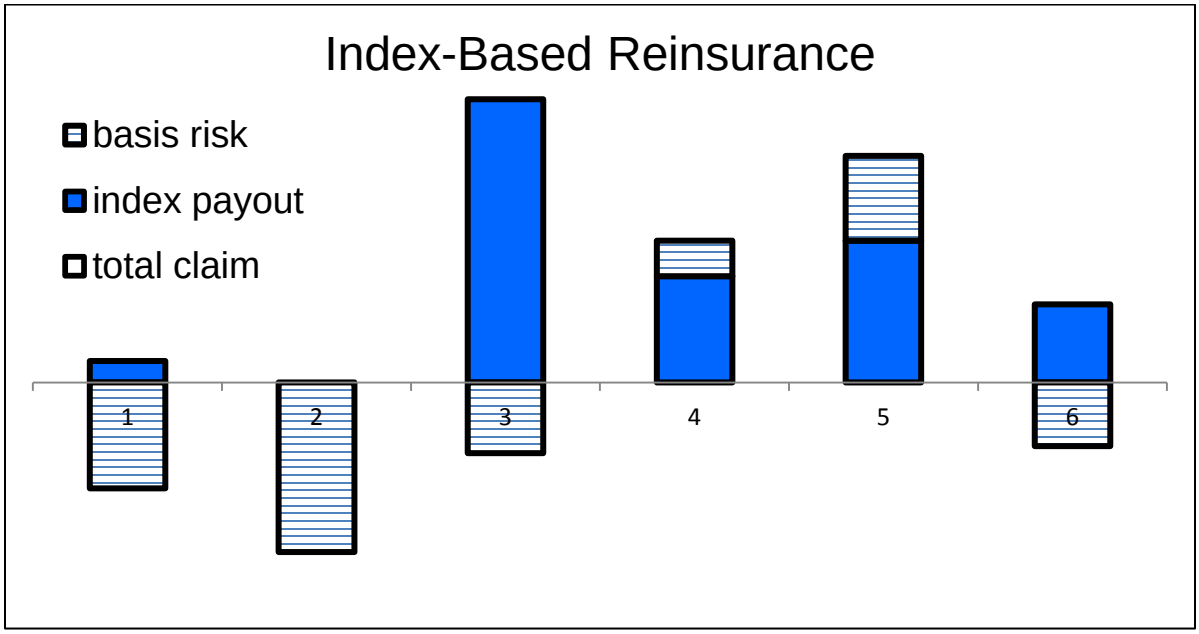


Figure 115: Illustrative Impact of Index-Based Reinsurance on Six Loss Events



Statistically speaking, reinsurance is purchased to protect against one of three risk types:

- **Risk of Random Fluctuation**: The risk of deviation of actual claims from the estimated expected value when – by chance – a particularly high or low number of insured events occur and/or there are a particularly high or low number of individual claims. Covariant risk, or the risk that an event will impact a large number of the insured items/people at the same (e.g. an earthquake or flood), is perhaps the most commonly reinsured form of random fluctuation.

- **Risk of Error**: The risk of deviations that result from an incorrect assessment of a given probability distribution (e.g. portfolio mispricing risk). The risk of error is most present when an insurer expands into new fields and is confronted with information asymmetry.

- **Risk of Change:** The deviation from the estimated expected value of a given loss distribution due to an unanticipated exogenous change after the point in time when the distribution was generated impacting the curvature of the probability distribution. All insurance is subject to the "risk of change", or the risk of external factors affecting the profitability of a given program. Common examples of such risk include an adverse change in a salient macroeconomic interest rate or an adverse political action against the favor of a local microinsurance plan. The only remedy for such risk is timely corrective action, which is feasible in the absence of any long term guarantees. This is a strong argument to avoid long term guarantees in experimental new lines of business.

The main functions of reinsurance include the following:

- Increase capacity (in the aggregate or for single large risks)
- Achieve surplus relief
- Stabilize results
- Obtain catastrophe protection
- Enter or exit a market
- Gain access to expertise

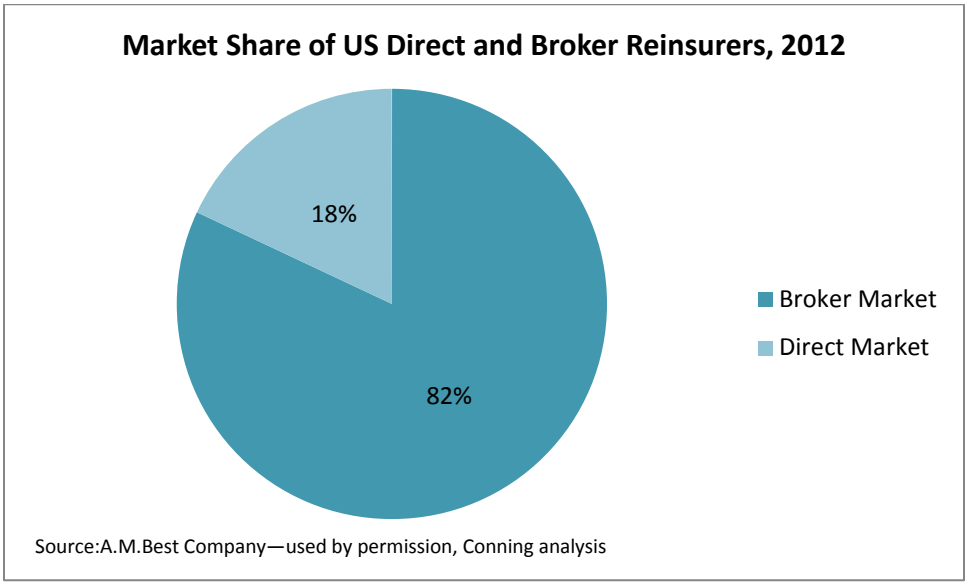
For a more detailed treatment of the reinsurance market and its various functions see Swiss Re's Essential Guide to Reinsurance.

C. The Reinsurance Placement Process

1. Representation

Reinsurance placement processes vary somewhat depending on the line of business being marketed and whether reinsurers are being approached by a cedant – a purchaser of reinsurance – directly or through a broker. Brokers are equipped to handle all manner of transactions, though their value-added services are especially valuable when it comes to larger or more complex placements – including placements supported by in depth modeling or analytics and/or placements that require a significant number of counterparties in traditional or alternative (e.g. ILS) markets. Overall in the US the trend in the marketplace has been increasingly to use brokers (see Figure 116). This tracks somewhat with the increasing dynamism of the reinsurance market which makes intimate and expansive market knowledge ever more important.

Figure 116: Market Share of US Direct and Broker Reinsurers, 2012



The services offered by individual brokers vary, though generally the benefits of working with one include the following:

- **Extend Internal Capabilities and Capacity:** Placement and management of portfolio risk transfer arrangements can be time consuming. Depending on the clients staffing levels and in-house reinsurance expertise, it may make sense to supplement the organizations own resources by utilizing outside assistance of the sort which brokers can provide.

- **Analytics:** Some brokers can supplement client exposure information with valuable analytics which can support placement negotiations as well as inform a client's risk transfer decisions.

- **Expertise:** The (re)insurance market is highly specialized and increasingly complex. Most intermediaries with expertise in disaster risk financing are in the market daily and have solid working relationships with reinsurance underwriters worldwide. This relationship capital helps them to know (or positions them easily to find out) what can be done by individual underwriters and what best terms and pricing should look like. Intermediaries also help translate between two segments of the financial industry (clients and risk transfer counterparties) and facilitate presentation of client exposures in the most market friendly manner. Some intermediaries have a history of innovation marked by unique or market-first transactions.

- **Market Standing.** Given the amount of business that an intermediary may place on an aggregate basis with underwriters – both in the catastrophe risk sector and others – they often have sufficient leverage to bring markets along on difficult or large risks where they might not otherwise participate. The strength of these aggregate trading relationships can also help with the collection of multiple quotations for specific coverage options and the facilitation of claim payments.

- **Representation:** By appointing an intermediary as a representative in the market a client gains a knowledgeable interest-aligned ally with limited concern around the profitability of the

reinsurance agreement ultimately placed. In direct negotiations clients may be dealing with counterparties with the opposite incentives/interests depending on deal structure.

- **Contracts, Claims and Accounting:** Reinsurance placements require a good deal of servicing after they have been placed. Most intermediaries maintain dedicated servicing departments with resources to handle and expertise in contract language, claims management and premium billing.

- **Market Information:** Services around market information vary, though some intermediaries enable their clients to evaluate each carrier's security on an ongoing basis with ready access to relevant information such as: AM Best, S&P and Moody's ratings; breaking news about (re)insurers and their parent companies; stock performance charts; proprietary financial analyses; etc. Such information allows clients to evaluate the overall security of their risk transfer program and compare the financial condition of selected insurers. Clients may even be able contact intermediary financial analysts to get answers to any company specific or general security-related questions. If a reinsurer's rating drops below contractually required minimum rating levels, the intermediary should work on behalf of the cedant post haste to replace said capacity with adequate rated capacity.

While there is certainly value to these various benefits brokers are sometimes perceived as adding unnecessary extra cost to a transaction. While brokers do indeed require remuneration for their services this perception may be unfounded for a variety of reasons. In simple terms, to determine the net gain/(loss) from using an intermediary it would be important for any cedant to compare the intermediary's prospective remuneration against the following:

- The cedants actual and opportunity costs associated with allocating internal resources to direct placement negotiation and management.
- The internal expense ratio of direct reinsurers vs. the internal expense ratio of broker market reinsurers including broker remuneration.
- The cost of coverage may differ between broker and direct markets either due to cost of capital considerations or by virtue of an intermediary's buying power and ability to canvass a wide swathe of the marketplace.

2. The Placement Process

The following placement process commentary presumes NFIP would be buying some form of catastrophe excess of loss protection and would be working with a reinsurance broker to do so.

Pre-Submission

During this stage NFIP would assess alongside its broker what needs to be accomplished before entering the market and complete preliminary preparations. Key steps would include:

- Visit with broker to discuss program goals, expectations and current market conditions. Confirm understanding of current and desired market relationships and further familiarize broker with NFIP's recent business developments related to exposures, financial and business goals, tolerance for risk, risk management initiatives, strengths and limitations, legislative and regulatory issues which may need to be taken into consideration.
- Broker requests and secures all necessary underwriting and modeling information for pre-renewal catastrophe modeling/actuarial analysis to be performed by broker.

- Broker runs all relevant catastrophe models and discusses results with NFIP. NFIP and broker develop a mutual understanding of changes in expected loss, amount of probable maximum loss at various return periods and the effect of any model changes on loss estimates.
- Perform actuarial, financial and catastrophic analyses necessary to develop initial and "benchmark pricing". This involves assessment and quantification of any on-going risk management initiatives that NFIP may have in process in order to demonstrate the positive changes that will manifest in NFIP's book going forward and should be considered in both structure and pricing.
- Assess multiple reinsurance structures as alternatives. Weigh alternative structures against costs as measured by actuarial analysis, peer analyses and broker's knowledge of the reinsurance marketplace, all in the context of NFIP's goals and objectives.
- Review existing and alternative structures and assess which best address NFIP's financial, business and reinsurance objectives.
- Draft contract wordings including requested reinsurance structures and most beneficial terms and conditions utilizing NFIP's preferred wordings and broker's best practices.
- Forward underwriting submission package to NFIP for review and written approval prior to release to reinsurers. Full package to include: draft contract wordings, comprehensive underwriting data and catastrophe model results, as applicable, along with extensive narrative/qualitative information. Broker should ensure that the submission effectively conveys the unique functions of NFIP and its risk management practices through written explanations, maps, and other exhibits as appropriate.

Marketing Strategy

During this stage, broker confirms its understanding of how NFIP wants to be viewed in the marketplace, which trading partners NFIP specifically wishes to engage, and begins to formulate how best to approach the market in order to achieve NFIP's objectives. Key steps include:

- Evaluate reinsurance relationships. Review issues related to any existing or prospective markets including security, claims-paying record, and specific historical and personal relationships. It is important to screen the reinsurance markets to ensure that NFIP receives the best overall value from a relationship going forward.
- Discuss prospective marketing list, provide current financial information for consideration, and receive formal approval of those reinsurers available for marketing.
- Account Team members schedule reinsurer visits to explain the program, ensure seamless servicing and prepare markets for placement. Discuss potential reinsurer visits with NFIP and schedule as deemed appropriate.

Marketing

During this stage, broker finalizes the details of the most optimal submission for the markets to achieve NFIP's goals and begin executing the placement. Key steps include:

- Broker to provide a complete underwriting submission package to reinsurers following NFIP's approval.
- NFIP to visit identified leads and other key prospective markets alongside broker account team members.
- Broker to continue pricing negotiations in conjunction with contract wording negotiations to assess most beneficial terms and conditions.
- Broker to secure lead quotes from reinsurers and review in detail with NFIP.

- Broker to analyze pricing, terms and any structural options provided by NFIP's lead markets.
- Broker to present quotes, supporting analyses and program assessment to NFIP and review objectives and goals against the most effective and competitive program available.

Finalizing the Placement

During this stage, the broker should work with NFIP to determine firm order terms and execute on the same. Key steps include:

- Broker to receive NFIP's firm order terms and present approved contract wordings to all approved reinsurers.
- Broker to visit NFIP to discuss authorizations and agree to final signed lines for each reinsurer across the program based on NFIP's criteria for signings at appropriate security levels.
- Broker to finalize the program with reinsurers at NFIP's direction. Contract Wordings/Interests and Liabilities agreements will be immediately released for signature to NFIP and reinsurers simultaneously. Broker should attempt to have all contract wordings agreed to at inception of the placement.

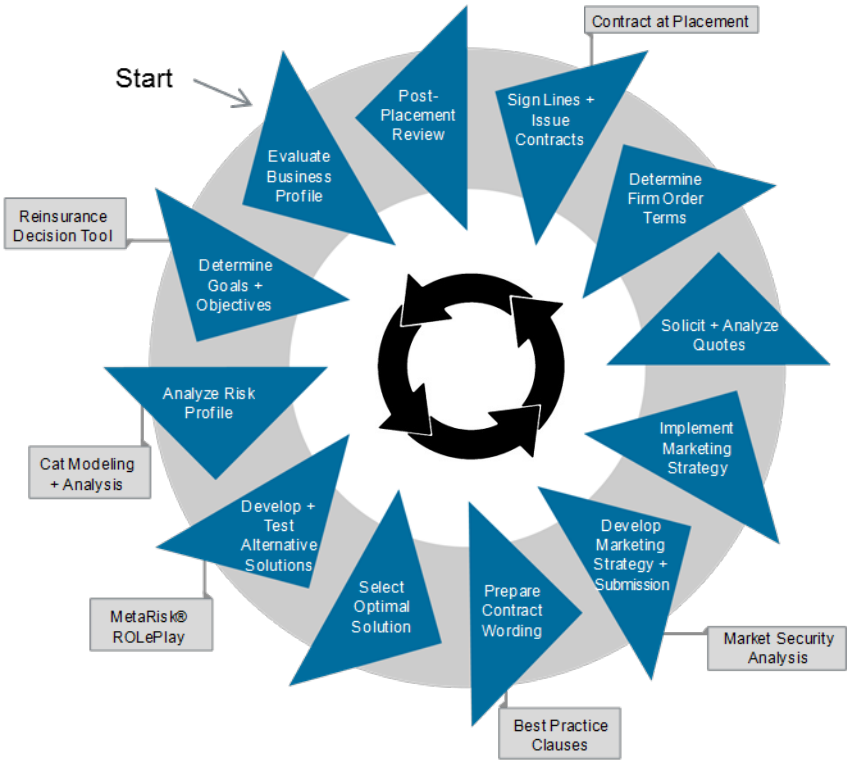
Post Placement

During this stage, which is continuous, the broker should assess the placement of the program, provide transaction documentation and maintain an ongoing dialogue regarding market conditions and NFIP's business. Key steps include:

- Meet immediately following placement to assess the program, achievement of goals, pricing parameters, strengths and weaknesses of the process. Identify key criteria in data needs, reinsurer issues/concerns and contract negotiations that should be noted and addressed for the following renewal year. Broker should memorialize the entire placement process in a summary document that outlines each step of the process.
- Benchmark NFIP's placement versus peers.
- Monitor Contract Wording signing process.
- Provide NFIP with a Post Placement Resource Manual to serve as a central reference to include accounting and claims information, reinsurer financials and final contract wording.
- Continually advise NFIP of current market conditions and reinsurer activity, including dissemination and discussion of market condition summaries, white papers and research materials.
- Broker to maintain regular contact with NFIP to ensure firsthand knowledge of, and exposure to, underwriting and risk management activities.

Figure 117 provides an overview of the primary phases in a typical placement as well as some of the tools and processes used to affect the optimal solution for NFIP. Importantly, each year NFIP should go "back to the drawing board" to ensure the reinsurance structure continues to fulfill the organization's goals and objectives and determine whether market conditions necessitate a change in course.

Figure 117: Typical Cyclical Reinsurance Placement Process



An overview of the expected outcomes/deliverables for each of the above placement process segments is shown in Table 28. While NFIP and its broker should aim to adhere to any initial plan, some flexibility is required in order to effectively respond to events as they unfold during marketing. Therefore all timelines below should be viewed as illustrative.

Table 31: Reinsurance Placement Process Deliverable Schedule

Month	Activity
Month 1 (Pre-Submission)	• **Pre-Renewal Meetings** – NFIP and Broker Account Team • **Modeling/Technical Meetings** – NFIP and Broker with Analytics Team • Modeling work commences • **Strategy and Brainstorming Meeting** – NFIP and Broker Account Team • Renewal project plan finalized • Begin collecting information for reinsurance submission
Month 2 (Marketing Strategy)	• Modeling/Technical Meeting – Review modeling work • Renewal Strategy and Planning Meetings – NFIP and Broker Account Team review final modeling results, current market conditions and finalize structure option(s) • Security Meeting – review potential reinsurers • Contract language review • Prepare materials for marketing trip and schedule meetings • Forward data to reinsurers that will be visited on marketing trip

Month	Activity
Month 3 (Marketing)	• **Marketing Meetings** – Visits with potential lead and key reinsurers • Trip debrief, discuss final changes to structure and renewal strategy • Full reinsurance submission to all reinsurers • **Begin receiving lead quotes** – all quotes due by [Month, Day]
Month 4 (Finalize Placement)	• **Renewal Strategy Meeting** – Analyze quotes received using capital modeling tool and meet to review quote analysis • Firm Order Terms finalized and sent to market • Receive authorizations • Finalize Contract Wording • Review authorizations and bind final lines • Contract issued at placement
Month 5 (Post Placement)	• Signed contract documentation distributed • Program manual created • Premium billings distributed • Contract continuously monitored

For a 144A catastrophe bond the placement process is somewhat different. These differences arise from the securities-based regulatory structure governing such a transaction and the general necessity to involve a variety of third-party service providers in the process including, but not limited to, the following: modeling firm; rating agency; legal counsel and; SPV administrator. The typical timeline for the issuance of a 144A cat bond is 12 weeks from the sponsor's expression of intent to issue a bond to deal execution (see Figure 118).

Figure 118: General Transaction Timeline for 144A Cat Bond (Source: GC Securities)

		Week of											
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Transaction Pre-work													
Confirm Third Party Modeling Firm / Legal Counsel	SPONSOR, GCS												
Select Coverage Details	SPONSOR, GCS												
Structuring / Modeling Risk Analysis													
Provide Sponsor exposure data to Modeling Firm	SPONSOR												
Data review / assumptions check													
Provide any remaining relevant information to Modeling Firm													
Kickoff meeting to discuss risk transfer structure / deal features / timeline	SPONSOR, GCS, LC, MF												
Finalize all deal features / MF to perform modeling analysis	SPONSOR, GCS, MF												
Participate in conference calls to discuss the modeling process SPONSOR interim risk results	SPONSOR, GCS, MF												
Decide upon final reinsurance structure / appropriate collateral solution; calculate respective probabilities	SPONSOR, GCS, MF												
Rating Agencies													
Begin preparing Rating Agency presentation materials	SPONSOR, GCS												
Revise Risk Analysis information for Rating Agency presentation	SPONSOR, GCS												
Finalize Risk Analysis and any SPONSOR information for Rating Agency presentation	SPONSOR, GCS												
Finalize Rating Agency presentation materials	SPONSOR, GCS												
Post presentation on Intralinks for Rating Agencies	SPONSOR, GCS, MF												
Follow up with Rating Agencies (as needed)	SPONSOR, GCS, MF												
Obtain preliminary ratings	SPONSOR, GCS												
Rating Agency review of underlying transaction documentation	SPONSOR, GCS												
Obtain final ratings	SPONSOR, GCS												
Legal / Documentation													
Prepare and discuss termsheet / Summary of Terms of catastrophe bond structure	GCS												
Revise and review subsequent drafts of termsheet / Summary of Terms	SPONSOR, GCS, LC												
Draft preliminary Offering Memorandum	LC												
Form SPR/SPV	SPONSOR, GCS, LC												
Draft and revise underlying transaction documentation and service provider contracts	SPONSOR, GCS, LC												
GCS to perform due-diligence on SPONSOR and MF	SPONSOR, GCS, LC												
MF to prepare risk analysis section for the Offering Memorandum	SPONSOR, GCS, LC, MF												
Finalize the preliminary Offering Memorandum	SPONSOR, GCS, LC												
Draft and revise underlying transaction documentation and service provider contracts	SPONSOR, GCS, LC												
Print preliminary Offering Memorandum and email to prospective investors	SPONSOR, GCS, LC												
Finalize all underlying transaction documentation and execute transaction documentation	SPONSOR, GCS, LC												
Marketing / Closing													
Prepare and revise Investor Marketing Presentation	GCS												
Review and comment on preliminary Investor Marketing	SPONSOR, GCS, LC, MF												
Finalize Investor Marketing Presentation	SPONSOR, GCS, LC, MF												
Announce Transaction and Investor Marketing / Formal Roadshow	SPONSOR, GCS, MF												
Participate in Investor Marketing (including investor conference calls)	SPONSOR, GCS, MF												
Open Order Books / Refine Price Talk / Price Transaction	GCS												
Print final Offer Memorandum / Close transaction and Execute transaction documentation	GCS												

GCS: GC Securities, LC: Legal Counsel, MF: Modeling Firm

If the cat bond were to provide $200 million of three-year single-limit protection, Figure 119 outlines the estimated transaction expenses (excluding compensation for investment bank(s) serving as structuring agent/bookrunner and any possible post-event fees):

Figure 119: Estimated Expenses Associated with $200 Million Catastrophe Bond Issuance

Estimated All-In Cost Calculation	At Closing	Year 1	Year 2	Year 3	Total
Transaction Expenses:					
- Legal (Deal Counsel)	375,000				375,000
- Legal (Underwriters)	100,000				100,000
- Legal: Local Domicile (annual fee includes Registered office, Corporate Trustee, 2 Directors)	35,900		10,900	10,900	57,700
- Legal (Indenture Trustee's counsel)	25,000				25,000
- Rating Agency - Initial Rating Fee; Surveillance Fee	139,000		15,000	15,000	169,000
- Modeling	230,000				230,000
- Reset Agent	0	75,000	75,000		150,000
- Claims Reviewer, *excluding contingent CR expenses*	22,000				22,000
- Loss Reserve Specialist, *excluding contingent LRS expenses*	50,000				50,000
- Offshore meeting expenses / Roadshow expenses (GC Securities)	40,000				40,000
- SPR Capitalization / Profit (assumed Bermuda)	1				1
- SPR Administrator: Minimum Acceptance Fee	10,000				10,000
- SPR Administrator Fees (Annual fee; Listing, Admin, Intralinks)	0	48,600	48,600	48,600	145,800
- Exchange listing fees (assumes for series and program)	4,500		1,500	1,500	7,500
- SPR government fees / license fees	0	14,575	7,995	7,995	30,565
- SPR Auditor	0	18,900	18,900	18,900	56,700
- Indenture Trustee Acceptance Fee	10,000				10,000
- Indenture Trustee Annual Administration Fee	0	10,500	10,500	10,500	31,500
- Escrow Agent	0	1,950	1,950	1,950	5,850
Miscellaneous (CT - Service of Process, Admin incidental costs, phone calls, courier, etc)	10,000	10,000	10,000	10,000	40,000
Excise Taxes	10,514	1,795	2,003	1,253	15,566
Total (All)	**1,061,915**	**181,320**	**202,348**	**126,598**	**1,572,182**

ESTIMATED EXPENSE (FOR $200MN DEAL)	**All-In ROL (per annum)**	**0.62%**	**0.10%**	**0.06%**
	Annualized ROL	**0.26%**	**0.26%**	**0.26%**

Note: Actual expenses will depend upon negotiations with individual service providers.

3. Optimal Risk Transfer

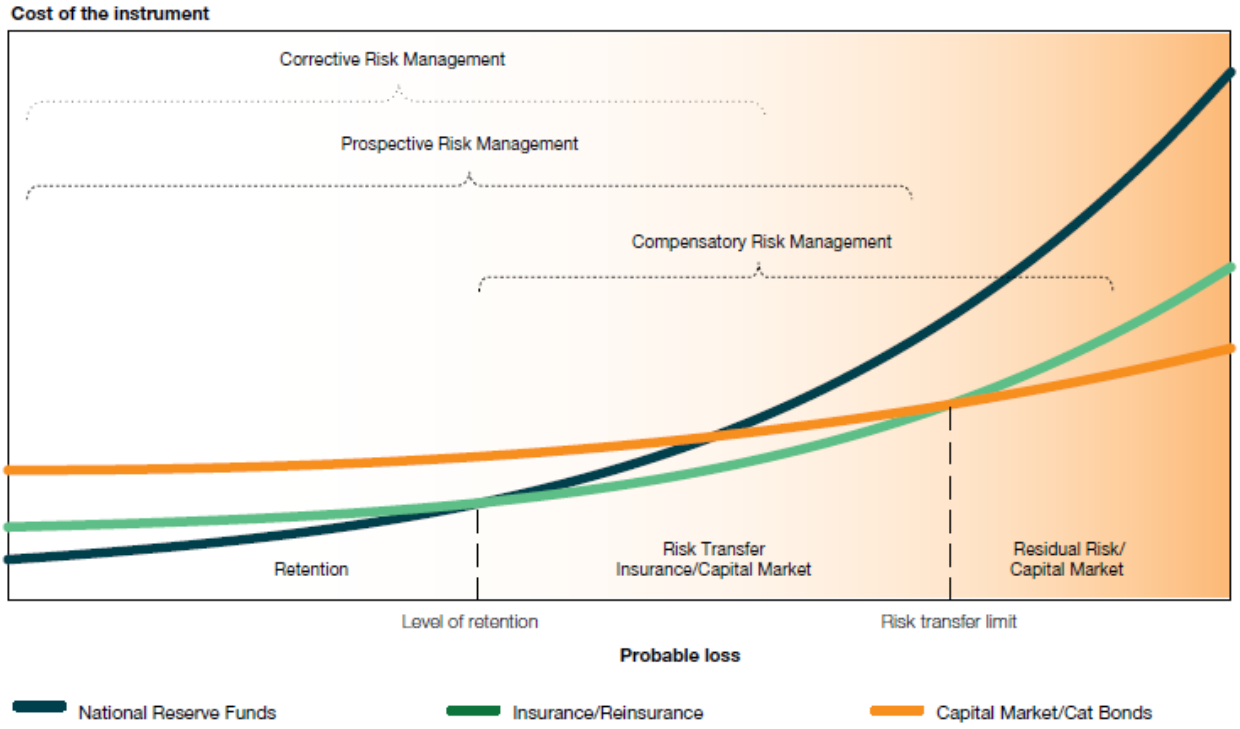
As noted in in the main body of this report, there are a variety of risk transfer principals that the NFIP will need to address in order to construct a sustainable risk financing program that will stand the test of time. Reinsurance, both traditional and capital market sourced, can play a meaningful role in the development of such a program. However, reinsurance is not a panacea – its usage should be optimized based upon a cedant's risk appetite, market conditions and the underlying risk characteristics.

To elaborate, at higher loss probabilities – those that fall within NFIP's annual expected attritional loss levels for instance – excess of loss reinsurance would likely be inefficient. At a certain point with coverage attaching too low NFIP's gross premium (expected loss plus the reinsurers' uncertainty, expense and profit loads) would likely exceed the equivalent costs for self-insurance. In industry parlance, this is referred to as "dollar swapping"; at this level of the loss distribution cedants should be positioned to manage anticipated losses and business expense through the premiums they charge their customers and the surplus funds they maintain.

At the opposite end of the spectrum – the tail of NFIP's loss distribution (e.g. losses that have a return period well above the 250 year level) – reinsurance again may be viewed as inefficient. Here minimum capacity charges required to unlock reinsurance capacity may hit a floor driving the relative cost of the protection up. Somewhere between these two points of the spectrum, reinsurance should prove cost-effective – basically the area in which the reinsurers' cost of capital proves less than an insurer's cost to self-insure. This is a concept we will return to later in the FIRS project; to truly be self-sufficient the NFIP needs to consistently re-evaluate these metrics against the appetite or lack thereof to secure further borrowing authority from the US Treasury.

Figure 120 demonstrates the sort of exercise which should be conducted to determine optimal risk financing. The three loss curves in this graphic chart the cost of the labeled instrument against the probability of loss. The curve which is the lowest at any given point along the X axis is the most efficient. For instance, in this particular example the chart demonstrates that the costs associated with the reserve funds (represented by the blue line) are more efficient lower in the loss distribution curve (to the left). Financing one's own risk within one's own risk appetite carries less cost then financing it through insurance. However, at some defined point utilizing third-party (re)insurance becomes a more efficient solution. It becomes more cost effective for the entity to pay a premium and transfer unwanted volatility (risk) that would otherwise need to be financed by themselves. In figure 120 this becomes the case where the green line (cost of insurance) drops below the blue line (reserves). A similar process then governs different risk transfer solutions at different points on the loss distribution. Generally, cat bonds (the orange line) become more cost effective higher in the loss distribution curve to the right; below the 75-100 year loss level, traditional reinsurance tends to be more cost effective than cat bonds.

Figure 120: Using Loss Probabilities to Determine Optimal Risk Financing Mechanisms[198]



D. AIR Industry Storm Surge Modeling Methodology

AIR Worldwide Estimate of Aggregate Industry *Insurable* Storm Surge Losses

Notes:

- 100% Storm Surge from the AIR Atlantic Tropical Cyclone Model 14.0.1 as Implemented in CLASIC/2 v15.0.1
- Based on AIR's Detailed Industry Exposure Database as of 12/31/2013
- Losses are insurable (i.e. ground up) and are shown in $Millions.
- Residential line of business includes Single-Family Home, Mobile Home, and Apartment Units.
- Commercial line of business includes Commercial, Industrial Facilities, and Apartment Buildings.
- The Auto line of business is excluded from this analysis.
- The analysis options used were 100% storm surge, demand surge, and no average properties.

Key:

- EV = Expected Value
- SD = Standard Deviation
- 2.00% = 1-in-50 Year Return Period
- 1.00% = 1-in-100 Year Return Period

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[198] Global Assessment Report on Disaster Risk Reduction, 2011

- 0.40% = 1-in-250 Year Return Period

Commercial Modeled Loss Results:

Table 32: AIR Worldwide Industry Insurable Storm Surge Modeled Loss Results; Commercial Only

State	Commercial				
	EV	SD of EV	2.00%	1.00%	0.40%
US	995	2,297	7,871	10,619	16,149
AL	19	165	226	486	1,071
CT	7	80	60	168	465
DE	0	13	0	0	2
FL	418	1,828	4,548	8,657	14,716
GA	7	118	21	125	360
LA	185	792	2,761	3,946	5,859
MA	13	113	150	399	844
MD	2	47	0	0	9
ME	3	37	1	37	212
MS	9	83	97	236	489
NC	65	256	875	1,257	1,811
NH	0	2	0	1	8
NJ	17	261	13	238	1,006
NY	35	528	121	590	2,287
RI	17	149	195	558	991
SC	72	385	1,122	1,597	2,644
TX	125	605	2,054	3,363	4,803
VA	1	46	0	3	13

In addition to the fact that non-residential business makes up only a small portion of NFIP business, commercial risk to storm surge is also negligible by comparison to residential. While these figures in Table 30 are not exactly comparable (coastal insured exposure was calculated based upon insured value whereas modeled loss numbers were calculated based upon insurable value (insured and uninsured)), the relativities should hold irrespective of the calculation basis. From this table you can see that commercial exposure to storm surge risk is more than 3 times smaller than residential exposure on a risk relative basis.

Table 33: Industry Insurable Modeled Loss as Percentage of Industry Insured Coastal Exposure (Source: AIR)

Industry Modeled Loss vs. Industry Exposure	Residential	Commercial
Coastal Insured Exposure	$4.663 trillion	$5.980 trillion
Expected Insurable Storm Surge Loss	$2.554 billion	$0.995 billion
Expected Loss / Exposure	0.05477%	0.01664%

2 APPENDIX – HISTORIC MARKET ASSESSMENT

A. Innovative/Notable Historic ILS Transactions

All transaction summaries have been based off of information on Artemis.bm. GC Securities is available to provide more detailed summaries upon request.

Blue Wings Ltd. – At a glance:

- **Issuer/SPV:** Blue Wings Ltd.
- **Cedant/Sponsor:** Allianz Global Corporate Specialty
- **Placement/structuring agents:** ?
- **Risk modeling/calculation agents etc.:** RMS
- **Risks/Perils covered**: US earthquake, UK flood
- **Size:** $150m
- **Trigger type:** Modeled loss and Parametric index
- **Ratings:** S&P: 'BB+'
- **Date of Issue:** Apr 2007 (redeemed Dec 2008)

Summary: This was the first catastrophe bond with flood risk exposure. The transaction transferred severe river floods in Great Britain and earthquakes in Canada and the US (except California). The earthquake risk used a "modeled loss" trigger and the river flood risk used a second generation parametric index trigger, making the bond innovative. The flood index was based on depths that were calculated in more than fifty locations across Great Britain and the British engineering firm, Halcrow Group, provided relevant needed information.

Allianz stated in Dec 2008 they were redeeming the bond which should have run until 2012. Allianz stated that they redeemed the bond because they could cover the risk more cheaply outside of the capital markets.

MetroCat Re Ltd. – At a glance:

- **Issuer / SPV:** MetroCat Re Ltd. (Series 2013-1)
- **Cedent / Sponsor:** First Mutual Transportation Assurance Co.
- **Placement / structuring agent/s:** GC Securities is lead manager, joint structuring agent, and sole bookrunner and Goldman Sachs is co-senior manager and joint structuring agent
- **Risk modelling / calculation agents etc:** RMS
- **Risks / Perils covered:** Storm surge (named storm induced)
- **Size:** $200m
- **Trigger type:** Parametric
- **Ratings:** S&P: 'BB-'
- **Date of issue:** Jul 2013

Summary:

This bond was rated solely using RMS' storm surge model, making it the first of its kind. It only covered storm surge resulting from named tropical storms, hurricanes, and tropical cyclones and is based on a parametric trigger. The Metro Transit Authority wanted a parametric trigger as it typically pays more quickly than traditional indemnity cover. The parametric trigger is based on actual recorded storm surge levels from locations around New York City, and as it is a parametric trigger, the payout may not correlate to MTA's sustained losses.

Parkton Re Ltd. – At a glance:

- **Issuer / SPV:** Parkton Re Ltd
- **Cedent / Sponsor:** North Carolina JUA / IUA
- **Placement / structuring agent/s:** Swiss Re Capital Markets and GC Securities were co-lead manager and joint bookrunner
- **Risk modelling / calculation agents etc:** AIR Worldwide
- **Risks / Perils covered:** North Carolina hurricane
- **Size:** $200m
- **Trigger type:** Indemnity
- **Ratings:** S&P: 'B+'
- **Date of issue:** Jul 2009

Summary:

This special purpose vehicle was set up for the benefit of the North Carolina Joint Underwriting Association and the North Carolina Insurance Underwriting Association. It is the first bond ever created to specifically support a residual market insurer within the United States. It provides reinsurance protection against hurricane losses in North Carolina and the Barrier Islands and is triggered by sustained storm losses of its beneficiaries that exceed a certain threshold.

Globecat Ltd. – At a glance:

- **Issuer / SPV:** Globecat Ltd.
- **Cedent / Sponsor:** Swiss Re
- **Placement / structuring agent/s:** Swiss Re acted as sole book runner.
- **Risk modelling / calculation agents etc:** EQECAT
- **Risks / Perils covered:** U.S. hurricane, U.S. earthquake, Latin America earthquake
- **Size:** $85m
- **Trigger type:** Modelled loss and Industry loss index
- **Ratings:** ?
- **Date of issue:** Dec 2007

Summary:

This bond was the first of its kind to cover Central American earthquake risks. Its index is based on the population exposed to certain levels of seismic activity using the Modified Mercalli Intensity scale. This was designed to help charitable foundations, governmental relief organizations, and corporations to help developing nations quickly respond to natural disasters. Funds will be rapidly distributed for relief efforts after an event, helping to eliminate the traditional lag time while affected areas wait for funds to be raised.

Akibare II Ltd. – At a glance:

- **Issuer / SPV:** Akibare II Ltd.
- **Cedent / Sponsor:** Mitsui Sumitomo Insurance Co. Ltd.
- **Placement / structuring agent/s:** Swiss Re Capital Markets are structuring agent and bookrunner. GC Securities are co-manager
- **Risk modelling / calculation agents etc:** AIR Worldwide
- **Risks / Perils covered:** Japan typhoon (wind & flood losses)
- **Size:** $130m
- **Trigger type:** Modelled loss
- **Ratings:** S&P: Class A - 'BB'
- **Date of issue:** Apr 2012

Summary:

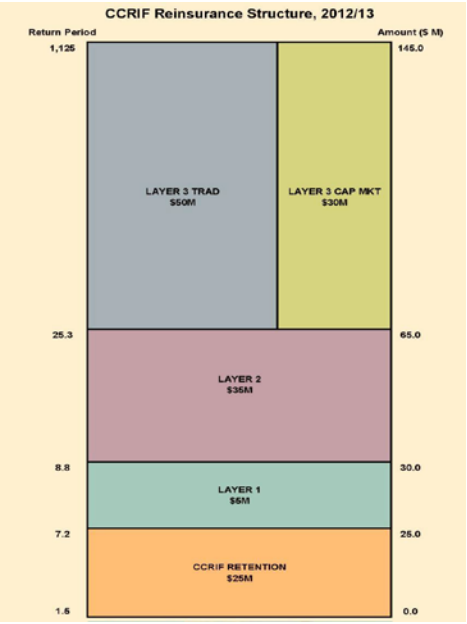
This bond was created to cover Japanese typhoon risks for the period ending March 2016. It is unique as it is the first bond of its kind to cover flood losses connected to typhoons using a modeled loss trigger, providing protection for commercial, residential, and industrial lines of business. Parameters provided by reporting agencies will be processed using the AIR model against a notional portfolio to establish a modeled notional loss and a corresponding event payment amount.

B. Innovative/Notable Historic Residual Market Programs

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) – At a glance:

- **Date established:** 2007
- **Description:** CCRIF is a risk pooling facility that is owned, operated and registered in the Caribbean for Caribbean governments. It is the world's first multi-national risk pool to cover earthquake and hurricane catastrophe cover. It is the only regional fund using parametric insurance. It backed by both traditional and capital markets.
- **Funding:** The CCRIF is capitalized by donors and members.
- **Size:**
    - 29 annual policies to 16 countries for the 2012-2013 policy/financial year
    - Annual premium just over $20 million (60:40 between cyclone and earthquake coverage)
    - Aggregate exposure for policies written = just over $625 million
    - Shareholder's equity = $109 million May 2013
- **Reinsurance:** CCRIF purchased $120 million of capacity above a $25 million retention to support claims**.** $30 million of the top layer was placed in the capital markets via a catastrophe swap between CCRIF and the World Bank Treasury.

Figure 121: CCRIF 2012/13 Reinsurance Program Structure



- **Members:** Aguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St Kitts & Nevis, St Lucia, St Vincent & the Grenadines, Trinidad & Tobago and the Turks & Caicos Islands.

World Bank MultiCat Program – At a glance:

- **Description:** The program helps member countries assess the capital markets and issue catastrophe bonds. The program supports a variety of structures including pooling multiple risks for multiple regions. The arranger is the World Bank in that it helps develop the disaster risk management policy, offers documentation, supports legal and operational framework and selects the service providers.

Structure: A special purpose vehicle (SPV) writes parametric insurance contracts with a government or public body. The SPV issues the cat bond and the World Bank places the bond through investment banks. The proceeds are invested by the SPV into AAA rated assets. (which forms the payout source if a covered event occurs.)

- **Sample Term Sheet:** Below is the summary of a term sheet of a catastrophe bond under the MultiCat platform.

Insured Entity	Government or government-owned entity
Covered Perils	Any peril that can be modeled
Trigger	Parametric, indemnity, modeled loss
Covered Amount	Depends on market appetite
Term	Normally 3-5 years, but can be up to 10 years

- **Example:**
  - **MulitCat Mexico 2009:** Mexico was the first sovereign entity to issue a catastrophe bond through the program
    - $290 million bond
    - Parametric insurance against earthquake, Pacific hurricane, and Atlantic hurricane risks in three areas.
    - Arranger: The World Bank Treasury
    - Co-lead managers/joint bookrunners: Goldman Sachs and Swiss Re
    - Advisor: Munich Reinsurance Co.

Table 34: MultiCat Mexico 2009 Notes Summary

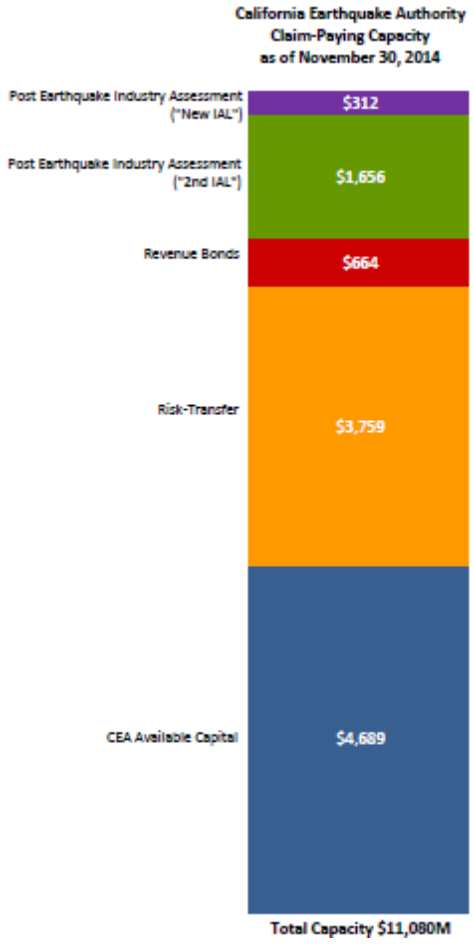
Summary of MultiCat Mexico 2009 Notes				
Note:	**Class A: Earthquake**	**Class B: Pacific Hurricane Zone A**	**Class C: Pacific Hurricane Zone B**	**Class D: Atlantic Hurricane**
Notional (US$)	140 million	50 million	50 million	50 million
Maturity	3 years	3 years	3 years	3 years

California Earthquake Authority - At a glance

- **Date Established:** 1996 by the California Legislature
- **Description:** a publicly managed largely privately funded entity that sells California earthquake insurance coverage through participating companies. It was created after the Northridge Earthquake losses created awareness of potential insurer insolvency if another earthquake occurred. Companies selling residential property insurance in CA can participate in the CEA or offer their own products. Most companies offering CA residential property insurance are CEA members. It is one of the largest providers of residential earthquake insurance in the world.
- **Rating:** AM Best: A-
- **Size:**
  - CEA has $4.4 billion in available capital

- Collects approximately $570 million in gross premiums per year.
- Claims paying capacity is over $9.8 billion at Sept 2013.

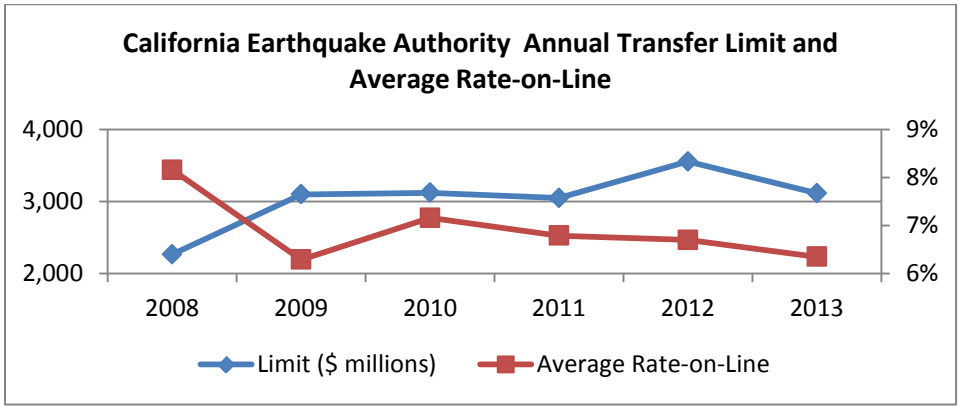
Figure 122: California Earthquake Authority Risk Transfer Structure at November 30, 2014



- **Risk Transfer program**
  - Aggregate present line for traditional reinsurance contracts = just over $3.3 billion CEA negotiated 2 transformer reinsurance contracts for a total amount under contract of $450 million (two in 2012)
  - CEA average rate on line across all risk-transfer = 5.87%

- **Average Risk-Transfer Limit and Average Rate-on-Line**

Figure 123: California Earthquake Authority Annual Risk Transfer Limit and Rate-on-Line – 2008-2013



3 APPENDIX – COST BENEFIT ANALYSIS

A. Reinstatements Explained

The reinstatement provision exists because many reinsurance contracts provide only one limit of coverage, and such limit of coverage must be replenished, or "reinstated" before being available for future losses. When a reinstatement is involved, there is usually an additional premium requirement. The additional premium is based on a pro ration as to the amount of limit exhausted by the particular loss. This type of reinstatement is commonly called "pro rata as to amount, 100% as to time." The following is a formula for calculating a reinstatement premium structured in this manner:

$$\frac{\textbf{Reinsurance Loss Paid}}{\textbf{Reinsurance Limit}} \quad \textbf{X} \quad \textbf{Reinsurance Premium}$$

So, if the reinsurance coverage was $20,000,000 in excess of $10,000,000 and there was a loss of $15,000,000 paid by the ceding company, $5,000,000 would be the reinsurance loss paid ($15,000,000 less the $10,000,000 retention). If the reinsurance premium for the contract was $400,000, the reinstatement premium would be:

$$\frac{\textbf{5,000,000}}{\textbf{20,000,000}} \quad \textbf{X} \quad \textbf{400,000} \quad = \quad \textbf{100,000} \quad \textbf{Reinstatement Premium}$$

As can be seen in the example above, reinstatements are not always for the full amount of coverage since many losses are less than the full limit. In such case, only the partial amount needs to be reinstated. It should also be noted that reinstatements are usually made automatic, meaning the cedant is required to purchase the reinstatement after a loss. This is usually done to avoid contentious negotiations around the possible reinstatement of a limit after a loss has occurred which can be adverse for the cedant since the cost for coverage is likely to go up after a loss.

While not very common in today's market, some reinstatement provisions allow for a further proration as to the time remaining in the contract period from the date of the loss. This type of reinstatement is called "pro rata as to time and amount."

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GUY CARPENTER

Guy Carpenter & Company, LLC
1166 Avenue of the Americas
New York, NY 10036
+1 917 937 3000

GUY CARPENTER

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RISK STUDY PROJECT

Technical Appendices to Reinsurance Study

FEMA

SEPTEMBER 29, 2014

Government Contract No.: HSFE60-13-C-0056
Prepared for ("Client"):

FEMA

Prepared by ("Consultant"):

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MARSH & McLENNAN COMPANIES

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GUY CARPENTER CONTACTS

Jake Clark	Managing Director	203.229.8848	Jonathan.Clark@guycarp.com
Alex Bernhardt	Senior Vice President	206.621.2924	Alex.Bernhardt@guycarp.com

1 SAMPLE REINSURANCE TABLE OF CONTENTS

Client Confidentiality

By accepting the attached or enclosed confidential information, the recipient agrees that it will not disclose, transfer, or otherwise communicate confidential information to any third party without receiving prior permission. “Confidential Information” includes, regardless of format and without limitation:

(a) general or specific knowledge about any of the following: financial or business plans; potential financial or business plans; operations or services; potential operations or services; products, potential products, contracts, potential contracts, industry know-how, formulas, production goals or quotas; purchasing, marketing or sales techniques; personnel or broker information; customer, client or supplier lists; actuarial analysis; policy forms; risk management tools; or other such material information; and

(b) data, records, processes, methods, techniques, systems, models, samples, devices, equipment, compilations, invoices, customer lists, or documents.

Further, the recipient will neither use the Confidential Information nor circulate the Confidential Information within its own organization except to the extent necessary for internal consideration and analysis in connection with assessing the placement.

This language does not supplant or replace any current non-disclosure or confidentiality agreements in place, which remain in full force and effect.

Contact a Guy Carpenter representative if you have any questions.

Corporate Overview

Corporate Overview Components

These items should be included in all Corporate Overviews

- Company background
- Management team or key personnel
- Current portfolio with underwriting summary and characteristics of portfolio
- Brief summary of reinsurance structure outlining what the client is looking for

Contracts at Placement

Please note the draft contract agreed to by the client has been included in the submission. The goal of this process is to have the final contract wording signed for each contract within two weeks after the program has incepted. With that in mind we ask that if you have any contract wording items that you would like to address that you communicate those at the time you send your quotation to us. Quotations that are received without any contract wording issues, will serve as official agreement to the final contract wording included in the submission. All reinsurers are expected to be able to return signed contracts to Guy Carpenter within two weeks of the inception of the program.

Renewal Expectations

Outline any renewal expectation or important facts the client would like considered when reviewing the submission.

Premium Information

This section should include relevant information regarding premium for the placement, including:

- Subject Premium,
- A 10 year history, if available,
- Premium estimated for the current treaty year and projected for the upcoming treaty year.

Section Should Further Include the Following as Required:

- Direct and/or earned premium;
- Treaty and/or calendar year basis;
- Report on the basis of rate development by line of business or level of detail that is needed to generate a reinsurance rate

Optional Components

These are optional components that may be included. Optional information is not limited to this list but should include any required information:

- Premium by country, state or county
- Premium by line of business
- Premium by business unit/profit center
- Any additional information

Rate Change History

The rate history should include 10 years, if possible, or the most complete information that is available.

Include the following:

- Rate change history by year and projected rate change

- Provide the rate rolled up to the level of the program to be analyzed
- Include the overall rate as well as by state or by line of business, as applicable
- Document whether the rate is a filed rate, includes/excludes credit/debit changes and/or exposure changes.
- If the rate excludes credit/debit/exposure changes, try to include if possible.

Exposure Information

All lines of business should include summarized limits profiles (including in force limits, deductibles and premiums). For property lines of business, many additional types of exhibits should be included in this section:

- Modeling input files, control totals
- Modeling assumptions document
- Control totals and geocode summaries
- PML summaries
- Etc.

Loss Information

The loss experience should span 10 years, if possible. This section of the submission should include loss history either from a ground up view or large losses depending upon attachment point.

Ensure Inclusion of the Following:

- Loss listing at 50% of the lowest retention being considered
- Ground Up loss development triangles and excess loss development triangles, if available/relevant
- Loss ratios by treaty and calendar year by line of business
- Policy Limits for large losses, if available

Optional Components

These are optional components that may be included. It is important to include any information deemed necessary for a complete submission, therefore information is not limited to this list but should include any required information.

- Description of large losses;
- Historical (as if) treaty experience.

Contract Disclosure and Documentation

Contract Disclosure

Draft contracts are included in the submission. These draft contract wordings have been approved by the client. If you elect to participate on this program, we encourage you to provide the attached contracts to the appropriate areas within your organization now so that you will be in the best position to sign the final contracts. Any proposals or negotiations for changes in contractual terms and conditions must be made during this time period. Upon completion of negotiations, negotiated terms will be incorporated into the document you have previously reviewed, and presented to you with notification of your bound line for signature. The final contract must be executed and returned to the Intermediary within 14 days of transmittal.

Contract Documentation

Summary, Draft Contract and Contract Comparison

A draft contract with all terms and conditions must be included in the submission package. If this is a renewal, a contract summary or document compare to renewal markets may also be included:

- Draft Contract
- Draft Interests and Liabilities agreements (I&Ls)
- Previous 'Special Acceptances' that may be grandfathered/carried into this contract year

Supplemental Information

Optional Components

These are optional components that may be included. It is important to include any information deemed necessary for a complete submission therefore information is not limited to this list but should include any required information:

- Financial ratings
- Risk management protocols/procedures
- Distribution mechanisms
- Legislative changes

FTP Site

If an FTP Site is being used, include the table of contents for the site and the log in information so that it is easy for markets to understand and access:

- Long Term perspective;
- Excluding storm surge; and
- Including FMI's Hurricane/Wind deductibles.

Included with the submission are instructions for accessing the FMI FTP site:

Site: http://files.guycarp.com

User name:
Password:

When accessing the site, you need to say "yes" to run the ActiveX component that is being downloaded from the server. Then, drill down through the folders until you see the files, right-click and choose Download. Attached are additional instructions for using the FTP site and some possible solutions for common problems.

FTP Site Instructions

Downloading files from Guy Carpenter

There are 3 ways to use the file transfer site using http, https (SSL) or ftp.

HTTP (web browser):

To **use http://files.guycarp.com you need IE 5 or higher.**
1) Type **http://files.guycarp.com** in the browser
2) User: type the user name you were given
3) Password: type the password you were given
4) Click on folder to open
5) Right click on the file, click on download

You will need to say yes to running each activex component that is being downloaded from the server. You will only need to download the components once.

HTTPs (web browser):

To **use https://files.guycarp.com you need IE 5 or higher.**
1) Type **https://files.guycarp.com** in the browser
2) User: type the user name you were given
3) Password: type the password you were given
4) Click on folder to open
5) Right click on the file, click on download

You will need to say yes to running each activex component that is being downloaded from the server. You will only need to download the components once.

Please note that you will experience a substantial performance decrease if you use https due to the encryption of the data.

2 SAMPLE EXCESS OF LOSS REINSURANCE CONTRACT

PROPERTY CATASTROPHE EXCESS OF LOSS REINSURANCE CONTRACT
(the "Contract")

issued to

NATIONAL FLOOD INSURANCE PROGRAM
Washington, DC, USA

including any and/or all companies that are or may hereafter become affiliated therewith

(collectively, the "Company")

by

THE SUBSCRIBING REINSURER(S) IDENTIFIED
IN THE INTERESTS AND LIABILITIES AGREEMENT(S)
ATTACHED TO AND FORMING PART OF THIS CONTRACT

(the "Reinsurer")

ARTICLE 1

BUSINESS COVERED

This Contract is to indemnify the Company in respect of the liability that may accrue to the Company as a result of loss or losses under Policies classified by the Company as _____, in force at the inception of this Contract, or written or renewed during the term of this Contract by or on behalf of the Company, subject to the terms and conditions herein contained.

ARTICLE 2

RETENTION AND LIMIT

The Reinsurer shall be liable in respect of each Loss Occurrence, for the Ultimate Net Loss over and above an initial Ultimate Net Loss of $_____ each Loss Occurrence, subject to a limit of liability to the Reinsurer of $_____ each Loss Occurrence.

ARTICLE 3

TERM

This Contract shall take effect at _____, and shall remain in effect until _____, applying to Loss Occurrences commencing during the term of this Contract.

ARTICLE 4

SPECIAL TERMINATION

A. The Company may terminate a Subscribing Reinsurer's percentage share in this Contract at any time by giving written notice to the Subscribing Reinsurer in the event of any of the following circumstances:

1. The Subscribing Reinsurer ceases underwriting operations.

2. A state insurance department or other legal authority orders the Subscribing Reinsurer to cease writing business, or the Subscribing Reinsurer is placed under regulatory supervision.

3. The Subscribing Reinsurer has become insolvent or has been placed into liquidation or receivership (whether voluntary or involuntary), or there have been instituted against it proceedings for the appointment of a receiver, liquidator, rehabilitator, conservator, trustee in bankruptcy, or other agent known by whatever name, to take possession of its assets or control of its operations.

4. The Subscribing Reinsurer's policyholders' surplus (or the equivalent under the Subscribing Reinsurer's accounting system) as reported in such financial statements of the Subscribing Reinsurer as designated by the Company, has been reduced by 20% of the amount thereof at any date during the prior 12-month period (including the period prior to the inception of this Contract).

5. The Subscribing Reinsurer has merged with or has become acquired or controlled by any company, corporation, or individual(s) not controlling the Subscribing Reinsurer's operations at the inception of this Contract.

6. The Subscribing Reinsurer has retroceded its entire liability under this Contract without the Company's prior written consent, except for retrocessions to members of the Subscribing Reinsurer's holding company group.

7. The Subscribing Reinsurer has been assigned an A.M. Best's rating of less than "A-" and/or an S&P rating of less than "BBB+." However, as respects Underwriting Members of Lloyd's, London, a Lloyd's Market Rating of less than "A-" by A.M. Best and/or less than "BBB+" by S&P shall apply.

B. Termination shall be effected on a cut-off basis and the Subscribing Reinsurer shall have no liability for Loss Occurrences commencing after the date of termination. The reinsurance premium due the Subscribing Reinsurer hereunder (including any minimum reinsurance premium) shall be prorated based on the period of the Subscribing Reinsurer's participation hereon, and the Subscribing Reinsurer shall immediately return any excess reinsurance premium received. Reinstatement premium, if any, shall be calculated based on the Subscribing Reinsurer's reinsurance premium earned during the period of the Subscribing Reinsurer's participation hereon.

C. Additionally, in the event of any of the circumstances listed in paragraph A of this Article, the Company shall have the option to commute the Subscribing Reinsurer's liability for losses on Policies covered by this Contract. In the event the Company and the Subscribing Reinsurer cannot agree on the commutation amount, they shall appoint an actuary and/or appraiser to assess such amount and shall share equally any expense of the actuary and/or appraiser. If the Company and the Subscribing Reinsurer cannot agree on an actuary and/or appraiser, the Company and the Subscribing Reinsurer each shall nominate three individuals, of whom the other shall decline two, and the final appointment shall be made by drawing lots. Payment by the Subscribing Reinsurer of the amount of liability ascertained shall constitute a complete and final release of both parties in respect of liability arising from the Subscribing Reinsurer's participation under this Contract.

D. The Company's option to require commutation under paragraph C above shall survive the termination or expiration of this Contract.

ARTICLE 5

TERRITORY

The territorial limits of this Contract shall be identical with those of the Company's Policies.

ARTICLE 6

EXCLUSIONS

A. This Contract shall not apply to and specifically excludes:

1. Losses excluded by the attached Nuclear Incident Exclusion Clause – Physical Damage – Reinsurance – U.S.A.

2. Liability of the Company arising by contract, operation of law, or otherwise, from its participation or membership, whether voluntary or involuntary, in any Insolvency Fund. "Insolvency Fund" includes any guaranty fund, insolvency fund, plan, pool, association, fund or other arrangement, howsoever denominated, established or governed, that provides for any assessment of or payment or assumption by the Company of part or all of any claim, debt, charge, fee, or other obligation of an insurer, or its successors or assigns, that has been declared by any competent

authority to be insolvent, or that is otherwise deemed unable to meet any claim, debt, charge, fee or other obligation in whole or in part.

B. Exclusions _____ and ____ shall not apply when exposures are only incidental to the original insured's major activities or total operations.

C. If the Company inadvertently issues a Policy falling within the scope of one or more of the preceding exclusions, such Policy shall be covered hereunder, provided that the Company issues, or causes to be issued, the required notice of cancellation within 30 days after a member of the executive or managerial staff at the Company's home office having underwriting authority in the class of business involved becomes aware that the Policy applies to excluded classes, unless the Company is prevented from canceling said Policy within such period by applicable statute or regulation, in which case such Policy shall be covered hereunder until the earliest date on which the Company may cancel.

ARTICLE 7

SPECIAL ACCEPTANCE

Business that is not within the scope of this Contract may be submitted to _____ (the "Lead Reinsurer") for special acceptance hereunder, and such business, if accepted by the Lead Reinsurer shall be covered hereunder, subject to the terms and conditions of this Contract, except as modified by the special acceptance. Any special acceptance agreed to by the Lead Reinsurer shall be binding on all Subscribing Reinsurers hereon. The Lead Reinsurer shall be deemed to have accepted a risk, if it has not responded within __ days after receiving the underwriting information on such risk. Any renewal of a special acceptance agreed to for a predecessor contract to this Contract, shall automatically be covered hereunder.

ARTICLE 8

PREMIUM

A. The Company shall pay the Reinsurer a deposit premium of $_____ for the term of this Contract, to be paid in the amount of $_____ on the first day of each calendar quarter.

B. Within __ days following the expiration of this Contract, the Company shall furnish to the Reinsurer a statement of the Gross Net Earned Premium Income for the term of this Contract and calculate a premium at a rate of ____% multiplied by the Company's Gross Net Earned Premium Income. Should the premium so calculated exceed the deposit premium paid in accordance with paragraph A of this Article, the Company shall immediately pay the Reinsurer the difference. Should the premium so calculated be less than the deposit premium paid in accordance with paragraph A of this Article, the Reinsurer shall immediately pay the Company the difference, subject to a minimum premium for the term of this Contract of $_____.

C. The Company shall furnish the Reinsurer with such information as may be required by the Reinsurer for completion of its financial statements.

[If the program is placed with a collateralized market and a trust account is used for premium/loss transactions, the following wording may be added to reflect premium payments being made into a trust account:]

Notwithstanding any other provision, if a reinsurance trust is established with respect to any Subscribing Reinsurer, the portion of the premium due under this Contract with respect to the Subscribing Reinsurer's interest and share will be made directly to the appropriate Reinsurance Trust Account by the Company and such payment will be deemed satisfaction of any premium payment owed by the Company to such Subscribing Reinsurer under this Contract.

ARTICLE 9

REINSTATEMENT

A. Loss payments under this Contract shall reduce the limit of coverage afforded by the amounts paid, but the limit of coverage shall be reinstated from the time of the occurrence of the loss, and for each amount so reinstated, the Company agrees to pay, simultaneously with the Reinsurer's loss payment, an additional premium calculated at pro rata of ___% of the Reinsurer's premium for the term of this Contract, being pro rata only as to the fraction of the Reinsurer's limit of liability hereunder (i.e., the fraction of $_____) so reinstated. Nevertheless, the Reinsurer's liability hereunder shall not exceed $_____ in respect of any one Loss Occurrence, and shall not exceed $_____ in respect of all Loss Occurrences during the term of this Contract.

B. If at the time of a loss settlement hereon the reinsurance premium, as calculated in accordance with the Premium Article, is unknown, the above calculation of reinstatement premium shall be based upon the deposit premium, subject to adjustment when the reinsurance premium is finally established.

ARTICLE 10

DEFINITIONS

- A. 1. "Ultimate Net Loss" means the actual loss paid by the Company or which the Company becomes liable to pay, such loss to include Loss Adjustment Expense, ____% of any Extra Contractual Obligation and ____% of any Loss in Excess of Policy Limits as defined in the Extra Contractual Obligations/Excess of Policy Limits Article.

2. Salvages and all recoveries (including amounts due from all reinsurances that inure to the benefit of this Contract, whether recovered or not), shall be first deducted from such loss to arrive at the amount of liability attaching hereunder.

3. All salvages, recoveries or payments recovered or received subsequent to loss settlement hereunder shall be applied as if recovered or received prior to the aforesaid settlement, and all necessary adjustments shall be made by the parties hereto.

4. The Company shall be deemed to be "liable to pay" a loss when a judgment has been rendered that the Company does not plan to appeal, and/or the Company has obtained a release, and/or the Company has accepted a proof of loss.

5. Nothing in this clause shall be construed to mean that losses are not recoverable hereunder until the Company's "Ultimate Net Loss" has been ascertained.

B. "Loss Adjustment Expense" means costs and expenses incurred by the Company in connection with the investigation, appraisal, adjustment, settlement, litigation, defense or appeal of a specific claim or loss, or alleged loss, including but not limited to:

1. court costs;

2. costs of supersedeas and appeal bonds;

3. monitoring counsel expenses;

4. legal expenses and costs incurred in connection with coverage questions and legal actions connected thereto, including but not limited to declaratory judgment actions;

5. post-judgment interest;

6. pre-judgment interest, unless included as part of an award or judgment;

7. a pro rata share of salaries and expenses of Company field employees, calculated in accordance with the time occupied in adjusting such loss, and expenses of other Company employees who have been temporarily diverted from their normal and customary duties and assigned to the field adjustment of losses covered by this Contract; and

8. subrogation, salvage and recovery expenses.

"Loss Adjustment Expense" does not include salaries and expenses of the Company's employees, except as provided in subparagraph (7) above, and office and other overhead expenses.

- C. "Loss Occurrence" means the sum of all individual losses arising out of Flood, as defined in the NFIP's flood insurance policy to mean:

1. A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from:

a. Overflow of inland or tidal waters;

b. Unusual and rapid accumulation or runoff of surface waters from any source;

c. Mudflow.

2. Collapse or subsidence of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated cyclical levels that result in a flood as defined above.

D. "Gross Net Earned Premium Income" means gross earned premium of the Company for the classes of business reinsured hereunder, less the earned portion of premiums ceded by the Company for reinsurance that inures to the benefit of this Contract.

E. "Policy" means any binder, policy, or contract of insurance or reinsurance issued, accepted or held covered provisionally or otherwise, by or on behalf of the Company.

ARTICLE 11

EXTRA CONTRACTUAL OBLIGATIONS/EXCESS OF POLICY LIMITS

A. This Contract shall cover Extra Contractual Obligations, as provided in the definition of Ultimate Net Loss. "Extra Contractual Obligations" shall be defined as those liabilities not covered under any other provision of this Contract and that arise from the handling of any claim on business covered hereunder, such liabilities arising because of, but not limited to, the following: failure by the Company to settle within the Policy limit, or by reason of alleged or actual negligence, fraud or bad faith in rejecting an offer of settlement or in the preparation of the defense or in the trial of any action against its insured or reinsured or in the preparation or prosecution of an appeal consequent upon such action.

B. This Contract shall cover Loss in Excess of Policy Limits, as provided in the definition of Ultimate Net Loss. "Loss in Excess of Policy Limits" shall be defined as Loss in excess of the Policy limit, having been incurred because of, but not limited to, failure by the Company to settle within the Policy limit or by reason of alleged or actual negligence, fraud or bad faith in rejecting an offer of settlement or in the preparation of the defense or in the trial of any action against its insured or reinsured or in the preparation or prosecution of an appeal consequent upon such action.

C. An Extra Contractual Obligation and/or Loss in Excess of Policy Limits shall be deemed to have occurred on the same date as the loss covered under the Company's Policy, and shall constitute part of the original loss.

D. For the purposes of the Loss in Excess of Policy Limits coverage hereunder, the word "Loss" shall mean any amounts for which the Company would have been contractually liable to pay had it not been for the limit of the original Policy.

E. Loss Adjustment Expense in respect of Extra Contractual Obligations and/or Loss in Excess of Policy Limits shall be covered hereunder in the same manner as other Loss Adjustment Expense.

F. However, this Article shall not apply where the loss has been incurred due to final legal adjudication of fraud of a member of the Board of Directors or a corporate officer of the Company acting individually or collectively or in collusion with any individual or corporation or any other organization or party involved in the presentation, defense or settlement of any claim covered hereunder.

G. In no event shall coverage be provided to the extent not permitted under law.

ARTICLE 12

NET RETAINED LIABILITY

A. This Contract applies only to that portion of any loss that the Company retains net for its own account (prior to deduction of any reinsurance that inures solely to the benefit of the Company).

B. The amount of the Reinsurer's liability hereunder in respect of any loss or losses shall not be increased by reason of the inability of the Company to collect from any other reinsurer(s), whether specific or general, any amounts that may have become due from such reinsurer(s), whether such inability arises from the insolvency of such other reinsurer(s) or otherwise.

ARTICLE 13

ORIGINAL CONDITIONS

All reinsurance under this Contract shall be subject to the same terms, conditions, waivers and interpretations, and to the same modifications and alterations as the respective Policies of the Company. However, in no event shall this be construed in any way to provide coverage outside the terms and conditions set forth in this Contract.

ARTICLE 14

NO THIRD PARTY RIGHTS

This Contract is solely between the Company and the Reinsurer, and in no instance shall any insured, claimant or other third party have any rights under this Contract except as may be expressly provided otherwise herein.

ARTICLE 15

NOTICE OF LOSS AND LOSS SETTLEMENTS

A. The Company shall advise the Reinsurer promptly of all losses that, in the opinion of the Company, may result in a claim hereunder and of all subsequent developments thereto that may materially affect the position of the Reinsurer.

B. The Company alone and at its full discretion shall adjust, settle or compromise all claims and losses.

C. As respects losses subject to this Contract, all loss settlements made by the Company, whether under strict Policy terms or by way of compromise, and any Extra Contractual Obligations and/or Loss in Excess of Policy Limits, shall be binding upon the Reinsurer, and the Reinsurer agrees to pay or allow, as the case may be, its share of each such settlement immediately upon receipt of proof of loss.

ARTICLE 16

CURRENCY

A. Where the word "Dollars" and/or the sign "$" appear in this Contract, they shall mean United States Dollars, and all payments hereunder shall be in United States Dollars.

B. For purposes of this Contract, where the Company receives premiums or pays losses in currencies other than United States Dollars, such premiums or losses shall be converted into United States Dollars at the actual rates of exchange at which these premiums or losses are entered in the Company's books.

ARTICLE 17

UNAUTHORIZED REINSURANCE

A. The Company agrees, in respect of its Policies or bonds falling within the scope of this Contract, that it shall forward to the Reinsurer a statement of the Reinsurer's Obligations. The "Reinsurer's Obligations" shall be defined as follows:

1. unearned premium (if applicable);
2. known outstanding losses that have been reported to the Reinsurer and Loss Adjustment Expense relating thereto;
3. losses and Loss Adjustment Expense paid by the Company but not recovered from the Reinsurer;
4. losses incurred but not reported and Loss Adjustment Expense relating thereto;
5. all other amounts for which the Company cannot take credit on its financial statements unless funding is provided by the Reinsurer.

B. The Reinsurer's Obligations shall be funded by funds withheld, cash advances, Trust Agreement or a Letter of Credit (LOC). The Reinsurer shall have the option of determining the method of funding provided it is acceptable to the Company.

C. When funding by Trust Agreement, the Reinsurer shall ensure that the Trust Agreement complies with the provisions of the "Trust Agreement Requirements Clause" attached

hereto. When funding by an LOC, the Reinsurer agrees to apply for and secure timely delivery to the Company of a clean, irrevocable and unconditional LOC issued by a bank and containing provisions acceptable to the Company in an amount equal to the Reinsurer's Obligations. Such LOC shall be issued for a period of not less than one year, and shall be automatically extended for one year from its date of expiration or any future expiration date unless 30 days (or such other time period as may be required by the Company), prior to any expiration date the issuing bank shall notify the Company by certified or registered mail that the issuing bank elects not to consider the LOC extended for any additional period.

D. The Reinsurer and the Company agree that any funding provided by the Reinsurer pursuant to the provisions of this Contract may be drawn upon at any time, notwithstanding any other provision of this Contract, and be utilized by the Company for the following purposes, unless otherwise provided for in a separate Trust Agreement:

1. to reimburse the Company for the Reinsurer's Obligations, the payment of which is due under the terms of this Contract and that has not been otherwise paid;

2. to make refund of any sum that is in excess of the actual amount required to pay the Reinsurer's Obligations under this Contract (or in excess of 102% of the Reinsurer's Obligations, if funding is provided by a Trust Agreement);

3. to fund an account with the Company for the Reinsurer's Obligations. Such cash deposit shall be held in an interest bearing account separate from the Company's other assets, and interest thereon not in excess of the prime rate shall accrue to the benefit of the Reinsurer. Any taxes payable on accrued interest shall be paid out of the assets in the account that are in excess of the Reinsurer's Obligations (or in excess of 102% of the Reinsurer's Obligations, if funding is provided by a Trust Agreement). If the assets are inadequate to pay taxes, any taxes due shall be paid or reimbursed by the Reinsurer;

4. to pay the Reinsurer's share of any other amounts the Company claims are due under this Contract.

E. If the amount drawn by the Company is in excess of the actual amount required for D(1) or D(3), or in the case of D(4), the actual amount determined to be due, the Company shall promptly return to the Reinsurer the excess amount so drawn. All of the foregoing shall be applied without diminution because of insolvency on the part of the Reinsurer.

F. The issuing bank shall have no responsibility whatsoever in connection with the propriety of withdrawals made by the Company or the disposition of funds withdrawn, except to ensure that withdrawals are made only upon the order of properly authorized representatives of the Company.

G. At annual intervals, or more frequently at the discretion of the Company, but never more frequently than quarterly, the Company shall prepare a specific statement of the Reinsurer's Obligations for the sole purpose of amending the LOC or other method of funding, in the following manner:

1. If the statement shows that the Reinsurer's Obligations exceed the balance of the LOC as of the statement date, the Reinsurer shall, within 30 days after receipt of the statement, secure delivery to the Company of an amendment to the LOC increasing the amount of credit by the amount of such difference. Should another method of funding be used, the Reinsurer shall, within the time period outlined above, increase such funding by the amount of such difference.

2. If, however, the statement shows that the Reinsurer's Obligations are less than the balance of the LOC (or that 102% of the Reinsurer's Obligations are less than the trust account balance if funding is provided by a Trust Agreement), as of the statement date, the Company shall, within 30 days after receipt of written request from the Reinsurer, release such excess credit by agreeing to secure an amendment to the LOC reducing the amount of credit available by the amount of such excess credit. Should another method of funding be used, the Company shall, within the time period outlined above, decrease such funding by the amount of such excess.

ARTICLE 18

TAXES

A. In consideration of the terms under which this Contract is issued, the Company undertakes not to claim any deduction of the premium hereon when making Canadian tax returns or when making tax returns, other than Income or Profits Tax returns, to any state or territory of the United States of America or to the District of Columbia.

- B. 1. Each Subscribing Reinsurer has agreed to allow, for the purpose of paying the Federal Excise Tax, the applicable percentage of the premium payable hereon (as imposed under the Internal Revenue Code) to the extent such premium is subject to Federal Excise Tax.

2. In the event of any return of premium becoming due hereunder, the Subscribing Reinsurer shall deduct the applicable percentage of the premium from the amount of the return, and the Company or its agent should take steps to recover the Tax from the U.S. Government.

ARTICLE 19

ACCESS TO RECORDS

A. The Reinsurer or its duly authorized representatives shall have the right to visit the offices of the Company to inspect, examine, audit, and verify any of the policy, accounting or claim files ("Records") relating to business reinsured under this Contract during regular business hours after giving five working days' prior notice. This right shall be exercisable during the term of this Contract or after the expiration of this Contract. Notwithstanding the above, the Reinsurer shall not have any right of access to the Records of the Company if it is not current in all undisputed payments due the Company.

B. Notwithstanding the above, the Company reserves the right to withhold from the Reinsurer any Privileged Documents. However, the Company shall permit and not object to the Reinsurer's access to Privileged Documents in connection with the underlying claim reinsured hereunder following final settlement or final adjudication of the case or cases involving such claim, with prejudice against all claimants and all parties to such adjudications; the Company may defer release of such Privileged Documents if there are subrogation, contribution, or other third party actions with respect to that claim or case, and the Company's defense might be jeopardized by release of such Privileged Documents. In the event that the Company seeks to defer release of such Privileged Documents, it shall, in consultation with the Reinsurer, take other steps as reasonably necessary to provide the Reinsurer with the information it reasonably requires to indemnify the Company without causing a loss of such privileges or protections. The Reinsurer shall not have access to Privileged Documents relating to any dispute between the Company and the Reinsurer.

C. For purposes of this Article:

1. "Privileged Documents" means any documents that are Attorney-Client Privilege Documents and/or Work Product Privilege Documents.

2. "Attorney-Client Privilege Documents" means communications of a confidential nature between (a) the Company, or anyone retained by or at the direction of the Company, or its in-house or outside legal counsel, or anyone in the control of such legal counsel, and (b) any in-house or outside legal counsel, if such communications relate to legal advice being sought by the Company and/or contain legal advice being provided to the Company.

3. "Work Product Privilege Documents" means communications, written materials and tangible things prepared by or for in-house or outside counsel, or prepared by or for the Company, in anticipation of or in connection with litigation, arbitration, or other dispute resolution proceedings.

ARTICLE 20

CONFIDENTIALITY

A. The Reinsurer hereby acknowledges that the documents, information and data provided to it by the Company, whether directly or through an authorized agent, in connection with the placement and execution of this Contract ("Confidential Information") are proprietary and confidential to the Company. Confidential Information shall not include documents, information or data that the Reinsurer can show:

1. are publicly known or have become publicly known through no unauthorized act of the Reinsurer;

2. have been rightfully received from a third person without obligation of confidentiality; or

3. were known by the Reinsurer prior to the placement of this Contract without an obligation of confidentiality.

B. Absent the written consent of the Company, the Reinsurer shall not disclose any Confidential Information to any third parties, including any affiliated companies, except:

1. when required by retrocessionaires as respects business ceded to this Contract;

2. when required by regulators performing an audit of the Reinsurer's records and/or financial condition; or

3. when required by external auditors performing an audit of the Reinsurer's records in the normal course of business.

Further, the Reinsurer agrees not to use any Confidential Information for any purpose not related to the performance of its obligations or enforcement of its rights under this Contract.

C. Notwithstanding the above, in the event that the Reinsurer is required by court order, other legal process or any regulatory authority to release or disclose any or all of the Confidential Information, the Reinsurer agrees to provide the Company with written notice of same at least 10 days prior to such release or disclosure and to use its best efforts to assist the Company in maintaining the confidentiality provided for in this Article.

D. The provisions of this Article shall extend to the officers, directors and employees of the Reinsurer and its affiliates, and shall be binding upon their successors and assigns.

ARTICLE 21

INDEMNIFICATION AND ERRORS AND OMISSIONS

A. The Reinsurer is reinsuring, subject to the terms and conditions of this Contract, the obligations of the Company under any Policy. The Company shall be the sole judge as to:

1. what shall constitute a claim or loss covered under any Policy;

2. the Company's liability thereunder;

3. the amount or amounts that it shall be proper for the Company to pay thereunder.

B. The Reinsurer shall be bound by the judgment of the Company as to the obligation(s) and liability(ies) of the Company under any Policy.

C. Any inadvertent error, omission or delay in complying with the terms and conditions of this Contract shall not be held to relieve either party hereto from any liability that would attach to it hereunder if such error, omission or delay had not been made, provided such error, omission or delay is rectified immediately upon discovery.

ARTICLE 22

ARBITRATION

A. Any dispute arising out of the interpretation, performance or breach of this Contract, including the formation or validity thereof, shall be submitted for decision to a panel of three arbitrators. Notice requesting arbitration shall be in writing and sent certified or registered mail, return receipt requested.

B. One arbitrator shall be chosen by each party and the two arbitrators shall then choose an impartial third arbitrator who shall preside at the hearing. If either party fails to appoint its arbitrator within 30 days after being requested to do so by the other party, the latter, after 10 days' prior notice by certified or registered mail of its intention to do so, may appoint the second arbitrator.

C. If the two arbitrators do not agree on a third arbitrator within 60 days of their appointment, the third arbitrator shall be chosen in accordance with the procedures for selecting the third arbitrator in force on the date the arbitration is demanded, established by the AIDA Reinsurance and Insurance Arbitration Society – U.S. (ARIAS). The arbitrators shall be persons knowledgeable about insurance and reinsurance who have no personal or financial interest in the result of the arbitration. If a member of the panel dies, becomes disabled or is otherwise unwilling or unable to serve, a substitute shall be selected in the same manner as the departing member was chosen and the arbitration shall continue.

D. Within 30 days after all arbitrators have been appointed, the panel shall meet and determine timely periods for briefs, discovery procedures and schedules of hearings.

- E. The panel shall be relieved of all judicial formality and shall not be bound by the strict rules of procedure and evidence. Notwithstanding anything to the contrary in this Contract, the arbitrators may at their discretion, consider underwriting and placement information provided by the Company to the Reinsurer, as well as any correspondence exchanged by the parties that is related to this Contract. The arbitration shall take place in _____, or at such other place as the parties shall agree. The decision of any two arbitrators shall be in writing and shall be final and binding. The panel is empowered to grant interim relief as it may deem appropriate.

F. The panel shall interpret this Contract as an honorable engagement rather than as merely a legal obligation and shall make its decision considering the custom and practice of the applicable insurance and reinsurance business as promptly as possible after the hearings. Judgment upon an award may be entered in any court having jurisdiction thereof.

G. Each party shall bear the expense of its own arbitrator and shall jointly and equally bear with the other party the cost of the third arbitrator. The remaining costs of the arbitration shall be allocated by the panel. The panel may, at its discretion, award such further costs and expenses as it considers appropriate, including but not limited to attorneys' fees, to the extent permitted by law.

ARTICLE 23

SERVICE OF SUIT

A. This Article applies only to those Subscribing Reinsurers not domiciled in the United States of America, and/or not authorized in any state, territory and/or district of the United States of America where authorization is required by insurance regulatory authorities.

B. This Article shall not be read to conflict with or override the obligations of the parties to arbitrate their disputes as provided for in the Arbitration Article. This Article is intended as an aid to compelling arbitration or enforcing such arbitration or arbitral award, not as an alternative to the Arbitration Article for resolving disputes arising out of this Contract.

C. In the event of the failure of the Reinsurer to perform its obligations hereunder, the Reinsurer, at the request of the Company, shall submit to the jurisdiction of a court of competent jurisdiction within the United States. Nothing in this Article constitutes or should be understood to constitute a waiver of the Reinsurer's rights to commence an action in any court of competent jurisdiction in the United States, to remove an action to a United States District Court, or to seek a transfer of a case to another court as permitted by the laws of the United States or of any state in the United States. The Reinsurer, once the appropriate court is selected, whether such court is the one originally chosen by the Company and accepted by the Reinsurer or is determined by removal, transfer, or otherwise, as provided for above, shall comply with all requirements necessary to give said court jurisdiction and, in any suit instituted against the Reinsurer upon this Contract, shall abide by the final decision of such court or of any appellate court in the event of an appeal.

D. Service of process in such suit may be made upon Messrs. Mendes and Mount, 750 Seventh Avenue, New York, New York 10019-6829, or another party specifically designated in the applicable Interests and Liabilities Agreement attached hereto. The above-named are authorized and directed to accept service of process on behalf of the Reinsurer in any such suit.

E. Further, pursuant to any statute of any state, territory or district of the United States that makes provision therefor, the Reinsurer hereby designates the Superintendent, Commissioner or Director of Insurance, or other officer specified for that purpose in the statute, or his successor or successors in office, as its true and lawful attorney upon whom may be served any lawful process in any action, suit or proceeding instituted by or on behalf of the Company or any beneficiary hereunder arising out of this Contract, and hereby designates the above-named as the person to whom the said officer is authorized to mail such process or a true copy thereof.

ARTICLE 24

GOVERNING LAW

This Contract shall be governed as to performance, administration and interpretation by the laws of the United States of America.

ARTICLE 25

ENTIRE AGREEMENT

This Contract sets forth all of the duties and obligations between the Company and the Reinsurer and supersedes any and all prior or contemporaneous written agreements with respect to matters referred to in this Contract. This Contract may not be modified or changed except by an amendment to this Contract in writing signed by both parties. However, this Article shall not be construed as limiting the admissibility of evidence regarding the formation, interpretation, purpose or intent of this Contract.

ARTICLE 26

NON-WAIVER

The failure of the Company or the Reinsurer to insist on compliance with this Contract or to exercise any right or remedy hereunder shall not constitute a waiver of any rights contained in this Contract nor prevent either party from thereafter demanding full and complete compliance nor prevent either party from exercising such remedy in the future.

ARTICLE 27

INTERMEDIARY

Guy Carpenter & Company, LLC, is hereby recognized as the Intermediary negotiating this Contract for all business hereunder. All communications (including notices, statements, premiums, return premiums, commissions, taxes, losses, Loss Adjustment Expenses, salvages, and loss settlements) relating thereto shall be transmitted to the Company or the Reinsurer through the Intermediary. Payments by the Company to the Intermediary shall be deemed payment to the Reinsurer. Payments by the Reinsurer to the Intermediary shall be deemed payment to the Company only to the extent that such payments are actually received by the Company.

ARTICLE 28

MODE OF EXECUTION

A. This Contract may be executed by:

1. an original written ink signature of paper documents;

2. an exchange of facsimile copies showing the original written ink signature of paper documents;

3. electronic signature technology employing computer software and a digital signature or digitizer pen pad to capture a person's handwritten signature in such a manner that the signature is unique to the person signing, is under the sole control of the person signing, is capable of verification to authenticate the signature and is linked to the document signed in such a manner that if the data is changed, such signature is invalidated.

B. The use of any one or a combination of these methods of execution shall constitute a legally binding and valid signing of this Contract. This Contract may be executed in one or more counterparts, each of which, when duly executed, shall be deemed an original.

IN WITNESS WHEREOF, the Company has caused this Contract to be executed by its duly authorized representative(s) this _____day of _____, in the year of 20__.

NATIONAL FLOOD INSURANCE PROGRAM

PROPERTY CATASTROPHE EXCESS OF LOSS REINSURANCE CONTRACT

NUCLEAR INCIDENT EXCLUSION CLAUSE - PHYSICAL DAMAGE - REINSURANCE - U.S.A.

1. This Reinsurance does not cover any loss or liability accruing to the Reassured, directly or indirectly, and whether as Insurer or Reinsurer, from any Pool of Insurers or Reinsurers formed for the purpose of covering Atomic or Nuclear Energy risks.

2. Without in any way restricting the operation of paragraph (1) of this clause, this Reinsurance does not cover any loss or liability accruing to the Reassured, directly or indirectly and whether as Insurer or Reinsurer, from any insurance against Physical Damage (including business interruption or consequential loss arising out of such Physical Damage) to:

   I. Nuclear reactor power plants including all auxiliary property on the site, or

   II. Any other nuclear reactor installation, including laboratories handling radioactive materials in connection with reactor installations, and “critical facilities” as such, or

   III. Installations for fabricating complete fuel elements or for processing substantial quantities of “special nuclear material”, and for reprocessing, salvaging, chemically separating, storing or disposing of “spent” nuclear fuel or waste materials, or

   IV. Installations other than those listed in paragraph (2) III above using substantial quantities of radioactive isotopes or other products of nuclear fission.

3. Without in any way restricting the operations of paragraphs (1) and (2) hereof, this Reinsurance does not cover any loss or liability by radioactive contamination accruing to the Reassured, directly or indirectly, and whether as Insurer or Reinsurer, from any insurance on property which is on the same site as a nuclear reactor power plant or other nuclear installation and which normally would be insured therewith except that this paragraph (3) shall not operate

   (a) where Reassured does not have knowledge of such nuclear reactor power plant or nuclear installation, or

   (b) where said insurance contains a provision excluding coverage for damage to property caused by or resulting from radioactive contamination, however caused. However on and after 1st January 1960 this sub-paragraph (b) shall only apply provided the said radioactive contamination exclusion provision has been approved by the Governmental Authority having jurisdiction thereof.

4. Without in any way restricting the operations of paragraphs (1), (2) and (3) hereof, this Reinsurance does not cover any loss or liability by radioactive contamination accruing to the Reassured, directly or indirectly, and whether as Insurer or Reinsurer, when such radioactive contamination is a named hazard specifically insured against.

5. It is understood and agreed that this clause shall not extend to risks using radioactive isotopes in any form where the nuclear exposure is not considered by the Reassured to be the primary hazard.

6. The term "special nuclear material" shall have the meaning given it in the Atomic Energy Act of 1954 or by any law amendatory thereof.

7. Reassured to be sole judge of what constitutes:

   (a) substantial quantities, and

   (b) the extent of installation, plant or site.

Note: Without in any way restricting the operation of paragraph (1) hereof, it is understood and agreed that

(a) all policies issued by the Reassured on or before 31st December 1957 shall be free from the application of the other provisions of this Clause until expiry date or 31st December 1960 whichever first occurs whereupon all the provisions of this Clause shall apply.

(b) with respect to any risk located in Canada policies issued by the Reassured on or before 31st December 1958 shall be free from the application of the other provisions of this Clause until expiry date or 31st December 1960 whichever first occurs whereupon all the provisions of this Clause shall apply.

12/12/57
NMA 1119

NOTES: Wherever used herein the terms:

1. "Reassured" shall be understood to mean "Company", "Reinsured", "Reassured" or whatever other term is used in the attached reinsurance document to designate the reinsured company or companies.

2. "Agreement" shall be understood to mean "Agreement", "Contract", "Policy" or whatever other term is used to designate the attached reinsurance document.

3. "Reinsurers" shall be understood to mean "Reinsurers", "Underwriters" or whatever other term is used in the attached reinsurance document to designate the reinsurer or reinsurers.

TRUST AGREEMENT REQUIREMENTS CLAUSE

If the Reinsurer satisfies its funding obligations under the Unauthorized Reinsurance Article by providing a Trust Agreement, the Reinsurer shall ensure that the Trust Agreement:

1. Requires the Reinsurer to establish a trust account for the benefit of the Company, and specifies what the Trust Agreement is to cover;

2. Stipulates that assets deposited in the trust account shall be valued according to their current fair market value and shall consist only of cash (United States legal tender), certificates of deposit (issued by a United States bank and payable in United States legal tender), and investments of the types permitted by the Company, or any combination of the three, provided that the investments are issued by an institution that is not the parent, subsidiary or affiliate of either the Reinsurer or the Company;

3. Requires the Reinsurer, prior to depositing assets with the trustee, to execute assignments or endorsements in blank, or to transfer legal title to the trustee of all shares, obligations or any other assets requiring assignments, in order that the Company, or the trustee upon the direction of the Company, may whenever necessary negotiate these assets without consent or signature from the Reinsurer or any other entity;

4. Requires that all settlements of account between the Company and the Reinsurer be made in cash or its equivalent; and

5. Provides that assets in the trust account shall be withdrawn only as permitted in this Contract, without diminution because of the insolvency of the Company or the Reinsurer.

3 BENCHMARK PRICING RATIONALE

Our modeling of each reinsurance structure evaluated and compared in the RDT requires the cost, or the premium charged by the reinsurers, as a key input for each structure. Estimating these reinsurance premium charges is particularly challenging for this study in the absence of a significant private sector reinsurance market for the peril of US flood. However, we believe that the significant reinsurance market for catastrophic wind provides a reasonable benchmark for flood reinsurance.

Our method for estimating the premium charges was based on the expected loss ratios for catastrophic wind reinsurance treaties that have actually been placed in the markets. We maintain a detailed database of actual placements which we mined for application to this study. We applied a consistent process in using this placement data with judgmental adjustments in some cases.

The first step in our process was to sort our database into relevant cedant segments in order to weight these segments appropriately for application to the NFIP portfolio. We selected the following segments and weights for this analysis:

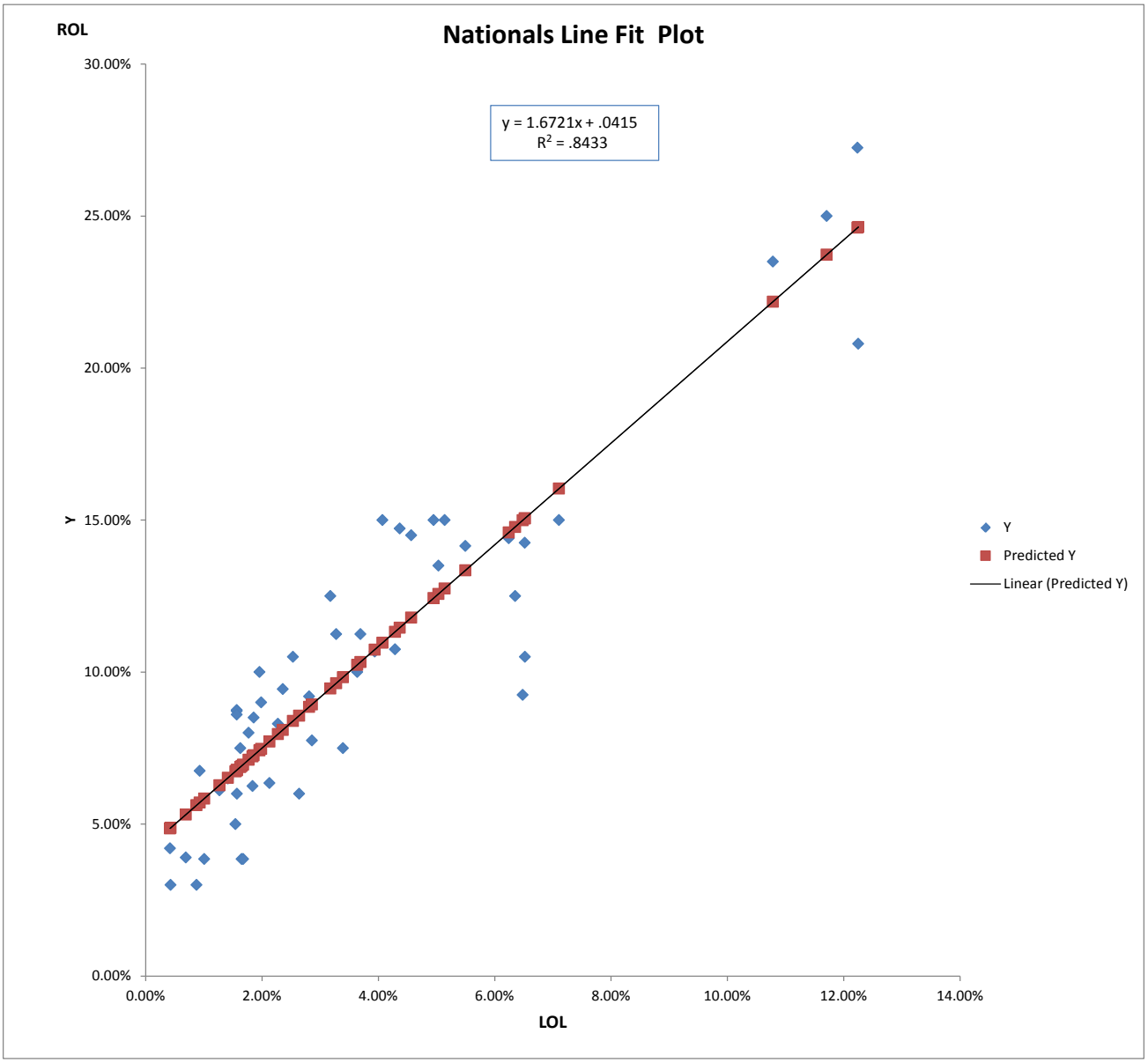
- National Carriers 25%
- Florida Companies 25%
- Louisiana Companies 10%
- Residual Market Pools 20%
- Cat Bonds 20%

For each placement within each segment, we pulled:

- **The Loss on Line (LOL)**: The modeled expected loss as a percentage of the reinsurance limit. Models and assumptions used for each program differ though the impact of model variance is minimized by the number and scope of programs included in our database and the storm surge model blending approach utilized by NFIP.
- **The reinsurance limit**: The amount of coverage purchased by each cedant.
- **The Rate on Line (ROL)**: The final reinsurance premium for the coverage placed in the market taken as a percentage of the reinsurance limit.

Then for each segment we fit a line using LOL as the independent variable and ROL as the dependent variable. Since our modeling of NFIP's portfolio calculated the LOL for each structure included in NFIP's RDT, we used LOL as a predictor of the ROL for each reinsurance structure (note, for occurrence based covers we used only the HU/TS loss curve to determine our pricing estimate). The expected reinsurance loss ratio = LOL/ROL, thus the expected loss ratio prediction is also a result of this process. The following graph shows one of the line fits using the National segment as an example:

Figure 1: The LOL/ROL Relationship for National Reinsurance Placements – Linear Fit



This fitting process was applied to each of the segments listed above, resulting in five separate linear formulas that were all applied to the same LOLs for each structure that we evaluated in RDT. Thus, we obtained five separate ROLs for each structure that were used for the occurrence structures evaluated.

These ROLs were used to estimate the deposit premiums on occurrence treaties (prior to reinstatement premiums in the event of actual losses and using only HU/TS losses). A loading was added for aggregate treaties based on the estimated cost of a pre-paid reinstatement increased by a judgmental market based percentage load. The resulting ROLs by segment were used to calculate five separate expected loss ratios (ELRs) by segment. The weighted average ELR was calculated for each structure evaluated using the weights by segment shown above. For each structure:

Reinsurance Premium = Expected Losses / ELR

The following exhibit shows an outline of the ELR estimation process for each reinsurance structure using the National segment as an example:

Figure 2: Calculated Expected Loss Ratios for NFIP Reinsurance Structure Options as if National

						Weight	25%			
						Priced As If National				
NFIP	limit	attach	type	AAL*	LoL	Occ Cover	adj for agg	Layer RoL	Layer $s	ELR
Structure	($Bs)	($Bs)		($MMs)	(%)	(%)	(%)	(%)	($MMs)	ELR
Option 1	16.9	7.8	agg	807.5	4.78%	12.14%	1.84%	13.99%	2,364	34.2%
Option 2	14.4	3.9	occ	683.5	4.75%	12.09%	n.a.	12.09%	1,741	39.3%
Option 3	10.5	7.8	occ	267.8	2.55%	8.42%	n.a.	8.42%	884	30.3%
Option 4a	14.4	3.9	occ	683.5	4.75%	12.09%	n.a.	12.09%	1,741	39.3%
Option 4b	5.25	3.75	agg	162.0	3.09%	9.31%	1.08%	10.40%	546	29.7%

* AAL for the occurrence options 2,3, and 4a exclude the inland flood peril

AAL for the aggregate option 4b reflects inurance from occurrence option 4a

The calculations were repeated for each of the five segments from which the weighted averages were calculated.

Although the occurrence covers that we evaluated include coverage for inland flood, we included the expected losses for only hurricane and named tropical storms in estimating the reinsurance premium for these covers. We believe reinsurers are likely to deem the inland flood exposure above selected occurrence cover attachment points to be insignificant and may effectively ignore it by virtue of the following factors:

- Very few historical inland flood events, even on an indexed basis, have threatened to breach the $3.9B level;
- Inland flood exposure provides reinsurers with significant diversification benefits versus already concentrated coastal exposure in the reinsurance market;
- Inland flood modeling is still very new so the extent of weight placed by the market on such estimated loss results will vary and may be ignored in some cases.

OLIVER WYMAN

FEMA

FLOOD INSURANCE RISK STUDY

Options for Privatizing the NFIP

MARSH & McLENNAN COMPANIES

Preface

This study of reasonable options for privatizing the NFIP is a part of the Flood Insurance Risk Study (FIRS) that was commissioned by FEMA to comply with the requirements set forth in Section 100232 “Reinsurance” paragraphs (a), (c) and (e) of the Biggert-Waters Flood Insurance Reform Act.

The preparation of this report was coordinated and led by Oliver Wyman, Inc. acting as a Subcontractor to Guy Carpenter & Company LLC in connection with Contract No. HSFE60-13-C-0056 effective September 30, 2013. Guy Carpenter also directly contributed to the delivery of this report.

The objective of the study is to articulate a broad range of options, methods and strategies for the privatization of the NFIP’s responsibilities for the provision of flood insurance.

The topics addressed in this study include:

- Analysis of the private sector’s capacity and appetite to provide flood insurance
- A review of the methods, means and procedures by which the consequences of flooding are handled in various countries around the world
- Articulation of a framework for considering the key policy levers available in the development of a flood risk financing plan
- Development and analysis of a set of structural options for privatization of the NFIP, which involve varying degrees of ongoing government involvement
- An assessment of each of these structural options
- Articulation of steps required to move towards privatization
- Reasonable methods by which the NFIP’s other critical responsibilities could be accomplished if the NFIP’s flood insurance responsibilities were privatized

This study draws on a combination of literature review, market interviews with members of major stakeholder groups identified herein and the analysis and conclusions of the project working team, conducted on a best efforts basis. Notwithstanding this, flood risk is an expansive and dynamic topic and one where it is impossible to represent all views of all stakeholders – we do not pretend to have done so, but believe that this study presents a balanced view of the key issues and the reasonable options for privatizing the NFIP. It should also be noted that there are observations and conclusions presented in this report that draw from the parallel work undertaken to deliver all aspects of the FIRS Contract. This includes the Reinsurance Study and supporting flood risk analytics detailed under the Contract specifications.

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1. Introduction

The National Flood Insurance Program (NFIP) is the primary underwriter of flood insurance policies in the United States. As a result of Hurricane Katrina, Rita and Wilma in 2005 and Superstorm Sandy in 2012, the program suffered tremendous losses that exposed significant weaknesses in the program's financial structure – it owed approximately $24 billion to the Treasury as of July 31, 2013. These events revealed a clear need for reform to both ensure the forward-looking sustainability of the program and the viability of the overall U.S. flood insurance market.

One such reform under consideration is to increase the role of the private sector in the flood insurance market. From a public policy perspective, there are many potential benefits to increasing the involvement of the private sector in the flood insurance market, including:

- Innovation through market competition
- Reduction of government exposure to flood risk
- Alignment of incentives along the flood risk value chain

Greater private sector involvement would promote innovation through market competition, potentially leading to improved product offerings, lower prices for consumers and greater flood insurance penetration over time. It would also reduce the amount of flood risk to which the government is directly exposed and create a new market and business line for insurers, reinsurers and the capital markets that would diversify their existing portfolios. Taken together, this would help align incentives by imposing market discipline on flood insurance premiums and help ensure the longer-term financial sustainability of all stakeholders within the flood insurance value chain.

Though there are many potential benefits to a private market for flood insurance, such a transition is not without obstacles. Today, catastrophic loss potential and insufficient insurance premiums (to cover such losses) remain paramount concerns. Historically private insurers chose not to underwrite flood risk due to the fact that it was difficult to measure and quantify and subsequently difficult to price adequately, especially given the potential for extreme losses due to catastrophic events.

That stated, the (re)insurance industry has made significant progress over the last 40+ years since the establishment of the NFIP. Advances in digital mapping technologies, the development of actuarial tools and growth in data place the industry in a position to underwrite and measure flood risk far better than it was able to in 1968. When considered in combination with the financial need to reform the NFIP, the present environment represents an opportunity to reconsider how to increase the role of the private sector in the flood risk financing chain.

The objective of this study is to provide a thorough review of the reasonable options for privatizing the NFIP.

The sections that follow are organized into 4 parts:

- **Section 1** provides a brief history of the NFIP and flood risk financing in the United States, including an overview of recent legislation.
- **Section 2** introduces a set of international case studies that describe how flood risk financing is addressed in other countries, including the United Kingdom, the Netherlands, France and Spain.
- **Section 3** delineates the various stakeholders in the flood risk financing chain and describes each of their unique perspectives and interests.
- **Section 4** studies options for privatizing the NFIP by introducing a long list of approaches to flood risk financing; articulating each of the key hurdles to achieving privatization of the U.S. flood insurance market; introducing a framework for winnowing down the long list into a set of viable options; and describing the reasonable pathways to privatization for the NFIP.

1.1. Brief history of the NFIP

Under the 1936 Flood Control Act, the U.S. government assumed responsibility for national flood mitigation (Arnold, 1988) and authorized the U.S. Army Corps of Engineers and other federal agencies to improve flood defenses. Despite spending more than $7 billion on defenses over the following 30 years, damages due to flood were approximately $1 billion each year (Task Force on Federal Flood Control Policy, 1966).

This prolonged economic loss prompted two studies in 1966 that investigated practical options for national flood insurance. One study, *A Unified National Program for Managing Flood Losses*, published by the Task Force on Federal Control Policy, called for an integrated program to manage flood losses that would involve federal, state and local governments as well as the private sector (Task Force on Federal Flood Control Policy, 1966). The second study, *Insurance and Other Programs for Financial Assistance to Flood Victims*, completed by the Department of Housing and Urban Development (HUD), evaluated a number of financial programs to protect against flood damages (HUD, 1966) and outlined four potential options for the implementation of a national flood insurance system:

A. An insurance program operated by private insurers assisted by the Federal government
B. A Federal flood insurance program operated by private insurers as fiscal agents of the Federal government

C. A fully private insurance scheme that is wholly managed, operated and financed by private insurers

D. An insurance program fully owned and operated by the Federal government

The latter report ultimately formed the basis for the establishment of the National Flood Insurance Program (NFIP) under the National Flood Insurance Act of 1968. The legislation authorized the Director of HUD to establish and carry out a flood insurance program by implementing either an industry-operated flood insurance program with government support ("Part A") or, in the event that this system was not successful, a government operated program with industry assistance ("Part B") (Comptroller General, 1979; HUD, 1966).

In 1969, the Director of HUD was charged as the administrator of the NFIP and entered into a contract with the National Flood Insurers Association (NFIA) to provide flood coverage throughout the U.S. (Comptroller General, 1979). The NFIA was a voluntary consortium of unincorporated, state-licensed property insurers formed to aid HUD in delivering national flood insurance. As part of the contract, NFIA members agreed to provide insurance products on a limited risk-sharing basis to policyholders throughout the country[1] (Comptroller General, 1979). The insurance policies were issued, marketed and serviced by the NFIA through arrangements with local insurance brokers, property agents and regional servicing companies (United States District Court, 1977). In exchange for this service, NFIA members received an operating allowance of 5% of the total flood premiums collected (GAO, 2009). At this time, flood insurance take-up rates remained very low, partially because the purchase of flood insurance was voluntary (Comptroller General, 1979); as of January 1973, only 200,000 property-owners (less than 0.3% of total households) were insured in the 2,000 communities enrolled in the program (Eagleton, 1977; US Bureau of the Census, 1974).

Following a series of catastrophic floods, Congress enacted the Flood Disaster Protection Act of 1973, which obligated property-owners seeking a loan from a federally regulated lending institution to obtain primary flood insurance if their assets were within a Special Flood Hazard Area[2] (SFHA) and participating NFIP community[3,4]. Furthermore, this legislation helped to increase flood risk awareness by requiring HUD to inform property-owners if their assets were located within a SFHA. These reforms led to a dramatic increase in insurance penetration (average annual growth of 63%) – by 1977,

---

[1] Members were required to pay a $50 admission fee per $25,000 of annual underwriting losses that they were willing to assume

[2] SFHAs are areas that have a 1% or greater chance of flooding in a given year (FEMA, 2007)

[3] This obligation is referred to as the Mandatory Purchase Requirement (MPR)

[4] Communities that participate in the NFIP are eligible for (but are not limited to) government flood insurance, development grants/loans, post-flood disaster assistance to repair insurable buildings and mortgage insurance/loan guarantees; non-participating communities are not entitled to these benefits (FEMA, 2013a)

more than 1.4 million properties were insured across 16,000 participating communities (Comptroller General, 1979).

HUD and the NFIA renewed their contract annually until disputes arose in 1977 regarding the financial control and authority of the program – this led to the dissolution of the NFIP under the Part A structure defined in the 1968 National Flood Insurance Act (Comptroller General, 1979). HUD argued that there were issues with the accuracy of the NFIA's financial data (United States District Court, 1977) and that risk sharing had been disproportionately assumed by HUD since the program's inception given that insurers had avoided paying out any of their pledged risk capital, despite the occurrence of severe floods since 1969 (Comptroller General, 1979). HUD alleged that the NFIA had also refused to bid its servicing contracts competitively (United States District Court, 1977) and an evaluation of the program by the Comptroller General established that the NFIA contract cost the government more than double the cost of the alternative Part B insurance program – a government operated program with industry assistance (Comptroller General, 1979).

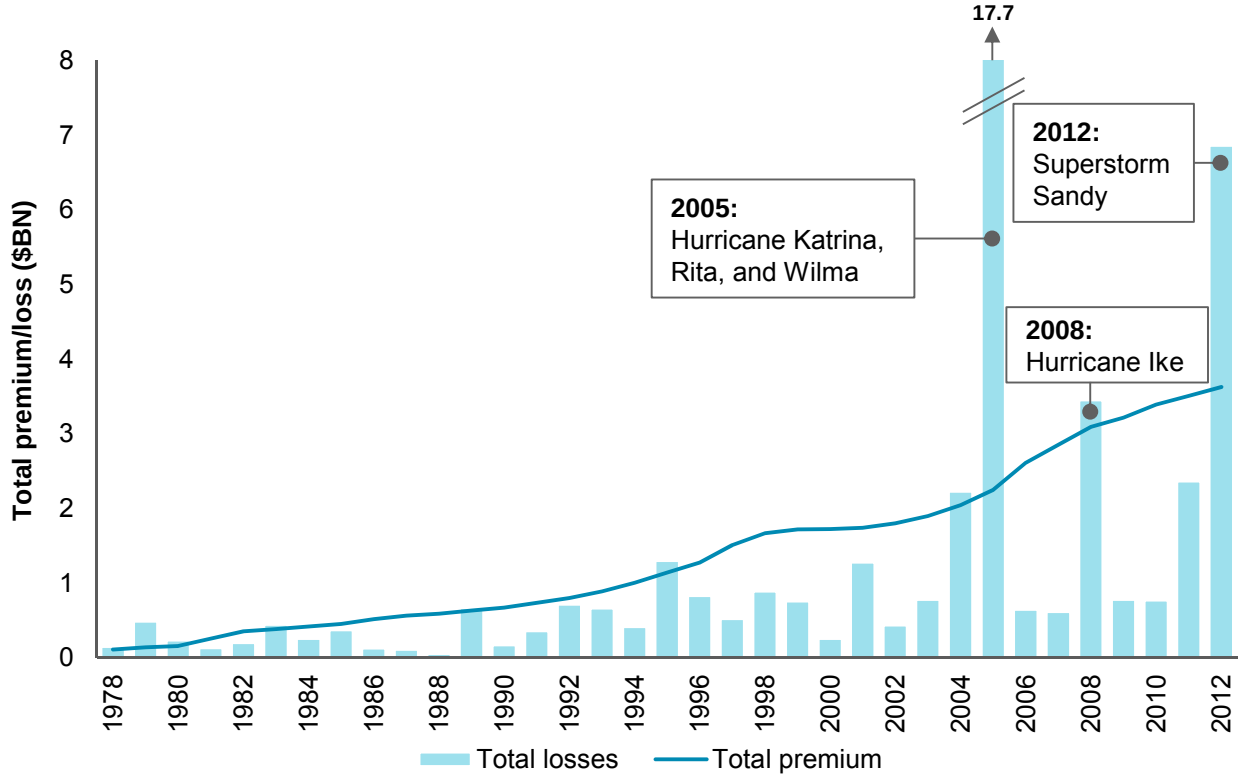
Given the inability to reach an agreement, the Secretary of HUD determined that the NFIP should transition to the operational structure specified under Part B of the National Flood Insurance Act. NFIA challenged this decision, but the court ruled in favor of HUD, citing that the insurance aspects of the flood program under the NFIA's management were unsuccessful despite the strong Congressional preference for the Part A operational structure (United States District Court, 1977). As such, the federal government became the sole servicing agent of the NFIP in 1978, accepting direct responsibility for underwriting, marketing, claims settlement and record maintenance (Comptroller General, 1979). Also at this time, the NFIP was transferred to the newly created Federal Emergency Management Agency (FEMA), a federal government agency charged with risk mitigation efforts, disaster preparedness and emergency response (Comptroller General, 1979; NFIP, 2010).

The success of the government's efforts to administer flood insurance without the support of private insurers and their established distribution network was limited. Between 1977 and 1983, policy growth stagnated while customer complaints increased. As a result, the government formed another agreement with private sector insurance companies to establish the Write Your Own (WYO) program whereby member insurers helped distribute, sell and service NFIP policies under their own name – but without assuming any flood risk – in exchange for an administrative allowance from the NFIP. Claims payments were made by the WYO carriers, but reimbursed by the NFIP. Today, WYO insurers account for roughly 85% of the total 5.6 million NFIP policies in-force (III, 2013).

To promote widespread access to flood insurance, the NFIP has historically subsidized a portion (currently ~20%) of its policies and cross-subsidized others (FEMA, 2013c). Although this subsidization increased the affordability of flood cover, this and other rate-setting problems have negatively impacted the program's long-term ability to handle its

financial obligations. Figure 1 compares the historical NFIP premium income to annual losses. Due to the severity of recent flooding events, including Hurricane Katrina, Rita and Wilma in 2005 and Superstorm Sandy in 2012, the NFIP did not collect sufficient premiums to independently payout the flood insurance claims of its policyholders from these events. As a result, the NFIP now has $24 billion in debt outstanding to the U.S. Treasury that the program is unlikely to be capable of repaying (GAO, 2013; Minor, 2014).

Figure 1: NFIP total premiums vs. losses (1978–2012)



Source: NFIP
NYC-FEA00111-001

The Biggert-Waters Flood Insurance Reform Act of 2012 was passed in a bi-partisan effort to improve the program's economic sustainability. Numerous reforms were included in this legislation, including guidelines for moving all NFIP insurance policies toward risk-based rates (GAO, 2009) and a requirement for FEMA to conduct an affordability assessment of the NFIP by analyzing alternative subsidization options (e.g. means-tested vouchers) among other alternatives. Five ways that the Act aimed to improve the economic viability of the NFIP's flood insurance portfolio were to:

- Move subsidized policies to risk-based rates upon lapse (and subsequent repurchase) or upon sale to a new owner – in addition, properties not previously insured would also be subject to risk-based rates.

- Transition second homes, businesses, Severe Repetitive Loss properties and substantially damaged and improved properties that are subsidized to risk-based rates, with annual premium increases of up to 25%.
- Create an NFIP Reserve Fund to provide additional capital as a contingency fund that is funded by earmarked "assessments" charged to NFIP policyholders. The main features and design of the Reserve Fund are as follows (FEMA 2014):
  - October 2013, assessments were introduced on all policies to begin funding the Reserve Fund. The assessments were set at 5% of policy-premium and are designed to increase annually until annual collections reach the statutory minimum of $1 billion
  - The funds collected will be held in a separately established reserve fund account and will help the NFIP meet expected future obligations of the program. These obligations are primarily loss obligations in higher than average loss years, although the funds may also be used to service the debt of the program.
- Eliminate rate grandfathering for buildings constructed in compliance with dated Flood Insurance Rate Maps (FIRMs) or policies-in-force that were priced based on dated FIRMs.
- Finally, the Act required FEMA to conduct a study of the private sector (re)insurance market so that Congress could contemplate how private sector capital might support the NFIP's mission[5]

Following the implementation of the Act, subsidized flood insurance premium rates began to increase to reflect full-risk premiums, with some homeowners experiencing significant increases in policy premiums. The rate increases resulted in political pressure to delay further rate increases. The pressures ultimately culminated in the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA-'14), which was signed into law on March 21, 2014. This legislation repealed and modified certain provisions of Biggert-Waters (BW-'12):

- Under BW-'12 subsidies on certain pre-FIRM properties were designed to be eliminated over time through rate increases of 25% until such time that affected policies achieved actuarially sound rates. Policies impacted included: non-primary residences, business properties, severe repetitive loss properties, and properties where cumulative loss payments had exceeded the fair market value of the impacted property.

[5] Please also refer to separately written Reinsurance Study that has been provided with this study as part of the Flood Insurance Risk Study (FIRS). This report provides insight into the history of the private sector's involvement in the U.S. flood insurance market and how the landscape around this market is presently evolving.

- Under HFIAA-'14 the glide-path for this effort was revised. Rather than the application of a 25% rate increase called for under BW-'12, the HFIAA-'14 modified the increases to a 5-15% range (subject to certain exceptions where BW-'12 calls for faster subsidy phase-out). Under this new plan it is expected that subsidies on all pre-FIRM properties will likely be eliminated over a 15-20 year time frame (FEMA 2014).

- The HFIAA-'14 also implemented a surcharge on all policyholders (US Congress, 2014b). The surcharges, which will commence in 2015, amount to $25 on all primary residences and $250 for all other policies. Funds generated from the surcharges will be applied to the Reserve Fund,

In light of the public debate that surrounded the NFIP's premium environment following the implementation of BW-'12, HFIAA-'14 reconstituted the framework of the Affordability Study (also called for under BW-'12) so that Congress could further study the issues surrounding these matters.

2. International case studies

The United States is not unique in its exposure to flooding. Floods are a global peril and affect more people worldwide each year than any other type of natural disaster (Swiss Re, 2012b). As a result, many countries throughout the world have undertaken extensive efforts to manage the risk of flood through investments in flood mitigation as well as the development of a domestic flood insurance market.

Flood insurance markets in other countries are diverse and vary significantly in terms of structure, insurance penetration and level of government involvement. In certain countries, flood insurance is underwritten solely by private insurers and purchased voluntarily with limited government involvement. In others, it is underwritten entirely by a government entity and all property-owners are mandated by the government to purchase it.

In evaluating different privatization options for the National Flood Insurance Program, it is important and valuable to also consider how other countries have approached flood insurance. Clearly, there is no universal solution to the problem of how to develop an effective flood insurance market, but studying the strengths and weaknesses of different approaches can reveal valuable lessons and trade-offs that help to inform potential privatization options for the NFIP.

The sections that follow focus upon 4 international case studies of flood insurance systems. Each case study follows a similar structure and includes an overview of the current and (if applicable) proposed flood insurance scheme, an identification of key stakeholders, a description of the flood insurance scheme mechanics and an evaluation of the scheme's strengths and weaknesses.

To ensure comparability across the different flood insurance schemes, the following assessment criteria were used to evaluate each case study:

- **Availability**: is flood insurance readily available to those who want or need it?
- **Affordability**: is flood insurance affordable to those who need it?
- **Economic viability**: is the system self-sustaining and viable over the long term, even after a catastrophe (e.g. no unnecessary burden on taxpayers)?
- **Incentive to mitigate**: is the public aware of flood risk and are policyholders, insurers and the government incentivized to implement mitigation or avoidance measures?

These assessment criteria provide a framework for comparing the schemes and represent the key dimensions that impact the effectiveness of any flood insurance system, ultimately helping to highlight inherent trade-offs that are made within any given approach. In addition to reviewing the flood insurance schemes, the case studies touch

upon other aspects of flood risk management, including each country's approach to flood risk mitigation and mapping.

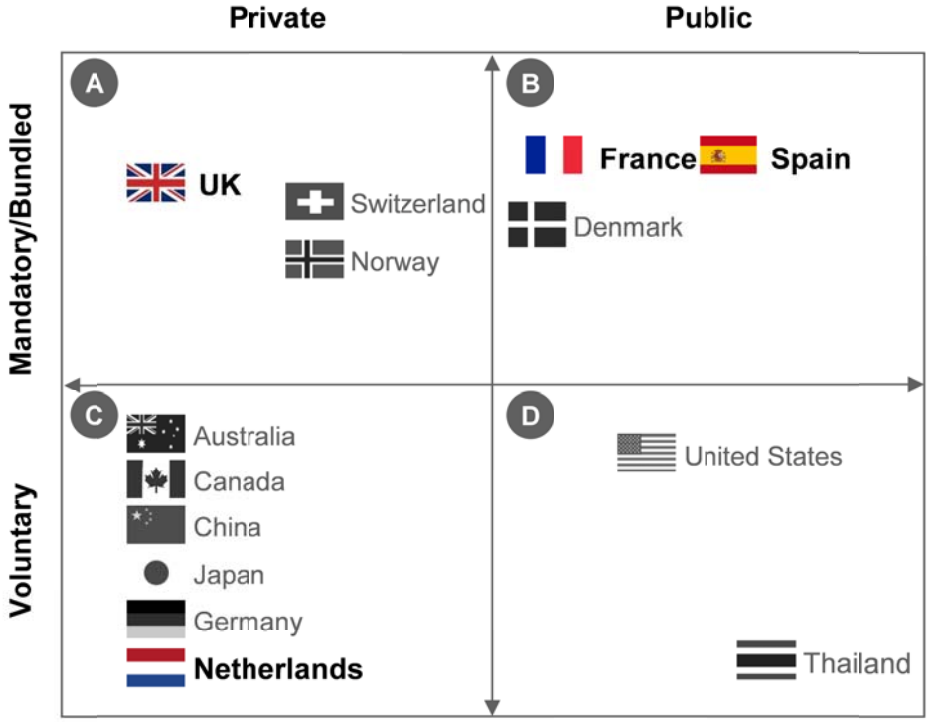
2.1.1. Case study selection

Before focusing upon a specific set of countries as the basis for an in-depth case study, a long-list of candidate countries was considered. This list focused primarily on developed countries that are more closely comparable to the United States in terms of exposure to flood risk and maturity of insurance market. Developing countries, including China and Thailand, were also considered given their recent experiences with flooding. However, they were ultimately not selected due to their relatively low residential property insurance market penetration and/or limited flood mitigation capabilities. An overview of the flood insurance approaches for each of the 13 different countries considered is included in Appendix A.

Figure 2 below illustratively categorizes the different flood insurance systems considered along two dimensions: (1) whether the flood insurance is underwritten primarily by the private or public sector and (2) whether flood insurance is mandatory or bundled alongside homeowners insurance or is voluntarily purchased by property-owners. Such bucketing helped to identify key differences among the various schemes and was used to identify and select a diverse set of representative countries to include in the case studies.

The U.S. has been placed in Quadrant D to reflect the fact flood insurance in the U.S. is primarily underwritten by the public sector (i.e. NFIP) and for the majority of property-owners, the purchase of flood insurance is voluntary and does not come bundled alongside a homeowners insurance policy. Its relative positioning near the borders of each dimension reflect the fact that flood insurance is mandatory for the small portion of property-owners residing in a SFHA and carrying a federally backed mortgage and the existence of a small private flood insurance market.

Figure 2: Comparison of select flood insurance systems



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We ultimately selected flood insurance schemes from four countries: the United Kingdom, the Netherlands, Spain and France. These countries were selected based on what we believe constituted a best fit versus the U.S. market in light of market landscape and issues to study. As previously indicated, Appendix A provides an overview of the flood insurance landscape across each of the 13 countries noted.

The United Kingdom represents a market where flood insurance is primarily underwritten by private markets, but is effectively mandatory as flood insurance is bundled with homeowners insurance[6]. The government has historically taken responsibility for risk mitigation efforts and played a very limited role in the flood insurance market, relying upon the private insurance markets to compensate property owners following major floods. The U.K. is also in the process of considering modifications to the manner by which flood risk financing is structured.

Spain and France represent markets where flood insurance is underwritten primarily by public entities (i.e. the government) and is also mandatory and bundled with homeowners insurance. Both France and Spain have long established state-owned

[6] Homeowners insurance is not mandatory in the UK, but penetration is high: 75–95% of households have some form of homeowners insurance

natural catastrophe reinsurers that underwrite most flood risk in their respective countries. While the two systems are similar, they differ significantly in terms of the amount of flood risk that their respective private markets assume: in France, private insurers are still at risk for a portion of the flood insurance they sell, while in Spain, private insurers cede the risk completely to the government reinsurer.

The Netherlands represents a market where flood insurance is private and voluntary, but historically has not been readily available to property-owners. Many of the other developed countries around the world that were included in the initial long-list also fall into this segment and typically their flood insurance markets are characterized by low penetration rates – as demonstrated by the US, market demand for flood insurance is limited when it is not required. Among these countries, the Netherlands was selected from this quadrant for two reasons. First, because its government has implemented what many consider to be the most advanced flood mitigation infrastructure in the world. And second, because the Dutch insurance industry recently went through an exercise to evaluate how to develop a private flood insurance market from the ground up in the form of the Dutch Flood Pool.

These selected countries represent a diverse set of flood insurance systems with varying levels of public/private sector involvement and insurance penetration. They demonstrate the broad spectrum of alternative approaches to the NFIP, including a mandatory private market, a mandatory public market and a voluntary private market.

2.1.2. Key findings

The United Kingdom, the Netherlands, Spain and France provide an informative representation of the strengths and weaknesses of alternative approaches to flood insurance. While none of these systems is perfect, each helps to highlight certain trade-offs that naturally result from key public policy decisions, including the mandatory/ voluntary nature of flood cover, the role of the government in flood mitigation and flood insurance and the level by which rates reflect individual property-owner risks.

The following provides a summary of the key lessons learned from the case studies. These lessons can and will be used to inform the discussions that follow in later sections of this study as privatization options specific to the NFIP are evaluated.

Key lessons from the case studies include:

1. **Mandatory flood insurance drives high penetration rates and mitigates adverse selection.** Most UK, French and Spanish property-owners are covered for flood simply because flood insurance is bundled with their property insurance. In the Netherlands, Dutch insurer proposals to introduce flood insurance to the market also required bundling flood insurance with mandatory homeowners insurance; without bundling, the Dutch insurers were unwilling to offer insurance as there would be a significant potential for adverse selection as well as an insufficiently sized risk

community. In contrast, penetration rates typically are much lower in countries where flood insurance is optional and/or not bundled (e.g. Australia, Germany and Canada).

2. **Bundling and multi-peril policies enable cross-subsidization and wider acceptance from policyholders.** In the UK, France and Spain, the marginal cost of flood insurance is typically unknown to the policyholder because it is bundled with a broader homeowner's insurance policy. Bundled pricing enables insurers to cross-subsidize policies to support affordability (although can result in a lack of pricing transparency), especially when there is a sufficiently large risk community. As a result, policyholders in these markets are less aware and concerned about the individual cost of their flood insurance. As a general statement, the cost of homeowners insurance, which includes coverage for flood, is not a highly contentious or debated issue in these countries. This is an indication that flood insurance in and of itself is widely affordable.
3. **Risk-based pricing promotes policyholder-level risk mitigation; however, a transition off of subsidized rates must be phased in over time.** The UK continues to transition to greater levels of risk-based pricing, which in turn improves individual property-owner awareness of flood risk. The Country's new flood scheme, which begins implementation in 2015, is called "Flood Re" and is being established by The Water Act of 2014. As proposed under this scheme, the transition toward improved risk-based pricing is gradual; high risk policyholders in the UK are expected to transition from capped (subsidized) premiums to risk-based premiums over a 20–25 year period.
4. **Shared risk-taking promotes broad based flood risk mitigation efforts across all stakeholders.** Ultimately, a significant weakness of the French, Spanish and Dutch systems is that policyholders have only limited awareness of their individual flood risk. Flood risk mitigation is viewed as the government's responsibility (whether through state-financed reinsurance or heavy investments in flood mitigation). In the Netherlands, given the Dutch government's historical success in flood mitigation, most Dutch property-owners, though aware of overall flood risk, do not demand flood insurance as they believe it is the Dutch government's responsibility to manage the flood peril. In all three systems, the large assumption of flood risk by the government creates limited incentive for mitigation amongst other stakeholders.
5. **Government involvement in the flood insurance market is an important element across all approaches.** In the UK, the flood insurance market has historically been supported through the private (re)insurance sector; government support was committed through significant investments intended to mitigate flood risk. Under the Flood Re scheme the Government will enact legislation to enable UK insurers to purchase affordable reinsurance for flood prone risks through a dedicated reinsurance entity. The private (re)insurance sector will continue to be the means through which flood risk insurance is financed, while the public sector will focus on flood mitigation measures.

6. **Flood risk mitigation is a critical ingredient in establishing a sustainable flood insurance market, but requires a significant investment.** The Netherlands committed to a significant investment in flood-control measures (e.g. dams and barriers) over the four decades following the 1953 North Sea flood. Since then, the country has not suffered significant flood damage even after Cyclone Xaver in 2013, which caused waters to rise to their highest levels since 1953.

2.1.3. Applying key findings to the U.S. market

While key findings from the case studies provide an informative overview of the trade-offs across different flood insurance systems, it is important to also recognize that the U.S. market has certain unique characteristics that may make it difficult to simply transplant practices from other countries.

The size and geographic diversity of the U.S. by itself is an obvious distinguishing feature relative to the United Kingdom, Netherlands, Spain and France. However, there are also more structural differences that must be taken into consideration, including:

- State vs. federal regulation of the insurance industry
- Historical role of federal government in flood mapping and disaster assistance
- Historical role of federal and local governments in floodplain management

In contrast to the other countries, where insurance tends to be centrally regulated by a federal government, state insurance regulators play an integral role in the US. Given the unique laws and regulations associated with each state, this presents particular challenges in terms of a private flood market that would not be present in other countries (i.e. navigating a less certain regulatory environment, subject to the diverse demands of many state insurance regulators).

Historical precedents in terms of the role of the federal government and local governments also present unique challenges. The fact that the U.S. has historically played a critical and very public role in formalized flood mitigation grants and disaster assistance (on both a pre- and post-disaster basis) sets an important and challenging precedent; as will be discussed in later sections of this study, such precedents make it difficult for the federal government to change the expectations of property-owners and the communities who expect federal aid following a disaster. Adding to these challenges is the role local governments in the U.S. have in establishing building and floodplain management standards through community ordinances; with thousands of local governments involved, the level of mitigation can vary substantially from community to community.

Notwithstanding these factors, relative to its peers, the U.S. is in a superior starting point from the perspective of its extensive mapping of floodplains, which cover 96% of the U.S. population (FEMA, 2009), and the level of mitigation already implemented, such as through floodplain management and regional watershed plans.

Ultimately, these observations are important to consider as any practical solutions inspired by key findings from these case studies must also take into account certain structural differences in terms of laws, regulations and precedents.

2.2. United Kingdom

2.2.1. Overview

Between 10–15%[7] of the United Kingdom's 10,800 coastline miles are less than 5 meters above sea level (Directorate-General for Maritime Affairs and Fisheries, 2009b). In total, out of the 26.4 million households in the UK, 2 million[8] are at risk of coastal or inland flooding, a number that is expected to grow to 3.5 million over the next 30–40 years if additional government intervention does not take place to counteract the impact of climate change (CML, 2014).

The UK's history with flood insurance can be broadly organized into three separate periods: (1) the "Gentleman's Agreement" between the late 1950s and 2003; (2) the Statement of Principles (SoP) between 2003 and 2013; (3) and the proposed Flood Re program, which is expected to formally launch in 2015.

The Gentleman's Agreement was an informal understanding between the UK government and British insurance industry that governed flood management in the UK for approximately 50 years, beginning in the late 1950s and ending in 2003. Under this unwritten agreement, insurers agreed to offer flood insurance to homeowners and small businesses and in exchange, the government agreed to enhance the nation's flood defenses and improve land use. During this time, flood insurance was readily available and affordable to UK property-owners, even in risk-prone areas. Rates were set at a flat percentage of the sum insured and practically all residential properties were offered flood insurance. Property insurance is required to secure mortgages in the UK and this has resulted in high penetration rates of household and flood coverage. Between 75–95% of UK households have homeowners insurance[9], which ultimately included a cross-subsidization between the 10% of the population exposed to significant flood risk and those that were not (CCS, 2008).

The Gentlemen's Agreement successfully ensured the existence of a flood insurance market in the UK for half a century, but reform became necessary by the late 1990s and early 2000s following two major floods in 1998 and 2000 that resulted in £500 million and £1 billion (roughly $750M - $1.5B) of losses respectively – sharply higher amounts than the UK insurance industry had experienced in the past. With the increased frequency and intensity of flood events, apprehensions of climate change and concerns

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[7] Located within 10 km of coastline

[8] 200,000 of these are considered high risk and have a risk of flood that exceeds 1.3% (e.g. within a 1 in 75 annual probability of flooding); low risk areas have less than 1.3% annual risk of flood

[9] There were 26.4 million households in the UK in 2012; 20.2 million households had content insurance and 17.0 million have building insurance; penetration range accounts for houses that may have one or both types of insurance (ABI, 2013)

over the government's commitment to and investment in flood mitigation, the private insurance industry was compelled to push for reform (Huber, 2004).

The Statement of Principles on the Provision of Flood Insurance (SoP) was created and agreed upon in 2003 to help formally address the concerns raised by the UK insurance industry. Under the SoP, the Association of British Insurers (ABI), a trade association that represents the majority of the UK insurance market, agreed to maintain bundled flood coverage with properties[10] in low risk areas or in areas where the government had plans to reduce the risk of flooding over the next 5 years. In exchange, the government committed to undertake a series of mitigation efforts, including investing in additional flood defenses and early warning systems. These changes helped to lower the level of flood risk to which private insurers were exposed and this agreement ultimately served as an interim solution for providing flood insurance to a large portion of the population (ABI, 2013).

Since the establishment of the SoP, insurance companies continued to assume the burden of claim costs, allowing the UK government to focus on flood mitigation and to limit the amount of post-disaster relief it committed to property-owners. For example, following the worst floods in recent UK history during the summer of 2007, UK insurers indemnified about £3 billion (~$4.5B) to policyholders whereas the UK government spent only £87 million (~$170M) on relief, primarily focused on investments in flood mitigation defenses (IWR, 2011; Lloyd's, 2008; Pitt Review, 2008).

Although insurers are authorized under the SoP to issue policies that are reflective of flood risk, only 22% of policies are risk-based. The remaining 78% are underpriced and are supported by implicit cross-subsidization from other policyholders (Defra, 2013a). In recent years, these subsidies have begun to unwind as insurers have exercised their freedom to charge risk-based premiums, creating fear that many higher risk policyholders may soon be unable to afford flood and property insurance. As a result, the SoP was not extended upon its expiration in 2013 and development of a longer-term, permanent flood insurance solution began.

After a period of debate and analysis, a new flood insurance scheme, known as Flood Re, was proposed and accepted by the Association of British Insurers[11]. Under Flood Re, a non-profit flood pool would be established in 2015 that aims to specifically address issues of affordability and availability for approximately 500,000 high risk households by offering them flood insurance at discounted rates through a capped premium. The discounted rates would primarily be paid for through a levy placed upon all other property-owners in the UK. Flood Re will then provide a means through which

[10] Includes households and small businesses

[11] As of the writing of this report, some aspects of Flood Re and its mechanics remain to be formulated. The descriptions here-in reflect our best understanding of the Flood Re scheme based upon the interviews conducted during the summer of 2014

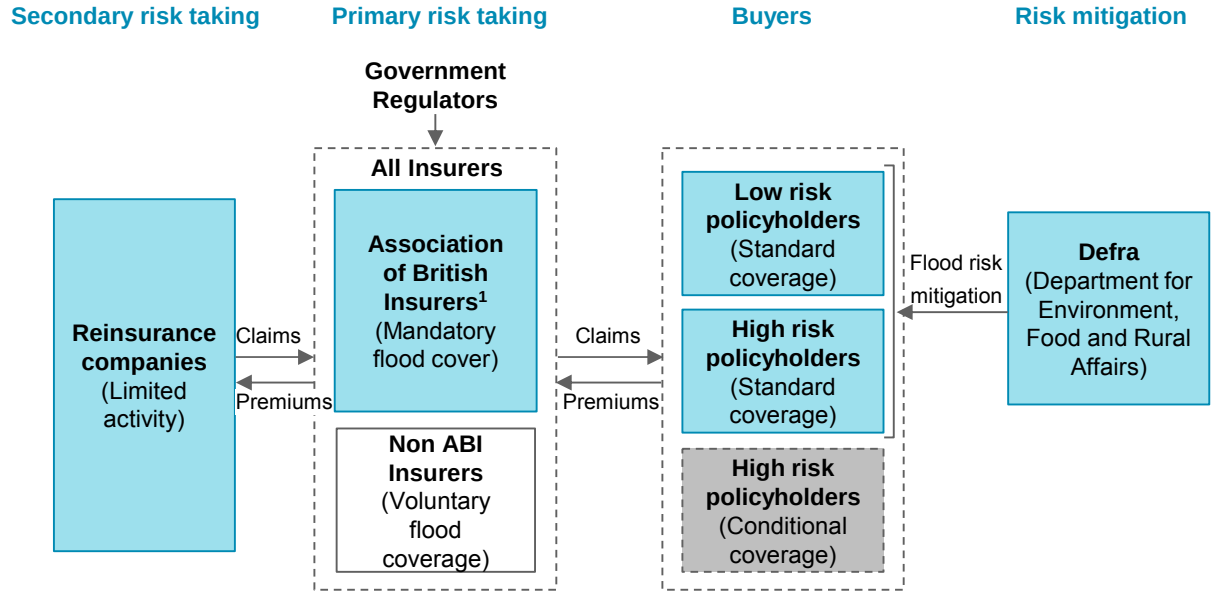
insurers can obtain affordable reinsurance to protect themselves against catastrophic flood losses. The scheme is intended to be self-sufficient and operated in a manner whereby the private sector insurance industry manages the risk, but it will take time for supporting industry funds built through premiums and levies to sufficiently accumulate to ensure this. In the interim, Flood Re would be back-stopped by Her Majesty's Treasury (HM Treasury). Without Flood Re, the features under the "Gentleman's Agreement" and the "Statement of Principles" that provided bundled flood insurance to property-owners would essentially end. High risk properties would be charged unaffordable premiums driven by the peril of flood and / or private market insurers would refuse to accept the risk rendering them uninsurable.

The two sections that follow provide a more detailed discussion of how the flood insurance systems function under both the SoP and Flood Re.

2.2.2. Statement of Principles system

Under the SoP, ABI members agreed to continue to extend flood coverage to the majority of homeowners in the UK to ensure indemnification in the event of a flood event. Figure 3 below illustrates the relationships between key stakeholders in the flood insurance value chain, identifying the stakeholders responsible for risk taking and risk mitigation and clarifying the different types of property-owners able to purchase flood insurance under this system.

Figure 3: Flood insurance value chain under the UK's Statement of Principles



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Under this agreement between the ABI and government, the government was primarily responsible for flood risk mitigation, which it deployed through the Department for Environment, Food and Rural Affairs (Defra). As the primary government agency

responsible for developing policies related to flood risk mitigation and flood zone identification, Defra works with local, county-level environmental agencies (EAs)[12] to implement risk mitigation standards and define flood risk management policy (Defra, 2013a). Though the government did not make an explicit monetary commitment towards investment in flood risk mitigation under the SoP, the UK government typically invested ~£500 million (~$750M) per year on flood defenses.

Similar to its role under the earlier Gentleman's Agreement, the UK government was not responsible for underwriting flood risk. Its role was solely focused on flood mitigation, while flood insurance was the responsibility of the private sector.

Primary risk taking, as illustrated above, was the role of private insurers. Members of the ABI – a consortium of approximately 300 companies that provide ~90% of insurance coverage in the UK – were responsible for underwriting the vast majority of flood insurance, which continued to be bundled with homeowners insurance (ABI, 2014). Non-ABI members could also provide flood insurance, but were not required to extend coverage to their policyholders under the SoP.

Neither the ABI nor the government set premiums. Instead, each insurer was free to set rates. Insurers largely continued to cross-subsidize policies to help ensure it remained affordable and available to all eligible property-owners (including high risk customers).

From the perspective of owners of both residential and commercial properties, flood insurance continued to be included in bundled form alongside property insurance. As illustrated above, however, insurers were no longer required to provide insurance to all property-owners under the SoP. ABI members continued to provide what was known as "standard coverage" to low risk policyholders that had flood risk of <1.3% (i.e. 1-in-75 year event) and to high risk policyholders located in areas where the government had mitigation plans to reduce flood risk to that level within 5 years. ABI members had the option, but not the requirement to provide "conditional coverage" to high risk policyholders in areas where the government did not have mitigation plans to achieve a <1.3% probability of a flood event within 5 years. Despite clear coverage and mitigation mandates specified in the SoP contract, there were no defined procedures in place to ensure that insurance companies or the government were meeting these conditions.

While the option of secondary risk taking (e.g. through reinsurance) existed under this system, most of the risk was retained by primary insurers. In the UK, flood associated with windstorm (e.g. storm surge) is commonly included in an insurer's catastrophe reinsurance, but the attachment level of these programs, which defines at what point reinsurance is paid out, is typically set above an insurer's exposure to inland flood. As a

[12] EAs in each country include: Environmental Agency in England, Natural Resources Wales in Wales, Northern Ireland Environmental Agency in Northern Ireland and the Scottish Environment Protection Agency in Scotland

result, primary insurers retained the majority of the flood risk they provided. Obtaining efficient reinsurance protection for inland flooding particularly on a stand-alone basis is more challenging. The SoP was designed as a temporary agreement to provide flood coverage to most UK households and was applicable for review and renewal in 2013. However, it became evident that a number of inherent weaknesses in the system would need to be addressed to equalize financial burdens and create incentives for risk mitigation throughout the value chain. In particular, the agreement resulted in adverse selection given that it prevented ABI members from revoking coverage from high risk properties that could only be insured through cross-subsidization between high and low risk policyholders. The agreement also limited some policyholders from changing insurance providers since high risk policyholders that changed insurers would not obtain guaranteed coverage under the mandates of the SoP.

2.2.3. Proposed Flood Re system

To address the limitations of the SoP, Defra, the ABI, HM Treasury and other key stakeholders collaborated to identify different options for the future delivery of flood insurance in the UK. The working group identified five different options with varying levels of government participation, ranging from a completely free market solution to direct government subsidization. The options included:

- **Option 1:** Government would not renew the SoP and would instead allow the flood insurance market to develop on its own. This would create incentives for insurance companies to eliminate cross-subsidies so that policyholders would pay risk-based premiums.
- **Option 2:** Government would play a very limited role in mitigating flood insurance; it would provide information to households at risk of flooding and provide a limited amount of funding to local authorities to spend on flood risk reduction.
- **Option 3:** A temporary, subsidized insurance pool funded by levies from all insured UK households would be created for a select number of high risk properties. The scheme would provide a means through which insurers could reinsure themselves against catastrophic flood losses.
- **Option 4:** Government would provide direct subsidies to reduce the premiums for a targeted group of high risk properties.
- **Option 5:** Each insurer would provide flood coverage to a proportion of the households that are exposed to high flood risk.

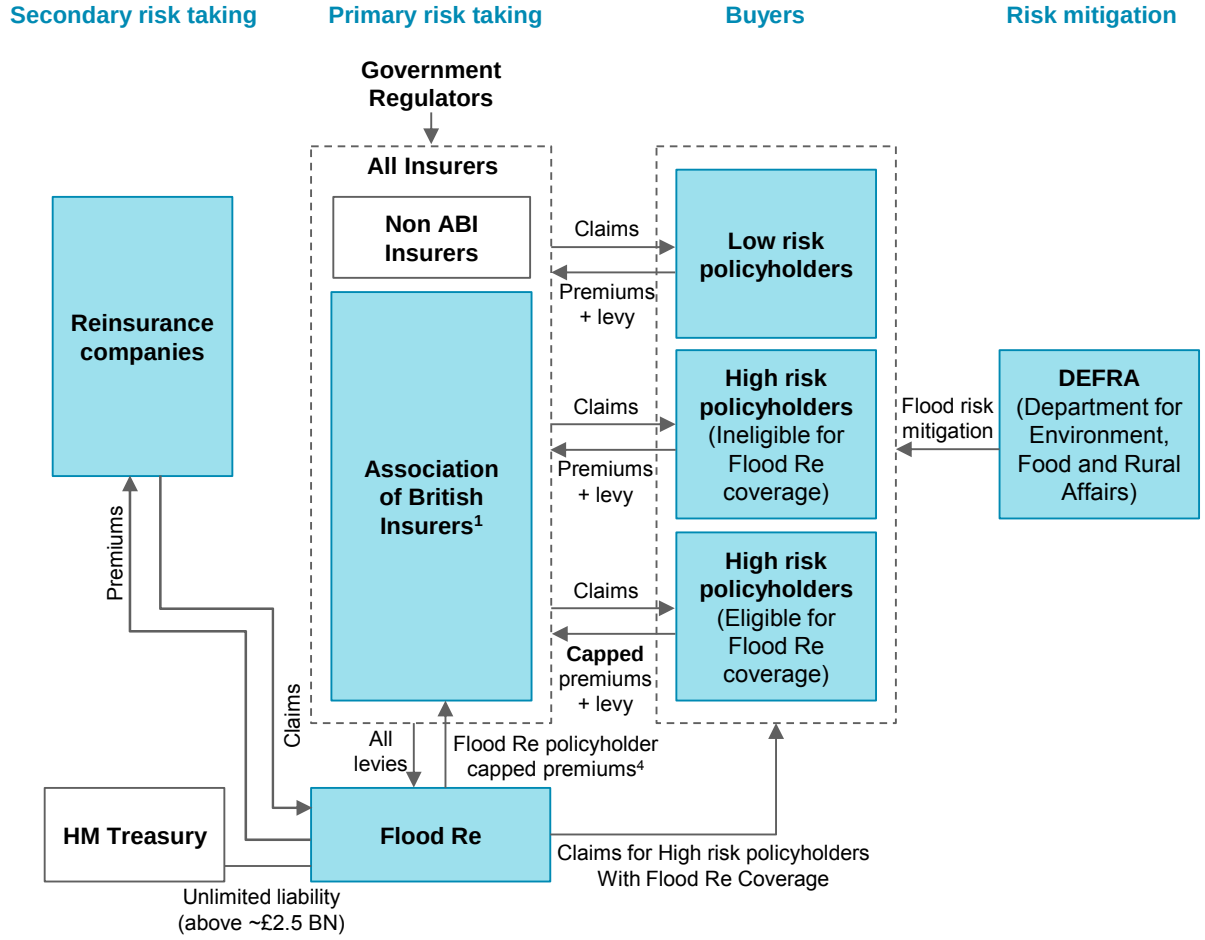
Ultimately, the stakeholders agreed to pursue the third option, known as Flood Re, because it would help transition the system to a flood insurance market that reflects risk-based rates, while maintaining near-term affordability and availability for high risk and lower income households (Defra, 2013c).

From a policy perspective, the stakeholders believed that a transitional period towards risk-based rates was important to address equity concerns with respect to the many homeowners who could not possibly have known of their exposure to flood risk at the time their property was purchased. An additional economic rationale for Flood Re is that without a transitional period, many high risk policyholders would become uninsured for flood risk due to the high cost of flood insurance and would more likely require, and demand, post-disaster aid following a major flood event.

Flood Re is ultimately set-up to be a temporary program that would launch in 2015 and wind-down over the next 20–25 years. Flood Re would create a pool that helped to provide subsidized flood insurance for certain high risk residential property-owners (Defra, 2013b). This option would provide time for all stakeholders, including Defra and homeowners, to reduce flood risk before transitioning from capped to fully risk-based premiums (Defra, 2013).

Figure 4 illustrates the flood insurance value chain under the proposed Flood Re scheme.

Figure 4: Proposed Flood Re system value chain



1. ABI includes approximately 300 member insurance companies, which provide over 90% of domestic coverage to the UK market

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Policyholders are divided into three groups depending on their exposure to flood risk and their ability to satisfy certain criteria for Flood Re coverage. For a property to be eligible to receive capped premiums under Flood Re, it must have been built prior to 2009 and must have a risk-based premium that exceeds the specified council tax band cap (ABI, 2013). Qualifying Flood Re policyholders would be given the option to purchase flood insurance by paying capped premiums based on their council tax band. By utilizing the council tax band the industry is attempting to scale what property-owners must pay for flood insurance based on their income; council tax bands in the U.K. are categorized by the market value of U.K. properties.

To ensure that affordable coverage is available for the highest risk homeowners, all property insurance companies would be required to pay a fixed levy[13] to fund the Flood Re pool; this levy would be calculated based on the number of policyholders that an insurer underwrites and would be passed on to customers from their insurance provider. Policyholders living in low risk areas would continue to receive flood insurance coverage as a standard feature of household insurance, and all remaining high risk policyholders could seek flood insurance coverage, conditional on their ability to pay the premiums quoted by their insurer (Defra, 2013a).

Mitigation requirements defined under Flood Re require the government to maintain responsibility for implementing risk defenses and developing a unified map that identifies all sources of flooding[14]. Additionally, ABI members would create and maintain a database that tracks all property-level flood insurance claims (including those that are not related to Flood Re policyholders).

Insurers have the option to transfer the flood risk from eligible policies to the Flood Re pool, along with their associated capped flood premiums[15]. This pool is expected to earn ~£180 million (roughly $270M) a year from mandatory levies and ceded policy premiums, which should in time accumulate so that protection is afforded if and when a 1 in 200 year flood event occurs (losses of ~£2.25 billion, or ~$3.4B)[16]. In the event that the levy and capped premiums are unable to adequately fund Flood Re, each ABI member would be charged an additional fee to cover the shortfall. It is ABI's intention to reinsure the flood pool in order to reduce annual fluctuations in Flood Re's finances. If the losses to the Flood Re pool exceed £2.25 billion, then the UK Treasury would assume direct and unlimited liability for claims settlement (Defra, 2013b).

2.2.4. Criteria-based evaluation

The UK flood insurance system has been largely successful in terms of its ability to provide the majority of its citizens with affordable flood insurance through the private markets. While the government historically has not been responsible for providing flood insurance, it has played a critical parallel role in mitigating flood risk to help manage and limit the country's (and insurance industry's) overall exposure to flood.

Flood insurance has also achieved high penetration rates in the UK market primarily because it has been de facto mandatory for most homeowners since it is bundled alongside homeowners policies purchased from the majority of British insurers. The

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[13] Estimated between £8–10.50 per policy (~$12-15)

[14] Map will focus on England and is set for completion by December 2015

[15] Less an administration fee used to cover insurance underwriting costs

[16] Excess earnings after claims pay-out will be placed in an equalization reserve used to satisfy claims in years when losses exceed levies and premiums

high penetration rates were a critical ingredient towards enabling affordable coverage for all property-owners as policies historically were heavily cross-subsidized between high and low-risk policyholders. The sufficiently large risk community helped to enable this cross-subsidization and the mandatory nature of the insurance helped to limit adverse selection.

The key weakness of the historical UK flood insurance schemes, under both the Gentlemen's Agreement and the SoP, was the potential for moral hazard both on the part of the government and policyholders. Though the government has been responsible for mitigating flood risk, it has lacked a strong financial incentive to act since the private insurance industry assumed virtually all flood risk during this period of time (Huber, 2004). Moreover, cross-subsidization made it difficult for policyholders to be aware of their individual exposures and so households in high risk areas did not have a strong incentive to mitigate flood risk since their insurance was already subsidized.

The transition to risk-based rates that has occurred over the last decade has helped to address some of these issues. As individual rates more fully reflect the flood risk of specific properties, property-owners have become more aware of their exposure and more incentivized to mitigate risk.

What the Flood Re example demonstrates is that a transition to risk-based rates requires time, especially since the jump from subsidized rates to risk-based rates can be dramatic, especially for those exposed to the highest levels of risk. The Flood Re proposal to phase out subsidies from high risk properties over a multi-year period reflects the importance of enabling a politically and economically feasible transition for this population of households.

Furthermore, exposure of insurance companies, which would guarantee claims under £2.5 billion (~$3.75B), and the government, which would guarantee claims exceeding £2.5 billion, creates an incentive to mitigate flood risk and ensures collaboration across the value chain. To date, there has been little analysis into how this fund would unwind given its economic uncertainty over the implementation horizon (Defra, 2013b); this would need to be re-evaluated throughout the life of Flood Re to ensure that no stakeholder is faced with a disproportionate financial burden.

2.2.5. Key takeaways

1. Under the SoP, insurance companies are permitted to charge risk-based premiums; however, 78% of flood insurance premiums are currently underpriced to ensure that flood coverage is widely available to UK property-owners. The Flood Re pool is designed to transition these policies to full risk rates over a 20–25 year period.

2. Historically, private reinsurance for flood in the UK has been limited due to the risk associated with coverage; Flood Re offers a solution to this, by allowing private insurers to cede high risk policies to an insurance pool with capacity of up to ~€2.5 billion.
3. Under Flood Re, cross-subsidization between policies retained by private insurance companies would be significantly reduced. As such, insurers could move towards a completely risk-based pricing system.
4. By providing a means through which insurers can obtain reinsurance against catastrophic flood losses, Flood Re enables high risk properties to obtain flood insurance. With all policyholders contributing to the solution through bundling and the funding mechanisms of Flood Re, the private sector insurance industry, with governmental support, is constructing a flood solution that should protect taxpayers from assuming the cost of flood losses following large catastrophic losses.
5. The temporary nature of Flood Re should incentivize policyholders, and the government alike, to mitigate flood risk and ensure affordable coverage is available when the pool is finally wound down.

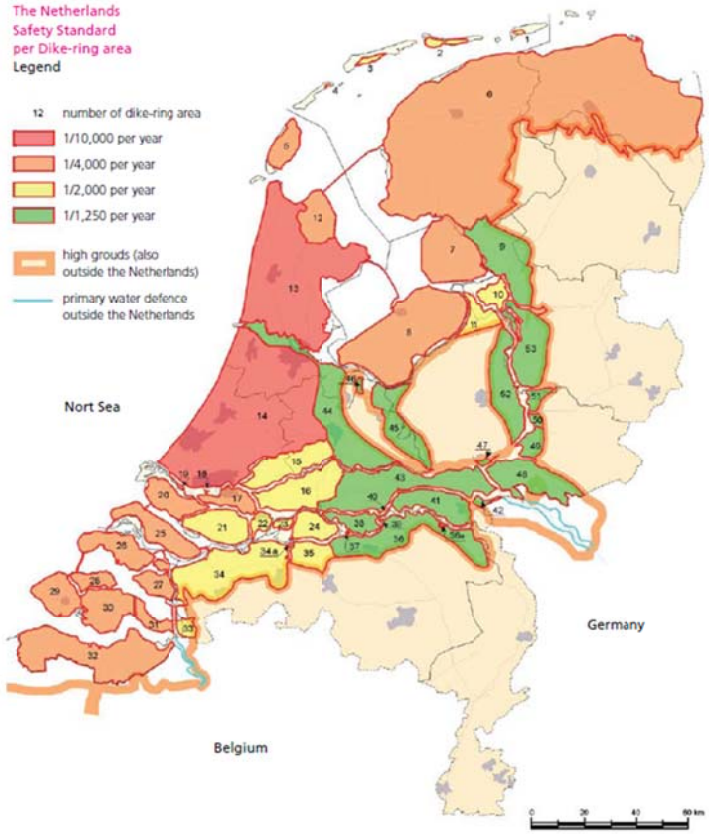
2.3. The Netherlands

2.3.1. Overview

In 1953, the Netherlands suffered €250 million (~$325M) in damages and over 1,800 fatalities due to extensive flooding of the North Sea (Risk Management Solutions, 2003). As a result, the Dutch government formed the Delta Commission, an advisory group that would help to reduce flood-related loss through the implementation of mitigation strategies (US Congress, 2014b). The commission detailed an extensive set of recommendations, including the construction of multiple dams and storm surge barriers, to effectively reduce the Dutch shoreline and national flood risk (Delta Works Online Foundation, 2014).

In addition to this infrastructure, the commission identified flood-prone areas, defined required levels of protection based on population density/wealth, and commissioned the construction of dike-rings to defend against flood (J. Aerts, 2009; J. C. J. H. Aerts & Botzen, 2011). 53 dike-rings exist today (see Figure 5) with factors of safety ranging from 1 in 1,250 to 1 in 10,000 year events (J. Aerts, 2009). Flood mitigation infrastructure in the Netherlands is considered a best-in-class example and is highly sought after by governments worldwide (Higgins, 2012). Although the annual probability of flooding is low due to protections afforded by this mitigation infrastructure, recent studies have estimated that 9 million Dutch citizens currently still live in flood prone areas below sea level (accounting for 65% of the country's GDP production) and that hypothetical damages associated with flooding of all dike-rings could be as high as €190 billion (~$247B) (Deltacommissie, 2008).

Figure 5: Netherlands dike-ring system (J. Aerts, 2009)



Source: J. Aerts, 2009
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Private flood insurance has remained largely unavailable in the Netherlands since 1955, when the Dutch Association of Insurers[17] (VvV) prohibited its members from offering flood insurance. This restriction was lifted in 1998 to comply with competition regulations but has had little effect on flood insurance availability (Seifert, Botzen, Kreibich, & Aerts, 2013); in 2012, Neerlandse became the first company to offer private flood insurance since the 1950s and limits coverage to a maximum of only €75,000 (~$97,500) (Lloyd's, 2013).

Given this limited level of private coverage, the Dutch government provides post-disaster relief through the Calamities and Catastrophe Act (WTS), which draws funding directly from the Treasury. Under this legislation, the government uses its discretion to compensate up to a total of approximately €500 million, or approximately $650M, for victims of freshwater flooding, earthquake or disaster (Bek,

[17] A trade association of insurers that provides coverage for 95% of the overall industry (ACM, 2013b)

Bugra, Hjalmarsson, & Lista, 2013). Saltwater flooding is not explicitly supported by the WTS but may be considered on a case-by-case basis. Compensation for flood-related damages from the WTS is based solely on the discretion of the government and is available only for risks that are considered uninsurable (Bruggeman, 2010).

In 2006, the Dutch government began consultation with VvV to design a flood insurance system that would reduce public reliance on the WTS. Given the volatility of public funding during times of economic crisis, the government encouraged a largely privatized system (ACM, 2013b). In 2012, the VvV proposed that all of its members[18] bundle flood insurance with tenant, household and business (including inventory)[19] insurance to create a Dutch Flood Pool (DFP) that would provide coverage to its policyholders in the event of flood (ACM, 2013b). As a result of changes in political parties, the government did not pledge support or offer to participate in the proposed scheme (e.g. through an unlimited guarantee). Despite the DFP's ability to provide widespread protection against flood, the Netherlands' Authority for Consumers and Markets (ACM) indicated that the program was anticompetitive and halted its implementation for the time being (ACM, 2013a).

The following two sections describe the current flood insurance system in the Netherlands as well as the proposed Dutch Flood Pool.

2.3.2. Current flood insurance system

Figure 6 below illustrates the Netherlands' current flood insurance value chain and interactions between key stakeholders. Through construction and maintenance of flood defenses that comply with minimum dike-ring safety levels, the Dutch government is responsible for flood risk mitigation and defense. These efforts are highly visible to the public and create widespread awareness of flood risk. However, limited recent flooding damages and an expectation for post-disaster relief via the WTS has resulted in a private insurance market that is largely undeveloped, with a limited number of property-owners actually purchasing private flood insurance.

In the event of a flood, the government assumes the majority of financial responsibility and compensates flood victims after a disaster through the WTS. This fund is financed by the Dutch Treasury and distributes remuneration on a case-by-case basis. However, the WTS does not clearly define the criteria for flood-related compensation before a disaster or have a formal system in place for collection of premiums to fund compensation efforts (J. C. J. H. Aerts & Botzen, 2011), raising concerns about the program's sustainability and ability to incentivize mitigation amongst property-owners.

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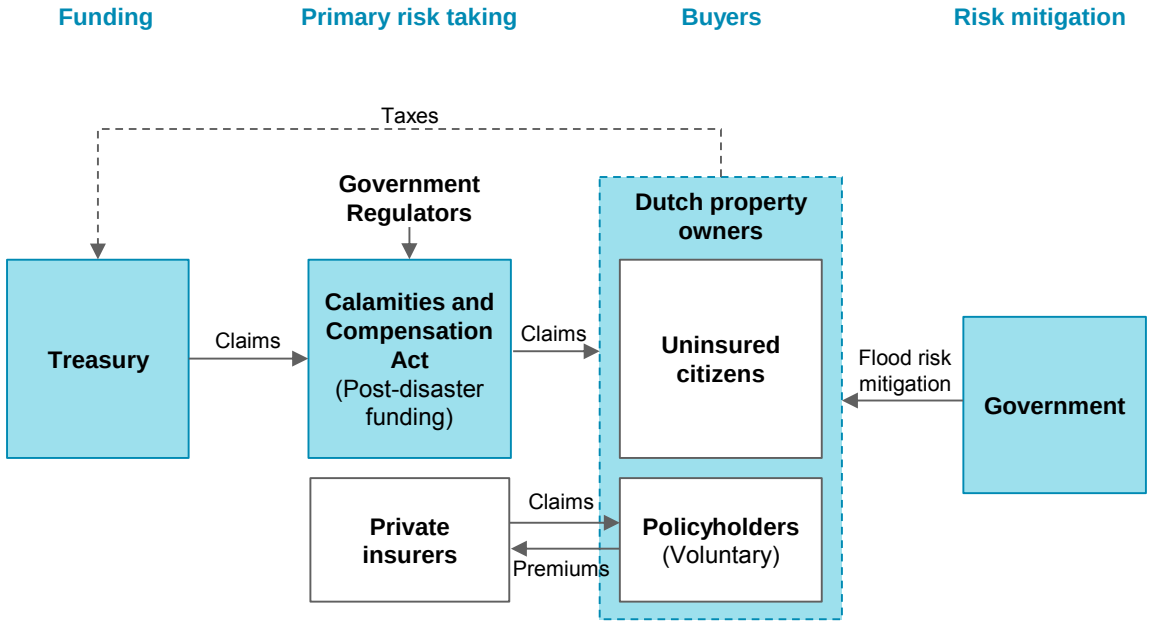
[18] Non-VvV insurers could also offer flood insurance to their policyholders and participate in the benefits of the DFP

[19] 96.4% of homes and 58.5% of household contents were insured in 2010; business and inventory insurance ranges from 40–80% and 30–50%, respectively (ACM, 2013b)

Low private flood insurance penetration in the Netherlands is largely due to the citizens' perception that flood defenses and post-disaster relief through the WTS are adequate and will continue.

Figure 6: Current flood insurance system value chain



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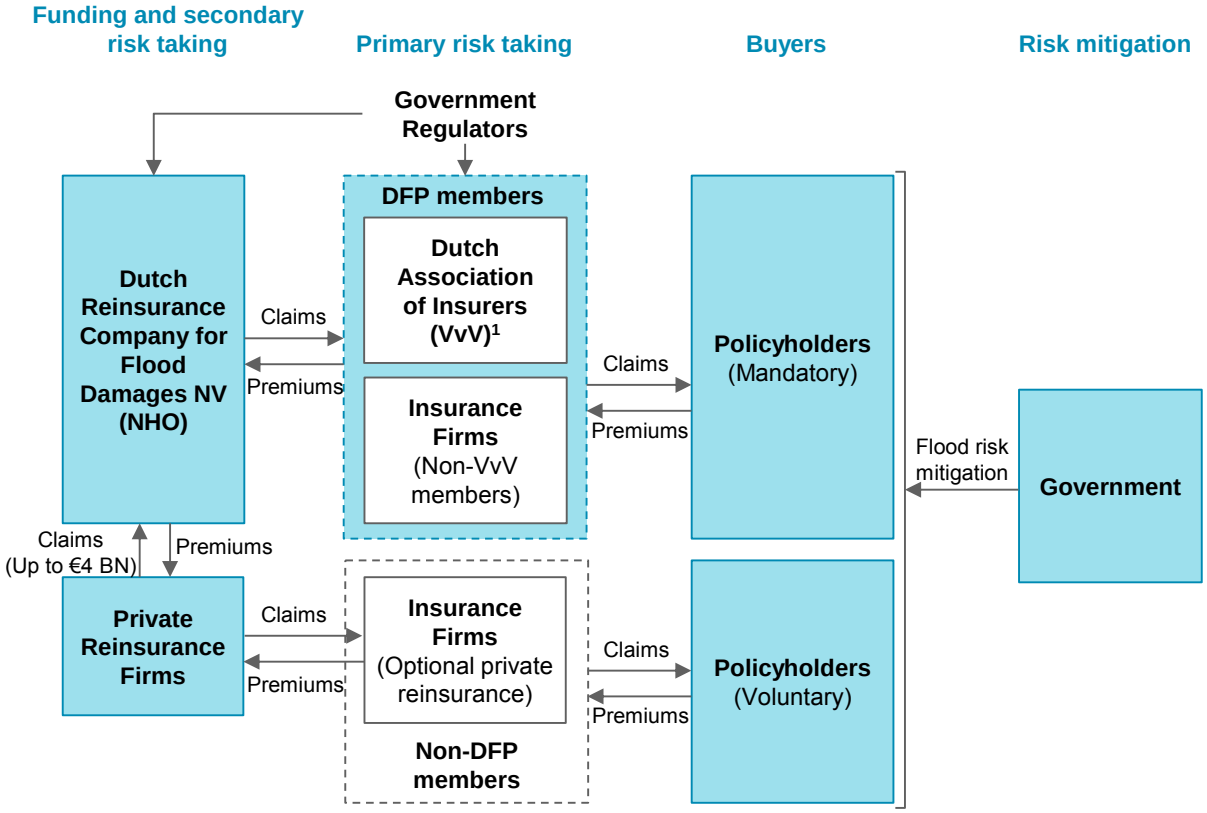
2.3.3. Proposed Dutch Flood Pool system

Strong flood protection systems help protect against flood risk but, due to the large portion of the population that resides below sea level, the Netherlands has a high loss exposure that has increased further due to climate change. A 2006 audit of flood protection standards implemented since 1953 indicated that 24% of the Netherland's flood defenses are outdated. Furthermore, a recent report from the Delta Commission estimated that regional sea levels will increase by up to 1.3 meters by 2100, which could cause up to €3.7 trillion (~$4.8T) in flood-related damage if no mitigation action is taken (Deltacommissie, 2008). These findings, coupled with a lack of flood insurance availability, prompted the VvV to propose the Dutch Flood Pool.

Figure 7 below illustrates the proposed insurance value chain and interactions between key stakeholders.

Figure 7: Proposed Dutch Flood Pool system value chain



1. Members of VvV provide over 95% of domestic coverage in terms of gross premium income to the Netherlands market

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In this system, all property-owners insured by members of the DFP[20] would be required to purchase basic flood insurance[21]. DFP members would be required to collectively contribute €1 billion (~$1.3B) in premiums (referred to as an "equalization layer") to the Dutch Reinsurance Company for Flood Damages NV (NHO)[22], an entity managed by the VvV and used to satisfy flood-related claims.

[20] DFP members could elect to offer additional coverage above this mandatory level or offer lower deductibles to their customers

[21] Basic coverage for private homes would be €250,000 and €25,000 for the building and contents (fixed €500 deductible), respectively; coverage for businesses would be €500,000 and €250,000 for building and contents, respectively (fixed €5,000 deductible)

[22] Although all VvV members will be mandated to provide this coverage to their policyholders, non-members can join the DFP voluntarily and adhere to the same payment/coverage schedule

Contribution to the NHO would be determined by calculating the participation percentage (based on gross property insurance premium income) of the insurer. Insurance companies would be responsible for passing along this cost to their customers using risk-based or fixed rates (ACM, 2013b). The VvV initially estimated that the impact on policyholders would be a 5–10% increase in existing home insurance premiums (ACM, 2013b). An additional €4 billion (~$5.2B) in reinsurance would be purchased via private reinsurers. In the event that total reparations for a particular flood event exceeded the NHO reserves, reparations would be divided equally amongst claimants, resulting in a lower settlement for all claimants (VvV, 2012).

Although this system was found to be anti-competitive and ultimately unconstitutional by ACM, there are a number of system benefits that are important to highlight. Most obvious, primary administration of the DFP via VvV and issuance of flood insurance through all of the trade organization's member insurers would help to avoid adverse selection and ensure widespread flood insurance penetration. Given the high visibility of flood mitigation efforts that exist today and the fact that the cost of flood would be cross-subsidized in the near term, flood risk awareness among policyholders would likely be unaffected. Pooled resources would also help to reduce the financial burden associated with the development of flood risk models used to price policies. Finally, risk mitigation responsibility would be shared among all members of the value chain and decrease reliance on post-disaster relief from the government.

2.3.4. Criteria-based evaluation

Extensive flood mitigation has reduced the risk of flooding in the Netherlands and resulted in limited private flood insurance offerings; however, exposure to flood remains high. Government focus on implementation of mitigation defenses and the development of policies to ensure risk minimization have significantly reduced damages due to flooding. Even the minimum level of protection enforced under dike-ring standards (1 in 1,250 year event) far exceeds the design specifications of most mitigation systems in other countries; as a result of this, a risk culture has developed in the Netherlands that does not incentivize property-owners to engage in risk mitigation. Furthermore, funding post-flood losses from the Treasury places the entire financial burden on the government and raises concerns regarding the economic viability of the current system, especially in the face of climate change.

The proposed Dutch Flood Pool aimed to gain high market penetration through mandatory bundling of flood insurance with property and content insurance at limited added cost to the policyholder (5–10% of existing home insurance premiums) (ACM, 2013b). Cross-subsidization between members of the DFP would have ensured that coverage was affordable and increased adoption. Cost sharing achieved through the DFP and its member insurers would also allow for the country to move towards a flood insurance system that is more risk-based (e.g. pooling of costs to develop enhanced flood risk assessment tools).

The high penetration that would have been achieved through a partnership with the Dutch Association of Insurers would have created a risk community and subsequent premium income to support the economic viability of the flood insurance scheme over the long term. In addition, the more equitable distribution of financial burden would have helped create an incentive to mitigate flood risk for all stakeholders, including the government, insurers and eventually property-owners. All of these parties would have been exposed to losses in the event of flooding and would have been motivated to reduce their probability of loss exposure.

2.3.5. System summary

1. The Dutch government has identified flood prone areas and constructed dike-rings to ensure high levels of protection that range from 1-in-1,250 to 1-in-10,000 year events. This level of protection has been effective but has also contributed to a largely undeveloped private flood insurance market, low flood insurance uptake, and a perception of lower flood risk amongst policyholders.
2. Funding for post-disaster relief is currently provided by the government through the Calamities and Catastrophe Act; property-owners have grown to expect this government aid, which has resulted in limited incentives for private flood risk mitigation.
3. Introduction of a mandatory Dutch Flood Pool, funded by fixed premiums paid by all property-owners, would ensure widespread availability of coverage and allow for insurance to remain largely affordable through cross-subsidization. However, this creates limited incentives for policyholders to implement defenses against flood.
4. Despite the Dutch Flood Pool's ability to provide widespread protection against flood, the Netherlands' Authority for Consumers and Markets indicated that the program was anticompetitive and halted its implementation.

2.4. Spain

2.4.1. Overview

In order to provide better protection against natural and human catastrophes, the Spanish government mandated bundling of extraordinary risk insurance with all life, personal, and property insurance policies in 1954[23]. In addition to this required coverage, the Consorcio de Compensación de Seguros (CCS), a State-backed reinsurance company, was created to provide extraordinary risk coverage for policies that are optionally ceded from insurance companies to CCS (CCS, 2008). Today, about 66% of

[23] Extraordinary risks refer to natural and man-made catastrophes including earthquakes, floods, volcanic eruptions, uncharacteristic cyclonic storms, meteorites, terrorism, etc.

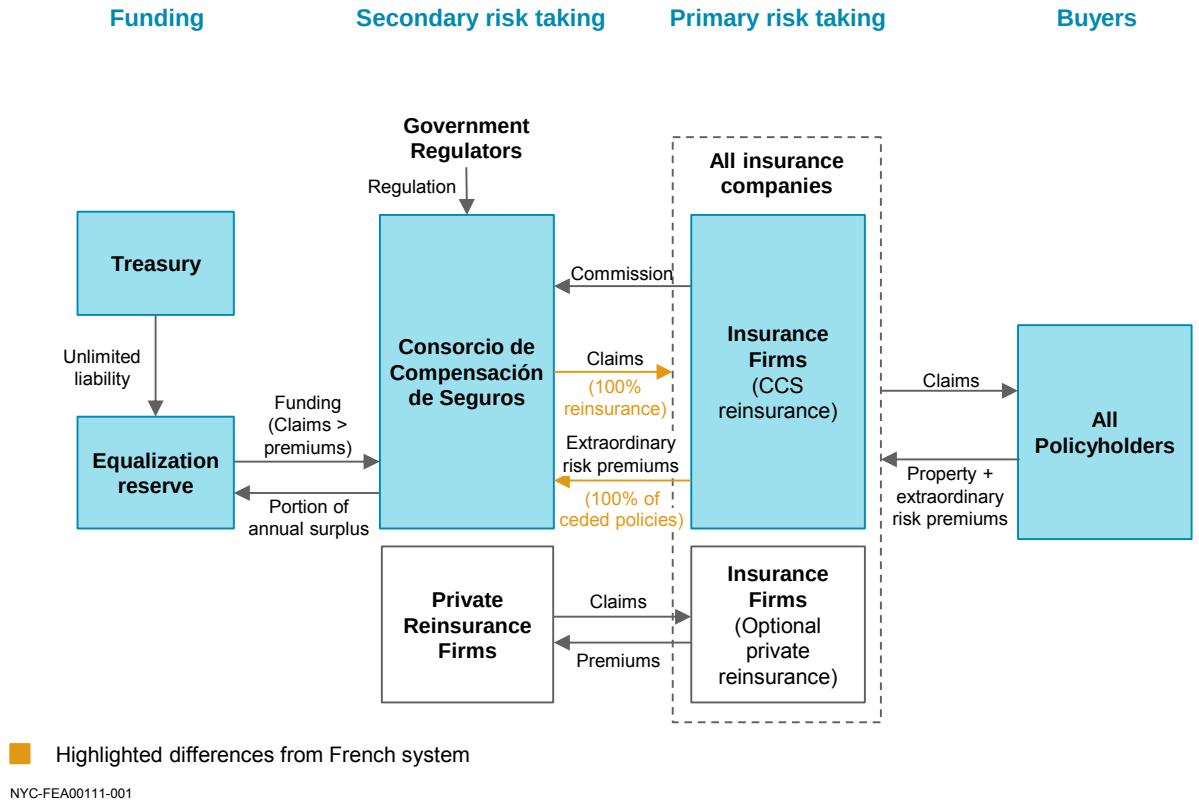
all households in Spain have property insurance (Mapfre, 2012) and, as a result, receive protection against extraordinary risks.

Of all extraordinary risks considered under this mandatory insurance policy, flooding is the most destructive, accounting for 69% of all natural catastrophe insurance claims between 1987 and 2011 (CCR, 2012). To help mitigate flood risk, the government established the Directorate General of Civil Protection and Emergency which gathers and analyzes hydro-meteorological information and establishes early warning systems for both hydrological and weather-related risks (Consorcio de Compensación de Seguros, 2013c; Dirección General de Protección Civil). The government also initiated a program in 2007 to map flood zones and identify areas at high risk of flooding (Cantos, 2008); however, the infrastructure to monitor flood accumulation is still limited (Axco, 2014d).

2.4.2. Current flood insurance system

Figure 8 depicts the current insurance system value chain in Spain and interactions between key stakeholders that are discussed below. In this system, the government requires that insurance for extraordinary risks, including flooding, be mandatorily bundled with all property, life and personal accident policies. Premiums charged to policyholders upon purchasing extraordinary risk coverage are defined by the government as a fixed percentage/monetary amount based on the value of the insured capital and the type of insurance (e.g. commercial vs. residential property) (CCS, 2014).

Figure 8: Spain's current flood insurance value chain



These premiums are paid to insurers who can choose to cede (i.e. transfer) their extraordinary risk exposure to CCS or private reinsurance firms[24]. CCS requires all insurers to fully cede (e.g. no quota share) the policies for which it reinsures. CCS then guarantees that it will compensate policyholders for all extraordinary risks. However, if a primary insurer does not cede a policy and assumes coverage for extraordinary risks, CCS will still indemnify claims in the event that that insurer is no longer able to meet its financial obligations to policyholders (e.g. bankruptcy) (CCS, 2008). This indemnification policy can create a disincentive for insurers to adequately capitalize against flood losses, but does protect policyholders from insurer counterparty risk[25]. In some cases, CCS requires policyholders to pay a deductible that is defined as a fixed percentage of premiums, with a fixed monetary minimum/maximum[26]; insurers that do not cede policies to CCS are not subject to a fixed deductible (CCS, 2013a).

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[24] CCS pays insurers a 5% commission on the value of the ceded premium

[25] The risk that the insurer cannot meet its financial obligation to the policyholder

[26] By default, the deductible is set at 10%, with a minimum of €150 and a maximum of €1,500 *(Axco, 2014d);* there is no deductible required for policies covering automobiles, residential premises or residential associations (CCS, 2008)

Ceded premiums and deductibles are used by CCS to settle extraordinary risk claims. After tax profits, in years where claims are less than income, are contributed to an equalization reserve used to fund losses in future years that exceed collected premiums (Consorcio de Compensación de Seguros, 2012d). In the event that claims exceed the sum of CCS's collected premiums and equalization reserve, the Spanish government assumes unlimited liability for reinsurance. CCS has never called on the government backstop and, as of FYE 2012, the value of the equalization reserve had grown to €5.75 billion (~$7.5B) (Consorcio de Compensación de Seguros, 2012a). This sum provides CCS with the capacity to cover more than six 1-in-500 year events (e.g. 10 times the storm "Klaus" of 2009 or more than 6 times the Basque Country floods of 1993, which were two significant catastrophic losses to impact the region.) (Najera, 2012).

2.4.3. Criteria-based evaluation

In Spain, insurance against flood risk is readily available due to mandatory bundling of extraordinary risk coverage with all life and non-life personal property insurance policies. These policies are priced using fixed percentage or currency amounts irrespective of underlying policyholder risk, resulting in high affordability due to cross-subsidization between policyholders.

The focus on availability and affordability results in limited incentive for policyholders to mitigate risks, since customers are unaware of the risk-weighted price of their flood exposure. CCS and the government have had limited coordination in developing flood zone maps and related policies, which further impedes the ability to calculate risk-based premiums and inform the public of their flood risk. Similarly, insurers that cede policies to CCS have limited incentive to become involved in risk mitigation. Despite these observations, the system has proven itself to be economically viable in that CCS has never required a capital injection from the government to date.

2.4.4. System summary

1. 66% of households are insured against extraordinary risks due to mandatory bundling with property insurance. Insurance companies have the option to completely cede these policies to CCS, resulting in limited incentive for flood risk mitigation by these companies.
2. Cross-subsidization is common in this system due to the use of fixed premiums and deductibles. Given that the specific flood risk of a policyholder is not considered when setting rates, policyholders also have no incentive to reduce their flood risk.
3. CCS has never called on its government backstop and has accumulated €5.75 billion (FYE 2012) in its equalization reserve, sufficient financial protection against six 1 in 500 year events.

2.5. France (Régime Cat Nat)

2.5.1. Overview

France first introduced Régime Cat Nat (Cat Nat) in 1982 following severe flooding of the Saone River (CCR, 2011; Reuters, 1981). Under this legislation, all insurance providers are required to bundle natural disaster insurance[27] (including coverage for flood damages) with real or personal property coverage (CCR, 2011). Also, under Cat Nat, the government authorized Caisse Centrale de Réassurance (CCR), a State-owned reinsurance company, to provide reinsurance for natural catastrophe policies. Using a combination of quota-share and stop-loss coverage (see details in Section 2.5.2), CCR provides an unlimited State-backed guarantee (CCR, 2014). Today, market penetration in mainland France is 98% (Montador, 2014) for natural catastrophe insurance. Of historical claims, 59% (1982–2011) have been attributed to floods (CCR, 2011).

In addition to this mandatory insurance program, the French government has initiated a number of mitigation efforts to reduce risk due to natural hazards. The Law on Enhanced Environmental Protection was passed in 1995, which details a protocol for municipalities to identify natural risk remediation efforts, referred to as Plans for the Prevention of Foreseeable Natural Risks (PPRs) (OECD, 2005). Established PPRs entitle community members to lower insurance deductibles and encourages sustainable building practices. Additionally, a public fund financed by mandatory payments from property-owners (Barnier Fund) was created to acquire at-risk property in areas where the cost of flood mitigation is too high (Darling, Skillen, & Wu, 2006; Jha, Bloch, & Lamond, 2012). Despite these efforts, an estimated 10% of the French population is still at risk of flooding, with 3.4 million homes located in designated flood plains (SOeS, 2012).

2.5.2. Current flood insurance system

Figure 9 depicts the Cat Nat system value chain and interactions between key stakeholders. As was discussed above, Cat Nat ensures that all real and personal property-owners that seek coverage for damages are also insured under a mandatory multi-peril natural catastrophe policy. These policyholders must pay a fixed, standard premium (12% for all property excluding land motor vehicles[28]) that is defined by the government as a percentage of their property insurance[29]. Furthermore, deductible amounts are also fixed currency or percentages, based on the asset use and type of

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[27] A comprehensive list of natural catastrophes covered under Cat Nat is not defined, flooding, earthquake and avalanche are included

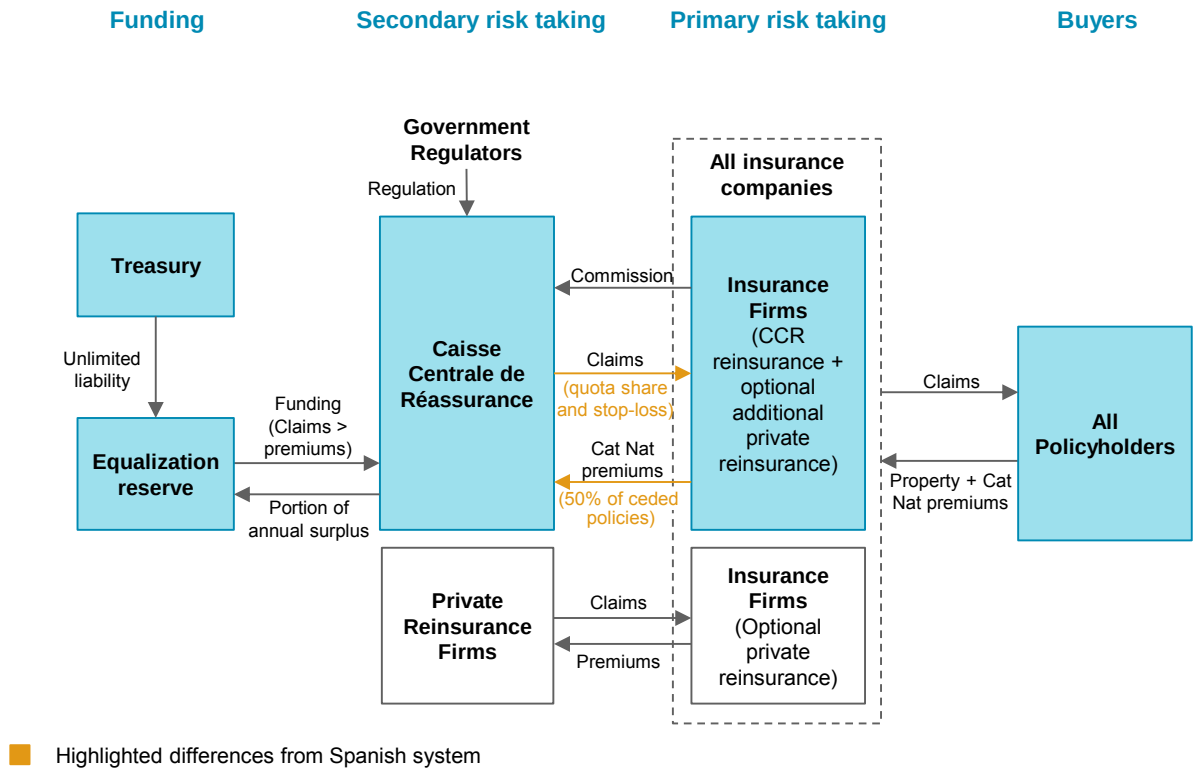
[28] 6% for land motor vehicles related to theft and fire, 0.50% for all other damages

[29] In France, property insurance premiums are also defined by the government (Higgins, 2012)

insurance coverage obtained. This lack of risk-based pricing is partially mitigated by deductible amplifiers that are applied to customers in areas with more than three instances of a particular natural disaster within the past 5 years where the government has not established a PPR[30].

Insurance companies have the ability to reinsure through CCR, private reinsurance firms, or both. CCR provides natural catastrophe reinsurance to over 90% of insurance companies and requires them to cede 50% of their premiums (quota-share). Additionally, CCR reinsurance contracts define a stop-loss threshold, typically between 200–360% loss to premium ratio (Montador, 2014), that limits the risk of insurers in the event of a large claim. Partial ceding requires insurance companies to retain some risk; however, private reinsurance can be used to cede the remainder of the policy.

Figure 9: France's Régime Cat Nat system value chain



CCR uses ceded policy premiums to settle claims and contributes a portion of its annual premium profits to an accumulating equalization reserve, which allows for coverage of losses in future years that exceed collected premiums. In the event that claims exceed the sum of CCR's collected premiums and equalization reserve, the French government

[30] For example, in areas without a PPR and three instances of a particular natural disaster in the past five years, premiums are doubled (CCR, 2011)

assumes unlimited liability for natural catastrophe reinsurance. CCR did require a one-time (net) capital injection of €239 million (~$311M) in 1999 (Montador, 2014), but has since introduced deductible amplifiers and changed its required premium (increased from 9 to 12%). The equalization reserve has increased to €2.87 billion (~$3.73B) as of FYE 2012 (CCR, 2013), and has demonstrated prolonged economic viability despite having settled about 22 million claims between 2000 and 2011[31] (CCR, 2011).

2.5.3. Criteria-based evaluation

The French natural catastrophe insurance program focuses largely on providing policyholders with affordable and widely available coverage against natural disasters. Natural catastrophe insurance is mandatorily bundled with property insurance, resulting in high market penetration. Although some effort has been made to reflect the riskiness of a given property and encourage personal risk mitigation using deductible amplifiers, charging customers fixed percentage amounts, based on property insurance premiums, results in cross-subsidization that makes natural catastrophe insurance more affordable.

Unlike the Spanish system, the inability to cede the entire risk to CCR results in a sharing of natural catastrophe risk and creates an incentive for the insurer and government/reinsurer to participate in mitigation activities. The system has been demonstrated as economically viable after the deductible amplifiers were introduced and pricing was increased, but a capital injection from the government was required earlier in its history.

2.5.4. System summary

1. Property insurance penetration in France is very high (~98% in the mainland) due to mandatory coverage requirements for natural catastrophes. Over 90% of these policies are reinsured by CCR (Montador, 2014).
2. However, public awareness of flood risk is low since premiums for natural catastrophe insurance are set at a fixed percentage and do not fully reflect a policyholder's exposure to risk. Deductible multipliers are used for more disaster prone areas, which does create some incentive for policyholders to mitigate.
3. Optional partial ceding of natural catastrophe policies to CCR ensures that private insurers, CCR, and the government (through the State-backed guarantee) are incentivized to engage in risk mitigation.

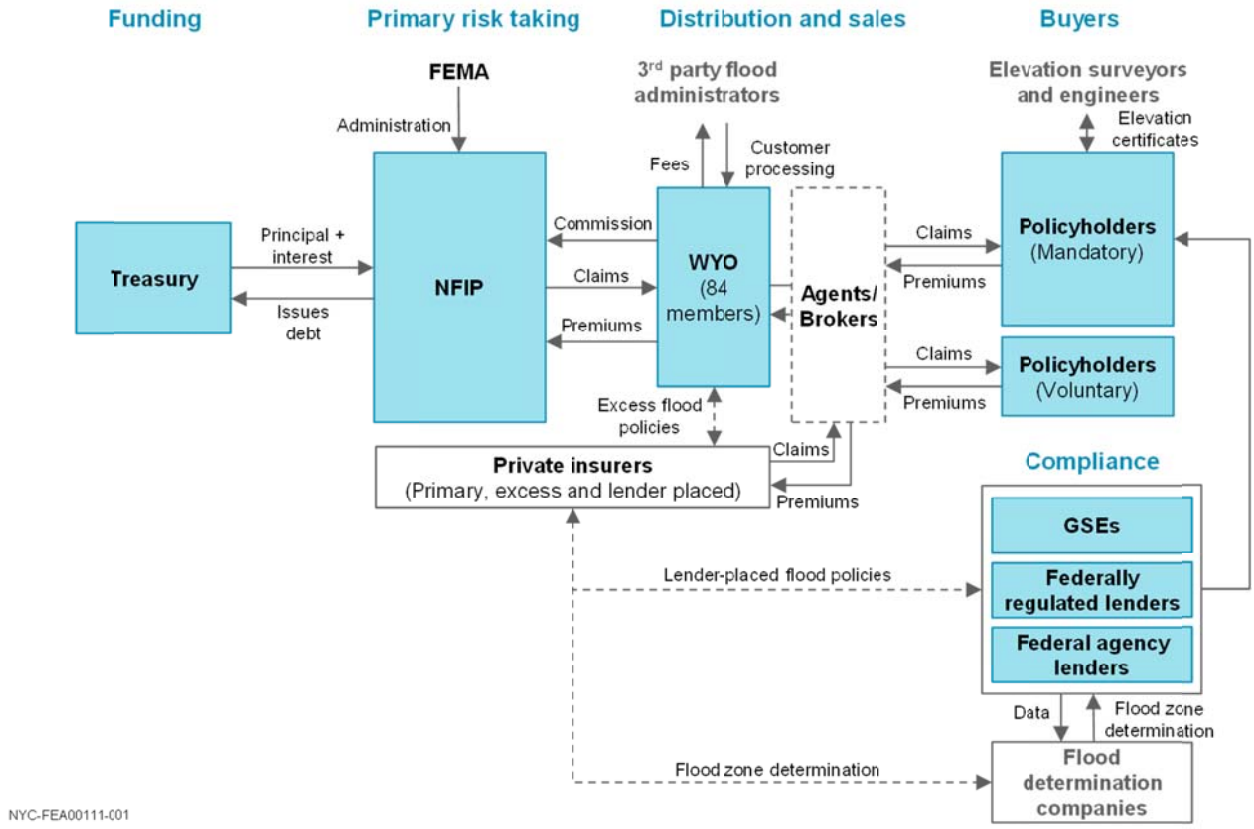
[31] 37.1 million claims were accepted between 2000 and 2011; 59% of which were flood related

3. Stakeholder perspectives

The National Flood Insurance Program (NFIP) relies on a number of key stakeholders to ensure that flood insurance is widely available to property-owners across the United States. Figure 10 illustrates the flood insurance value chain and the interaction of the various stakeholders groups, which include:

- **Buyers:** property-owners, both retail and commercial, that purchase flood insurance from the NFIP or from private insurers
- **Compliance:** federally regulated lending institutions that are responsible for enforcing the mandatory purchase requirement as part of the review of all mortgage loan applications
- **Distribution and sales:** WYO insurers, agents and brokers that process flood insurance applications and service claim requests
- **Risk takers:** the NFIP and private insurers that currently underwrite flood insurance. Note that this group includes private insurers that write primary insurance, as well as those that cover losses in excess of the NFIP (this latter group particularly important where properties are located in SFHA's)
- **Funding:** in the case that the NFIP is unable to meet its liabilities, it has the ability to borrow from the Treasury (i.e. taxpayers) for additional funding

Figure 10: Current flood insurance system value chain



3.1. Stakeholder overview

In the United States, property-owners that seek mortgage loans from federally regulated lending institutions[32] are required to obtain primary flood insurance if their property is located within a Special Flood Hazard Area[33] (SFHA) of a participating NFIP community. This obligation is referred to as the Mandatory Purchase Requirement (MPR). Property-owners located in these SFHAs are informed of their MPR by lenders during the mortgage application process and can choose to purchase flood insurance through the NFIP or through a private insurer (FEMA, 2007).

Flood insurance can be purchased directly from the NFIP through insurance agents (NFIP Direct) but is primarily obtained through Write Your Own insurers (WYOs). WYOs are insurers that have agreed to write and service NFIP policies under their own name in exchange for an administrative allowance. Many WYOs, in turn, make use of third

[32] Refers to federally regulated lenders/agents and government sponsored entities

[33] Areas that have a risk of flooding that exceeds 1% (e.g. 1 in 100 year probability)

party administrators to perform a range of operational tasks, including claims management, administration and underwriting.

The NFIP assumes all risk associated with standard policies underwritten by WYOs, but leverages the WYO carriers for their distribution and marketing capabilities. The NFIP receives flood insurance premiums via the WYOs and is also supported by the Treasury, which provides a financing backstop. The revenues collected, which include risk premiums and fees, are used to not only service claims, but also to invest in developing and improving national flood risk maps that are used by a number of stakeholders, including lenders and private insurers.

In addition to the key stakeholders discussed above, there are a number of other important members of the flood insurance value chain. To determine if a property is subject to the MPR, lending institutions often hire third-party flood determination companies to determine if a property is located within a SFHA and therefore required to purchase flood insurance.

If for any reason property-owners that are required to purchase flood coverage do not have an active flood policy in place, lenders can also force-place coverage through FEMA's Mortgage Portfolio Protection Program (MPPP) or a lender placed insurer. The price of a lender placed insurance policy is typically much higher than a standard NFIP policy as such policies are priced to encourage policyholders to renew their NFIP policies.

Some property-owners are not obligated to purchase flood insurance based on their flood zone designation or borrowing requirements, but may still choose to do so to protect their assets. These individuals can purchase flood coverage through the private markets or from the NFIP if they reside within a NFIP participating community.

Under the Biggert-Waters Act of 2012, lenders are required to accept private primary flood coverage as long as it satisfies criteria defined in the MPR (e.g. coverage must be as broad as the NFIP)[34]. As such, both mandatory and voluntary policyholders can secure primary coverage through private insurers or the NFIP. Private flood insurance companies also offer excess coverage on a voluntary basis to cover the full value of a structure. These companies typically define their own minimum primary coverage requirements and are monitored by state insurance regulators.

[34] While the Biggert-Waters Act of 2012 requires lenders to accept private flood insurance, lenders have been known to reject such policies as they do not have the staff, nor the knowledge to validate whether or not a private flood insurer's policy will adhere to NFIP standards

3.2. Detailed stakeholder perspectives

Individual stakeholders within the U.S. flood insurance value chain can be categorized into three broad groups:

- Government
- Institutions (e.g. insurers)
- Property-owners

In a sustainable flood insurance system, the economic costs and benefits of assuming flood risk are distributed across government, institutions and property-owners in a way that aligns economic incentives and appropriately spreads risk.

Currently, the system is unbalanced:

- Federal Government assumes the majority of flood risk through the NFIP, but does not receive premiums that sufficiently reflect risk
- Private insurers assume a limited amount of risk and primarily play an operational role through the WYO program
- Many property-owners still benefit from subsidized rates that do not sufficiently reflect their individual risk, which can lead to moral hazard

While the move towards a system with a greater role for private markets will help to address some of this imbalance, such change will naturally come with resistance. As a result, each stakeholder group's view on privatization can vary significantly.

The purpose of the sub-sections that follow is to provide an overview of each stakeholder group and its unique perspective on privatizing the NFIP.

3.2.1. Government

3.2.1.1. NFIP

The NFIP was established by Congress in 1968 to help reduce future flood damages through State and community floodplain management regulations; to assist property-owners by making flood insurance more available; and ultimately to reduce Federal expenditures for disaster assistance and flood control (FEMA, 2002). Currently, there are over 22,000 communities that participate in the NFIP. In exchange for access to flood coverage, these communities have adopted minimum floodplain management guidelines designated by FEMA and enforced regulations to improve flood mitigation infrastructure within SFHAs. Communities with properties in flood zones that do not

participate in the NFIP are ineligible for NFIP insurance and a number of other federal benefits, including development grants/loans, post-flood disaster assistance to repair insurable buildings and mortgage insurance/loan guarantees (FEMA, 2013a).

FEMA estimates that about 20% of NFIP policies are subsidized. Since the premiums of subsidized policies do not fully reflect the risk associated with underlying properties (FEMA, 2013c), the NFIP is subsequently exposed to liabilities (i.e. claims) that it may not have sufficient capital to payout following a significant flooding event. Ultimately, such rate subsidization has created funding shortages that continue to threaten the financial sustainability of the program. This is further exacerbated by poor enforcement of the Mandatory Purchase Requirement, limited private market participation and public pushback on proposed rate increases under Biggert-Waters, which together have significantly limited the ability of the NFIP to reduce its exposure to flood risk and lift itself up onto sound financial footing.

From the perspective of the NFIP, privatization presents an opportunity to transfer its exposure to flood risk to other stakeholders that may be able to more efficiently assume and manage the risk sustainably. By spreading the NFIP's exposure to flood risk through such privatization the NFIP would potentially enhance its sustainability by reducing risk and related volatility[35]. Privatization would also enable the NFIP to focus its efforts on flood mapping and mitigation efforts, two very important aspects that support the nation's objective to reduce the negative aspects to flooding. The NFIP's exact role in a private flood insurance system will vary depending upon on the type of private flood insurance system that is pursued, of which there are many potential options. These options are explored in detail in Section 4, which follows this section.

3.2.1.2. State insurance regulators

State regulators are responsible for regulating, monitoring and ensuring compliance of insurance market participants within each state. These entities play a limited role in the current flood insurance system because the NFIP is a federal program administered by FEMA that relies primarily on relationships between the NFIP and local communities.

In a flood insurance market with increased privatization, the role of state regulators would increase, requiring them to authorize/oversee private insurance companies that participate in the insurance market. This monitoring would increase the burden of oversight, but would also ensure that state-specific insurance solutions would be developed to suit local social and economic conditions.

For a privatized flood insurance system to be successful, regulators would need to become more familiar with how flood insurance is modeled, priced and managed.

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[35] Please see the Reinsurance Study that has been provided in conjunction with this report for further detail on this point, including the issue of catastrophic risk financing

Although state insurance regulators have limited experience with flood, familiarity with insurance policies for other natural perils (e.g. earthquakes) will help to close this gap.

Related to this, a protocol for identifying private flood insurance policies that meet government standards would need to be created to ensure compliance of such policies with the MPR. As discussed further in Section 3.2.5 on Lenders, such a protocol is necessary to provide lenders with assurance that a private flood insurance policy is in compliance with the MPR and can be accepted as an alternative to an NFIP policy.

3.2.2. Institutions

The current flood insurance market is dominated by the NFIP, which leverages a network of insurers through the WYO program to underwrite policies throughout the country. To reduce the administrative burden of policy underwriting and servicing, most WYOs contract specialized third party administrators.

Due to a limited appetite for flood risk and an inability to compete with subsidized NFIP prices, there are only a few private insurance companies that offer primary, excess and force-placed coverage. These carriers are often regional and primarily serve lower risk and/or higher net worth property-owners.

3.2.2.1. Write Your Own insurers (WYOs)

The Write Your Own program was established in 1983 to:

- Increase the size and broaden the geographic distribution of the NFIP's policy base
- Improve customer service to policyholders
- Provide the insurance industry with direct operating experience with flood insurance

Today, the 80+ insurers that participate in the WYO program issue 85% of all NFIP policies (III, 2013). These WYOs are composed of Property & Casualty insurers that have entered into an arrangement with FEMA to issue NFIP flood policies under their own names. WYOs are responsible for marketing and selling NFIP flood insurance policies as well as servicing those policies upon a claim – their agents represent the customer's primary point of contact. This system enables the NFIP to leverage the competencies of private market insurers, including their extensive industry knowledge and established relationships with policyholders throughout the United States.

Insurers are incentivized to participate in the WYO program for two reasons. First, insurers are directly incentivized through the fees they earn from the NFIP in exchange for selling policies and handling claims. Fees paid to WYOs typically represent ~30% of total NFIP premiums, but have been as high as 67% of premiums during years with elevated flood claims, such as the 2005 hurricane season (GAO, 2009). Second,

insurers value the ability to directly offer NFIP flood insurance since it provides a benefit to their policyholders who are able to purchase all desired coverage from one agent, helping to improve customer satisfaction and also to deepen customer relationships.

However, there are several pain-points to participating in the WYO program that participating insurance companies consistently point to, including:

- Administrative burden and operational complexity
- Program uncertainty
- Reputational risk

WYOs are subject to significant regulation and extensive auditing by FEMA to ensure compliance with program requirements, which evolve constantly and are often administratively very difficult to keep up with and manage. As a result, WYOs often struggle to maintain operational efficiencies. In addition, their agents do not always understand the implications of recent changes. The uncertainty that periodically arises prior to a reauthorization of the NFIP program by Congress can also lead to a state of limbo for the WYOs, who do not know if they can keep processing business. Finally, WYOs often note that significant reputational risk can arise from participation in the program, especially following a flood event, when policyholders become upset by the claims process and attribute the experience to the WYO.

Under a flood insurance system where private sector insurance providers take on a larger risk bearing role, the demand for and the number of WYOs would decline as customers shift towards purchasing competitively priced private options. If this system allowed for a higher level of rate, price and form freedom, WYO insurers might exit the program to compete in the private flood market. Many WYO insurers already have administrative infrastructure and customer relationships in place to deliver private flood coverage – they simply require the regulatory means and risk underwriting tools to catalyze their market entry.

3.2.2.2. Private primary insurers

Today, there are a limited number of private insurance companies that provide primary flood coverage[36]. While the Biggert-Waters Act requires lenders to accept private flood coverage, most private insurers have largely avoided underwriting flood because of their limited flood risk assessment capabilities, concerns regarding their ability to charge risk-based premiums, and the added exposure accumulations in catastrophic loss prone regions this business would bring. Currently, very few private insurers underwrite flood and the ones that do largely focus on lower risk, high net worth property-owners.

To encourage private insurance companies to offer flood coverage, current levels of insurance premium subsidies would need to be phased out and all rates would need to move in the direction of risk-based levels adequate for the private industry. By definition, full risk rates – also known as "actuarially sound rates" or "risk-based rates" – are premium rates that fully incorporate exposure to risk. The NFIP's definition of full risk rates differs from that of private insurers, however. First, whereas the NFIP's full risk rates must simply incorporate expected losses (i.e. claims) and operating costs, a private insurer's full risk rates must also incorporate a return on capital. As a result, while 80% of NFIP policies are considered to be at full risk rates from the perspective of the NFIP, those same policies may still be underpriced from the perspective of private insurers as was noted earlier in this report. Second, the NFIP's full risk rates are set based on an average historical loss year and do not incorporate the losses associated with catastrophic loss years, such as 2005. In such catastrophic loss years, the NFIP expects to borrow from Treasury to pay for claims and repay those funds in years with lower levels of losses.

To overcome this issue, the NFIP must adequately price policies at a level that reflects full risk rates that incorporates both a return on capital as well as catastrophic loss years. Without such adequate rates, private flood insurers would simply be unable to compete with the NFIP in an economically viable way. Assuming the NFIP addressed its rate challenges, private insurers may be able to efficiently assume flood risk alongside or in place of the NFIP.

Biggert-Waters strived to reduce rate subsidies and grandfathering for certain high risk properties in an effort to improve the economic viability of the NFIP and incentivize the entrance of additional private carriers. Following widespread criticism, strongly vocalized by homeowners, realtors and politicians directly affected by the planned rate increases, Congress passed HFIAA-'14. This legislation effectively extended the glide-path under which these rate reforms would take place; as previously noted, FEMA believes it will take another 15 to 20 years for subsidies under the NFIP to be phased

[36] Discussion with industry experts indicated that private primary coverage within SHFAs is primarily limited to two carriers: Private Market Flood (Lloyd's coverholder) and Homeowner's Choice. For additional detail please refer to the Reinsurance Study provided in conjunction with the FIRS Contract.

out. This will only further limit the number of private insurers that enter the flood insurance market in the short to medium term.

3.2.2.3. Lender placed insurance

Lender placed insurers[37] (also referred to as force-placed insurers) provide flood coverage for property-owners that are required to own flood insurance under the MPR, but that have failed to secure it for any number of reasons (e.g. cancellation by property-owner, termination by previous insurer). As a result, lender placed policies are bought on behalf of property-owners for premiums that exceed those of a normal NFIP policy, which helps to encourage the policyholder to renew or purchase a new NFIP policy.

Currently, lender placed insurers have the freedom to develop and enforce underwriting standards that may differ from NFIP policies[38] (e.g. many lender placed plans do not cover personal items). In a system with increased private sector involvement, lender placed insurers would still exist and be largely unaffected so long as the MPR and the requirement for property-owners to absorb costs associated with coverage remained in place.

3.2.2.4. Excess flood insurers

Despite the limited development of the private primary flood market, there are several private insurers that currently offer excess flood coverage in the United States. Insurers in this market provide additional flood coverage above existing primary NFIP policies (e.g. $250,000 coverage limit for residential policies). The excess insurance business in this market has developed as a result of market demand – specifically, high net worth individuals demand larger limits than those available through the NFIP. Prior to Hurricane Sandy (and the political ramifications that followed), these market offerings attracted limited attention from regulators. As a result, insurers had greater flexibility in developing policy pricing and underwriting requirements (e.g. requirement of primary flood insurance). For insurers offering products in this space, their exposure to flood claims is more remote, since the excess coverage they provide only covers losses above and beyond losses covered by a primary NFIP flood policy.

To remain profitable in an insurance system with increased privatization, excess flood insurers may consider extending coverage to more lower value properties or expanding into the primary insurance market. With underwriting capabilities already well

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[37] Note that FEMA also provides lender placed insurance options under their MPPP, but does not actively market the program to lenders

[38] Coverage limits must still align with minimum requirements defined in the MPR

established, these insurers could quickly extend their offerings and take advantage of primary and excess cross-sell opportunities in the flood insurance market.

3.2.2.5. Lenders

Under the current flood insurance system, federally regulated lending institutions play a critical role in ensuring that borrowers comply with the MPR. Lenders are prohibited from issuing, renewing or increasing property loans unless appropriate flood coverage is in place and have a direct interest in guaranteeing coverage is in place given their underlying mortgage loan exposure. Lenders are also required to track outstanding loans to ensure that flood coverage is maintained and, where appropriate, notify policyholders if their flood determination status and insurance requirement changes (FEMA, 2007).

Currently, most property-owners obtain flood insurance through the NFIP. These policies have limited counterparty risk because they are guaranteed by the government and are federally standardized, which allows lenders to gain comfort with their underlying terms. Although the standardized nature of flood policies facilitates product familiarity, stringent NFIP guidelines limit lender freedom to specify alternative coverage requirements that could allow for better asset protection.

In a flood insurance system with increased private sector involvement, insurers would likely introduce new policies that may not align directly with a standard NFIP policy form. This could be a function of both commercial market influences as well as the influence of state insurance regulators on policy forms. Assuming that lenders continue to be responsible for ensuring that borrowers are MPR compliant, the manner in which this landscape develops would necessitate increased resources on the part of lenders in order to review whether private flood policies comply with the MPR and meet the lender's needs and to manage the counterparty risk associated with the private insurer.

To reduce the administrative burden that lenders face under increased privatization, state regulators would need to define and enforce minimum standards for private flood coverage. These guidelines could be implemented through the inclusion of a safe harbor provision whereby state regulators provide written determination that a private flood policy meets the statutory requirements for flood insurance[39]. This legislation would enable lenders to more quickly review coverage terms and ensure protection of mortgaged properties in the event of flood.

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[39] At the time of writing this study, there is a joint agency (Office of the Comptroller of the Currency, Treasury; Board of Governors of the Federal Reserve System; Federal Deposit Insurance Corporation; Farm Credit Administration; National Credit Union Administration) notice of proposed rulemaking to amend regulations related to loan requirements in SFHAs that calls for and includes such a safe harbor provision (OCC, 2013)

3.2.2.6. Flood determination companies

Flood determination companies are typically contracted by lenders to determine whether a property is subject to the MPR, and to provide some additional support to insurance companies during policy underwriting. These companies are the largest users of flood maps in the U.S.. They employ a high level of process automation to deliver their service efficiently. Demand for flood zone determinations is driven by the MPR, but relies largely on the accuracy and completeness of flood maps provided by FEMA.

In a flood insurance market with increased privatization, lenders would still be required to evaluate customers against the MPR and identify property-owners that require flood insurance. As a result, flood determination demand would be largely unaffected. To increase revenue, certain companies may also consider extending underwriting support to private insurers.

The success of flood determination companies in a private market does rely largely on maintaining the MPR and continued access to accurate flood maps. As mentioned above, a reduction in NFIP policies will reduce the level of funding for risk map efforts at FEMA. As such, an alternative means of funding or a source of private mapping would need to be in place to allow for accurate determinations in the future.

3.2.2.7. Third party administration

Most WYOs do not actually process NFIP policies themselves but instead subcontract third party administrators to fulfill functions such as marketing, underwriting, claims servicing, and statistical filing of financial information to comply with FEMA's requirements. These administrators are particularly helpful to both smaller WYOs, which typically do not have the capacity and/or expertise to independently underwrite and service NFIP policies, as well as the larger WYOs, which often must contend with complex IT systems to support their normal customer base. Administering NFIP policies can be complex and third party administrators are often better positioned to address the unique requirements of the NFIP system.

Third party administrators exist in the current insurance system due to large demand for services from WYOs. However, administrator income is limited to the fees allocated by WYOs and would likely be further constrained due to a decrease in WYO policy volume under increased privatization. To offset some of these losses, these administrators would likely need to extend their services to private carriers (e.g. smaller private insurers unable or unwilling to fully develop the infrastructure or technical expertise to underwrite and service flood policies).

3.2.3. Policyholders

In 2013, approximately 13% of homeowners in the U.S. were reported to have flood insurance, a decrease from 17% in 2008 (III, 2013). These individuals largely purchase

flood insurance in order to comply with the MPR and secure coverage primarily through the NFIP. In those cases where private insurance is obtained, it is typically written on an excess basis and thereby responds to policyholder claims only after the NFIP policy has been exhausted. Outside of the SFHA's private sector insurers will offer primary flood insurance, but the number of policies sold is quite small as has been well documented. In the event that flood coverage is required but not obtained, lenders also have the option to force-place coverage with an insurer of their choosing.

Property-owners purchase flood insurance to protect their investments against exposure to flood risk and/or to satisfy mortgage lender requirements. Generally, given the widespread availability, standardized terms and lower rates, most property-owners purchase flood coverage from the NFIP instead of the private flood insurance market. A small subset of property-owners, typically of higher net-worth properties, may look to private insurers to obtain coverage in excess of the NFIP policy limits (i.e. $250,000 for a residential property).

The largest benefit for many individual property-owners under the current system is the ability to obtain subsidized coverage through the NFIP. Lower prices for individual flood insurance policies are achieved through two channels:

- Direct subsidies to subsidized policies
- Cross-subsidies to grandfathered policies

The 20% of policies that receive outright subsidies are not a financially sustainable investment for the NFIP, as evidenced by recent experience. While grandfathered policies do not present the same financial risk as the subsidized policies – they are cross-subsidized across a broader pool of policies typically within the same flood zone – they similarly result in individual policy rates that do not fully reflect risk, which may benefit some policyholders and hurt others[40]. In addition, and as previously noted, the method and level to which potential catastrophic large losses are reflected in non-subsidized rates needs to be reviewed in order to increase the loss level to which the NFIP can operate self-sufficiently and thereby protect tax-payers from covering unfunded flood losses.

NFIP communities also benefit from certain forms of post-flood disaster assistance following a catastrophic event. However, there is a general misconception that the NFIP and FEMA provide extensive post-disaster relief directly to property-owners. It should

[40] Grandfathered policies provide cost savings to property-owners such that the premiums of individual grandfathered policies do not fully reflect the risk based on the latest Flood Insurance Risk Map (FIRM). These policies are only available to property-owners that have flood insurance policies in place when a new FIRM becomes effective and where the property was built in compliance with the FIRM in effect at the time it was constructed. The objective of grandfathered policies was to ensure that property-owners who complied with the rules are not faced with significant rate changes following the issuance of a new FIRM

be noted that this funding is focused largely on priorities established by the states where declared disasters have occurred and not on direct loss compensation to private property-owners.

Under a future insurance system with increased privatization, property-owners would still be responsible for the purchase of flood coverage to comply with the MPR while the level of subsidization and cross-subsidization of premiums to individual policyholders would likely decrease. However, increased competition amongst insurance companies and resulting competitive market rates would potentially provide property-owners with the opportunity to select from a broader set of policies that offer the a more customized balance between cost and coverage.

As evidenced by the legislative debates regarding Biggert-Waters and HFIAA, a successful private system would require insurers and regulators to control flood insurance premium increases to avoid rapid premium spikes as subsidies are reduced.

4. Privatization options

The purpose of this section is to provide an in-depth review of an array of privatization options for the NFIP, identifying the strengths and weaknesses of each option and articulating potential pathways to implementation. However, before evaluating and comparing across the options, it is important to first establish why privatization of the NFIP is desirable and what benefits it would yield from a public policy perspective.

There are several distinct reasons why increased private market participation in the flood insurance market would yield a more optimal long-term solution to managing flood risk.

Three key advantages of increased private market participation include:

1. Innovation
2. Market efficiency
3. Alignment of incentives and roles

Each of these advantages would likely help improve flood risk assessment, insurance penetration and flood mitigation.

Innovation is an important benefit of any competitive private market. A flood insurance market with increased competition will naturally spur innovation in terms of products, processes and marketing. While there has been significant progress in measuring and mitigating flood risk over the past 40+ years since the establishment of the NFIP, private sector competition could catalyze innovations in flood risk analytics and modeling and produce new flood insurance products that would better meet customer needs and yield greater levels of insurance market penetration.

Based on interviews with the small number of private insurers that write flood, the practical reality is that the primary choice available to residential customers for flood insurance is the NFIP[41]. A competitive private market would introduce alternatives that could benefit the needs of customers by, for example, providing broader coverage than the NFIP or by combining perils so as to allow property-owners to purchase a single policy that would cover all of their exposures (including flood), thereby simplifying the distribution of the product and improving customer experience. Greater private market participation could also create a competitive environment that would encourage operational and market efficiency. Private insurers would be driven by market forces to streamline the processes used to market, sell, underwrite, and process flood insurance

[41] For more details on the makeup of the private market for flood insurance in the US refer to the Reinsurance Study produced as a companion to this report also under the Flood Insurance Risk Study project.

policies and to service flood insurance claims. For instance, private insurers could seek out alternative approaches to estimating the elevation of individual structures, which currently requires costly elevation certificates through professional surveyors. Private companies could potentially lower these underwriting costs by employing technologies to estimate elevation, such as leveraging property specific data from Google Street View or employing LIDAR technology. Such operational efficiencies would, all else equal, help private insurers lower operating costs, which in turn would enable them to compete more on price to the benefit of consumers. In general, a competitive market would tend to lower prices making flood insurance more affordable to many homeowners and thereby improve penetration rates.

Most importantly, greater private market participation could potentially improve the alignment of incentives across the flood insurance value chain, including the federal government, communities, private insurance market and property-owners.

In addition to these general private market advantages, there are several advantages of private market participation that are unique to the insurance industry:

1. The insurance industry pre-finances catastrophic risks by managing aggregate capital and reflecting the cost of holding that capital in its rate/premium charges, thus paying catastrophic claims from current revenue and surplus funds.

2. The insurance industry can diversify catastrophic risks with uncorrelated or less correlated risks from other catastrophic perils, other geographic regions globally, non-catastrophic risks, and risks from unrelated lines of business.

3. Individual insurance companies can decline acceptance of risks that are priced inadequately or highly correlated with their portfolio (although they usually share in the pooling and cross-subsidization of such risks that are unable to find private market insurance).

4. Individual insurance companies may have some flexibility to increase price quotes for risks that contribute more correlation to their total portfolio of risks, subject to regulatory constraints.

Many of the risks that are declined coverage or quoted higher rates by individual insurers that use their flexibility cited above will find their way either to other insurers, whose portfolios are less correlated to those risks, or to public-sector sponsored residual markets that will assume the risks that private insurers will not write. In the case of flood insurance, this is an important consideration. If the effort to privatize flood insurance simply shifts risks from the NFIP to State based residual markets, this might undermine the desired outcome. In many cases State sponsored pools already have challenges managing the catastrophe exposures they carry, often relying on surcharges, levies and other post-disaster financing methods which directly or indirectly can impact policyholders (e.g. tax-payers).

Unlike the private insurance industry, the NFIP has not historically pre-financed catastrophic loss potential by holding capital from which to pay claims, nor has it historically loaded rates to maintain an adequate level of capital for that purpose. The NFIP has instead borrowed from the Treasury to finance catastrophic loss years. Only under the newly established Reserve Fund created by BW-'12 will the NFIP begin to address this, but it will take time for appropriate capital to accumulate particularly in light of the debt that the NFIP currently carries.

The NFIP also cannot diversify its portfolio of flood risks by insuring unrelated risks that are uncorrelated or less correlated with its portfolio, nor does it enjoy some of the flexibility cited for individual insurance companies. Thus, even if the NFIP intended to pre-finance for catastrophic loss years, these disadvantages would lead to higher required risk loads in NFIP rates than in private industry rates.

Under the current system, the federal government assumes the vast majority of flood risk along multiple dimensions. The NFIP alone is currently responsible for "both sides of the coin" in the sense that it underwrites the majority of flood risk in the United States and is also responsible for flood risk mitigation through its flood risk reduction and assessment activities. More broadly, the federal government is also expected (albeit not required) to provide emergency funding to communities following a catastrophic flood event, such as Katrina, in amounts that often exceed the claims dollars paid out by the NFIP – a significant unfunded liability. The precedents set by highly publicized instances of federal aid following catastrophic events have also created a public perception that individual property-owners do not need to insure against low probability, high severity flood events, effectively creating a moral hazard.

Reducing the federal government's exposure to flood risk through greater private market participation alone will not perfectly align incentives. However, it will likely result in an improvement in incentive structures by allowing the federal government to focus on flood risk mitigation while private markets focus on flood insurance underwriting.

Such a realignment of roles would also be advantageous in that it would improve the dynamics between the suppliers and consumers of flood insurance. Presently there are practical issues that result from the government's role in flood insurance, flood mitigation and flood risk maps. Privatizing flood insurance would help remove the NFIP from the political quagmire of unpopular premium increases, unpopular map revisions and claims settlement controversies and in turn allow it to focus on its emergency management and risk mitigation responsibilities – a potentially better aligned and more effective distribution of roles. In addition, a competitive private flood insurance market would also elevate the credibility of flood risks to consumers if multiple insurers point out such risks to consumers.

Ideally, limiting the federal government's involvement in underwriting flood insurance and limiting expectations of federal assistance after disasters would also force property-owners to recognize, mitigate and insure against their own flood risks.

With $3.5 billion of premiums collected by the NFIP in FY2012, the primary flood insurance market is also a significant opportunity for private insurers. As NFIP flood insurance rates continue to rise and more homes are required to purchase flood insurance due to expanding SFHAs and increased non-compliance penalties to lenders, the size of the U.S. flood market is expected to continue to grow. One market analyst has estimated that the theoretical size of the flood market could be as great as $15–25 billion of premiums per annum assuming that market penetration rates reach 20–30% (Assured Research, 2013).

However, despite this significant business opportunity, very few insurers have entered the private flood market with any significant direct underwriting of flood risk. While inertia from the status quo clearly plays a role – such as the fact that WYO insurers are able to profit from the current system through collecting fee income without assuming any flood risk – there are also legitimate hurdles that must be overcome before the private sector is able to play a more significant role in the flood insurance market.

The remainder of this section is organized into five parts:

1. Approaches to flood risk financing
2. Hurdles to privatization
3. Privatization options for the NFIP
4. Selecting a pathway to privatization
5. Additional considerations

The first sub-section more broadly describes the various approaches to flood risk financing to provide a foundation for understanding the natural tensions between different stakeholders and the various policy levers available to any given country.

The second sub-section focuses in on the United States and identifies the key hurdles that must be overcome before any significant level of private market participation in the flood insurance market can be envisioned. The hurdles articulated in this section reflect perspectives from interviews of private market players including WYO insurers, private insurers that already underwrite flood risk (both admitted and non-admitted) and insurers that are considering entering the market. Ultimately, each of these hurdles must be overcome to a certain extent to enable greater private market participation and will not be overcome without reform and public-private sector cooperation. This sub-section also summarizes the key disadvantages associated with privatization.

The third sub-section describes structural options available to the NFIP that could be considered to implement a flood insurance market solution that involves the private sector. These options assume that each of the privatization hurdles identified in the second sub-section have been addressed to some extent. In total, five unique structural options are delineated and evaluated in terms of their impact to stakeholders and their strengths and weaknesses. While comparisons are made across the different structural

options described in this section, our objective here is to articulate the inherent trade-offs across the various choices to help inform debate and not to advocate for a particular approach. That stated, as the NFIP selects a path and begins to transition to that vision over time, each of the various structural options outlined could play a role at different times and against different elements of NFIP's portfolio to improve the nation's flood risk management approach. Given the diverse exposure profile and political landscape, coupled with the time likely required to affect a successful transition to a more stable flood management platform, a diverse set of approaches and solutions will be required.

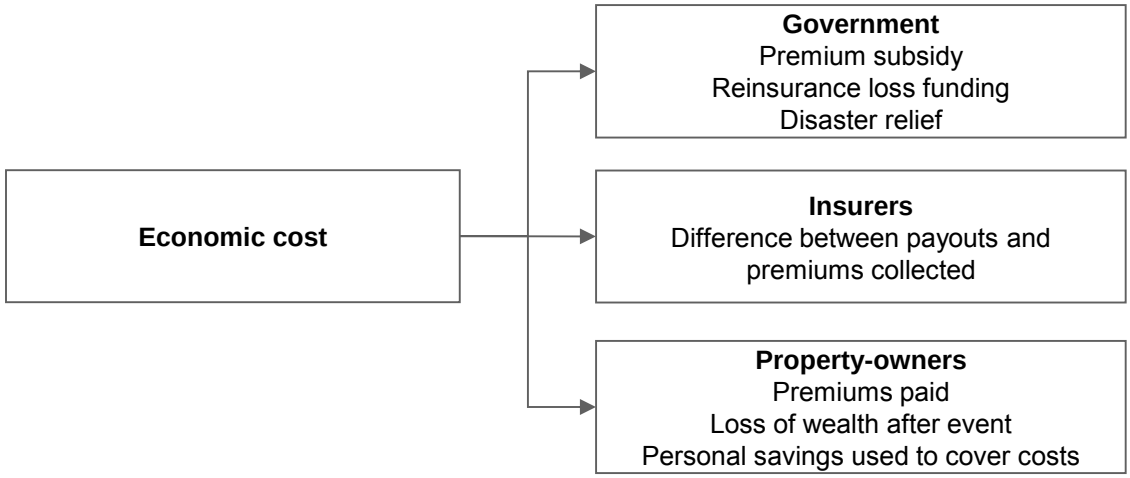
The fourth sub-section compares across the structural options presented in the prior sub-section and applies a "decision tool" for selecting an optimum pathway for privatization. In addition, the sub-section delineates concrete steps the NFIP could take to encourage progress towards privatization and presents an illustrative "glide-path" to privatization over a 20-year period from current state to future state where the U.S. flood insurance system is led by the private sector, with limited government involvement.

Finally, the section ends with a review of additional considerations that must also be discussed in conjunction with any privatization option in an outcome where the NFIP no longer was responsible for underwriting flood insurance. In particular, we discuss how the NFIP's role in flood mitigation and flood mapping will be addressed in a future state with greater private market participation.

4.1. Approaches to flood risk financing

Virtually all countries are exposed to at least some level of flood risk. In any given year, the economic and financial costs of damage from a flood can range from limited to catastrophic. While there are an infinite number of ways to finance flood risk, the cost must ultimately be allocated across 3 stakeholder groups: government, insurers and property-owners. This dynamic is illustrated below in Figure 11.

Figure 11: Allocation of economic costs from flooding



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Following a major flood event, government (at the local, state and federal levels) inevitably will be exposed to some level of cost. At a minimum, government is exposed to the cost of repairing damage from flood to public infrastructure. Depending on its level of involvement in the flood risk value chain, it potentially could also be exposed to the flood risk of privately-owned property as well. This is of course the case for the U.S. government, which is exposed to the flood risk of all privately-owned property that is insured through the NFIP. The U.S. government is also exposed to the cost of flooding after a disaster , through the disaster relief it provides in the aftermath of catastrophic events.

Insurers and reinsurers are only directly exposed to the flood risk they underwrite. The cost that they bear is effectively the difference between the amount they collect through premiums and they amount they must pay out in claims. In the U.S., this exposure is currently limited in size given that the majority of the market's policyholders purchase flood insurance from the NFIP and not private insurance companies.

Property owners ultimately bear the most immediate economic cost of flooding, and in the absence of any flood risk financing system would independently all loss sustained in the event of a flood. Clearly, few people are independently able to assume this level of financial exposure, so the natural course would be to turn to insurance. However, as evidenced by the low take up rates (both in and out of SFHAs) individual property owners appear to underestimate their flood risk and the cost associated with flooding. For a variety of behavioral, psychological and economic reasons, there is apparently a natural inclination for people to discount the potential for events that have not been experienced directly; few will go out of their way to pay for insurance viewed as less than critical.

The manner in which the costs of flood should be allocated across these 3 different stakeholder groups is as much a question of economics as it is of public policy. In

marrying the objectives of economics and public policy, the ideal flood risk financing system would create the appropriate incentives and mechanisms to ensure that our country and all of its citizens would be able to recover quickly and efficiently from a catastrophic flooding event at the lowest possible total cost.

Given that flood risk is something that every property owner, community and state has an influence over, it is important that each party is properly incentivized to limit and mitigate its own exposure to such risks.

If the federal government assumes too much risk, it will naturally lead to moral hazard. However, as discussed in more detail later in Section 4.1.1, it is difficult to imagine a practical system in which there is not some level of government involvement in the flood risk financing chain. Flood risk stands in contrast to other traditional property and casualty risks in that it is potentially catastrophic. As a result, whereas pooling a large number of individual risks of fire, auto or life will yield a stable and predictable level of aggregate risk, a large pool of flood risks does not result in a normally distributed portfolio of risks over the long run. Flood losses are highly correlated as when a flood occurs, many properties are affected. Thus the portfolio distribution for flood is characterized by a “fat tail” that represents the probability of low frequency, but very high severity events. When low frequency and high severity events occur with a portfolio of highly correlated risks, the government will ultimately play a role in paying for the economic costs associated with a flood, whether or not it chooses to underwrite the risk. As a result, government involvement is necessary, as it will inevitably bear some of the economic cost.

Similarly, insurers are a necessary intermediary to help pre-finance the costs of recovering from a catastrophic flooding event. Insurers can spread risk and help individual property-owners mitigate their exposure to the volatility of unique events. The key is designing a system whereby insurers are incentivized to properly achieve such a role, with sufficient rewards for risk taking. Otherwise, without the involvement of the government or insurers, individual property-owners would be left to bear the economic costs of catastrophic flooding alone.

With the objectives to support the right incentives and to deliver the lowest cost, we seek to balance the involvement of government, insurers and property-owners by first identifying a range of different options and then evaluating what can be practically and effectively implemented within the context of the broader political economy.

4.1.1. Flood insurance policy decision framework

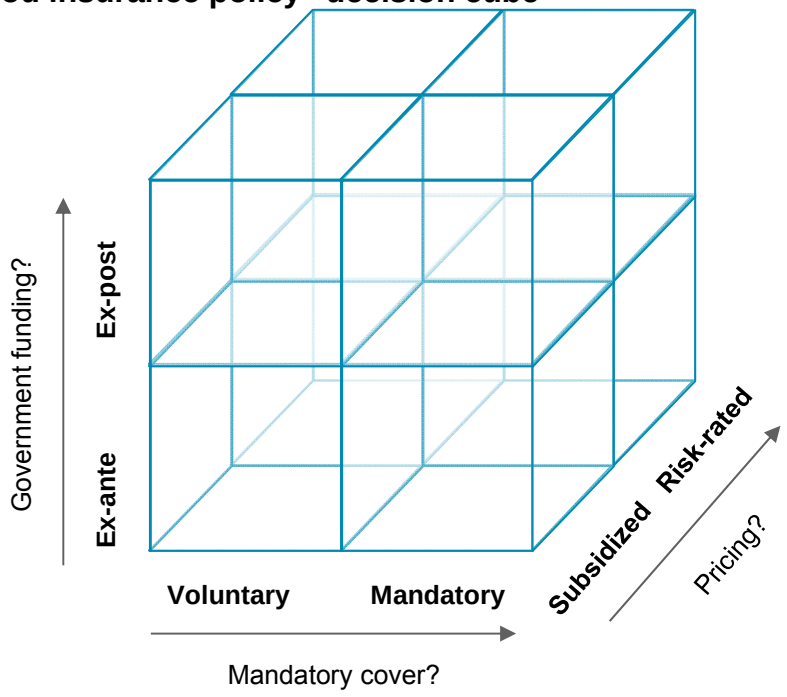
Toward seeking a practical way to balance cost sharing between government, insurers and property-owners, we first decompose a generalized flood insurance system into three distinct, though not entirely independent, dimensions:

1. What level of funding role (pre or post-event) is played by the government

2. Whether or not it is mandatory for property-owners to purchase flood insurance
3. Whether the price of flood insurance will be cross-subsidized, risk-rated, or somewhere in between

Each choice along these dimensions results in a different stakeholder bearing a larger or smaller portion of risk. The figure below illustrates this framework as a decision cube.

Figure 12: Flood insurance policy "decision cube"



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The government funding dimension describes the policy choice of creating an explicit role for the government along the flood risk financing chain either before (ex-ante) or after (ex-post) the flooding event. Government funding before the flooding event occurs when the government assumes flood risk upfront, primarily by pre-financing the risk through collecting premiums in an insurance program such as the NFIP. Government funding after the flooding event occurs when the government does not pre-finance flood risk and instead must allocate resources to pay for economic costs following the event, such as federal government appropriations for disaster relief. The benefit of the government assuming the flood risk before the event is the speed by which funds are deployed to the individuals and communities affected by a flooding event. The cost is that financial resources much be diverted from other uses to fund the costs of potential future events.

The voluntary/mandatory flood insurance dimension describes the policy choice of whether or not to require that property owners purchase flood insurance. In many countries, including Australia, Canada, China, Germany, Japan, Netherlands, and Thailand among others, the purchase of flood insurance by property owners is entirely voluntary. In contrast, other countries, including Denmark, France, Norway, Spain, Switzerland, and the United Kingdom, require that it is purchased, typically as a part of a broader homeowner's insurance policy. The benefit of a mandatory policy is that it increases the size of the risk pool and prevents adverse selection. The cost is that it forces all property owners to purchase a policy, regardless of whether or not they desire coverage.

The pricing dimension describes the policy choice of whether the flood insurance premiums fully reflect risk or are effectively subsidized. Subsidized rates support affordability, but typically transfer the risk from property-owners to the government. In contrast, risk-based rates attempt to fully incorporate the risk of an individual property. A benefit of risk-based rates is that by fully reflecting all costs they provide the property-owner and community with transparency into such risk creating incentives. The disadvantage of risk-based rates is that ignoring affordability will inevitably impact uptake of such policies. In addition, without considering historical circumstances, certain grandfathered policies would see significant jumps in premiums were a shift to full risk-rating be made too quickly.

Illustrating these three policy dimensions as binary choices helps to organize the long list of various approaches to flood risk financing, effectively creating a list of 8 unique combinations. Table 1 below summarizes these various combinations and the overall "desirability" of each option relative to the following objectives:

- Align incentives, encourage systemic resiliency and deliver at lowest cost, and
- Overcome political constraints and facilitate a practical transition strategy

Table 1: Long list of policy options

Government funding?	Mandatory to offer cover?	Pricing?	Decision cube	Primary stakeholders bearing uncompensated risk	Desirability
Ex-ante government funding role	Voluntary	Subsidized		• Government and insurers, both of which would be affected by adverse selection • Low-risk policyholders may be cross-subsidizing	◑
		Risk-based		• Government and insurers, both of which would be affected by adverse selection	●
	Mandatory	Subsidized		• Government may pay outright subsidies • Low-risk property-owners subsidize higher-risks as a result of cross-subsidies	◕
		Risk-based		• Even distribution of risk – primary issue is affordability	●
Ex-post government funding role	Voluntary	Subsidized		• Insurers, who would be affected by adverse selection • Low-risk policyholders may be cross-subsidizing	◔
		Risk-based		• Insurers, who would be affected by adverse selection	◑
	Mandatory	Subsidized		• Low-risk property-owners subsidize higher-risks as a result of cross-subsidies	◑
		Risk-based		• Insurers – primary issue is affordability	◕

● High desirability ○ Low desirability

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Upon carefully evaluating each of these high level options, it becomes clear that only a subset of this long list would actually serve as a viable flood risk financing system for the United States. Specifically, there are two options, which are highlighted above, that have the greatest desirability given the criteria stated.

Both of these options have government funding events before they happen and include risk-based rates. The only difference is that one option is characterized by mandatory flood insurance and the other has voluntary flood cover. The reason that these two options are more desirable than the rest is because the benefits to government of funding losses before the event and using risk-based rates outweigh their associated costs over the long term.

As respects the former category of benefits, there is a significant body of literature on the pros and cons of ex-ante (pre-event) vs. ex-post (post-event) risk transfer. While

there are indeed tradeoffs – premium cost in exchange for volatility reduction – there is generally an optimal level at which certain types of risk should be transferred to maximize capital efficiency. This level is generally identifiable with adequate actuarial and – in the case of large risks – catastrophe model analysis[42]. Though even without conducting such an analysis the widespread voluntary usage of insurance and various requirements to purchase underscore the importance of ex-ante risk transfer to society, industry and individuals.

Beyond potential financial benefits, there are a number of intangible/political benefits to pre-event risk financing approaches. On this subject, history has shown that the post-event government funding option is ultimately not viable in the United States. The federal government is largely expected to provide financial support following a flood regardless. It has already set many precedents with respect to its involvement in post-disaster aid. In many ways, the expectation of federal aid is already an expectation of property-owners nationwide. As a result, pre-event financing is preferable as it ensures that the government incorporates the cost of such risks into its budgeting thus avoiding unwelcome surprises or having to make substantive financial outlays under duress. It also ensures resources are available and can be readily deployed after a catastrophic event.

Risk-based rates are preferable to subsidized rates primarily because the former promotes transparency regarding risk and aligns incentives. Higher-risk properties are charged higher rates, and vice-versa. While subsidized rates can be helpful towards addressing affordability issues, they also can promote (and have promoted) poor decisions on the part of property-owners and their political representatives. Subsidies effectively create a moral hazard, especially when the subsidies are not well targeted. The subsidization or transfer of the cost of flooding from higher risk policyholders to lower risk policyholders and/or taxpayers also removes the incentive to undertake mitigation efforts, thereby encouraging ever increasing societal costs.

Thus, the two options above with pre-event (ex-ante) government funding and risk-based rates are the most desirable. While the last policy dimension of voluntary vs. mandatory flood insurance is an important difference, whether one is preferable to the other reflects normative views regarding the relative importance of individual choice (i.e. whether or not to purchase flood insurance). A voluntary system provides individual property-owners with the choice to buy flood insurance, but also naturally leads to adverse selection, as higher-risk property-owners feel a stronger need to purchase insurance whereas low to moderate-risk property-owners do not. The NFIP has worked hard over the past 40 years to promote greater awareness of flood risk, yet market penetration remains insignificant outside those property-owners who are forced to buy

[42] Such analytics are not generally available to retain consumers. Though for an analysis of the costs and benefits of reinsurance to insurers see: Cummins, et al; The Costs and Benefits of Reinsurance; 2008.

flood insurance as a result of the MPR provisions. Besides the choice property-owners have, insurers can also choose whether or not to participate in the flood insurance market.

The key benefit of a mandatory system is that it creates a broader spread of risk and limits the amount of adverse selection that is feasible. For this particular dimension, the choice of voluntary versus primary flood insurance is not binary in actuality. Instead, there exists a continuum of mandatory vs. voluntary flood insurance requirements on each side of the insurer-policyholder transaction. From a review of the approaches taken outside the U.S., a mandatory system will not in and of itself address all of the challenges associated with flood risk financing, however the mandatory approaches do appear to create an easier means through which to finance the problem. By utilizing a mandatory system through which flood risk is financed on a pre-event basis, the cost required to address the risk would become clearer to all stakeholders, which in turn will prompt better risk management decisions on the part of all stakeholders.

In utilizing the decision framework for a flood risk financing system, we are able to not only identify potential options, but also to winnow down the long list to this smaller subset of options. This exercise ultimately helps us focus upon the decision framework's two viable options, which also have a variety of potential underlying structural sub-options specific to a privatized flood insurance market that we will discuss in Section 4.3.

However, before reviewing the structural options in detail, it is critical to highlight the various key hurdles that must be overcome for any private flood insurance market to be viable in the context of the NFIP and U.S. market.

4.2. Privatization hurdles and disadvantages

4.2.1. Key hurdles to privatization

While most stakeholders we interviewed agree on a need for greater private market participation in the flood insurance market and echoed many of the potential benefits articulated earlier, they also identified a set of specific hurdles that still must be overcome before any step-change towards privatization is achievable.

The hurdles can be organized into five categories:

1. **Data and analytics:** better flood risk assessment tools (e.g. flood maps, advanced storm surge and inland flood modeling) and data (e.g. loss experience) are needed to measure, price and understand risks at the individual and portfolio level
2. **Underwriting freedom and full risk rates:** private insurers must have sufficient underwriting freedom (e.g. rate, form, selection) available to them to be able to underwrite flood insurance policies in an economically viable way

3. **Size of risk community:** a diverse and large number of policyholders are necessary to spread risk and prevent or limit adverse selection; lender acceptance of private flood insurance policies also affects this hurdle
4. **Insurability of risk:** due to the catastrophic nature of flood risk, some level of government involvement is needed to manage extreme tail events
5. **Effective transition:** the path towards achieving fully risk-based pricing must be gradual as rapid transition may prove politically impractical and administratively infeasible

These hurdles were each emphasized by multiple stakeholders during the course of our interviews – each hurdle is elaborated upon in Appendix B. For some insurers, broad concerns regarding the above hurdles have directly limited the level of interest and consideration allocated towards evaluating flood insurance as a viable product.

While certain smaller private insurance companies have already entered the market, competing directly with the NFIP to sell flood insurance to certain property owners, the reality is that the number of such insurers is small and their impact on the market to date has been minor. For instance, Private Market Flood, which is a private non-admitted flood insurer based out of Tallahassee, FL, sold 150 policies as of February 2014, after its first 3 months of writing policies (Simpson, 2014). Other, more established admitted insurers such as Chubb, AIG Private Client, Fireman's Fund, and ACE Ltd have also entered the market, but they have only done so for very specific types of clients and risks. These insurers focus predominantly on the affluent / high-value homeowners market. Where they are offering flood insurance within an SFHA they are typically providing excess insurance coverage that responds above the NFIP insurance policy. Overall, the primary residential flood insurance market will continue to be dominated by the NFIP under the current market structure.

To achieve a step-change in the role of private sector insurers, each of these hurdles must be addressed in some manner. Appendix B reviews each hurdle in turn, providing additional background and describing stakeholder perspectives and alternatives for how each hurdle may be addressed.

4.2.2. Disadvantages of privatization

Beyond the difficulty of overcoming the above hurdles to privatization, it is also important to recognize that there are disadvantages and trade-offs associated with such an end state, including:

- Less reliable flood risk underwriting capacity
- Greater complexity associated with state insurance regulation
- More difficult enforcement of flood mitigation standards (e.g. building standards)

- Flood insurance affordability issues

Relative to the federal government, private insurers are more susceptible to market cycles – their capacity to assume flood risk will ebb and flow over time. As a result, under a private flood insurance system, the availability of flood insurance across all geographies will be less consistent than under the current NFIP-led system. To mitigate this issue, and ensure consistent flood insurance availability, some level of government involvement will be required to fill the gap (e.g. through some form of residual market mechanism).

The involvement of state insurance regulators, who currently have very limited exposure to flood risk, also adds complexity and additional costs relative to the current state. The involvement of 50 different state insurance regulators will inevitably result in more heterogeneity, which will lead to additional costs:

- To insurers, who must wrestle with adapting to the complexities and uncertainties of state insurance regulation
- To lenders, who must allocate resources towards evaluating a more heterogeneous set of flood policies
- To property-owners, many of whom would no longer benefit from any cross-state subsidies that are feasible under a federal program

Enforcement of flood mitigation standards is also more challenging within a private flood insurance system, primarily because the current system makes the availability of NFIP flood insurance within a community contingent on the implementation of certain flood mitigation standards. This particular issue is discussed further in Section 4.5.1.

Finally, as private insurers are profit-seeking entities, they will not independently price flood insurance policies in a way that ensures affordable premiums. In particular, high-risk properties that are located within a SFHA are likely to be viewed as ‘uninsurable’ risks that would face unaffordable premiums if offered coverage. This issue would similarly need to be addressed through some level of government involvement and is explored further in Section 4.5.3.

Ultimately, in evaluating any private sector solution to flood insurance, it is important to consider how the above hurdles are overcome and how the disadvantages are outweighed by the advantages associated with privatization.

4.3. Structural privatization options

Assuming that we are able to address the privatization hurdles articulated in the prior section of this report, policymakers and the insurance industry will still need to agree upon a targeted national flood insurance system that defines the specific roles and

functions of each stakeholder along the flood insurance value chain. Roles and incentives must be aligned, whether it is the federal government or the individual property-owner.

Broadly, we believe there are five structural privatization options for delivering flood insurance to the U.S. market, which are outlined in Table 2 below.

Table 2: Structural privatization options

	Cedant option	Residual market option	Reinsurer option	Pool option	Open market option
Overview	• NFIP provides primary insurance to policyholders • Portion of flood risk is transferred to private markets using reinsurance or an alternative risk transfer instrument	• Private insurers provide coverage to majority of policyholders • NFIP provides primary insurance focused on residual market risks	• Private insurers underwrite primary flood risk • Government acts as a reinsurer of a last resort	• Private insurers jointly underwrite primary flood risk • Private insurers pool flood risk and jointly reinsure • Government acts as a reinsurer of a last resort	• NFIP stops underwriting flood risk and run-offs portfolio
Primary risk taker(s)	• NFIP	• Private insurers • NFIP (residual market only)	• Private insurers	• Private insurers via NFIP pool	• Private insurers
Secondary risk taker(s)	• Reinsurers • Capital markets	• Reinsurers • Capital markets	• NFIP • Reinsurers • Capital markets	• Reinsurers • Capital markets • Federal government	• Reinsurers • Capital markets
Key hurdles	• Cost associated with risk transfer • Reinsurance and capital markets capacity • Mismatch in primary and secondary market pricing	• Private insurers' access to data and technology needed to measure risk • Private insurers' ability to charge risk-based rates • Size of risk community	• Design of the reinsurance structure (e.g. tranching public-private loss)	• Achieving risk-based pricing • Size of risk community	• Private insurers' access to data and technology needed to measure risk • Private insurers' ability to charge risk-based rates • Size of risk community • Treatment of residual risks, access and affordability issues

The above options are organized from left to right in terms of the approximate level of government involvement, from the greatest involvement under the cedant option, in which the government is still the primary risk taker, to the least involvement under the open market option, in which the private market supports both primary and secondary risk taking.

- The cedant option involves the private market through transfer of flood risk from the federal government (i.e. NFIP) to the reinsurance or capital markets.
- The residual market option attempts to bifurcate the primary flood insurance market, with private insurers insuring the majority of flood policies and the government only insuring "residual" risks that are uninsurable in the private market, such as older high-risk properties that were built before certain flood mitigation standards were

implemented. Structurally, this option is common in the US' Gulf States for addressing the peril of wind

- The reinsurer option places the federal government in a secondary risk taking role, with private insurers exclusively acting as the primary risk taker. This option keeps the government involved, but in the smallest risk-taking position.
- The pool option is led by private insurers that jointly underwrite primary flood risk and jointly reinsure flood risk. While tested, this option would require the government to oversee and act as an ultimate back-stop to the pool.
- Finally, the open market option includes no direct insurance role for the federal government, which instead would be responsible for flood mitigation. This is the "full" privatization option.

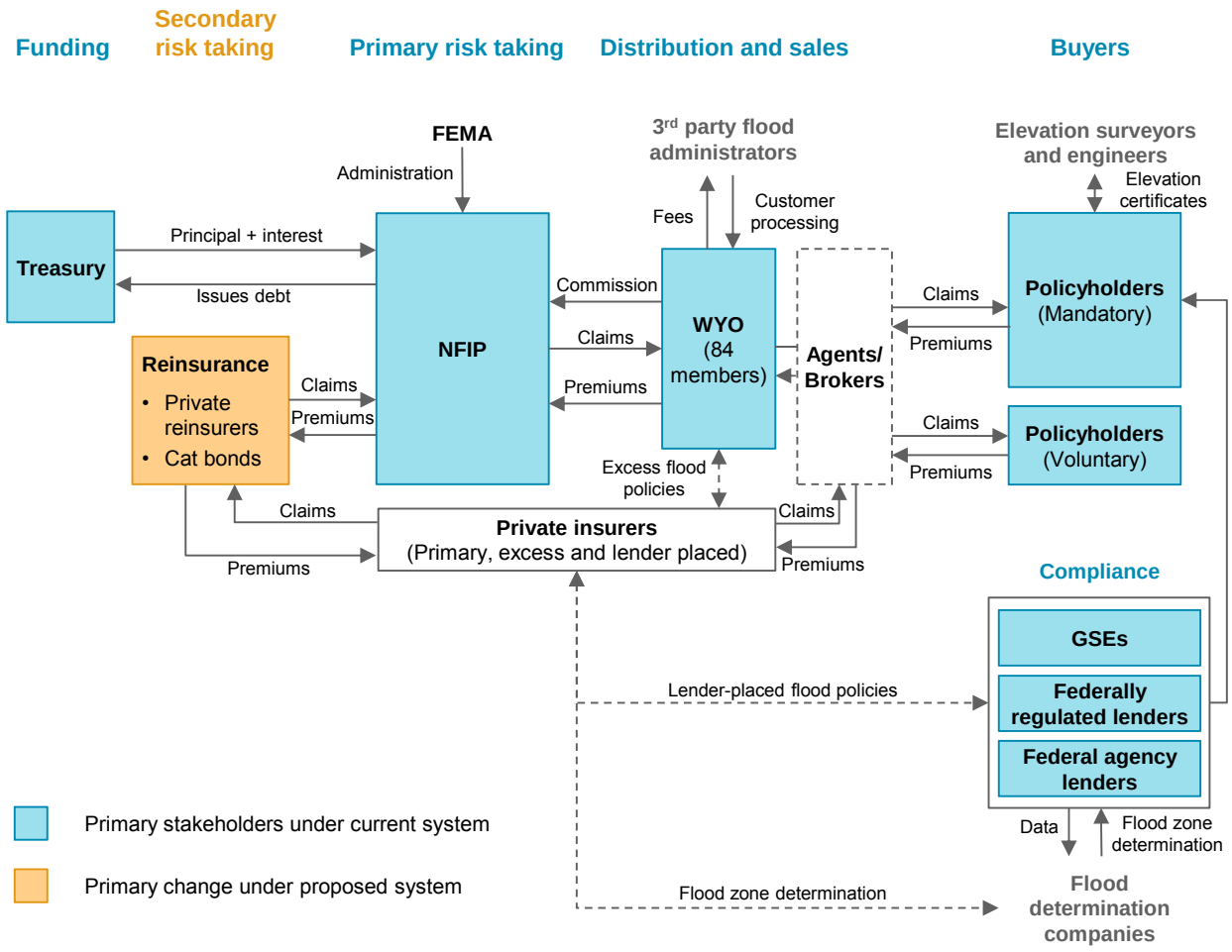
While each of the five options is unique, they are not necessarily mutually exclusive. For instance, it is possible to imagine that the federal government cedes flood risk (i.e. the cedant option) in a system where the federal government supported a residual market (option 2) or acts as a reinsurer itself (option 3). Alternatively, a potential path towards privatization may ultimately involve use of multiple options over time (e.g. the cedant option in near term and the residual market option in the medium term).

Before elaborating on potential paths to privatization in Section 4.4, the sub-sections that follow delineate each of these structural options in more detail, articulating the roles of each of the key stakeholders along the value chain, as well as the strengths and weaknesses of each option.

4.3.1. Cedant option

The figure below illustrates the flood risk financing value chain under the cedant option.

Figure 13: Cedant option, flood risk financing value-chain



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This option summarizes the flood risk value chain as enabled by Biggert-Waters, which authorized FEMA to secure reinsurance coverage through the private markets[43]. Under this option, the NFIP would maintain its current role and be responsible for the majority of primary risk taking. However, NFIP would also cede a portion of this risk to private reinsurers and/or the capital markets.

[43] Section 100232

The key benefit of this option is that ceding flood risk to secondary markets would help reduce the government's total exposure and provide an additional layer of protection before the Treasury backstop would need to be utilized. From a risk management perspective, utilizing the protection of reinsurance to cover losses in only the more extreme years would help the government manage and reduce the volatility of its losses over time. It would also allow for a diversification of the risks held by reinsurers and capital markets, which will attract the interest of international markets potentially facilitating an even more efficient allocation of exposure.

Another benefit of this option is that it is administratively practical. Under Biggert-Waters, FEMA already has the authority to purchase reinsurance. In addition, unlike some of the other options, it can be implemented purely at the federal level, avoiding the complexities of any private market solution that requires the involvement of state regulation. As a result, if this option were to be implemented it would not require a significant change and is potentially much more administratively feasible than some of the other options, which require more significant reform.

The key weakness of this option is that it requires that the NFIP to continue to play an active and critical role in the flood insurance market. This change would also not help increase participation from private insurers in the primary markets where competition is most lacking.

Another more practical roadblock is that risk transfer comes with a cost, which must be either absorbed by the government or passed along to policyholders in the form of higher premiums and/or fees. Whether or not the financial cost justifies the benefit will largely depend on price. This is a topic that is explored in detail in the Reinsurance Study[44].

Finally, one additional consideration is the private market's reinsurance capacity. While the market is currently robust, the capacity will vary on a forward looking basis depending upon the future macroeconomic environment and future losses. While the reinsurance sector has expanded significantly since 1992, and in the process become far more resilient following the hard lessons from Hurricane Andrew, the (re)insurance sector remains a cyclical business. As a result, not unlike other insurance markets, capacity from the risk transfer market for flood may vary over time. This consideration is inherent in all options for privatization, and is well understood by insurance industry professionals as the "insurance cycle," which includes both soft and hard markets.

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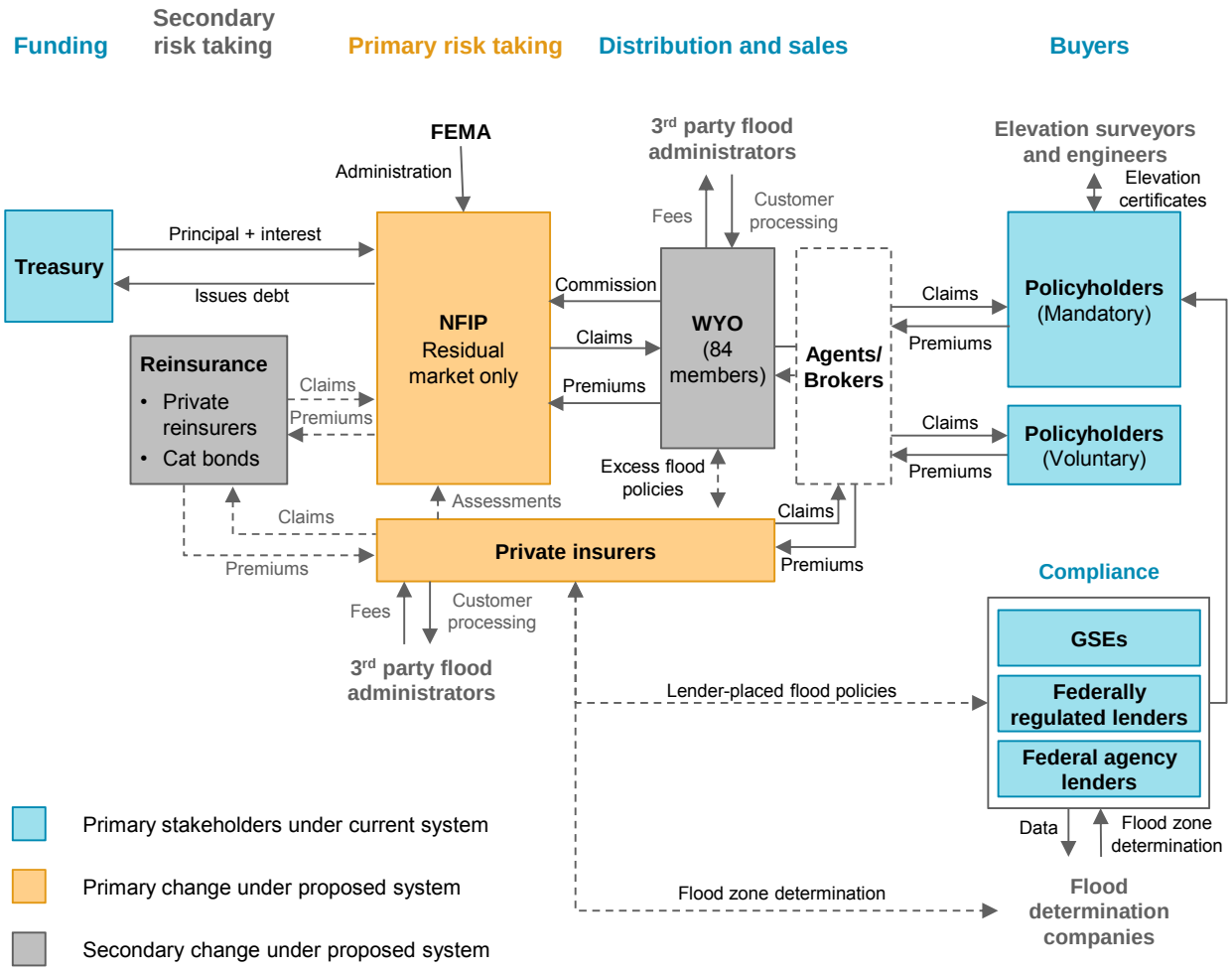
[44] See Reinsurance Study -- Current Market Assessment prepared by Guy Carpenter as a part of the Flood Insurance Risk Study.

4.3.2. Residual market option

The figure below illustrates the flood risk financing value chain under the residual market option.

Figure 14: Residual market option, flood risk financing value-chain



The residual market option would represent a significant departure from the current state as it would require private insurers to play a much more significant role in the primary markets, and it would diminish the NFIP's role to that of a residual market. Under this system, private insurers would assume the majority of primary risk taking, providing flood insurance to most property-owners. The NFIP would act as an insurer of last resort for property-owners that could not obtain coverage from the private markets.

This system would be similar in form to the residual markets employed for windstorm at a state level in Florida or Louisiana, which is described in more detail in the Current Market Assessment[45] – the key difference would be that this would be a residual market directly supported by the federal government, rather than indirectly supported by a back-stopping fund.

Private insurers would play a much larger role in this system as they would be responsible for underwriting the majority of flood insurance policies. Under a properly functioning residual market, the only individual risks that would fall to the federal government to insure would be properties that were unable to obtain private market insurance. Such risks would likely include older owner-occupied properties located in higher risk areas that were built prior to the issuance of flood insurance risk maps, homes in coastal counties or other high risk properties which would fall outside the appetite of many private carriers. The objective of creating a residual market for such risks would be to help ensure that flood insurance is widely available, even for properties that may be exposed to risks that the private markets are unwilling to assume. While the residual market would need to be capitalized to support its obligation to insured properties, for losses exceeding the residual market's capacity (either internal or as leveraged through access to reinsurance) assessments of some magnitude could be levied against participating private insurers to partially finance such losses adding another layer of protection for taxpayers before the US Treasury would need to step in.

The key benefits of this option are that:

- Private insurers would assume the majority of flood risk and thereby reduce the government's exposure
- Policyholders would have more options from the private market and be able to purchase coverage that best suited their needs
- Private insurers would help market flood insurance and also align individual flood risk with actual cost as they are less likely to cross-subsidize
- Higher-risk policyholders that are unable to obtain private market insurance would still be able to buy flood insurance via the residual markets
- The need for the US Treasury to finance excess risk may be diminished depending on program design

Underpinning the assumption that private insurers would assume the majority of flood risk is that the hurdles identified in the previous section are addressed, especially in terms of rate and form freedom. Private insurers would not be willing to enter a market and compete on prices if they are not rewarded for assuming risk. However, if provided

[45] See Reinsurance Study -- Current Market Assessment prepared by Guy Carpenter as a part of the Flood Insurance Risk Study.

with sufficient rate and form freedom as well as a stable regulatory environment, private insurers potentially could play a significant role in the primary flood insurance market. The addition of a federally run residual market would only be necessary to provide so-called “uninsurable risks” with coverage.

The key weakness of this option is that the pathway to this privatization option would likely require new legislation to enable this modified NFIP structure. In addition, this option would require a very careful transition from the current system, including:

- The process of moving or transferring NFIP policies to private markets
- Finding alternative sources of funding for flood mapping and mitigation
- Addressing the potential decline of NFIP subsidized policies

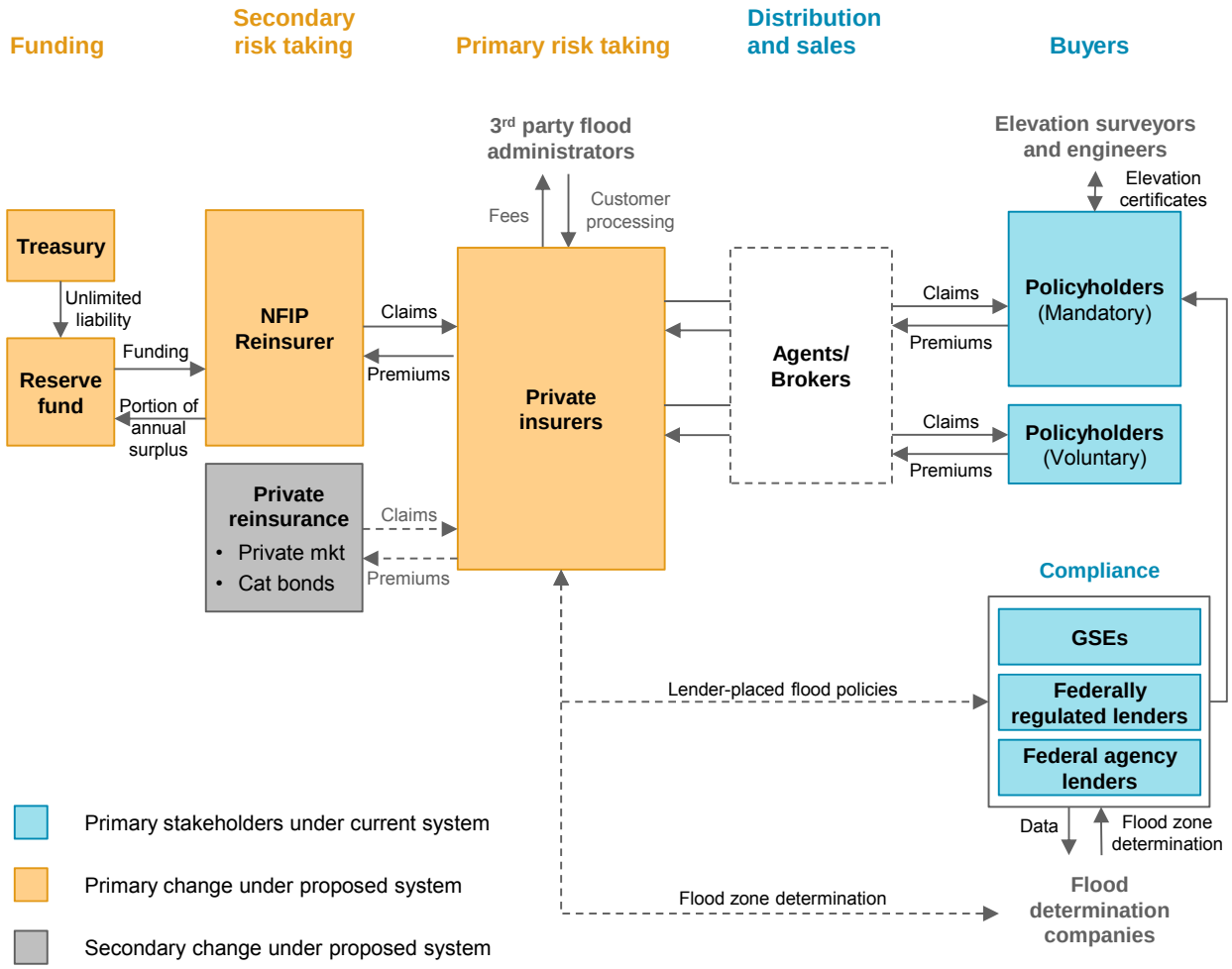
It important to note that the rate and form freedom, requirements for new enabling legislation, and carefully managing transitions, are common between this and the following options. For example, any of the options that reduce the size of the NFIP’s annual premiums could impact funding for the NFIP’s flood mapping and mitigation activities, about 5% of premiums are used for that purpose annually – this issue is discussed further in Section 4.5.

Finally, as with other residual markets, in a residual market for flood insurance the NFIP would only accept risks that no private market insurer is willing to insure. As a result, it would be left with all of the bad risks and none of the good risks – an extreme example of adverse selection. While insurer assessments might mitigate this issue, getting private insurers on board with paying such assessments would be challenging. An important offset to this downside risk is if the private markets are able to significantly improve market penetration, then the costs to the federal government of post-event disaster assistance would be reduced. In recent years, such costs have often been greater than the size of NFIP flood insurance claims.

4.3.3. Reinsurer option

The figure below illustrates the flood risk financing value chain under the reinsurer option.

Figure 15: Reinsurer option, flood risk financing value-chain



Under the above structural option, the NFIP would remove itself from its current role as a primary risk taker and instead act as a national reinsurer, similar to the role of the CCR and CCS in France and Spain, respectively, described in Sections 2.4 and 2.5. The role of primary risk taking would be led instead by private insurers in a competitive market that would have the ability to purchase reinsurance from the government or from the private reinsurance market. The need for a government reinsurer would be to enable private insurers to manage the low frequency, high severity tail risk associated with the catastrophic nature of flood.

The key benefits of this system are that:

- It would take government out of the primary insurance business
- Private insurers would assume more flood risk and reduce the government's exposure
- Policyholders would have more options from the private market and be able to purchase coverage that suits their needs
- Private insurers would help market flood insurance and also align individual flood risk with actual cost as they are less likely to cross-subsidize
- Government could provide a more reliable source of stable reinsurance capacity than private markets
- Private insurers would be encouraged to enter the market since they would be able to obtain a stable and potentially less expensive source of reinsurance from the government

Similar to the residual market option, this option would rely primarily upon private insurers to underwrite flood insurance and, therefore, also benefit from market competition in terms of greater innovation, efficiency and penetration. The key difference here is that the government also plays a role in assuming some level of tail risk, which would help enable private insurers to be able to successfully invest in developing a primary flood insurance market in a way that would also financially reward the risk they assumed and value they provided.

Government funded reinsurance would also effectively allow private insurers access to a stable and potentially less expensive source of risk transfer. Of course, within this structural option, there are also an infinite number of variations in terms of how government reinsurance coverage would be structured (e.g. quota share, stop-loss), the price at which such reinsurance would be sold, and the amount of capacity the government would be willing to provide.

The key weaknesses of this system are that it:

- Requires significant negotiations between government and private insurance industry to establish an acceptable level of and structure for risk-sharing
- Merely shifts competition between the government and private sector from the primary insurance market to the reinsurance market
- In light of natural catastrophe trends, anticipated trends surrounding climate change, and budgetary constraints across the public sector, this approach may not reduce the federal government's exposure given the volatility surrounding the peril of flood.
- If this approach were adopted a precedent could be set to do the same for other loss exposures such as hurricane or terrorism.

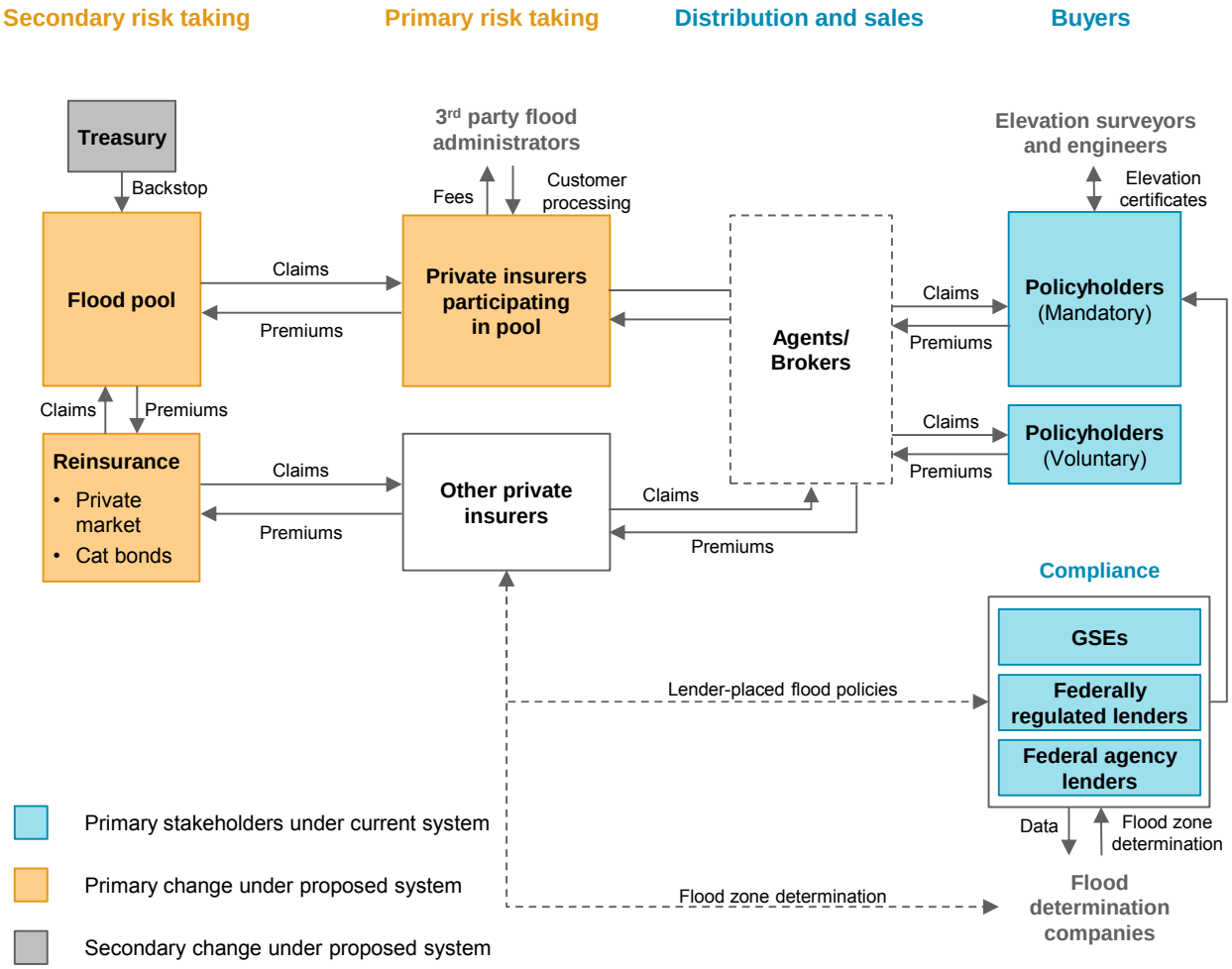
- Likely requires legislation to enable modified structure
- Leaves the government potentially exposed to unfunded losses in the short term until reserves accumulate and sufficient funds are available to pay reinsured losses
- Requires careful transition from current system
  - Moving or transferring NFIP policies to private markets
  - Finding alternative sources of funding for flood mapping and mitigation
  - Addressing the potential decline of NFIP participating policies

The majority of these weaknesses are no different than those of the residual market option. The exception is that this type of system is public-private partnership that would require significant coordination and negotiation between the federal government and insurance industry to achieve a system where the government assumes a role and sufficient level of risk that supports a market environment in which the private insurance industry would be able to succeed economically.

4.3.4. Pool options

The figure below illustrates the flood risk financing value chain under the pool option.

Figure 16: Pool option, flood risk financing value-chain



Under the pool option illustrated above, the federal government assumes a lesser role in the flood insurance market. The majority of the value-chain from distribution and sales to primary and secondary risk taking would be assumed by the private markets.

In order to ensure sufficient availability of flood insurance to all property-owners, including higher risk properties that would have fallen to the residual markets under option 2, the insurance industry could form a pool to help create a larger risk community that would improve the spread of risk and prevent any individual insurer from being vulnerable to outliers (i.e. concentrated exposures to specific geographic regions). While the pool in the above illustration is organized and administered by the private

sector, it could also be set-up by the NFIP. The pool option is relatively flexible and there is ultimately a spectrum of options for how the pool is structured.

Under this system, there is a potential need for a government back-stop supporting the flood pool, as there was for the system currently being developed in the United Kingdom under the proposed Flood Re system, described earlier in Section 2.2.3. Such a back-stop would help private insurers and reinsurers manage low frequency, high severity events that the private markets are unable to absorb.

The key benefits of this system are that:

- FEMA already has authority to set up such a pool (Part A of 1968 National Flood Insurance Act)
- Government has limited to no role in assuming flood risk under this system, though it potentially would be needed as a backstop
- Policy ceding to private flood insurance pool allows for some level of geographic risk diversification
- Pooling could also support shared industry investments in flood underwriting technology and data
- Policyholders would have more options from the private market and be able to purchase coverage that best suits their needs
- Private insurers would help market flood insurance and also align individual flood risk with actual cost as they are less likely to cross-subsidize

Given the historical precedents set under Part A of the original 1968 National Flood Insurance Act, this option may be easier to pursue than the residual or reinsurance option. However, modifications might be required to avoid the issues that gave rise to its past failure.

The key weaknesses of this system are that:

- Adverse selection is likely unless flood insurance is mandatory or bundled with homeowners policies
- Flood insurance policies would likely need to be standardized to be deemed acceptable for cessation into pool, limiting amount of customization and innovation
- Requires careful transition from current system
  - Moving or transferring NFIP policies to private markets
  - Finding alternative sources of funding for flood mapping and mitigation

- Lack of incentives for flood mitigation as concept of “NFIP participation” and the associated floodplain management requirements would no longer exist[46]

Attempting to create this system, which would be similar in many ways to Flood Re in the UK, without the same level of insurance market penetration would be difficult. Clearly, as discussed in the section on hurdles, the current level of demand for flood insurance by U.S. residential property-owners in particular is limited given some of the biases described earlier. As a result, without greater levels of government mandated flood insurance, the entire system would be highly susceptible to adverse selection. In an environment where only high risk property-owners were willing to purchase flood cover, this flood insurance system would not be viable as premiums would either be unaffordable or the insurers would not be able to sufficiently price policies.

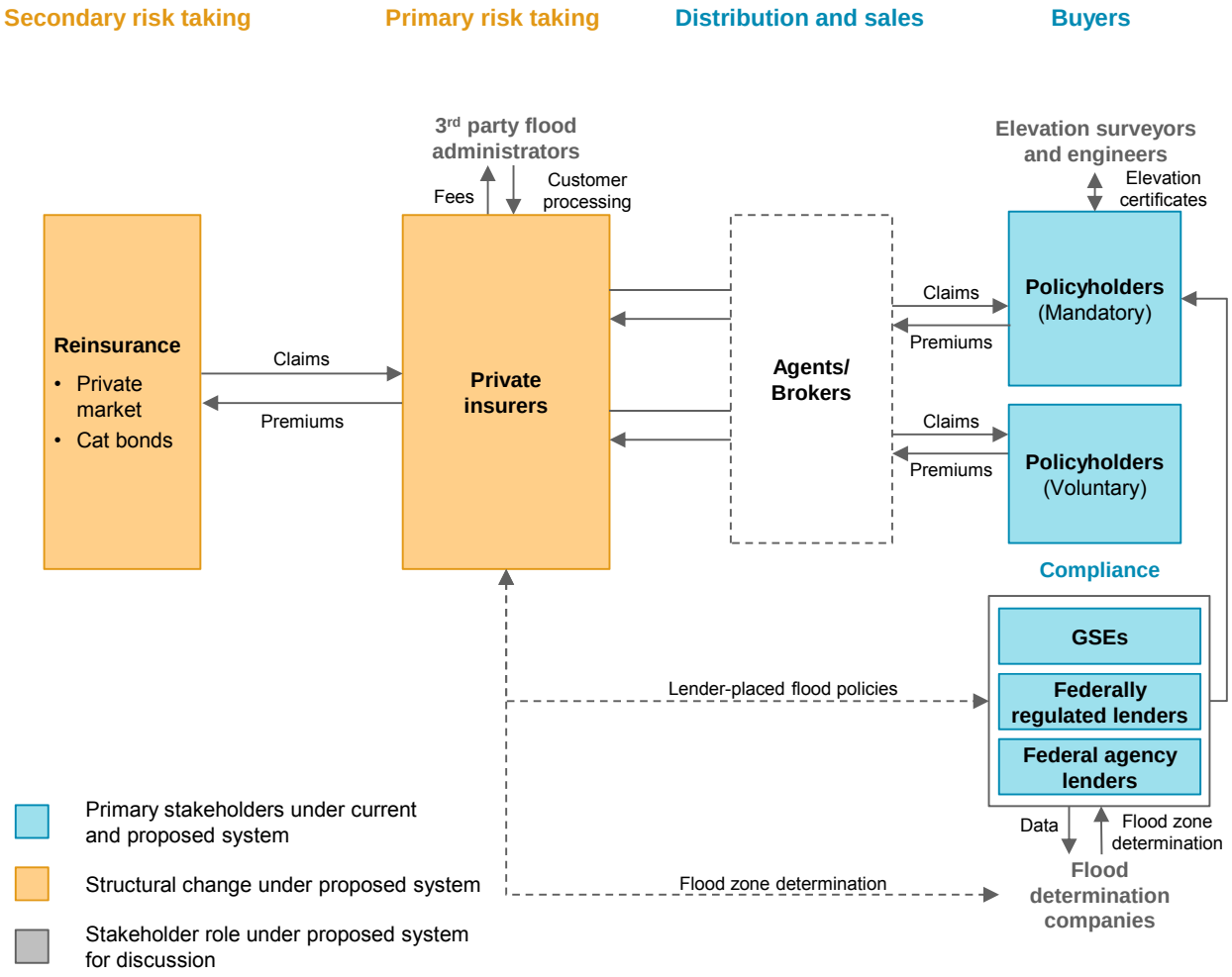
However, if there is a sufficient level of market penetration facilitated through increased demand – either created by the government through expanded mandatory purchase requirements or organically – this system would potentially create a healthy private flood insurance market that yields affordable flood insurance to property owners that is self-sustaining and requires only limited government support.

[46] Such drawbacks could be addressed by tying mitigation efforts to Federal Disaster Assistance. The “New York Rising Community Reconstruction Program” undertaken by the State of New York following Hurricane Sandy might serve as an example.

4.3.5. Open market option

The figure below illustrates the flood risk financing value chain under the open market option.

Figure 17: Open market option, flood risk financing value-chain



An open market option is a flood insurance system that included no government involvement except in regulation. Private insurers provide flood insurance and similar to other insurance markets, would have the option of ceding risk to private reinsurers or the capital markets.

The key benefits of this system are that:

- Government does not directly assume any flood risk

- Policyholders would have more options from the private market and be able to purchase coverage that best suited their needs
- Private insurers would help market flood insurance and also align individual flood risk with actual cost as they are less likely to cross-subsidize

The key weaknesses of this system are that:

- Unlikely to yield a sufficient level of private market participation to ensure readily available flood coverage
- Higher-risk property-owners may not be able to obtain coverage from private markets at affordable rates
- Potentially would place greater pressure on government to provide additional post-event federal assistance
  - Requires significant transition from current system
  - Finding alternative source of funding for mapping/mitigation
  - Lack of incentives for flood mitigation as the concept of “NFIP participation”, and the associated floodplain management requirements, would no longer exist

The reality is that this structural option is the least viable or administratively feasible of the 5 options. There are three reasons why.

First, the property insurance industry has historically refused to underwrite primary flood insurance to any meaningful degree. This fact contributed to the establishment of the National Flood Insurance Program in 1968.

Second, market penetration would likely be very low as already demonstrated under the current system where admitted private insurers have only been willing to assume a very narrow segment of the market (i.e. high-valued properties and lower risk properties). High-risk properties have generally been avoided.

Finally, a large, unknown and unfunded public liability still exists under this system to pay for post-event losses. As described in the original 1966 HUD study, the size of this unfunded liability “depend[s] upon the scale of the particular flood disaster and somewhat upon the dramatization of the suffering in the disaster.”

4.4. Selecting a pathway to privatization

The purpose of this section is to provide a framework for evaluating the remaining short list of structural privatization options. To do so, this section applies the framework that was introduced in Section 2 to evaluate the case studies, with the addition of one criterion. For the convenience of the reader the criteria are summarized below:

- **Availability**: is flood insurance readily available to those who want or need it?
- **Affordability**: is flood insurance affordable to those who need it?
- **Economic viability**: is the system self-sustaining and viable over the long term, even after a catastrophe (e.g. no unnecessary burden on taxpayers)?
- **Incentive to mitigate**: is the public aware of flood risk and are policyholders, insurers and the government incentivized to implement mitigation measures?
- **Transition from current state**: what are the legal, regulatory and operational hurdles for implementing such a path towards privatization?

This last criterion, difficulty of transition, is an important addition to the list of assessment criteria used to evaluate the case studies. While the first 4 criteria focus primarily on the technical soundness of the privatization options, this last criteria reflects the issues of administrative feasibility and political viability, which are inevitably important practical hurdles in any path towards privatization and, as such, should be considered.

Table 3 below provides a summary qualitative assessment of each of the structural options based upon these 5 criteria and is included to provide a comparative analysis of the options. It is important to note, however, that the purpose of this assessment is not to identify a single optimum pathway to privatization as these structural options are not necessarily mutually exclusive – for instance, it is possible for the NFIP to implement the cedant option in addition to the residual market option as well as the reinsurer option. The purpose of this assessment is instead to further winnow down the list of options based upon their technical soundness, as defined by availability, affordability, economic viability and incentive to mitigate as well as their administrative feasibility and political viability as defined by how difficult it would be to practically transition – considering legal, regulatory and operational hurdles – from the current state into one of these options.

Table 3: Assessment of structural privatization options

	Cedant option	Residual market option	Reinsurer option	Pool option	Open market option
Availability					
Affordability					
Economic viability					
Incentive to mitigate					
Transition from current state					

Positive assessment Negative assessment

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In terms of **availability**, the cedant option, residual market option and reinsurer option are the most likely to ensure that flood insurance is widely available to those who need it since the federal government would retain a large role in each of these options. The pool option's ability to support flood insurance to the same degree could be dampened as private insurers assume a greater underwriting role in the process. The open market option would likely have the lowest level of availability as it would lack any government involvement prior to a flood event. As a result, higher risk property-owners, who would be potentially viewed as "uninsurable" or "bad risks" would likely struggle to obtain coverage.

In terms of **affordability**, holding all else equal, the residual market and reinsurer options should result in the most affordable premium prices to policyholders because of the heavy involvement of the federal government, which has a lower cost of funding (e.g. access to low-interest debt from Treasury as needed) and does not require a return on capital in the same way a privately owned enterprise does (e.g. no need to produce profit for shareholders)[47]. All else equal, the cedant option and pool option would likely lead to less affordable prices as both would involve private sector participation in the secondary and primary markets, respectively, which in turn would require that prices

[47] As a separate and distinct insurance program, the NFIP does not have a "cost-of-capital" in the same sense that a private sector company does. However, it does need to reflect an appropriate cost of "self-sufficiency" in order to protect the U.S. taxpayer from untoward volatility.

embed a return on capital to such enterprises. The open market option would theoretically yield the highest prices since the government would be removed from the equation. However, we would also expect that competition would drive down costs and increase efficiency, which would offset the initial higher costs.

In terms of **economic viability**, the pool option and open market option are most viable, assuming that the key privatization hurdles summarized in Section 4.2 are overcome. The pool option and open market option would be most viable because they involve the private markets and are therefore naturally subject to the rules and constraints of market forces. To be sustainable, they must by definition be economically viable. The reinsurer option and cedant option would be less economically viable, primarily because the government most likely would need to assume high-risk properties that private markets otherwise would exclude. For the cedant option, the NFIP would also become more dependent upon private market reinsurance capacity, which can vary depending on the macroeconomic environment. The residual market is the least economically viable in that the assumption of such high-risk properties would ultimately require external subsidies – either cross-subsidies from other properties or subsidies through direct government funding – in order to ensure affordability. In addition, a residual market would shrink the size of the NFIP's portfolio and result in a greater adverse selection problem than the current state.

In terms of **incentive to mitigate**, the main determinant of this dimension is the decision of whether to implement subsidized or risk-based pricing. The best means of sending a signal to individual policyholders and to incentivize mitigation actions is to reflect the true risk of their individual exposure with accurate premium pricing and to provide discounts on these premiums when certain mitigation actions have been completed[48]. Whether policies reflect risk-based pricing is not directly dependent on the particular structural option. As a result, each of the structural options would be expected to achieve similar results, assuming the same approach to pricing was implemented.

Finally, in terms of **transition from current state**, the cedant option is the easiest and subject to the least amount of legal, regulatory or operational hurdles. As a result of Biggert-Waters, FEMA and the NFIP already have the legal right to purchase reinsurance under current law. In addition, the cedant option alone would result in the least amount of change relative to the current state, therefore limiting operational hurdles. Next to the cedant option, the transition to the pool option would be the least difficult, since the pool arrangement is also already allowed under current law. However, this option would ultimately still require significant change. As described in Section 4.3.4, the pool option involves a significant redesign of the flood risk financing chain. As a result, such a transition would require a complete redesign of both the NFIP and the rest

[48] There is a rich literature on this subject. For instance see: Botzen, et al; Willingness of Homeowners to Mitigate Climate Risk through Insurance; 2008. Community level incentives to mitigate will be different though related.

of the industry. It would also require significant cooperation between the public and private sectors as this option is ultimately a public-private partnership. The residual market option, reinsurer option and open market option would be the most difficult to transition to from the current state because each would require the same redesign of the flood risk financing chain as the pool option and in addition would require statutory changes as it would involve removing the NFIP from the primary flood insurance market.

Accordingly, a discussion of the advantages and disadvantages across the criteria and 5 options do not reveal a clear winner, which is unsurprising in light of the fact that different stakeholders will obviously apply different weights when making their subjective assessments.

Each of the five options is designed to transition from larger to smaller Federal involvement. We have observed that private insurers are already moving (albeit very slowly) into the primary flood insurance market, attracted by niche opportunities to sell flood insurance, thereby moving toward a bifurcated market of the type that would be seen under option 2, the residual market option.

There are several possible concrete steps the NFIP could take to further encourage progress from left to right through the options. These are discussed below in the context of the key hurdles identified earlier in this section:

1. **Supporting enhanced data and analytics**
   A. Place some NFIP coverage into the reinsurance market, however small, that will incentivize and accelerate continuing investment into sophisticated flood modeling capabilities
   B. Investigate alternative technologies to replace the antiquated approach used for determining property elevations; propose changes in laws and procedures that would bring these technologies more quickly into use
   C. Further pursue satellite technology to enhance the level of detail and reduce the costs associated with flood map updates
   D. As floods are a global problem, work closely with foreign authorities to coordinate research efforts and more efficiently disseminate technology solutions; similarly, further engage the academic community
   E. Share data with the private sector to support entrepreneurial efforts to measure and quantify flood risk
2. **Supporting underwriting freedom and full risk rates**
   A. Enhance disclosure and reporting to make the true economic costs of premium subsidies and cross-subsidies more transparent to policyholders, regulators and politicians

B. Progressively remove and/or reduce premium subsidies, within the legal authority provided by Biggert-Waters and HFIAA; a process that has already commenced

C. Incorporate into NFIP pricing a cost of capital to appropriately reflect the risk premium that would be demanded in a privatized market. That is, in addition to expected loss, price with a risk load to an explicit and reasonable return period threshold. This would effectively make the premium self-sufficient providing tax-payers a return for carrying the volatility of costs emanating from flooding eventsConvene a working group of appropriate stakeholders to discuss and address the political interference that can prevent freedom of forms and rates (possibly under the oversight of the NAIC)

3. Maintaining/expanding the size of risk community

A. Develop enhanced reporting requirements to be put on mortgage lenders and WYO insurers that would better enforce compliance with existing mandatory purchase requirements[49]. Investigate strategies to expand mandatory purchase requirements beyond the most highly exposed to those properties modestly exposed to flood, drawing analogies to other lender-required coverage, such as probability of fire, etc.

B. Encourage legislation that would address ambiguity of “equivalent form” that currently poses a roadblock to lender acceptance of private flood insurance policies

C. Use efforts around this legislation to work with State regulators and insurers to achieve improved consistency of policy language – this could help address confusion with policyholders over issues of storm deductibles and the debate over wind versus flood damage and avoid some of the conflict between policyholders, insurers, and government after a major catastrophic event.

4. Enhancing the insurability of risk

A. Shift more energy of the NFIP toward developing new approaches to risk mitigation

B. Create a more detailed set of property assessments that could further enhance the accuracy of property-specific flood severity assessment, which through price effects yields better incentives for property-owner led mitigation

5. Facilitating an effective transition

A. Convene a semi-permanent working group of mixed stakeholders to:

i. create a long-term vision for privatization,

[49] In the 1998 Vermont floods, 84% of the homes impacted lacked flood insurance although purchase provisions indicated that 45% were required to carry it. In NYC during Superstorm Sandy, it is estimated that less than 20% of the residential buildings carried flood coverage (Kunreuther & Michel-Kerjan, 2013).

ii. identify and track metrics that would measure progress toward vision, and
iii. identify and actively work to remove obstacles to achieving the vision

Clearly some of the recommendations above will be easier to achieve than others. However the key benefits of privatization, including aligned incentives across stakeholders, would result in more effective mitigation and greater societal resiliency to flood events at lower total cost, thereby suggesting only one direction of action.

4.4.1. Illustrative glide-path to privatization

There is ultimately no single right approach to transitioning our country's existing flood risk financing system to a system with a greater level of private market participation. The multifaceted perspectives collected from interviews of the various stakeholders are a reminder of the complexity of this issue, which involves many parties and perspectives and requires significant collaboration to reform in any significant manner.

In addition, as recent experience has demonstrated, flood risk financing reform affects individuals and communities in a very personal manner, as it directly involves their homes and their livelihoods. In the U.S., homeownership is still a cornerstone of the so-called American Dream and one that is well supported and financed by homeowners and the housing industry. As a result, any threats to homeownership are well defended against. In many ways, the complexities of identifying a path to privatization for the flood insurance system in the U.S. are similar to that of solving the American health care system – there is no single, clear solution, it is heavily politicized, and harsh criticism of any change is inevitable.

The right approach or path to privatization will also depend upon a variety of existing external factors. For example, the economic desirability of the flood insurance market for private insurers, reinsurers and the capital markets will depend upon levels of available capital and expected returns from alternative sources of risk. Conversely, the government's ability to achieve reform will also depend upon housing prices, recent experience with catastrophic events and the political climate. If the objective is to achieve greater private market participation and thereby reduce the potential loss exposure falling to the U.S. taxpayers, reform will require a longer term approach that remains flexible enough to adapt to these exogenous factors.

While the prior section provides an assessment of each of the structural privatization options, it is important to recognize that any successful path to privatization will most likely involve the application of more than one of these options over time. This is necessary, because under current circumstances it would be politically and administratively infeasible to be able to achieve a relatively immediate transition from the current system to anything drastically different. That a number of the reforms from Biggert-Waters calling for the aggressive phase-out or elimination of subsidies were repealed just two years after they were passed and replaced with more gradual subsidy

phase outs reflects the political reality that any changes must be implemented in a manner that enables individuals to gradually transition to higher rates. Any drastic increase in the cost of flood insurance will be rejected.

While the increased participation of private market players in the flood insurance market will ultimately take place naturally as a result of market forces, any significant and systematic change will require reform.

Market forces that will encourage private sector involvement in the flood insurance business include:

- Rising flood insurance premiums
- Soft market in insurance and reinsurance industry[50]
- Technological advances in assessing flood risk

Increases in flood insurance premiums and a soft market in the wider insurance and reinsurance industry have already spurred the entrance of a number of private market insurers into the flood insurance market, particularly in states such as Florida, where there is a concentration of flood prone properties that have experienced a significant mark-up in NFIP prices. Advances in the analytics and data used to quantify flood risk will also help insurers more accurately measure and understand risks and ultimately identify opportunities to insure properties profitably at competitive prices.

There is however, a limit to the percentage of the overall flood insurance market that the private sector will penetrate under the current environment. While many private insurers and reinsurers may be compelled to enter the market under current conditions, they will ultimately do so selectively – with a focus on lower risk properties already priced adequately by the NFIP. As a result, the near term outcome will be that private insurers will primarily “take out” lower risk policies from the NFIP’s portfolio and likely exacerbate the issue of adverse selection. In contrast, higher risk properties that are located in a SFHA, that have previously suffered a loss, or that receive a subsidized or cross-subsidized rate, will remain in the NFIP’s portfolio – private insurers will not compete against the NFIP for policies that are inadequately priced from their perspective. Near term this dynamic may be acceptable; simply reducing the NFIP’s exposure to catastrophic loss may have its own benefit. As the NFIP addresses its costing challenges overtime, flexibility to address the more difficult elements of the portfolio may present itself over the medium to long-term. This topic is discussed in more detail in Section 3.2.2.2.

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[50] In the insurance industry, a soft market represents the part of the economic cycle where it is a buyer’s market that is characterized by lower prices, broader coverage, reduced underwriting criteria, increased capacity and increased competition

To achieve a more significant or systematic change to the U.S. flood insurance market that leads to broader privatization of the NFIP's portfolio of flood insurance policies will require gradual changes that utilize existing levers in the near term and create new levers in the longer term through legislative reform.

Existing levers that the NFIP could utilize to encourage greater private market participation include:

- Increasing policy premiums within constraints of current law
- Pursuing reinsurance as a vehicle to manage risk
- Modifying the expense structure of the WYO program
- Improving the enforcement of the Mandatory Purchase Requirement through further collaboration with federal lending regulators
- Identifying opportunities to share NFIP data

New levers that the NFIP or Congress could create over the longer term to encourage greater private market participation include:

- Expanding the size of the flood insurance risk pool through broadening the MPR
- Implementing risk-based rates that incorporate cost of capital similar to that of private insurers
- Implementing affordability requirements for subsidized NFIP policies
- Pursuing legislation to reform NFIP's role in flood insurance value chain (e.g. pursuing residual market, reinsurer or pool options)

One potential glide path to a scenario where the NFIP is fully privatized is included in Table 4 below, which outlines the phasing of change utilizing many of the levers described above.

In this illustrative scenario, the target end-state would be a flood insurance system where over 90% of the flood insurance market was privatized[51].

[51] 90% represents a target level of private market participation in the flood insurance system. The value is meant to be illustrative and help to describe a future state US flood insurance system where private insurers play a leading role, but where a certain amount of government involvement will still be necessary

Table 4: Illustrative 20-year glide path to privatization

Phase	Description
Prelude to Privatization *Present to 2016*	• Establish future-state vision of U.S. flood insurance system – Articulate mission/objective of U.S. flood insurance system – Describe optimal role of each stakeholder in future-state system – Define metrics by which system is measured and incentives by which stakeholders are held accountable – Involve key stakeholders in iteration of vision • Pursue reinsurance modestly at first, but expand as finances permit • Implement changes using existing levers: – Continue to raise premium rates and move towards risk-based pricing of individual policies – Modify expense structure of WYO program to reduce cost[52] – Improve collaboration with federally regulated lenders on enforcement of Mandatory Purchase Requirement – Identify opportunities to share NFIP data
Formative Years and Transition *2017 to 2028*	• Begin to reposition NFIP as insurer/reinsurer of last resort and encourage private sector participation through: – Implementation of risk-based rates, priced at levels that incorporate cost of capital of private insurers – Expansion of risk pool through legislative revision of Mandatory Purchase Requirement (e.g. require purchase/offer of flood insurance for more properties) – Identification of specific “high risk” legacy properties that NFIP will continue to provide insurance to – explore a means to reduce these risks and an alternative means to fund resulting losses that emanate from them • Coordinate private market participation through use of Residual Market, Reinsurer or Pool option • Take steps to address moral hazard associated with expectations around ex-post Federal disaster aid • Continue to play an active role in flood mitigation
Achieving the Vision *2029 to 2034*	• Wind down NFIP’s role in flood insurance underwriting • Target that 90%+ of flood risk is underwritten by private sector and limit role of NFIP to extreme tail risks

The above glide-path represents one possible approach to achieving an end-state where the flood insurance system is ultimately privatized and requires only limited

[52] In the context of privatizing flood risk, the key benefits of modifying the expense structure of the WYO program are that it would (1) increase the opportunity cost for many primary insurers of participating in the WYO program and not participating in the primary private flood insurance market and (2) potentially result in significant annual cost savings, which could either be passed onto policyholders in the form of lower rates or applied to pay for future losses

government involvement. The above transition would take place over 20 years, during which the NFIP would gradually reduce its role over multiple phases.

In the “Prelude to Privatization” phase, which would take place over the next 2 years, the NFIP would work with Congress to establish a clear future-state vision of the American flood insurance system. Such a vision and overarching strategy is important and necessary in order to establish longer term market stability, which is a prerequisite for most insurers prior to making any significant capital investment in the flood market. It would also serve to put all stakeholders on notice, and with fair warning, that everyone will be required to play their appropriate role to manage the ever increasing challenges associated with flood management and disaster recovery.

To develop such a vision, the NFIP must first clearly define the overall objective of the flood insurance system and the optimal role of each stakeholder to achieve that objective. Defining the value that each stakeholder adds to the system is important in determining the appropriate relative reward each stakeholder receives for participating in the system.

In addition, an objective set of metrics must be defined to measure and to communicate progress to all stakeholders, including the general public. The following metrics, which are meant to be suggestive of the key criteria that could be used, would ideally measure and communicate point-in-time estimates of the:

- Actuarial soundness of policy premiums: a metric for the economic viability of overall flood insurance pricing that provides transparency regarding the level of subsidies supporting the system
- Total amount of uninsured flood risk: a metric for the size of the unfunded liability that taxpayers may need to fund in the form of emergency disaster relief in the event of a catastrophic event. This metric also serves as a measure for moral hazard as it represents the amount of uninsured property value exposed to flood risk
- Total percentage of flood risk insured by private insurers: a metric for measuring progress towards privatizing the flood insurance system
- Severity of flood events that insurance system is able to sustain: a metric for communicating the resiliency of the system to different levels of catastrophic events – it aims to define the scenarios that the system can sustain and those that it cannot
- Customer satisfaction: a metric that is both necessary and critical – for the flood insurance system to succeed it must add economic value and satisfy a customer need

Creating a small set of key metrics is critical towards providing transparency, improving communication and ensuring accountability.

During this phase, the NFIP would also pursue risk transfer modestly during this period in order to offload some of the risk to the private markets to the extent that its finances permit. To create a market more amenable to privatization, the NFIP would also utilize existing levers to increase rates, lower costs, broaden the size of the risk community and improve flood risk modeling capabilities. This would be accomplished by continuing to raise premiums within the constraints of current legislation, revising the WYO expense structure[53], improving the enforcement of the MPR and identifying opportunities to share its data publicly so as to enable the private sector to use such data to better quantify and measure flood risk. Such near-term changes would put the NFIP on the path towards privatization and begin to address key privatization hurdles.

In the "Formative Years and Transformation" phase, significant reforms would be implemented over 10 years to transition the existing system to one that is largely privatized. During this time, the private sector would begin to play an active and leading role in the market. To achieve this vision, the NFIP and federal government would need to collaborate with private insurers to establish a coordinated effort to manage flood risk over the long term utilizing the residual market, reinsurer or pool structural options. To encourage private market participation, legislative reforms would be needed to achieve risk-based rates for the majority of the NFIP portfolio; to expand the size of the risk pool (potentially by broadening the MPR); and to address "high risk" legacy properties that the private sector would not be able to directly underwrite without government support. While the NFIP's role in the flood insurance market would be reduced, it would likely retain a role in insuring certain "high risk" properties and continuing to lead flood mitigation efforts. Such a transition would need to address a number of issues, including, but not limited to:

- Collaborating with the private sector to create a new insurance system that is largely underwritten by private insurers
- Negotiating with private insurers on what properties would be included in the "high risk" pool and determining how those policies would be subsidized
- Passing legislation to broaden the MPR in order to create a larger risk community and limit adverse selection and moral hazard
- Educating state insurance regulators on flood risk and creating the right processes and incentives to limit the influence of short-term political demands to regulate policy premiums

[53] WYO carriers currently compete for NFIP premium volume based purely upon the amount of commission they are able to offer agents. This is arguably an unintended consequence of the WYO Arrangement and could potentially be addressed by (1) eliminating the state tax premium and (2) capping allowable agency commissions. These two changes could free up quite a bit of room for WYO carriers to operate and allow the NFIP to lower the WYO expense allowance without having a deleterious impact on the overall WYO program.

- Identifying how to continue to maintain and encourage local community flood mitigation in a system where the legacy NFIP community agreements are no longer effective

While it would be potentially faster and easier to rebuild the flood insurance system from scratch, it is ultimately practically impossible to do so. A longer transition period is necessary.

In addition to the structural changes implemented over this period, there will also need to be a significant shift in the perception of flood risk and the role of the federal government in providing disaster aid. Implicit expectations by property-owners that they will be provided federal assistance following a catastrophic event such as Hurricane Katrina or Superstorm Sandy create a moral hazard that come with an economic and financial cost. Historically, the issue has been that the cost of such moral hazard is often imperceptible. When no catastrophic event occurs, there is no tangible cost originating from the moral hazard.

During this phase, it will be critical that the NFIP and the federal government take steps to recognize and communicate the size and potential cost of such unfunded liabilities. Measuring and communicating a metric for the moral hazard, such as the “total amount of uninsured flood risk” metric described earlier is one step towards that goal. Ultimately, a broader public relations effort will also be necessary to educate and influence public perception. The moral hazard associated with flood risk is in many ways no different than the moral hazard associated with the implicit government guarantees of Fannie Mae and Freddie Mac prior to the 2008 Financial Crisis. At the time, the government’s implicit guarantee benefited the GSEs through lowering their borrowing costs, which in turn inflated their margins. However, as has history demonstrated, the underlying credit risk was still present and upon the bursting of the housing market in 2008, the federal government was forced to respond and ultimately pay for the cost.

Once significant private sector involvement is achieved, the “Achieving the Vision” phase would ideally involve a period where the NFIP further winds down its underwriting exposure and the private sector solidifies its market role. The final result would be a flood insurance system led by private insurers and reinsurers and supported to a limited and explicit extent by the NFIP.

4.5. Additional considerations

In addition to defining how flood risk is distributed between government, insurers and property-owners, any flood insurance system solution will also need to consider how to address a number of important issues, including the:

- NFIP’s responsibilities for flood mitigation and flood mapping
- NFIP’s outstanding debt to U.S. Treasury

- Affordability of flood insurance

The first three (of four) sub-sections that follow describe each of these issues within the context of options for privatizing the NFIP.

Separately, whereas the privatization options described earlier in this study consider methods to privatizing flood insurance where the policyholder is an individual property-owner, the fourth sub-section below briefly describes the concept of community based insurance (CBI) for flood risk, where an entire community is insured together as a single portfolio of risks.

4.5.1. Flood mitigation and flood mapping

In the national debate regarding the future of the NFIP, the fact that flood insurance is only one of the NFIP's three key responsibilities is often overlooked. Flood mitigation and flood mapping are two public goods for which the NFIP has historically been responsible.

Over the past 4 decades, the NFIP has led significant advancements in the quality of flood mapping in the United States. For instance, through the recent Map Modernization and RISK Map programs, which were supported by significant Congressional appropriations, flood maps were digitized into a GIS format for 96% of the U.S. population. As a result, individuals can now directly access flood maps online and businesses are able to leverage the public data to assess and manage risk. The NFIP's flood maps are ultimately the key data source used by both insurers and flood vendors to identify and assess flood risk.

The NFIP has also been responsible for establishing strong flood mitigation standards. Through its direct relationship with participating communities, the NFIP has set standards in terms of floodplain management and hazard mitigation, such as building codes that have helped to control and limit flood risk.

It is necessary to consider the NFIP's responsibilities for flood mitigation and flood mapping under any of the flood insurance privatization options because the budget for these two NFIP functions is funded through NFIP insurance premiums. While Congressional appropriations have supported specific projects, the on-going budgets for mitigation and mapping are primarily funded through insurance premiums. If NFIP insurance premiums decline or go away entirely, the flood mitigation and mapping programs would need to be supported by alternative sources of funding. Two possibilities include Congressional appropriations and / or a tax, or fee, on private market insurers and/or homeowners and business that already benefit from these public goods.

Even if funding is not an issue, another implicit change that would result in the privatization of the NFIP is the fact that flood mitigation incentives at the local community level would be affected. Under the current system, the incentive that drives a local community to become a NFIP participating community is the access to NFIP flood insurance. By agreeing to participate, the local community and all of its citizens are able to purchase NFIP flood insurance. In return, the community agrees to carry out a flood mitigation program that requires it to designate a local floodplain manager, adopt certain floodplain management standards, and enforce flood mitigation standards and regulations].

Without the carrot of NFIP insurance, local communities will not have the same incentives to invest in floodplain management and it may become more difficult for the federal government to enforce regulations and standards. A potential solution to this issue would be to offer a new carrot to local communities, such as making access to federal disaster relief partially or entirely contingent upon adoption of appropriate mitigation policies and practices. Such an approach would incentivize communities to adopt floodplain management ordinances and mitigate flood risk. This type of approach may be politically challenging, as it is difficult for the government to withhold federal assistance following a catastrophe, even if done so to limit moral hazard. However, the role that public-sector disaster assistance plays in the aftermath of a flood or other type of natural catastrophe must be re-thought. Various options leave room for the NFIP to offer incentives. In the reinsurer option for example, the government could offer access to higher rated, federally backstopped insurance in a similar manner as state guarantee funds operate today in admitted vs. non-admitted markets.

4.5.2. Outstanding debt to U.S. Treasury

As of July 2013, the NFIP owed approximately $24 billion to U.S. Treasury primarily due to the losses incurred following Hurricanes Katrina, Rita and Wilma in 2005 and subsequent costly events, such as Superstorm Sandy.

In any transition to a system with greater private sector involvement, servicing and repaying this debt will continue to be a critical issue that must be addressed, especially in an environment of rising interest rates, where the cost of servicing the debt may rise more quickly than premium rates. Ultimately, this issue can only be resolved through repaying the debt or through debt forgiveness. However, the latter is politically difficult and therefore unlikely to take place in the near future given the political landscape. Congress currently expects existing policyholders to repay the debt, which is impractical given that the premium rates are presently not at actuarially sound levels. The only scenario in which the NFIP would be able to collect sufficient premiums to repay the debt is one where there are multiple years where costs are below expectations (i.e. no catastrophic events). However, in light of potential shifts in the frequency and severity of the flood hazard due to climate change and increasing concentrations of coastal exposure, this is a very optimistic scenario.

The reality is that there is a broader balancing act that ultimately will require trade-offs. The economic reality is that it is impossible to immediately pay down the debt, raise a reserve, achieve actuarially sound premiums and also maintain sufficiently competitive prices that remain affordable and help improve penetration rates.

4.5.3. Affordability of flood insurance

There are many benefits of flood insurance: it provides funds to promptly support rehabilitation following a catastrophe; it helps to spread risk and distribute the cost of flood damage; and it helps manage the cost of flood risk to taxpayers. Additionally, assuming that prices reflect risk, it provides incentives to discourage future investments in flood-prone areas.

However, for flood insurance to be effective, it also needs to be affordable, especially for property-owners who already live in higher risk areas. Otherwise, individual property-owners will simply not be able to afford insurance even if they must purchase it because of a mandatory purchase requirement.

This issue has historically been addressed through significant subsidies to the NFIP. As widely reported, approximately 20% of the NFIP portfolio's policies have premiums that are subsidized and are not actuarially sound. Much of these subsidies were originally intended to support a transition to help property-owners who had purchased or built their homes before flood insurance risk maps were produced for their location and before they possibly could have known that they were located in a flood zone. The problem with these subsidies is that while they lower the premiums of those particular policies, the subsidies are not allocated on a means-tested basis – certain subsidies are going to property owners that can afford higher premiums.

While ideally, flood insurance subsidies will not be necessary in the future because all properties will be built with full knowledge of local flood risks and priced accordingly, in the near term, any flood insurance system will need to address the affordability issue. Subsidies are ultimately a poor delivery system for addressing this issue. Instead, more direct and transparent means-based approaches are necessary. One such delivery mechanism that has been studied and suggested by Caroline Kousky and Howard Kunreuther is to apply means-tested vouchers coupled with mitigation loans (Kousky & Kunreuther, 2013). This approach and others will likely be evaluated in greater depth in the Affordability Study required under Biggert-Waters.

4.5.4. Community-based insurance

Community-based insurance (CBI) is an insurance technique in which all the eligible risks in a given community are jointly insured and decisions regarding risk pricing and

mitigation are made at the community level. While this form of insurance does not currently exist for flood risk in the US[54], it represents a compelling potential alternative approach towards providing ex-ante funding for flood risk to individual property-owners.

Under this system, flood insurance premiums covering a pool of individual risks are collected by a community organization (e.g. a municipality or special purpose district). This organization is then insured on a portfolio basis capturing the various benefits of risk pooling for its underlying constituents. Such benefits include potentially lower overall premiums by virtue of the spread and volume of risk falling under a CBI policy.

Such a system effectively replicates the NFIP at the community level and requires each community to answer the questions explored in this report with respect to the potential privatization of NFIP, including:

- Should flood insurance coverage in our community be required for all members or just those in SFHAs?
- How do we address coverage affordability for low-income community members?
- How do we ensure adequate spread of risk within the community to ensure attractive CBI rates?
- Will we transfer all of the community's flood risk to NFIP or the private market or will we retain a portion of such risk? If the latter, via which risk transfer mechanism and by what legislative authority?

For the NFIP, CBI may represent an alternative way for some communities at risk of flooding to take the necessary steps to protect their citizens while improving program efficiency[55] and still incentivizing mitigation. However, shifting the NFIP's policy design to accommodate a CBI approach would be somewhat disruptive as it would likely require the NFIP to change many of its current practices and to answer a variety of strategic questions alongside its stakeholders.

From the NFIP's perspective, CBI raises the following core issues:

- **Underwriting**: NFIP's underwriting/pricing model would need to be updated to account for community risk characteristics and the collective risk of loss (portfolio or group risk rating). Data collection methods would need to be updated as would actuarial techniques used to develop adequate portfolio risk pricing. Given the

[54] CBI is often used in international contexts, particularly in health insurance. Some resources of interest on this subject follow: http://siteresources.worldbank.org/SOCIALPROTECTION/Resources/0503.pdf and http://www.who.int/health_financing/Community_based%20TMI.pdf.

[55] Efficiency gains could come in the form of better MPR enforcement; lower necessary risk loads to achieve risk-based pricing due to benefits of portfolio diversification; fewer policies for NFIP to manage and therefore lower administrative costs; etc.

volume and spread of risk certain CBI policies might offer, some would likely be attractive to the private (re)insurance market allowing the NFIP to remove itself from the risk-bearing equation altogether. Such an outcome may precipitate the need for the NFIP to reevaluate its role as a funder and supporter of its other core activities beyond flood insurance – namely mapping and mitigation – as these activities may be better managed at the community level.

- **Distribution**: In maintaining the status quo, all members of a community in a MPR-zone could be required to contribute to the funding of CBI coverage while non-MPR citizens could be allowed to participate voluntarily. In this setup, the manner in which voluntary coverage would be made available, advertised and purchased (if not through WYO insurers and their agency networks or NFIP Direct as at present) would need to be addressed. However, there is no reason why CBI should be limited to the status quo. For instance certain communities may wish to explore mandatory participation of individual risks in a community beyond the current MPR provisions – however, depending on the mix of flood exposed vs. low-risk homes/businesses in a community and the income base, extending the MPR could be contentious.
- **Administration**: Administratively, under CBI, a new means of collecting premium may be necessary. In order for risk pooling at the community level to take place, the current means of policy distribution and administration through WYO insurers and their agents might be replaced in favor of other mechanisms typically used by community organizations (e.g. charging flood insurance premium alongside taxes) to achieve improved program efficiency, compliance enforcement and communal risk management. In such a scenario, claim adjustment and payment would also need to be managed by the community which could require the development of new administrative capabilities. In short, CBI could require an overhaul of the NFIP's current policy administration system and a reevaluation of its related expenses.
- **Risk Transfer**: In a CBI program, the risk of loss would be transferred from individual community members to a community organization for pooling and then transferred on to NFIP or a private (re)insurer. It would need to be determined what amount of risk the CBI coverage holder should retain or if 100% of the risk would be transferred to NFIP or the private (re)insurance sector. There is also the issue of individual policy design. Communities could adopt NFIP's current policy forms to facilitate risk transfer from individuals to the community risk pooling mechanism or could develop their own language in consultation with NFIP or the private sector.
- **Community Eligibility**: Communities would presumably need to meet certain eligibility requirements in order to qualify for NFIP CBI coverage. The NFIP's Community Rating System (CRS) already provides an excellent backbone for determining community-level risk, although communities with different geographic characteristics, administrative levels or sizes (e.g. watershed, States) that are not participating in CRS might be interested to participate in a CBI program. Developing standards that enable a community to qualify for such coverage under NFIP would be important.

Ultimately, developing a flood insurance product that applies at the community level poses some distinct challenges for NFIP and could entail some substantial costs in support of the required product design, stakeholder education and system updating. However, these costs may well be warranted given the various benefits of CBI which include, but are not limited to: possible reductions in premium costs for individuals due to the merits of risk pooling; greater engagement of local communities in flood risk management; possibly greater risk-bearing engagement of private (re)insurers in the U.S. flood market; etc.

Appendix A. Flood insurance systems considered

Table A.1

Country	Background	Obligation	Gov't involvement
Australia	• Government mandates fire, storm and earthquake coverage; flood is excluded • Insurance distinguishes between riverine (5% penetration) and flash (60% penetration) flood coverage; flash flooding coverage often included as standard policy feature (CCS, 2008) • Affordability of flood insurance remains an issue • Insurers are required to make an offer for flood coverage, policyholders may then reject it. • About 170,000 households are vulnerable to 1 in 100 year floods and a further 300,000 are susceptible to Maximum Probable Flooding events[56] (CCS, 2008)	Voluntary	Private
Canada	• There exists no national flood insurance scheme or restriction on floodplain development (Axco, 2014a) • Flood coverage is excluded from standard homeowners policies and where offered, prices are extremely high (CCS, 2008) • ~50% of commercial properties have flood insurance (Hemenway, 2013) • 2013 floods in Canada cost CA $1.7 billion in insured losses and CA $5 billion in economic losses (Axco, 2014a)	Voluntary but largely unavailable	Private; post-disaster relief
China	• Flood insurance is often available as an addition to fire insurance, but penetration remains low; ~80% of flood insurance is purchased by large to medium-sized enterprises (Walker, Lin, & Kobayashi, 2009) • Flood insurance is rare due to limited levee system development, an inability to identify flood risk and low willingness to pay amongst lower income property-owners in high flood risk areas (Michel-Kerjan & Kunreuther, 2011) • Flood exposure is significant: 52% of China's production centers are exposed to riverine flood and 25% to storm surge (Swiss Re, 2006) • Only 1–2% of $52 billion flood losses in 2010 were insured (Guy Carpenter, 2010)	Voluntary	Private

[56] Largest possible flood event that could occur within a given area

Country	Background	Obligation	Gov't involvement
Denmark	• Mandatory tax applied to all private fire insurance policies used to provide funding in the event of flooding and damage to private forest as a result of windfall (Stormrådet, 2014) • Post-disaster relief is distributed by the Danish Storm Council (collective of national and municipal government, environmental agencies, insurers and competition authority) (Stormrådet, 2014) • Flood exposure is significant: 72% of GDP is within 50 km of the coast and 22% of coastal zone (10 km of coast) is less than 5 meters above sea level (Directorate-General for Maritime Affairs and Fisheries, 2009a) • 2011 flooding in Copenhagen area resulted in $1.15 billion in damages (Axco, 2014b)	Mandatory	Public
France	• Multi-peril natural catastrophe insurance (including flood) is bundled with real and personal property insurance (98% penetration) (Montador, 2014) • State-owned reinsurer offers optional coverage based on combination of quota-share (50%) and stop-loss; company has unlimited government guarantee • Flood exposure is significant: historically, 59% of claims to CCR have been for flood related damages (CCR, 2011) • Recent floods caused losses of €300 million in June 2013, of €800 million in Nov 2011, and €870 million in June 2011 (Axco, 2014c)	Mandatory	Public-private partnership
Germany	• Coverage is voluntary (30% penetration) and used as a supplement to homeowners insurance (90% penetration) (Axco, 2013a), which excludes storm surge and ground water damage • State does not guarantee indemnification for victims of natural catastrophes (CCS, 2013b) • Flooding losses have been significant: 21 deaths, €1.8 billion in insured losses, and economic losses of €11.6 billion in 2002 storm (CCS, 2008)	Voluntary	Private
Japan	• Flood coverage is often optionally bundled with fire insurance; premiums are high, making insurance less affordable for policyholders (OECD, 2006) • Floods caused by tsunamis are not covered by private multi-peril policies (CCS, 2008); penetration rates for flood insurance range from 35% - 49% (Paklina, 2003) • Limited historical damages due to flood: only 2% of damage between 1955 and 2004 was caused by floods, 98% was due to wind and earthquakes (Kikugawa, 2005) • Flood exposure is significant: 49% of population and 75% of assets are concentrated in flood prone areas (Sato, 2006) • Typhoons in 2004 caused insured losses of $3.6 billion (CCS, 2008)	Voluntary	Private

Country	Background	Obligation	Gov't involvement
Netherlands	• Limited number of private insurance players due to government focus on mitigation; first local player since 1953 entered in 2012 • Post-disaster relief fund used as primary compensation for property-owners • Private flood pool, administered by the Dutch Association of Insurers would make flood insurance coverage mandatory for property-owners; subsidized by levy • 65% of GDP production (9 million citizens) lies below sea level (Deltacommissie, 2008)	Voluntary but largely unavailable; *Proposed private flood pool would be mandatory*	Private; extensive mitigation and post-disaster relief
Norway	• Mandatory bundling of multi-peril coverage (includes storm surges, flood, landslides, etc.) with fire insurance; flat rate charged regardless of property type, geography or risk (CCS, 2008) • Managed by fire insurance companies as an insurance pool; limit of ~$2 billion in indemnification per event (damages distributed between members according to market share) (CCS, 2008) • Norway has an extended coastline and many rivers and glaciers, but the risk of flood is confined to less populated areas (Axco, 2013b)	Mandatory	Private
Spain	• Mandatory bundling of multi-peril extraordinary risk insurance (including extraordinary floods) with life, personal and property insurance; fixed rate charged based on underlying asset value and irrespective of risk • Government insurance via state-owned reinsurer that provides optional 100% insurance for extraordinary risks; company has unlimited government guarantee • Program economically viable and has not required a capital injection from the government to date • About 69% of the claims to CCS in the last 25 years have been for flood related losses (CCR, 2012); recent floods caused losses of €233 million in 2010, €245 million in 2008 and €239 million in 2007 (Axco, 2014d)	Mandatory	Public
Switzerland	• Mandatory natural catastrophe insurance (includes flooding) for all property-owners in most regions; 82% of properties insured through not-for profit Public Insurance Companies for Buildings (PIBs) and remaining through private insurers (WFCP) • Premiums are fixed; 95% of private insurers (SVV, 2014) cede 80% of their losses to an industry-wide Natural Hazard Pool and retain 20%, with a stop-loss (CCS, 2008) • Significant exposure to flood risk; 71% of insurance claims for natural perils have been flood-related between 1973 and 2011 (Swiss Re, 2012b) • Losses of CHF 2.3 billion during 2005 floods (Swiss Re, 2012a) was borne primarily by private insurers with limited CHF 700 million paid by PIBs (CCS, 2008)	Mandatory	Public-private

Country	Background	Obligation	Gov't involvement
Thailand	• Government launched an optional insurance fund to provide multi-peril coverage in 2011, flood insurance largely unavailable prior to this time (Willis, 2012) • Fund is financed by fixed premiums (Willis, 2012) and is capable of absorbing losses up to $16.2 billion, making it the biggest excess-of-loss program globally (AM Best, 2012) • Significant exposure to flood risk; 2011 floods damaged or destroyed 4 million homes and caused insured losses of $15 billion (AM Best, 2012) and total economic loss of $45.7 billion (Insurance Journal, 2012) • Modeling of flood risk has been limited (Insurance Journal, 2012) but government created a $9.4 billion water management and flood prevention program in 2012 (AM Best, 2012)	Voluntary	Public
United Kingdom	• All homeowners must have flood insurance to secure mortgage credit; as such, penetration is high (75–95%) (ABI, 2013) • Statement of Principles between government and private insurers to provide affordable coverage in exchange for increased flood protection; expired in 2013 and not renewed given that 78% of current policies are underpriced due to cross subsidization (Defra, 2013a) • Flood Re pool proposed for launch in 2015 to provide transitory coverage for 500,000 highest risk households and allow insurers to move towards risk-based pricing • Significant exposure to flood risk; 2 million households at risk of flooding; floods in 2007 caused ~£3 billion worth of damages	Mandatory	Private

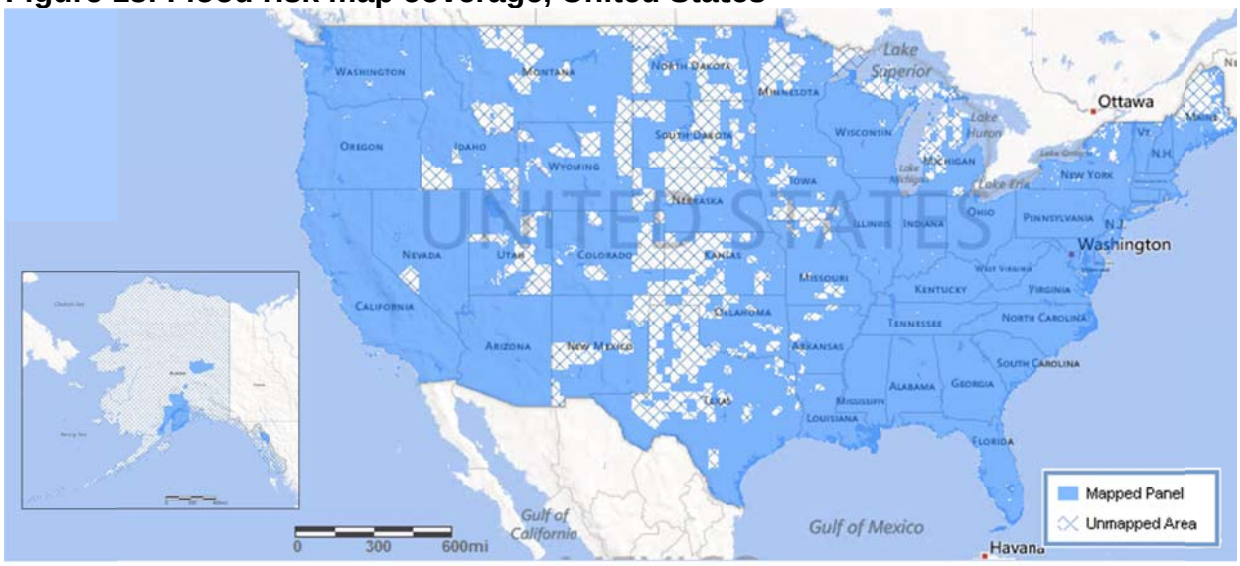
Appendix B. Discussion of privatization hurdles

B.1. Data and analytics

Data and analytics are critical in terms of flood risk assessment and insurance underwriting. When the NFIP was created in 1968, the information and infrastructure necessary to underwrite flood insurance was largely unavailable given that concerted efforts to map and understand flood risk did not begin until the late 1950's (FEMA, 2002). However, since that time the industry has made major advances, including digitization of maps using Geographic Information Systems (GIS) technology, development of advanced flood zone determination analytics and collection of historical loss data.

Flood maps are used by all stakeholders and are used directly by flood determination companies and lenders to determine the flood zone that a particular property is located within. They are, therefore, essential to the enforcement of the Mandatory Purchase Requirements. Under the NFIP, FEMA has assumed primary responsibility for flood zone mapping in the United States and has created 100,000 Flood Insurance Risk Maps (FIRMs) that indicate the base flood elevation (BFE) and flood zone designation for 96% of the U.S. population (See Figure 18). These maps are used over 30 million times each year (FEMA, 2009), largely by flood determination companies.

Figure 18: Flood risk map coverage, United States



Source: FEMA Map Service Center
NYC-FEA00111-001

Mapping efforts have been aided by a number of government programs, including the Map Mod and Risk MAP initiatives. As a result of these programs, 95% of FIRMs have been digitized and made available to the public online. Development of new maps is time consuming, largely as a result of the community appeals process (18–24 months),

but also necessary given that hydrology and terrain are always changing. Despite declines in public funding and the significant time investment, FEMA strives to ensure that 80% of maps are up-to-date at all times (FEMA, 2009) in accordance with FEMA's latest engineering standards (i.e. NVUE standards).

Elevation certificates are another tool used by FEMA to provide a more comprehensive understanding of the flood risk associated with a property and to help ensure that property-owners are in compliance with local floodplain management policies. These elevation certificates are completed by a State-licensed surveyor, architect or engineer and are required for properties in high-risk flood zones. Information in an elevation certificate includes, but is not limited to, the elevation of the lowest living area, geographic location, and the foundation system of a particular structure (FEMA, 2012).

Elevation certificate data are very important given that small differences in building elevation relative to the BFE can impact the risk profile of a property. As such, elevation certificates are sometimes used to support policyholder petitions against a particular flood zone designation in Letters of Map Amendment or Revision (LOMA or LOMRs). At present, obtaining an elevation certificate is the responsibility of the property-owner and is both time consuming (up to several weeks) and costly (typically ~$400); however, there have been advancements in technology that may allow for future estimation of elevation using readily available proxy data such as Google StreetView.

With the limited development of the private flood insurance market in the U.S., the underwriting process today is largely a NFIP defined procedure executed by WYO members that leaves limited room for creativity or advancement of analysis. CoreLogic (a flood vendor) and/or NFIP data are used by private carriers that currently write flood insurance outside of the WYO program to select more favorable risks from low to moderate risk zones. However, these analytics are still limited in scope due to private insurer focus on conservative pricing for higher net worth and excess flood insurance customers. Notwithstanding the limited investment in internal flood risk modeling capabilities, there are a number of underwriting tools from specialist modeling vendors (e.g. EQE, RMS, AIR) that will be released in the near term that may help to encourage private insurers to begin offering flood coverage by offering them more advanced risk measurement capabilities.

Discussions with private insurers highlighted that their appetite to enter the flood insurance market is limited by a lack of internal capabilities related to flood modeling, data, and analytics. These insurers require property-level data[57] to determine insurance premiums and expressed skepticism in the accuracy and completeness of available flood maps used to calculate insurance rates. Interviewed stakeholders indicated a belief that map results are politicized and not entirely reflective of flood risk in certain

[57] As compared to reinsurers, which focus on portfolio-level data

areas given the intense political pressure that FEMA faces following severe flood events. This lack of confidence in the data also extends to elevation certificates, which insurers indicated to be error prone due to varying interpretations of the elevation certificate form, ultimately resulting in improper building classification, and by implication, the rating and premiums charged.

In order to overcome these data and analytics limitations, there are a number of actions that may be taken. Clearly, flood risk maps are an essential part of any flood insurance system and are required to calculate risk-reflective rates. These mapping efforts would likely need to be assumed by a public sector entity over the long-term to ensure consistency and widespread availability, although it is possible that provided with sufficient incentives, private enterprises could assume this responsibility as well. Assuming the role of private insurers in the flood market increases, a stable source of funding for flood mapping such as an industry levy should be considered that would be collected from all companies that make use of flood risk maps (including surplus lines carriers and flood determination companies).

Development of proprietary flood policy underwriting tools to leverage map information will require a significant investment in capital and time from private insurers and, as such, publically available data and tools should be leveraged until internal capabilities are built out. Private companies will also need to design an equivalent source to FEMA's elevation certificates to provide the property-level information needed as an input for these underwriting tools; there may be opportunities for insurers to pool resources in the development of such tools.

In addition, the NFIP holds a very valuable data-set of information through which many entities in the private-sector, together with the modeling capabilities that are coming on-line, could build their understanding of flood risk in the United States. While rules are being considered to ease the circumstances around which this information can be shared (i.e. enabling FIMA to utilize this information with reinsurance companies for the purposes of securing reinsurance), FIMA should consider the merits of broadening the circumstances under which such data might be shared. For instance, for those insurers inclined to enter the flood market, this data could help them understand the prospects of doing so – it would also help technical firms, such as model developers, (re)insurance brokers who have invested in the appropriate infrastructure and / or universities conducting technical studies all of which might promote the assumption of risk by the private sector.

B.2. Underwriting freedom and full risk rates

Underwriting freedom is consistently cited as one of the key hurdles to the privatization of flood insurance by primary insurers. As private enterprises, the strategic actions of insurers are ultimately driven by the objective of delivering value to shareholders, primarily in the form of maximizing returns on capital. While the flood insurance market presents a significant opportunity to grow and potentially diversify the property and

casualty insurance market, private insurers are naturally hesitant to enter the flood market in a meaningful way due to concerns over whether such an investment would be economically profitable.

Private insurers are concerned about the economic profitability of underwriting flood insurance predominantly for three reasons:

1. NFIP's subsidization of premiums and the lack of full risk rates
2. Concerns regarding underwriting freedom, both in terms of the freedom to define premium rates and policy forms (e.g. terms and conditions)
3. Concerns regarding additional catastrophic flood exposure against the backdrop of the first two points above, and the politicized environment that exists in a number of States around the entire issue

The first point alone is a significant hurdle for any private insurer to overcome. Although the subsidies will generally be phased out under HFIAA, this will be a gradual process that is expected to take 15-20 years to completely address. Until this process has had a chance to mature, private insurers will be cautious to compete meaningfully against the NFIP to underwrite flood insurance for the 20% of property-owners that currently purchase NFIP policies at subsidized rates. Even for the remaining 80% of the NFIP policies, it would be difficult to expect private insurers to compete without the ability to price policies at what they consider to be full risk rates.

By definition, full risk rates – also known as "actuarially sound rates" or "risk-based rates" – are premium rates that fully incorporate exposure to risk. From the NFIP's perspective, there are two varieties of full risk rates, one that is property specific and another that is class specific (e.g. an entire flood zone). The key difference between the two varieties is how risk is reflected in premium rates: property specific full risk rates fully incorporate risk into individual policies, while class specific full risk rates fully incorporate risk into a class or portfolio of policies. In either case, the overall level of risk is fully reflected in total premiums.

The NFIP's definition of full risk rates differs from that of private insurers, however. Whereas the NFIP's full risk rates must simply incorporate expected losses (i.e. claims) and operating costs, a private insurer's full risk rates must also incorporate a return on capital. As a result, while 80% of NFIP policies are considered to be at full risk rates from the perspective of the NFIP, those same policies may still be underpriced from the perspective of private insurers as was noted earlier in this report.

To overcome this issue, the NFIP must adequately price policies at a level that reflects full risk rates, incorporating a return on capital. Without such adequate rates, private flood insurers would simply be unable to compete with the NFIP in an economically viable way.

The second point above highlights the importance of underwriting freedom to private insurers more broadly. Private insurers believe that their ability to transform the flood insurance market into an economically profitable enterprise is greatly limited without sufficient freedom in terms of both rate and form. While such underwriting freedoms are always a concern of private insurers given that they function within a heavily regulated market, this concern is further pronounced in the flood insurance market given the history of government intervention in similar insurance markets, such as wind and earthquake.

The main driver of this concern is regulatory uncertainty at the state level. State insurance regulators would be expected to play an increasingly important role in a growing private flood insurance market since they are primarily responsible for regulating private insurers. Private insurers noted that the role of state insurance regulators ultimately poses a significant challenge since there is naturally uncertainty surrounding the level of rate and form freedom that the state insurance regulators would maintain. Many of the private insurers that were interviewed for this study pointed to the intervention by state regulators controlling rates for wind insurance in Florida as well as earthquake insurance in California – in both cases, the private markets have withdrawn given the lack of rate freedom. As noted earlier, this is an issue that should be a concern and focus of any privatization effort undertaken by the NFIP. If a key objective is to provide a sustainable flood insurance market that also protects tax-payers from assuming the cost of un/under-funded loss exposure, the privatization avenue selected must take care not to simply create a shift in exposure from the NFIP to State property pools. In many cases these facilities have their own financial challenges covering their existing portfolios of risk.

Concerns with underwriting freedom are already reflected in current market dynamics in terms of the greater participation in the excess flood insurance market of non-admitted insurance carriers, which are not subject to the same state insurance regulations as admitted carriers. Much of this uncertainty also reflects the fact that both state insurance regulators and private insurers have limited experience in underwriting flood risk. Overcoming this hurdle will require both parties to work together and develop a mutually beneficial partnership that balances between protecting consumers and enabling a functioning market for private flood insurance.

Ultimately, unless private insurers can be assured of an expected return on their investment in underwriting flood policies, they will be unlikely to divert resources into building out the capabilities necessary to compete in this market.

B.3. Size of risk community

To encourage private companies to enter the U.S. flood insurance market, options for maintaining or expanding the desirable risk community need to be considered. FEMA currently uses the MPR to enforce NFIP coverage uptake amongst property-owners in participating SFHAs. However, a 2006 study by the Research and Development

Corporation (RAND) indicated that NFIP flood insurance penetration for properties subject to the MPR is only 67% (Dixon, Clancy, Seabury, & Overton, 2006). This lack of compliance with the MPR is attributed to a number of factors, including lack of lender fines, enforcement failure upon sale to secondary markets unfamiliar with flood (Kunreuther & Michel-Kerjan, 2013) and confusion due to multi-regulatory oversight (e.g. OCC, DFIC, Federal Reserve, FCUA). MPR compliance is expected to rise as a result of increased fines under the Biggert-Waters Act, but it will still remain an issue as updated FIRM studies and climate change increase the number of properties in designated SFHAs.

The 5.5 million NFIP policies in force today are concentrated in highly flood prone States such as Florida (37.1%), Texas (11.4%), and Louisiana (8.8%) (FEMA, 2013b), with penetration in non-SFHAs as low as 1% (Dixon et al., 2006). Within the NFIP portfolio, actuarially sound polices are of particular interest to private insurers and represent 78.5% of all policies. Within this group, 39.4% of properties[58] are in low to moderate risk flood zones B, C, or X and have Preferred Rate Policies (PRPs) (FEMA, 2011). These PRP properties are not subject to the MPR and represent the most desirable customers for private insurers.

Discussions with private insurers confirmed that, given the limitations of the current flood insurance program, lower risk properties are targeted for private coverage. These companies also provide some surplus coverage to higher net-worth property-owners that either seek voluntary coverage or are required by lenders to obtain insurance in excess of the NFIP minimum. Private insurers expressed an inability to compete with FEMA prices for the remainder of properties outside of this group and limited appetite for insuring the large risk population in higher risk flood zones.

With access to a larger risk community, private insurers can build portfolios that are geographically diversified, cross-subsidized, and, as a result, able to include higher risk policies. One approach to increasing the risk pool is to permit bundling of flood with other perils or homeowners insurance policies. This would help to diversify insurer risk exposure, but would also likely require rate controls that may discourage property-owners from purchasing any insurance in the future (e.g. mandatory inclusion of earthquake in homeowners policies in California coupled with high prices for earthquake insurance caused the number of homeowner policies to decrease significantly).

Under BW-‘12 provisions to address the financial shortcomings of the NFIP and requirements that lenders accept private insurance were helpful steps in encouraging private insurer activity in the flood market. The subsequent legislation under HFIAA-’14, modified and extended the glide-path under which subsidized policies will be phased out. This will have a dampening effect on the interest and speed around which the flood

[58] Remaining policies that are actuarially sound are in high hazard areas prone to 1% annual flood (A or V zones)

risk community expands. To encourage greater private market participation, more NFIP policies must move towards risk-based pricing that is positioned to fund the catastrophic loss potential imbedded in the portfolio and is deemed appropriate by private sector standards. .

There are also several policy levers related to the MPR that could be used to expand the risk community. Regulators might consider implementation of a safe harbor provision whereby a written determination for policies that meet MPR requirements is issued[59]. This rule would ease lender burden during policy review and assure insurance companies that their policies will be accepted for primary coverage purposes. Alternatively, the MPR itself could also be expanded to include minimum requirements for properties outside of SFHAs, although this would likely be met with adverse reactions from property-owners and diminish focus that should be placed on rate reforms.

B.4. Insurability of risk

Flood is different from other perils in that the distribution of potential losses is skewed such that certain low frequency, high severity events are not insurable. Given this unique characteristic, flood losses have the potential to exceed the aggregate capacity of private insurers and render the market insolvent. For example, Hurricanes Sandy and Katrina caused over $145 billion in economic losses (King, 2013), imposing strain on private insurers and resulting in significant debt incurred by the NFIP. It is difficult to accurately predict storm events such as Katrina due to flood map limitations and a lack of advanced modeling capabilities as discussed in Section B.1. Historical loss data to support analytical efforts is also required but is limited due to the relative infrequency of catastrophic flooding.

The insurability of a particular risk is also contingent on having a large number of homogenous exposure units. This is a key difference between flood and other perils given that flood exposure is concentrated in specific geographic regions. In the U.S., flood risk is concentrated in a limited number of states, with 50% of all policies in force located across Florida, Texas and Louisiana. Outside of these designated zones, the risk of flood, and subsequent demand for insurance, is much lower.

Stakeholder discussions confirmed the difficulty with predicting and insuring against catastrophic flood events, with most insurers interviewed indicating that flood is considered “uninsurable” today by their organization. Some interviewed stakeholders expressed concern about the capitalization structure of private insurers currently involved in the flood insurance market and questioned their ability to remain solvent in

[59] Note that a Notice of Proposed Rulemaking was presented by the OCC, Federal Reserve, FDIC, FCA and NCUA on October 11, 2013 that proposed this provision (OCC, 2013)

the event of a large flood event[60]. Clearly, state regulators will need to play a role in reviewing capital adequacy standards for companies that underwrite flood risk to avoid such insolvency.

At the individual risk level, insurability would clearly be adversely impacted by regulatory rate suppression of any segment of risks, but some risks can be considered uninsurable even with complete rate freedom and widely accepted modeling technology. This is a result of the practical limitations of rating technology, risk classification systems, and distribution systems, as it is generally impractical for these tools to reflect the peculiarities of each and every risk. Even if a tool could reflect the peculiarities of every individual risk, it's unclear whether regulatory rate filing requirements would permit the application of such detailed technology in practice at the individual consumer level.

To increase private market participation, the government should continue investing in flood risk mitigation. Through these efforts, flood exposure of higher risk properties will be controlled, effectively increasing the number of desirable properties for target by private carriers for flood insurance. In addition to this, the U.S. government may choose to provide a backstop for insurance companies above a pre-defined threshold that will limit exposure in the event of flooding (see Sections 2.2 through 2.5 for examples in other countries). Similarly, serving as a state reinsurer, primary carrier exposure to high impact flood events can be reduced. Both of these approaches rely on shared risk-taking between the public and private sector and help to reduce the potential financial burden on any one party.

B.5. Effective transition

Transition to risk-based pricing is a challenging but critical component of flood insurance privatization in the US. Repeals to the Biggert-Waters Act, legislation intended to ensure economic viability of the NFIP, have clearly indicated that transition must be gradual and allow for stakeholders to understand their magnitude of risk exposure. Extending the glide path for risk-based rate implementation beyond the five years initially framed by Biggert-Waters should allow higher risk property owners to adjust their risk taking behavior and implement mitigation defenses to ensure future insurance premiums are affordable. This extended implementation horizon will also allow private insurers and reinsurers to develop the appropriate risk modeling capabilities required to underwrite private flood and provide adequate risk-based coverage.

[60] These comments tended to come from some of the large and well diversified insurance companies and were often made in the context of the Florida property market

Appendix C. Federal insurance programs

Table 2

Dept	Agency	Program	Purpose	Date est.	Size
Agriculture	Federal Crop Insurance Corporation	Risk Mgmt Agency	Provides crop insurance to American producers	1938 (FCIC) 1996 (RMA)	Policy Count:1.17 MM Total Premium: $11.1 billion Crop Value Insured: $117 billion Acres Insured: 282 MM As of 2013: http://www.rma.usda.gov/pubs/rme/2013aboutrma.pdf
HHS	Centers for Disease Control and Prevention	Smallpox Injury Compensation Program	Provides benefits and/or compensation to certain individuals, including health-care workers and emergency responders, who are injured as the result of the administration of smallpox countermeasures, including the smallpox vaccine	2003	
	Centers for Medicare and Medicaid Services	Medicare	Provides hospital and medical insurance coverage to persons age 65 and over and those who have permanent kidney failure, or End Stage Renal Disease, and people with other disabilities	1965	Total Income: $533 billion Total Expenditures: $550 billion Total Premiums: $8.2 billion Total Enrolled: 51 MM As of 2013: http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/Downloads/TR2013.pdf
	Centers for Medicare and Medicaid Services	Medicaid	Government insurance program for persons of all ages whose income and resources are insufficient to pay for health care	1965	Total Expenditures: $432 billion, $251 billion government and $181 billion state spending Total Enrolled: 72.2 MM As of 2012: http://medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Financing-and-Reimbursement/Downloads/medicaid-actuarial-report-2013.pdf

Dept	Agency	Program	Purpose	Date est.	Size
Homeland Security	Federal Emergency Management Agency	National Flood Insurance Program	Insures homeowners, renters, and businesses against floods	1968	Total Coverage: $1.3 TN, $527 billion of coastal property. Total Policies In Force by CY: 5.6 MM Total Earned Premium by CY: $3.5 billion Total Debt: $25 billion As of 2013: https://www.fema.gov/statistics-calendar-year/total-earned-premium-calendar-year http://www.fema.gov/statistics-calendar-year
Transportation	Federal Aviation Administration	Aviation War Risk Insurance Program	Provides products that address the insurance needs of the U.S. domestic airline industry not met by the commercial insurance market	2002	Deductible of $50 MM, primarily for widebody and jumbo jets As of 2013: http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_insurance/ext_coverage/
Treasury	Office of Domestic Finance	Terrorism Risk Insurance Program	Temporary program that provides for a system of shared public and private compensation for insured commercial property and casualty losses arising from acts of terrorism	2002	Program Trigger: $100 MM Individual Company Trigger: 20% of commercial premiums Cap on Assistance: $100 billion per year Post Trigger Federal Assistance: Government 85%/Insurer 15% Recoupment of Assistance: Surcharges of 3% of annual premiums As of 2013: http://www.fas.org/sgp/crs/terror/R42716.pdf
Int'l Assistance Programs	Overseas Private Investment Corporation	Insurance Department	To promote and facilitate U.S. investment in emerging market economies by helping businesses manage risk	1971	Total Premiums & Fees: $17 MM Maximum Exposure: $3.1 billion OPIC's capital, allowance, retained earnings and reserves for insurance totaled $1.1 billion As of 2013: http://www.opic.gov/sites/default/files/docs/OPIC_Handbook.pdf
Other independent agencies	Federal Deposit Insurance Corporation	Bank Insurance Fund	Contributes to stability and public confidence in the nation's financial system by insuring deposits, examining and supervising financial institutions, and managing receiverships	1933	MERGED INTO THE DIF 2006
		Savings Association Insurance Fund	Contributes to stability and public confidence in the nation's financial system by insuring deposits, examining and supervising financial institutions, and managing receiverships	1933	

Dept	Agency	Program	Purpose	Date est.	Size
		The Deposit Insurance Fund	Insures the deposits of individuals by the FDIC. Sets aside to pay back the money lost due to the failure of a financial institution and is funded by insurance payments made by the banks	1933	Members: 6,812 FDIC-insured commercial banks and savings institutions Total Income: $14.2 billion Assessment Revenue: $9.7 billion Insured Deposits: $6.1 TN Reserve ratio to reach 1.35% of est. insured deposit by 2020 Insured to at least $250 K As of 2013: http://www.fdic.gov/about/strategic/report/2013annualreport/AR13section2.pdf
	National Credit Union Administration	National Credit Union Share Insurance Fund (NCUSIF)	Insures the savings of 80 MM account holders in all federal credit unions and many state-chartered credit unions	1934, as Bureau of Federal Credit Unions, within Farm Credit Administration	Total Insured: 6,550 Credit Unions Total Liability: $866.5 billion in insured deposits Limit: $250 K per account As of 2013: http://www.ncua.gov/Legal/Documents/Reports/AR2013.pdf
	Pension Benefit Guaranty Corporation	Pension Benefit Guaranty Corporation	Insures certain pension promises made to employees and retirees against default due to corporate bankruptcy and pension underfunding	1974	Total Pension Plans: 24,400 Total Workers: 42 MM Total Deficit: $35.6 billion Total Premium: $3 billion As of 2013: http://www.pbgc.gov/documents/2013-annual-report.pdf#page=9
	Securities Investor Protection Corporation (SIPC)	Securities Investor Protection Corporation (SIPC)	To return funds and securities to investors if the broker-dealer holding these assets becomes insolvent	1970	Member Assessments: $418 MM Members: 4,180 Coverage: Up to $500 K of customer's net equity balance Claims: 328 customer protection proceedings since 1970, less than 1% of members Backstop: SEC has the authority to lend SIPC up to $2.5 billion As of 2013: http://www.sipc.org/Content/media/annual-reports/2013-annual-report.PDF

Dept	Agency	Program	Purpose	Date est.	Size
Other		Nuclear Risk	The Price-Anderson Act commits the federal government to cover the portion of the costs of very large nuclear accidents exceeding certain thresholds, but did not assign agency responsibility for doing so. It establishes a process for the preparation of compensation plans after any such incident	1954	The nuclear power industry is responsible for approximately the first $12 billion of third-party damages, after which federal indemnification would begin. No premiums are charged for this coverage Owners of nuclear power plants pay a premium each year for $375 MM in private insurance for offsite liability coverage for each reactor unit As of 2013: http://www.naic.org/cipr_topics/topic_nuclear_liability_insurance.htm

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Report qualifications/assumptions and limiting conditions

This study of reasonable options for privatizing the NFIP, is a part of the Flood Insurance Risk Study (FIRS), commissioned by the FEMA to comply with the requirements set forth in Section 100232 “Reinsurance” paragraphs (a), (c) and (e) of the Biggert-Waters Flood Insurance Reform Act. This report was prepared by Oliver Wyman, Inc. acting as a Subcontractor for Guy Carpenter & Company LLC in connection with Contract No. HSFE60-13-C-0056 effective September 30, 2013. The objective of the study is to articulate a broad range of options, methods and strategies for privatization of the NFIP’s responsibilities for the provision of flood insurance.

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Oliver Wyman
1166 Avenue of the Americas, 29th floor
New York, NY 10036
Tel: 1 (212) 541-8100 Fax: 1 (212) 541-8957
www.oliverwyman.com

Oliver Wyman Pte. Ltd.
Registration Number 200302655G