FINANCIAL ADAPTATION THROUGH PARAMETRIC INSURANCE PRODUCTS:

UTILIZING THE CARIBBEAN CATASTROPHE RISK INSURANCE FACILITY AS A MODEL FOR A PROPOSED UNITED STATES NATIONAL CATASTROPHE RISK CONSORTIUM

Daniel E. Peterson+

University of North Carolina School of Law

Center for Law, Environment, Adaptation, and Resources

+ Post-Graduate Research Fellow, University of North Carolina School of Law Center for Law, Environment, Adaptation, and Resources ("CLEAR"). I wish to thank Professors Donald Hornstein and Victor Flatt for their expert guidance, as well as their constructive criticisms and comments throughout the researching and drafting of this paper, and really throughout much of my law school career. Their mentorship was invaluable. All errors, of course, are mine alone.

An overwhelming amount of the world community now agrees that there must be *some* international reaction to global climate change. However, when it comes to articulating precisely how humans are going to respond—mitigate and adapt—and who is going to *pay* for these changes, there seems to be an endless 'passing of the buck.' Part of this is completely understandable; global climate change is such a broad and amorphous problem and attempting to assign fair and equitable dollar amounts will invariably be met with powerful objections. However, there is a risk that we are running out of time to make real and meaningful change.

Increased global collaboration is necessary to formulate specific solutions for particularly climate-sensitive regions of the world; mechanisms to mitigate and adapt to the risks presented by global climate change must continue to evolve as the science directs us. Waiting for a level of 'scientific certainty' in both causation of the problems and their solutions is not how civilization has ever dealt with measurable risk.

Indeed, insurance as we know it today— as a market response to risks posed— has, can, and certainly will continue to play a role in adapting to climate change and mitigating losses to climate change. The World Bank has emerged as a leader in financing catastrophe risks associated with global climate change. A particular success story is the Caribbean Catastrophe Risk Insurance Facility ("CCRIF"). By pooling the common risks posed to that vulnerable corner of the world, and by utilizing other risk transfer products available, the CCRIF is an effective and efficient example of how insurance can serve as a catalyst for financial adaptation of global climate change on a regional level.

Adaptation and mitigation are two terms of art in the ongoing discussion on the global response to climate change. They are not interchangeable, though in some instances they may appear to be so. 'Adaptation' refers to preparatory plans and actions focused on affecting changes in human or ecological patterns in order to respond to a certain range of climate change consequences. 'Mitigation' can refer to two different concepts. One is the reduction of greenhouse gas emissions, which mitigates against a deepening of severity in global temperature gains. Hazard/disaster mitigation are preparatory plans and action focused on reducing the *ex post* costs (economical and otherwise) of disaster damages, should the disaster occur. In this paper, mitigation will be discussed in the latter context. Both adaptation and mitigation has a place in the literature because when considering how to manage risks, accounting for these two cost-reducing strategies emerges as foundational. The common link between adaptation and mitigation are that they should be generally viewed as *ex ante* solutions to threats, not responses to disasters. One might view the objective of adaptation to strengthen our defenses against the consequences of global climate change, and the objective of mitigation to put civilization on the offensive against global climate change. Though cost-benefit analyses disagree on how much a particular adaptation or mitigation activity will reduce costs over time, there is near universal agreement that certain strategies under these headings *will* save money, time, and lives when disaster strikes.

This paper will discuss the growing coastal property insurability crisis, developments in catastrophe securitization, how the CCRIF works, how vulnerable U.S. states have dealt with coastal insurability problems, and how the CCRIF can serve as a model in developing catastrophe mitigation and financial adaptation strategies for the United States. By using the

CCRIF as a model in designing an American solution, policymakers will reduce risk exposure to both constituents and their insurers by increasing loss predictability through insurer information-sharing and risk pooling. There are bills on the floor of the U.S. Congress designed to find national solutions to the varying catastrophes that threaten the different regions of the country. Already and in particular, the states in the southeastern U.S. have had to address wind-related property insurance market failures in the face of intensifying Atlantic hurricane seasons. Many states continue to struggle with the economic realities of their situation. A U.S. National Catastrophe Risk Consortium that operates similarly to the CCRIF, writing parametrically triggering insurance policies is a market-based solution that would, on one hand, promote the stabilization—and thus availability—of insurance markets in places of high-risk (especially the Atlantic and Gulf coasts), while on the other promoting financial adaptation and hazard mitigation, through the pooling of those financially interested in the coastal markets. I propose that these states can be better-served by a CCRIF risk transfer model than other options. I propose that property insurance policyholders are better served by a CCRIF risk transfer model than other options. I propose that U.S. coastal infrastructure will be improved and both regulatory and market-based solutions will be assisted by a CCRIF risk transfer model as opposed to other models. Even if the U.S. moves forward without such a facility, it is my hope that the CCRIF risk transfer model will serve as a 'best practice' example to American policymakers. Further, discussing the CCRIF and proposing a related model for the United States in this paper will suggest in concrete terms how this insurance model can be utilized in mitigating and adapting to global climate change across the world.

I. General Discussion of Rising Catastrophe Threat: Exposure Rising

Sustaining insured losses is one way of viewing the business of insurance. If no payouts ever occurred, then there would be no market for insurance. Insurers thus are in a constant balancing act to take on appreciable, measurable, and predictable risk. The mere threat of increased tropical cyclone[1] activity and a parallel increase in tropical cyclone strength as a result of global climate change, have made insurers contemplate financial sustainability if they enter or increase underwriting at-risk coastal markets.[2] Without the development of innovative risk transfer products, the rising exposure levels in the U.S. coastal market, along with a noticeable uptick in strong Atlantic hurricane seasons will continue to threaten the viability of meaningful property insurance in areas prone to catastrophe insurance. Though the focus of this paper will be catastrophe insurance as it relates to Atlantic tropical cyclones, the same general theme runs through all of catastrophe insurance as it relates to global climate change: though no one knows for sure what *exactly* is going to happen as a result of the scientific fact that the Earth is warming, there is enough scientific evidence to conclude that a measurable risk exists, which should prompt adaptive action and the undertaking of hazard mitigation practices.

Continued economic development of U.S. coasts, magnify any increases in hurricane activity and severity.[3] Indeed, 38% of the aggregate insurance exposure of the Atlantic and Gulf

[1] Though somewhat self-evident, in the interest of clarity, the term 'tropical cyclone' is being used here as a more inclusive term than simply saying 'hurricane.' 'Hurricane' will however, be used when the situation calls.
[2] L. James Valverde, Jr. and Marcellus W. Andrews, *Global Climate Change and Extreme Weather: An Exploration of Scientific Uncertainty and the Economics of Insurance*. Insurance Information Institute. New York, June 23, 2006.
[3] AIR Worldwide Corp. *The Coastline at Risk: 2008 Update to the Estimated Insured Value of U.S. Coastal Properties*. Boston, June 11, 2008.

coast states is located in their coastal counties; that exposure is 17% of the entire nation's insurance exposure. Before the stock market crashed in 2008, the risk modeling firm AIR Worldwide anticipated insured value to grow at an annual rate of over 7% in these counties, which would double the insured exposure every decade that this rate maintained.[4] Considering that, from 1986-2006, tropical cyclones accounted for 46.3% of U.S. insured catastrophe losses, it is clear that continued economic development on the Atlantic and Gulf coasts is going to have consequences that the U.S. must be prepared to deal with and adapt to into the future.[5]

Though natural variability makes scientific certainty difficult in determining whether global climate change is going to increase the frequency and severity of tropical cyclones in the North Atlantic, several factors strongly suggest that there is indeed such a correlation. Factors independent of global climate change, such as El Niño[6] and Atlantic Multidecadal Oscillation ("AMO"),[7] bring tropical cyclone counts down in the North Atlantic—the body of water of

---

[4] Id.

[5] Weishart, Steven N., on behalf of the Insurance Information Institute. "The Challenges of Insuring Coastal Properties." Presentation to the N.C. General Assembly Joint Select Committee on the Potential Impact of Major Hurricanes on the North Carolina Insurance Industry. Raleigh, N.C. October 16, 2008.
This 46.3% of catastrophe losses equates to $137.7 billion; the other perils included in "catastrophe losses" for this purpose are (% of catastrophe losses, $Billions 2007 USD): fire (2.2%, $6.6), non-tropical cyclone and non-NFIP wind/hail/flood (3.1%, $9.3), earthquakes (6.4%, $19.1), winter storms (7.8%, $23.1), terrorism (7.5%, $22.3), tornadoes (26.0%, $77.3), and a catch-all 'other' category (0.6%, $1.7).

[6] El Niño refers to above average sea surface temperatures in the Pacific Ocean, around the Equator. Trade winds in the Pacific then relax, which results in flooding along the west coast of South America, droughts on land masses in the Western Pacific, and a less active hurricane season in the North Atlantic. (From the National Oceanic and Atmospheric Administration, El Niño website. Available at: http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html)

[7] Atlantic Multidecadal Oscillation is a scientific phenomenon where the sea surface temperature of the North Atlantic Ocean (between Greenland and the Equator) is warmer for 20-40 years (this 'positive AMO' produces more active hurricane seasons in affected waters) and then cools for another 20-40 years (this 'negative AMO' produces less active hurricane seasons); AMO

concern in this paper. However, while El Niño and AMO have no relation to global climate change, changes in sea surface temperatures surely do.[8]

When AMO is in its 'negative phase,' tropical cyclone activity in the North Atlantic decreases in both number and intensity; the most recent negative phase occurred in the 1970s, through the 1980s, and into the early years of the 1990s.[9] However, during that same time period, in the Earth's other oceans, tropical cyclone *intensity*—though not *activity*—increased while sea surface temperatures did the same. In the mid-1990s, the AMO reversed into its 'positive phase'.[10] Since then, eight of the ten hurricanes causing the most insured losses in U.S. history have taken place,[11] with seven of them occurring since 2004.[12] Both frequency and intensity are now on an upward trend in the Atlantic. While positive-phase AMO and increased coastal insurance exposure plays a role, the IPCC suggests that most of the warming in the North Atlantic can be attributed to *global* rises in sea surface temperatures, rather than the

---

causes about a 1°C in variance of SST between extremes. (From the National Oceanic and Atmospheric Administration, Physical Oceanography Division website. Available at: http://www.aoml.noaa.gov/phod/amo_faq.php

[8] IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 5.

[9] IPCC, 2007: Observations: Surface and Atmospheric Climate Change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 306.

[10] The IPCC places the date around 1995, though others argue that Hurricane Andrew in 1992 is the appropriate date.

[11] If Hurricane Andrew is included in the modern positive AMO, then 9 out of 10.

[12] Valverde and Andrews, *supra*, at 29.

regionally-restricted AMO. [13] As SST is expected to continue to rise on a global scale for years, conclusions on increased tropical cyclonic activity and severity will only improve as the SST variable is monitored. However, both insurance and global community do not, should not and cannot operate on scientific certainty when addressing *risk*. Further exasperating the need for action is the fact that the scientific community has concluded that the rising sea level is directly attributable to global climate change and that this risk will result in an increase in damage by tropical cyclones.[14] The time for adaptation and hazard mitigation is now.

II. A Story of Adaptation and Mitigation

The world's confrontation with global climate change takes on many fronts, but perhaps none so urgent as its response to damage already done or damage certain to be done. How we adapt to the threat of change and how we mitigate against high-cost change and deepening future change is vital.

Financial adaptation has emerged with the development of a broad array of catastrophe risk transfer tools, from basic wind-hail damage property insurance to the issuance of catastrophe bonds in securities markets. When taken as a whole, these catastrophe risk transfer tools offer a method of diversifying risk for policyholders and insurers, investors and financial institutions, and taxpayers and governments. How are the above products examples of financial adaptation? These mechanisms and products have evolved over time in an effort to respond to a

[13] Id. at 305. ("In particular, the satellite era after about 1970, the trends… appear to be robust in strong association with higher SSTs.")

[14] IPCC, 2007: Observations: Oceanic Climate Change and Sea Level. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 414.

certain range of probable losses that *will* be experienced because of intensifying climate changes. As discussed above, studies suggest that, as the average global temperature increases, prime conditions are created for an increase in the number of hurricanes and an increase in the intensity of hurricanes. It is unlikely, however, that Category 4 hurricane winds that wreak havoc on the North Carolina coast are going to wreak similar havoc on the Texas coast. However, as will be shown below, with increasing catastrophe risk transfer mechanisms, damages experienced by the North Carolina coast can be recouped because its risk is pooled together with Texas disaster risk, Louisiana disaster risk, and perhaps even California disaster risk. Losses are spread out and, because wise private investors know to diversify risk, investing in catastrophe risk is likely a profitable venture, so long as every 'bad' event doesn't occur in the same close time period.[15]

Property Insurance and Natural Catastrophes: Loss-based and Parametric Index; Wind and Hail as Perils Covered

Insurance which covers natural catastrophes might be the most straightforward form of financial adaptation discussed in this paper. Yet because of its widespread necessity, many factors weigh on its availability. There are also different approaches in the mechanics of covering natural catastrophes in insurance. One method operates to meet the necessity of individual property insurance; a loss-based model that indemnifies policyholders whom have had the natural catastrophe strike their homes and businesses. In the United States, where private markets have failed to meet these individual property insurance needs in areas where risk of the

[15] Even if, for example, a 1:250 year hurricane becomes a 1:100 year hurricane, there is a small likelihood that two 1:100 year storms would strike two distinct geographic locations.

natural catastrophe (e.g., hurricane wind damages)—leaving homeowners and their mortgagees exposed to great loss—state governments have developed residual market mechanisms to provide insurance.

Two principles underlie the availability and pricing in all types of insurance: adverse selection and moral hazard.[16] These are only exasperated in natural catastrophe-prone areas due in large part to the concentrated nature of the risk.

As suggested, adverse selection occurs to some degree naturally in the insurance market. High-risk individuals or entities desire insurance, while insurers seek out low-risk individuals or entities as policyholders. Both the high-risk policyholders and the insurers are acting rationally in their own economic interest. The key variable is availability of information; prospective policyholders know more about their individual risk profiles, while insurers know more about risk in general. To create a sustainable insurance market, insurers must be somewhat successful in attracting low-risk policyholders in order to subsidize those high-risk policyholders. Insurers achieve this by, in effect, 'rewarding' lower risk profiles with lower premiums and deductibles than those high-risk policyholders for the same coverage as the high-risk policyholders; the chances of a payout, by definition, are lower to the perceived low-risk policyholders, but are nonetheless given the peace of mind *should* the improbable occur. Without such a pricing incentive, rational low-risk individuals and entities are likely to make the decision to 'go bare'—not purchase insurance for the low-risk, and either self-protect or self-insure. When this happens, to compensate for a lack of low-risk policyholders, insurers are pressed into raising

[16] *See,* Abraham, Kenneth S. Insurance Law and Regulation. Foundation Press. 4th Ed, 2005. pp. 5-7.

rates or reducing coverage to the remaining high-risk policyholders. As the risk pool for an insurer concentrates in high-risk policies, coverage will become unaffordable for the policyholder, causing them to drop-off the insurance market. If this continues to happen, eventually the insurer becomes overwhelmed by claims from what high-risk policyholders remain, and the insurer goes insolvent from lack of premium revenue.[17]

Insurance is a societal good; it is more economically efficient for the whole to pool its risks together than it is for each individual to self-insure.[18] Thus, to combat the ills of adverse selection, (i) risk profile information is commonly pooled between insurers (specifically, through the Insurance Services Organization),[19] (ii) governments regulate the industry to prevent the threat of price-fixing that may result from such widespread information-pooling[20], and (iii) residual market mechanisms are created in an attempt to provide insurance for all those who need it.[21] Managed incorrectly, these tools intended to combat adverse selection may only serve to exasperate adverse selection.

When applied to coastal windstorm insurance in the southeastern United States, it is clear that adverse selection occurs as a compound of all three mechanisms intended to minimize it.

---

[17] Abraham, Kenneth S. Insurance Law and Regulation. Foundation Press. 4th Ed, 2005, at 4. *See also*, Tom Blake, *Containing the Promise of Insurance: Adverse Selection and Risk Classification*, 9 Conn. Ins. L.J. 371, 375-376 (2003).

[18] This efficiency is not only applicable to individuals in society; it applies to more advanced level of risk-transfer. Indeed, the crux of the proposal in this paper utilizes the spreading and diversification of catastrophic risk. Incidentally, risk-pooling also vests insurers, mortgage lenders, and government entities in each property, making mitigation a more plausible investment strategy.

[19] Abraham, *supra* at 34; *see also*, www.iso.com

[20] Id.

[21] *See, e.g.*, N.C. Gen. Stat. § 58-45-1 (2009). Interestingly—though this may be changing soon—the United States has residual market mechanisms in place for auto and property insurance, but not for health insurance.

The uncertainty of climate change causes an increase in the imperfection of the information available to insurers regarding wind damage. As a result, insurers are hesitant to write insurance on this peril because the industry cannot accurately quantify its probable maximum loss. State insurance regulators and legislative policyholders, whom do have a responsibility to ensure that insurer price-fixing does not happen, are politically pressured to keep rates too low. Residual market mechanisms are especially vulnerable to political pressure, as these mechanisms are often narrowly controlled by statute and regulation.

The average property insurance premium increase of forty-six percent across the United States, between 2001 and 2006, on-face suggests that insurers have enjoyed success, both in evincing rate increases from state regulators and annual profitability overall. However, Hurricane Andrew swept in a new era of windstorm devastation; it took the private insurance industry in Florida eleven years to make-up its losses from the 1992 hurricane.[22] If this trend is permitted to continue, and it did in 2004 and again in 2005, the increase in storms and storm intensity as a result of global warming will cause an ever-threatening diminution of insurers' ability to adjust losses—any losses, anywhere—be they on the coast or otherwise.

Besides problems associated with adverse selection, over-subsidization of high-risk policyholders will further incentivize high-risk behavior. The reality is that a disproportionate amount of people *choose* to live or hold real estate in coastal areas. While there are more appealing qualities to coastal living than pure economic rationality, when a behavior should have

[22] Weishart, Steven N., on behalf of the Insurance Information Institute. "The Challenges of Insuring Coastal Properties." Presentation to the N.C. General Assembly Joint Select Committee on the Potential Impact of Major Hurricanes on the North Carolina Insurance Industry. Raleigh, N.C. October 16, 2008.

economic consequences, states (and the federal government) should not be encouraging this sort of behavior by creating artificial insurance incentives to living on the coast. While measures should be taken by vested actors—the State, the insurance industry, the property owner, and arguably the financial industry—to both new and existing structures that are built on the coast so that they are able to better withstand windstorms, the plain fact is that less people need to choose to live on the coast. When insurance rates do not reflect the risk of the behavior engaged in, the behavior is encouraged and the risk is magnified. The model of the CCRIF discussed later balances coastal insurance needs while encouraging an accurate representation of the risk presented to coastal communities.

III. Catastrophe Securitization Products Today

Traditional Reinsurance

Reinsurance, at its base, is 'insurance for insurers.' Large and well-capitalized reinsurance firms enter into contracts with primary insurers (e.g., State Farm, Allstate, and the 'Coastal Wind Pools' described above) to pay for losses endured by the primary insurer after a certain amount of dollar loss.[23] Thus, most traditional reinsurance contracts are indemnity-based. As a result, high exposure in residual market mechanisms (or by actually writing policies in under-priced, high-risk areas) creates another expense for the insurance industry: higher reinsurance premiums. Additionally, in an affirmative effort to limit its own exposure reinsurers usually provide 'tranche' coverage; that is, the firm will cover in insured losses by a primary

[23] Abraham, *supra*, at 739. *See also*, "Glossary of Reinsurance Terms." Captive.com: The Business to Business Risk and Insurance Exchange. 2009. Available at: http://www.captive.com/service/signetstar/GlosRein.html

insurer in between, for example, $1 billion and $1.3 billion[24]. That tranche would have its own premium and 'co-participation' value.[25] The same reinsurer, or a competitor, might cover between $2.4 billion and $3 billion at its own premium and co-participation value. Both the tranche system of premiums and co-participation are reinsurance mechanisms which fight the analogous moral hazard that primary insurers seek to prevent in individual policyholders.[26] The primary insurer would have less incentive to act prudently in issuing policies if its risk profile was insulated from loss after a certain amount. Reinsurers do not have the capacity to monitor each policy written by the primary insurer and are thus acting at an information deficit in that respect.[27]

Insurers are empowered to assess their own risk and reinsure up to whatever limit it deems to be necessary. This makes probable maximum loss calculations even more economically relevant. The prudent primary insurer is going to expend some of its capital on reinsurance to protect itself from a devastating future event. The insurer, however, has a responsibility to its shareholders and policyholders to commit the correct amount of funds. With trusted loss models, reinsurance premiums should be relatively less expensive as an insurer purchases more because the event which would require *that* much amount of indemnification would be less and less likely to happen. Without accurate assessments of risk exposure, or

[24] *See, e.g.,* N.C. Underwriting Insurance Association Reinsurance Structure, 2007. http://www.ncjua-nciua.org/mbr_co/REINSURANCE%20052007.pdf

[25] 'Co-participation' is essentially the reinsurance term for 'deductible.' For example, the North Carolina Insurance Underwriting Association pays an average of 20% co-participation throughout its tranches of reinsurance coverage.

[26] Neil Doherty and Kent Smetters, *Moral Hazard in Reinsurance Markets*, 75 Journal of Risk and Insurance 375, 375. (Sep. 2005.)

[27] Id. at 375. (Article notes that monitoring is particularly expensive when the reinsurer and primary insurer are not organizationally affiliated.)

simply too much risk exposure, reinsurance will be expensive for the solitary reinsurer. In turn, reinsurers, like primary insurers, seek to spread their risk through the capital markets whenever possible.

Catastrophe Securitization

The securitization of catastrophe insurance has evolved since the lessons and advances deriving from the insurance industry's experience with Hurricane Andrew and has accelerated since 2005, the year Hurricane Katrina devastated the Louisiana and Mississippi Gulf Coasts.[28] The market shift to catastrophe securitization as a utilized risk-transfer tool is a response to the magnitude of losses from Hurricanes Katrina, Rita, and Wilma; Swiss Re reports that these storms combined to cause $114 billion (2007 USD) in insured losses.[29] Forty-five percent of 2005 hurricane losses were paid by reinsurers.[30] These losses are a heavy burden on the insurance and reinsurance industry and result in reinsurance premiums on primary insurers and large increases in individual policyholder premiums.[31] This reactionary result does not promote financial adaptation, it does not promote sound mitigation practices. It *does* encourage, however, antagonistic relations between the insurance industry and political representatives and consumer advocates. As the United States wind insurance experience since Hurricane Andrew has

[28] *See, e.g.*, Michael Lewis, *In Nature's Casino,* The New York Times Magazine, 2007.
[29] J. David Cummins and Mary A. Weiss, *Convergence of Insurance and Financial Markets: Hybrid and Securitized Risk-Transfer Solutions*. 76 Journal of Risk and Insurance, 493, 494 (Sep. 2009).
[30] Weishart, *supra*.
[31] *See, e.g.*, Lewis, *supra.*

demonstrated, reactionary insurers coupled with reactionary governments will not yield insurable results.[32]

Even if unchecked by rate regulation though, insurers would likely continue to be hesitant to write sufficient property insurance because—again, as Hurricanes Andrew and Katrina have shown—predicting the amount of damages to insured property is difficult; a problem further exasperated by the presence of compulsory insurer-sponsored residual market entities in many states, as described both above and, in more detail, below. The problem with predicting the 'probable maximum loss' is that, even as risk modeling has improved, there is the *possibility* that a storm no one has ever recorded could come along. Also, there are blind spots in both human intuition on risk and computer risk modeling; a metropolitan city built beneath sea level, for instance, has a sizable interest in both ensuring and insuring that its levees won't break.[33]

Insuring for this kind of risk is characterized as 'insuring against the tail,' referring to a catastrophic storm's place on the Bell curve.[34] The further down the tail— and away from frequent events—the less information there is available on a prior like-event (if there is any information available at all). The less information available, the more challenging it is to actuarially price the catastrophic event. The more difficult a catastrophic event is to price, the less likely an insurer is going to want to write insurance against that event.

Issuing catastrophe bonds and like securitization products ameliorates that problem to some extent, by diffusing risk through financial markets. These products operate essentially as

[32] One need only look at the homeowners insurance crisis in Florida for evidence of this.
[33] Lewis, *supra*; Doherty, *supra* at 376.
[34] Lewis, *supra*.

futures contracts with parametric triggers; if the contracted event occurs, meeting predetermined thresholds (e.g., surface wind speed), a certain amount of the investment (perhaps all of it) goes to the issuing insurer in order to offset its payouts to policyholders as a result of the event. [35] However, if the event does *not* occur within the contracted time period, the principal is returned to the investor, with a high rate of interest.[36]

The broad mechanics of the catastrophe bond market are important to note at this point. Insurers contract with sophisticated, financial institutions (e.g., an investment bank) to create special purpose reinsurance vehicles ("SPRV's") which actually sell and guarantee the bonds to investors.[37] SPRV's also invest in high-rated securities independent of the catastrophe market in order to diversify its portfolio and, hopefully, be able to provide more liquidity to the primary insurer in the case of an insured-against event.

Increasingly, catastrophe bonds are not issued as mechanisms of indemnity coverage.[38] Instead, as indicated above, the insurer only retains the principal on the bond when certain parametric triggers are satisfied. Though insurers might prefer indemnity-based coverage, if for no other reason than the coverage provided from the issued bonds is in direct correlation with the insurer's losses, the market for catastrophe securities has seen a shift towards parametric triggers. Parametric triggers written into the security contract provide increased investor confidence in the predictability of its risk because investor loss is unrelated to damages assessed after a particular

[35] *See, e.g.*, U.S. General Accounting Office, *Catastrophe Insurance Risks: The Role of Risk-Linked Securities and Factors Affecting Their Use*. Report to the Chairman, Committee on Financial Services, House of Representatives. September 2002.
[36] Id.
[37] Id.; Doherty, *supra* at 377.
[38] U.S. General Accounting Office, *supra*.

disaster. Instead, parametric-triggering/index catastrophe insurance and securitization contracts provide for *x* amount of investor loss when *y* severity of catastrophe strikes, no matter how much that catastrophe actually costs.[39] In essence, investors acting as reinsurers in the capital markets are demanding the same limitation of risk exposure that insurers seek as a response to adverse selection.

Individual investors, hedge funds, and investment banks—like large reinsurance firms—cannot easily monitor what policyholder risks the insurer is underwriting.[40] If the insurer is writing too many high-risk policies, under an indemnity-based bond, the investor stands to lose more of its principal, more of the time.[41] However, with a parametric trigger, rather than an indemnity-based contract, the insurer can either issue the bond at a high value or agree with the investor on a lower interest rate on the principal because the exposure of the investor is *limited* to the predefined set of parameters at the time the bond is issued.[42] The virtue of parametric triggers in relation to the Caribbean Catastrophe Risk Insurance Facility will be explored in greater detail below and, along with this discussion, will serve as the basis for a recommended course of action for the United States in dealing with financial adaptation and hazard mitigation into the global climate changed future.

While catastrophe securitization took off in the 1990s, general market investment in general is not new to the insurance industry. However, given the recent stock market crash of 2008, the catastrophe securitization market should be more and more attractive to the issuing

[39] Id.
[40] Doherty, *supra* at 378.
[41] As described above, insurers are often forced to write many poor risks in a concentrated area by way of residual market mechanisms.
[42] U.S. General Accounting Office, *supra*.

insurance industry, financial service institutions, and investors because the main driver behind these securities—natural catastrophe risk—is non-correlated to other market fluctuations on Wall Street.[43] Catastrophe bonds were one of the few financial products to continue to make money through the global financial crisis. Issuance did slow in the last quarter of 2008;[44] the couple of contributing factors need to be discussed briefly here because they provide useful lessons for the future of financial adaptation to global climate change generally.

One reason catastrophe bond issues slowed at the end of 2008 was because the bonds are actually not as insulated from credit-risk as initially thought.[45] When the catastrophe bond market is operating under more typical normal economic conditions, bond-holders are essentially insuring insurers; that is, they are accepting 'insurance risk' which is typically uncorrelated to credit risk.[46] However, because large financial institutions issue catastrophe bonds for insurance and reinsurance companies, when one such institution collapses—such as Lehman Brothers—the guarantor of the bonds is suddenly illiquid.[47] Due to the fairly sudden and domino-effect nature of the financial crisis in 2008, a guarantor institution's credit rating would have been unhelpful. Though ultimately outside the intended scope of this paper to warrant in-depth discussion, there

[43] *See, e.g.*, GC Securities, *Cat Bonds Persevere in Tumultuous Market*, GCCapitalIdeas.com, Feb. 4, 2009.
[44] Id.
[45] *See, e.g.*, Catherine Evans, *Credit fears hit 'uncorrelated' catastrophe bonds*, Reuters UK. Dec. 10, 2008.
[46] The now-infamous 'credit default swap' is an exception to this distinction. However characterized, CDS transactions are—of course—by definition, insurance on credit-risk. Catastrophe bonds are insurance on natural catastrophe risk.
[47] Id.; Society of Lloyd's, *Cat Bond Resurgence*, July 6, 2009. Available at URL: http://www.lloyds.com/News_Centre/Features_from_Lloyds/News_and_features_2009/Market_news/Cat_bond_resurgence.htm

are calls for the catastrophe bond market to have increased collateral monitoring mechanisms in place.[48]

Another now-apparent interconnection between catastrophe securities and financial markets at-large actually speaks well for future issuances of the bonds and other catastrophe-linked derivatives. As market conditions continued to deteriorate in the third and last quarter of 2008 and as uncertainty abounded as to 'what's going to happen next,' hedge funds—major investors in catastrophe bonds—liquidated significant amounts of their catastrophe bond holdings in order to offset losses in other holdings.[49] While the liquidation of these assets does not hold true to the financial adaptation purpose of catastrophe bonds in the short-term, the mechanism's liquidity in a time of crisis makes it all the more an attractive investment.[50] Assuming that we are not in an indefinite financial crisis, under 'normal' market conditions, issuances of catastrophe bonds will stand to increase, especially with the aforementioned tightening of collateral requirements, providing more investors for the insurance industry to diffuse its risk.

IV. The Caribbean Catastrophe Risk Insurance Facility

A major hurricane can be expected to impact the Caribbean about once every two and half years.[51] For one or more of its small island countries, this is akin to a game of financial

[48] *See, e.g.*, Catherine Evans, *Cat bond market still seeking collateral solution*, Reuters UK. June 29, 2009; Navroz Patel, *For whom the cat risk tolls*, Risk Magazine. November 1, 2007.
[49] *See, e.g.*, GC Securities, *supra*.
[50] Id.
[51] The World Bank, *The Caribbean Catastrophe Risk Insurance Facility: Providing Immediate Funding After Natural Disasters*, Operational Innovations in Latin America and the Caribbean, (Vol. 2, March 2008).

Russian roulette every thirty months or so. While the 2005 Atlantic hurricane season will go down in infamy because of Hurricane Katrina, and justifiably so, consider that Katrina impacted less than one percent of annual U.S. gross domestic product and thirty percent of Louisiana's GDP.[52] In 2004, Hurricane Ivan impacted *two-hundred* percent of the annual GDP in each of the two Caribbean islands it primarily impacted: Grenada and the Cayman Islands.[53] Small island countries such as these also have trouble attracting private property insurers because (i) they are islands in the middle of warming seawaters and (ii) each island is a relatively small insurance market for private insurers.[54] Thus, most economic losses in the Caribbean from storms such as Ivan are borne by the government and individual households.[55] At the same time recovery needs were mounting, revenue was dropping.[56] The most pressing problem for the governments of Grenada and the Cayman Islands were an inability to meet immediate liquidity needs in the days, weeks, and months just after the storm.[57] As a result of the Hurricane Ivan, the Cayman government went from a projected budget surplus of $0.5 million in 2004 to a $36.7 million budget deficit—the largest in Cayman history.[58]

---

[52] Simon Young and Ekhousechi Iyahen, *Innovative risk transfer options as adaptation strategies to growing hydro-meteorological risks in the Caribbean Basin*. Caribbean Catastrophe Risk Insurance Facility. September 30, 2009. Available at URL: http://www.ccrif.org/

[53] Id.

[54] The World Bank, *supra* at 3.

[55] Id.

[56] Id.

[57] Id.; Michael Nixon, *The Cayman Islands Experience with the Caribbean Risk Insurance Facility*, Natural Catastrophe Risk Insurance Mechanisms for Asia and the Pacific Conference. Tokyo, Japan. November 4-5, 2008.

[58] Nixon, *supra*.

Out of the debris of Ivan, the governments of the Caribbean Community ("CARICOM")[59] requested from the World Bank assistance in accessing insurance markets for both catastrophic hurricanes and earthquakes.[60] The World Bank responded by developing the Caribbean Catastrophe Risk Insurance Facility ("CCRIF" or "the Facility") with the objective of preventing future liquidity crises like those in Grenada and the Cayman Islands after Ivan; the Facility would operate *not* as a primary insurer[61], but as something akin to a business interruption insurer of CARICOM governments that paid premiums into the Facility.[62] The Japanese government donated initial capital and the Jamaica Social Investment Fund was selected to procure contracts for development of the CCRIF.[63] To increase the envisioned Facility's chances of success, government losses in a series of stochastic events needed to be simulated beforehand; this was done by contracting a risk modeling firm, whose calculations could then construct individualized loss profiles for each Caribbean island.[64] Thus, even before CCRIF started writing policies to CARICOM governments, its formative stages were producing positive results for Caribbean adaptation to global climate change by promoting increased knowledge of the extent of catastrophic risk facing these islands. Insurance requires information; the more information available, the more predictable policy-triggering events become. As this

[59] CARICOM is a collaborative to promote the economies of its member states, including responses to global climate change.
[60] Francis Ghesquiere, et al., *Caribbean Catastrophe Risk Insurance Facility: A solution to the short-term liquidity needs of small island states in the aftermath of natural disasters.* www.aidandtrade.org
[61] That is to say that CCRIF does not write policies for individual households and businesses in the Caribbean.
[62] *See, e.g.,* The World Bank, *supra* at 1.
[63] Simon Young and Milo Pearson, *The Caribbean Catastrophe Risk Insurance Facility as a Technical Model*, Natural Catastrophe Risk Insurance Mechanisms for Asia and the Pacific Conference. Tokyo, Japan. November 4-5, 2008.
[64] Id.

predictability rises, so will the availability of insurance. Further, effective risk-modeling on a community level (such as the community of a small island state) can help governments better adapt to known threats and mitigate against future threats. Though CCRIF is still a relatively new program, evidence of individual member governments adapting and mitigating against global climate change threats are emerging as a direct result of the insurance CCRIF offers; these will be discussed further below.

With an objective of assuaging a post-disaster liquidity crisis, CCRIF policies have a parametric trigger, making it similar to catastrophe bonds.[65] CCRIF policies trigger only if certain thresholds are experienced on the member island; there are certain 'measuring points' specified for each island.[66] Though the worse a covered catastrophe is, the more the Facility will payout to the insured country, the Facility does not operate as an indemnity mechanism for non-catastrophic disasters; CCRIF is designed for the worst case scenarios.[67] For earthquakes, the measure is the amount of ground-shaking is determined by information from the global seismic center.[68] For hurricanes—the catastrophe at focus in this paper—wind speed is calculated an aggregate across the entire island, by inputs provided by the U.S. National Hurricane Center.[69] Based off of risk and loss models developed for the CCRIF, a loss index specifies what the Facility will pay out in the event of an insured occurrence on an insured island.[70] Of note, because the CCRIF operates as a sort of business interruption insurance for governments,

[65] *See, e.g.*, Young and Pearson, *supra*; The World Bank, *Results of Preparation on the Design of a Caribbean Catastrophe Risk Insurance Facility*. February 5, 2007, at 13.
[66] Young and Pearson, *supra*.
[67] Id.
[68] Id.
[69] Id.; The World Bank, *Results of Preparation on the Design of a Caribbean Catastrophe Risk Insurance Facility*, *supra* at 13.
[70] Young and Pearson, *supra*.

political and economic centers within the insured country are given greater weight.[71] The methodology of measurement for CCRIF threshold parameters is one advantage of parametric-triggering/index-based insurance over pure indemnity-based insurance. The above inputs of ground-shaking and wind speed are directly from agencies whose information is dispersed widely in the public domain.[72] The payout calculation is agreed to contractually when a government buys insurance from the Facility. This transparency—which also applies to catastrophe bond transactions generally—assists in the pricing of CCRIF policies and eliminates coverage-based litigation over the policy.[73]

In order to meet its objectives of easing government liquidity concerns in the wake of a catastrophe, the CCRIF and its insured countries must be confident in the measurement of the individual islands' loss risks because the loss index is developed to determine the amount the Facility owes the insured after an occurrence under the policy.[74] If there is an insufficient correlation between what the index reports the loss *should* and what the loss *actually* is after a catastrophic earthquake or hurricane, then the CCRIF's primary objective in providing sufficient immediate liquidity is frustrated.

CCRIF has laid emphasis on providing '*immediate* liquidity' at an affordable rate for its insureds. Policies written by the Facility are capped at twenty percent of a country's total

[71] Id.
[72] Id.
[73] *See, e.g.,* The World Bank, *Results of Preparation on the Design of a Caribbean Catastrophe Risk Insurance Facility*, *supra* at 65.
[74] This risk of difference between payouts under the policy and actual loss is known as 'basis risk.' *See, e.g.,* The World Bank, *Providing Immediate Funding*, *supra* at 5.

estimated losses.[75] This policy limit is, at current, thought of as providing a sufficient amount of capital in the immediate aftermath of the insured event. After that initial period which proved to be crucial after Hurricane Ivan, other sources of liquidity can be mobilized by the country. [76] The policy limit is one of the ways which encourages *ex ante* disaster mitigation across the Caribbean. In order to maximize what will be recovered from its CCRIF policy, the insured country has a direct financial stake in undertaking affirmative steps to make sure its post-disaster response mechanisms and infrastructure are sound and efficient.

If modeling is successful in producing a reasonable index—one representative of actual losses, there are great advantages for the insured islands. Because no actual losses must be adjusted before payouts are made by CCRIF in the event of an insured occurrence, the CCRIF can deliver on its promise to provide immediate liquidity to its insured countries.[77] The World Bank identified three primary strains on the budget of a country affected by a catastrophe: (i) relief operations, (ii) early recovery operations, and (iii) reconstruction operations.[78]

Relief operations are essentially emergency services that the displaced population requires to prevent secondary losses of life;[79] food and water distribution and shelter are among the concerns covered under relief operations.[80] Relief operations are the most immediate demands to be met by the government of an affected population; it is vital that the government undertake *ex ante* procedural mitigation steps to ensure an orderly flow of these services to its

[75] Id. at 6.
[76] Id.
[77] Young and Pearson, *supra*.
[78] The World Bank, *Providing Immediate Funding*, *supra* at 4.
[79] 'Secondary' losses of life refers to deaths deriving from the devastation of the catastrophe, not from the catastrophe itself.
[80] Id.

citizenry. Early recovery operations, such as utility restoration and debris removal, closely follow relief operations because they too prevent secondary losses, both human and economic.[81] Here again, if the government has engaged in a review of its procedures and taken steps to strengthen its infrastructure, the cost and time associated with restoring the country are reduced. Finally, reconstruction operations are fairly self-defined, but it should be emphasized that essential governmental services should be given priority, keeping the primary objective of the CCRIF in mind. Reconstruction continues after the immediate aftermath phase, but essential reconstruction can still be aided by CCRIF payouts, especially if the former two budgetary strains are mitigated against before the disaster. Considering the pre-CCRIF experience of Grenada after Ivan struck, it was about six months until the aggregate financial resources available to the country overcame its expenditure needs.[82]

How the CCRIF is Structured and the Benefits of Risk Pooling

The CCRIF was organized as a Limited Liability Company, whose operating structure is governed in the format of a trust.[83] The CCRIF Trust owns one-hundred percent of the CCRIF. The CCRIF Board of Directors is made up by the insured countries and countries who have donated to the Facility's operation, giving the financially vested countries ownership in the Facility. The CCRIF's day-to-day operations are actually managed by the facility supervisor, captive manager, and reinsurance broker. The facility supervisor is Caribbean Risk Managers Ltd., who is responsible for fundamental insurance activities, such as pricing and risk modeling. The captive manager is Sagicor Insurance Managers Ltd., responsible for "back-office

[81] Id.
[82] Id.
[83] The World Bank, *Providing Immediate Funding*, *supra* at 8.

operations" such as accounting and audit management. The reinsurance broker is Benfield Group Ltd., responsible for procuring sufficient reinsurance through either the purchase of traditional reinsurance or through the capital markets.[84] As of the end of the 2009 first quarter, CCRIF had procured $102,500,000 of reinsurance in traditional reinsurance markets and procured another $30,000,000 of reinsurance through a catastrophe swap, for a total reinsurance amount of 132,500,000.[85] Through its retained reserves and reinsurance, the Facility could sustain a 1-in-1000 year hurricane or earthquake, or any combination therein.[86]

Before the CCRIF, to procure the same type of insurance that the Facility provides, each CARICOM country would have had to purchase on its own through the private reinsurance market. By pooling together all of CARICOM individual risk portfolios[87], the probable maximum loss for a 1-in-200 year event is reduced by 76% for hurricanes and 65% for earthquakes, when compared to the aggregate probable maximum loss of each Caribbean country's individual probable maximum loss.[88] Though all vulnerable to hurricanes and earthquakes, it is unlikely that all insured countries would experience the same event within a close period of time. By pooling together resources, combating individual storm seasons becomes much more financially plausible than otherwise would be possible for a series of small island countries. However, this does not equate to inappropriate cross-subsidization. Premiums charged to individual countries, after all, are priced according to its own loss profile.

---

[84] The World Bank, *Providing Immediate Funding*, *supra* at 9; Young and Pearson, *supra* at 6.
[85] Caribbean Risk Managers Ltd., *CCRIF Quarterly Report: 1 December 2008 to 28 February 2009*. April 15, 2009.
[86] The World Bank, *Providing Immediate Funding*, *supra* at 10.
[87] It should be noted here that not all CARICOM members buy insurance from the CCRIF; however, all but Guyana, Montserrat, and the British Virgin Islands do.
[88] The World Bank, *Results of Preparation on the Design of a Caribbean Catastrophe Risk Insurance Facility*, *supra* at 7-8.

The CCRIF can also build reserves faster than most, or otherwise commit more resources to investing in modeling research, because of its low operating costs. As discussed earlier, parametric insurance policies do not require a staff of loss adjusters.[89] The foundation for the parametric policies themselves—the inputs—are measured and released to the public domain by entities completely independent from the Facility.[90] Additionally, because the CCRIF is structured as a non-profit entity, functioning much like a mutual insurance company, it is not required to pay dividends; all of its reserves go to its primary objective of insuring CARICOM governments.[91] The Facility is set to gain strength financially as time goes on, because it will have to commit less and less of its reserves to purchasing its own reinsurance; it can retain more of its own risk. Retention of more reserves and risk stabilizes insurance costs for its insured countries.[92]

As is seen above, the CCRIF is effective in pooling the interests of Caribbean governments. The CCRIF can also serve as a sort of a 'tip of the umbrella' in other collaborative efforts. One such example is the CCRIF's efforts to develop adaptation strategies to a risk as yet not covered by its parametric policies—that of flooding in the Caribbean. Responding to its insured countries needs, the CCRIF is developing an excess rainfall derivative that will have a parametric trigger just as the hurricane wind and earthquake policies, though it may be packaged into a catastrophe bond.[93] The development of such a financial product is crucial to the Caribbean and other similarly-situated locales because many of the same liquidity crises arise

[89] Id. at 9.
[90] Id.
[91] Id. at 8.
[92] Id.
[93] Sarah Hills. "Caribbean develops weather derivative for excess rainfall." Reuters. October 28, 2009.

from damages by floods as do catastrophic windstorms and earthquakes. The flooding product would cover some catastrophic hurricanes that might otherwise be missed by the CCRIF now; indeed, the prompting for such a product arose from an insured country's—Haiti's—experience with successive tropical storms and hurricanes which did not trigger the wind policy but nonetheless battered the impoverished country with torrential rainfall.[94]

V. Current U.S. "Coastal Wind Pool" Insurance Model

At its foundation, the current U.S. "Coastal Wind Pool" insurance model for coastal property owners on the Atlantic and Gulf coasts emerged from solutions originally intended to address the decreasing property insurance availability in urban America as a result of the civil unrest of the 1960s.[95] Without insurance availability, poor communities (coastal or non-coastal) with already low property values will plummet even further into economic despair. Additionally, accusations of redlining proliferated as insurers withdrew from 'riot-potential' areas.[96] The federal government facilitated the formation of 'FAIR Plans' in states to serve as 'insurers of last resort' to inner-city communities. Congress responded by passing the Urban Protection and Reinsurance Act of 1968.[97] A federal mandate issued from this Act to the states to form programs which would alleviate this insurance crisis. The United States Department of Housing and Urban Development, the federal agency responsible for assisting the state's in development of these programs, designated several urban community centers as eligible for a

[94] Id.
[95] Urban Property Protection and Reinsurance Act, P.L. 90-448, Title XI, 82 Stat. 555, 12 U.S.C. §§ 1749bbb-1749bbb-21 (1982).
[96] 'Redlining' is a term to describe an improperly discriminatory practice where insurers or bankers refuse to insure or lend, respectively, based solely on demographic information such as the racial or ethnic makeup of a community.
[97] P.L. 90-448, Title XI, 82 Stat. 555, 12 U.S.C. §§ 1749bbb-1749bbb-21 (1982).

since-expired federal reinsurance program, in return for states developing these residual markets.[98]

The common model for FAIR Plans quickly became the common model for Coastal Wind Pools in the southeastern United States. Coastal Wind Pools are statutorily-created residual market associations responsible for insuring property against windstorm and hail losses in the beach areas of coastal counties as designated by the states' legislatures.[99] Memberships in these separate coastal underwriting associations are a requisite to writing any property insurance in North Carolina, South Carolina, Florida, Alabama, Mississippi, Louisiana, and Texas.[100] As is often the case in the United States, insurance rates are not left solely to market forces, but instead are regulated by state departments of insurance. This regulation is necessary, to a certain degree, due to the nature of information-pooling between insurers; it is critical to avoid incidental or intentional price-collusion on the part of insurers.[101] However, rates have not kept up with the rising level of exposure these associations face. Therefore, the financial structure of the Coastal Wind Pool puts private insurers in a precarious business position by requiring a heightened risk exposure resulting from artificially discounted premiums and deductibles.[102] In addition, artificially low rates make living on the coast more economically viable than it should be in relation to the risk of living on the coast. This has a reverse-adaptation and reverse-mitigation

[98] Id. Only half of the fifty states retain these FAIR Plans today; most of the states which don't are concentrated in the Great Plains and Rocky Mountains.
[99] N.C. Gen. Stat. § 58-45-5(2); N.C. Gen. Stat. § 58-45-5(2a). (Definitions of "Beach area" and "Coastal area"); N.C. Gen. Stat. § 58-45-10.
[100] N.C. Gen. Stat. § 58-45-10; S.C. Code Ann. § 38-75-330(B) (2008); Fla. Stat. Ann. § 627.351(2)(b)(2)(a)(I) (2009); Code of Ala. § 27-1-24(a) (2009); Miss. Code Ann. § 84-34-3(3) (2009); La. R.S. 22:2293(A) (2009); Tex. Ins. Code § 2210.006(a).
[101] Abraham, *supra* at 5-7.
[102] John Murawski, *Storm rules push out insurer*, Raleigh News & Observer, Aug. 15, 2008.

effect; instead of retreating from the coast (one adaptation strategy) or building stronger structures on the coast (*the* most important hazard mitigation strategy), there is a demand for quick and profit-driven infrastructure build-up, ultimately resulting in more people and more dollar exposure than any series of insurers can handle, let alone one 'insurer of last resort.'

If a typical insurer doesn't have enough reserves, collect enough premiums and reinsure enough to cover against the probable maximum loss ("PML"), it puts itself in risk of insolvency. However, under the Coastal Wind Pool model, the statutes creating these entities essentially do not allow them to go insolvent. Instead, any losses past what a particular Coastal Wind Pool can endure are typically assessed against its member insurers based on a proportional calculation of the member insurer's net direct premium written in the non-coastal area of the state.[103] These losses are assessed against the member insurers and, after a certain amount, are explicitly passed along as surcharges to policyholders across the entire state.[104]

Striking a careful balance of interests is critical for the Coastal Wind Pool association itself, the state insurance regulator, and the state legislature. The issue of assessments is of particular sensitivity because, if over-exposed to non-recoupable assessments, insurers are going to be discouraged from writing insurance at all in other parts of the given state, but if allowed to pass on too many assessments to non-coastal policyholders, there will be an unfair level of subsidization by non-coastal policyholders to coastal policyholders. To effectuate long-term stabilization in coastal insurance markets, there needs to be a different solution than the current *post hoc* recovery the assessment strategy of Coastal Wind Pools mandates.

[103] *See, e.g.,* N.C. Gen. Stat. 58-45-46.
[104] Id.

VI. National Catastrophe Risk Consortium

Unlike the countries of CARICOM, the United States is not likely to suffer a liquidity crisis due to the impact of a catastrophic hurricane on its shores. Nevertheless, the Caribbean Catastrophe Risk Insurance Facility provides an operative model for creating a similar risk transfer facility for the country. Two bills before Congress, House Resolution 2555 and Senate Bill 505, propose a National Catastrophe Risk Consortium.[105] Most of the remainder of this paper will pivot off of these basic proposals to commend many aspects of the CCRIF and its policies to a U.S. National Catastrophe Risk Consortium ("NCRC" or "the Consortium"). In its conclusion, a separate U.S. Natural Disaster Mitigation Trust will be recommended, with links drawn between it and a NCRC. While the discussion here is limited to catastrophic hurricane coverage in the eastern half of the country, other catastrophes—such as earthquakes, tornadoes, and wildfires[106]—would be eligible under this NCRC. While the further diffusing of catastrophe risk through geographic and peril diversification is a positive, the NCRC or a National Catastrophe Fund has been discussed most prevalently with regard to coastal exposure to hurricanes in the wake of the 'Florida Quartet of 2004'[107] and Hurricanes Katrina, Rita, and Wilma in 2005.

[105] H.R. 2555, Title I (2009); S. 505, Title I (2009). Both bills, to date, have not moved past committee. However, this Consortium is to be what was originally envisioned as the National Catastrophe Fund, which both 2008 Presidential candidates supported.

[106] While earthquakes are unrelated to global climate change, tornadoes and wildfires will continue to increase as a result of the warming planet. *See*, IPCC Report: Summary for Policymakers, *supra*.

[107] The 'Florida Quartet of 2004' refers to the four hurricanes that struck Florida in 2004: Hurricanes Charley, Frances, Ivan, and Jeanne. Less than 24 hours before Hurricane Charley made landfall, Tropical Storm Bonnie made landfall in Florida as well.

Just as the CCRIF has enhanced risk-modeling and risk information-sharing in the Caribbean, so would the NCRC. Before discussing any direct financial adaptation roles the Consortium would fill, its role as a catalyst for improved knowledge on U.S. catastrophe risks should be discussed. The Coastal Pool insurance model—that of individual state residual market entities—does not provide the same capacity for information-sharing. The bills before Congress make this role of information sharing explicit, describing one of the Consortium's functions as being a "central repository of State risk information that can be accessed by private-market participants seeking to participate in the transactions (of reinsurance contracts and catastrophe securitization)."[108],[109] Additionally, in order to promote standardization within the "risk-linked securities market," the NCRC is responsible for "establish(ing) a catastrophe risk database to perform research and analysis."[110] Increased standardization of the catastrophe securities market would accelerate the usage of this vital form of financial adaptation because, as it stands now, the market is cumbersome as all issues are individualized contracts. If standardization meets market demands, the speed at which catastrophe securities are issued will increase as currently high transaction costs, related to customized contracts, plummet.

The Congressional NCRC would not provide liquidity to the governments of the United States or the several states after an insured catastrophe hits. Indeed, as proposed in Congress, it would not provide direct insurance policies to anyone. Instead, in respect to individual state

[108] H.R. 2555 § 102 (4); S. 505 § 102 (4).
[109] *See, e.g.,* George Davis, *Reliable Catastrophe Modeling Results Require Reliable Exposure Data*, ISO Review. August 2008. Available at: http://www.iso.com/Research-and-Analyses/ISO-Review/Reliable-Catastrophe-Modeling-Results-Require-Reliable-Exposure-Data.html
[110] H.R. 2555 § 102 (5); S. 505 § 102 (5).

residual property insurance mechanisms (e.g., Coastal Pools), the Congressional Consortium would, "at the discretion of the affected members and on a conduit basis, issue securities and other financial instruments linked to the catastrophe risks insured or reinsured through members of the Consortium in the capital markets."[111] Both bills mandate that the NCRC could not assume risk.[112] As proposed, the Consortium is voluntary for qualifying state residual markets; this should sustain throughout its creation.[113] However, to more effectively pool risks, the NCRC should be able to sell policies with a parametric trigger to participating state residual markets, just as the CCRIF insures participating countries themselves.

If permitted to write policies, the NCRC becomes a sort of catastrophic reinsurer for state residual markets, instead of a mere conduit between these residual markets and the reinsurance market. As extrapolated on below, this direct financial interest legitimizes the Consortium and enables it to act as the same 'tip of the umbrella' as the CCRIF in developing financial adaptation and hazard mitigation solutions. The Congressional NCRC's inability to take on risk by itself is a fundamental difference between the current U.S. proposal and the CCRIF. This difference should be amended; the NCRC should be able to write policies to qualifying state residual pools. With the CCRIF, parametric policies reduced the probable maximum loss of a 1:200 year hurricane by 76% from the aggregate probable maximum loss of CARICOM countries, if these governments were forced to approach the market individually.[114] Without an insurance policy attaching the residual market participants to the NCRC, maintaining a strong,

[111] H.R. 2555 § 102 (2); S. 505 § 102(2).
[112] H.R. 2555 § 102 (6); S. 505 § 102 (6).
[113] H.R. 2555 § 101(d); S. 505 § 101(d).
[114] The World Bank, *Results of Preparation on the Design of a Caribbean Catastrophe Risk Insurance Facility, supra* at 7-8.

diversified risk profile when approaching the reinsurance and capital markets may not prove efficacious as intended. The legislative phrase "at the discretion of the affected members" may frustrate the Consortium's objective to diffuse risk by geography and disaster. Instead, if state residual market entities are paying actuarially-sound premiums to the NCRC, and the NCRC can purchase traditional reinsurance market and issue catastrophe bonds and derivatives as the CCRIF does—as a special purpose reinsurance vehicle—the same dramatic reduction in hurricane probable maximum losses can be expected.

Additionally, by issuing parametrically triggering policies, there will not be inappropriate cross-subsidization of riskier state insurance markets. The increased transparency of when parametric policies trigger will increase the probability that more U.S. state residual market entities will want to be become participants of the Consortium. Legislators constructing the NCRC must take care to acknowledge the several states' distinct catastrophe risks; they must battle any perception that the NCRC is being designed as a "Florida Financial Preservation Intervention," rather than a meaningful mechanism of financial adaptation to the threats associated with our changing climate. Potential participants in the Consortium from other states (as proposed before Congress or proposed here in this paper) will need to have confidence that Florida, Texas, and other heavily exposed states are paying in relation to what it intends to get out. As discussed before, the parametric trigger helps to ensure this confidence level; premiums are commensurate with the insured state residual market entity's individual risk profile, the inputs which would trigger the policy are objective and available for public consumption, and risk is limited to a certain percentage of the worst-case scenario.

Anticipating what would be an especially sensitive objection considering the recent government bailout of financial institutions, it is important to clarify at this point what recommended relationship the Federal Government would have to risk incurred by the NCRC. Both bills in Congress specifically state that "the Consortium is not a department, agency, or instrumentality of the United States Government."[115] Of course, as already pointed out, both bills also deny the Consortium the right to incur its own risk. Further, the bills, in § 107 of each, deny the U.S. government from any liability of the "actions of the Consortium" and reiterates that the Consortium is a mere intermediary between the participating states and the traditional reinsurance and capital markets. If the Consortium were to be permitted to write reinsurance policies directly to state residual market entities, the currently proposed independence from the Federal Government should hold; no liability should attach to the Government if the Consortium were to become insolvent. However, here again, the United States can look to the experience of the CCRIF. As previously discussed, by retaining most of its annual reserves and by investing in traditional reinsurance and in the capital markets, through catastrophe securitization, the CCRIF can endure an 1:1000 event—it does this insuring a group of small island countries in a body of warm water prone to catastrophic hurricanes.

Currently, both bills propose that a Board of Directors supervise the NCRC, just as the CCRIF and many state Coastal Wind Pools are supervised. Under the Congressional proposal, the Secretary of the Treasury would be the Chairman of the Board.[116] The Secretaries of Commerce and Homeland Security would serve as directors until two states' residual market

[115] H.R. 2555 § 101(b); S. 505 § 101(b).
[116] H.R. 2555 § 105(a)(2); S. 505 § 105(a)(2).

entities join the Consortium.[117] At such a time, each participating state would have a representative on the Board (presumably even if all fifty states had residual market entities that were to eventually join the Consortium). Instead, since insurance is regulated at the state level in the United States, the NCRC should be exempted from state regulation and be regulated by the Secretary of the Treasury. The Board of Directors of the NCRC should be limited to manageable number, while being representative of the participating states, the insurance industry, and consumer advocates. In addition to general supervisory roles, the statute creating the Consortium should compel the Board to expressly consider financial adaptation and hazard mitigation in its decision-making.

Like the CCRIF, the NCRC would be a nonprofit entity.[118] Thus, it is not subject to paying dividends, making the Consortium more economical. If, as recommended in this paper, the NCRC were to be empowered to write parametric catastrophe policies related to the state's risk, the cost-effective nature of parametrically triggered policies would allow what it collected from premiums to accumulate as reserves quicker. As with the CCRIF, so long as there is a sufficient diversification of assets, when reserves are built up, more money is saved on traditional reinsurance contracts and catastrophe securitization contracts. This makes the insurance entity less prone to market fluctuations and drastic premium increases. Essentially, as premium reserves in a nonprofit, parametric catastrophe (re)insurer go up, downstream primary

[117] H.R. 2555 § 105(a)(3); S. 505 § 105(a)(3).
[118] H.R. 2555 § 104(a); S. 505 § 104(a).

insurance rates[119] should decrease as a result of increased security in the (re)insurers ability to sustain a catastrophic loss.

Here policymakers are confronted with a fundamental tension at stake in the availability of coastal property insurance in the United States. The primary stated purpose in the subheading of H.R. 2555 reflects a growing national debate that has been taking place in individual states; that stated purpose is: "To ensure the availability and affordability of homeowners' insurance coverage for catastrophic events." As has been discussed in this paper, rising levels of coastal development are exasperated by the risk that global climate change is going to increase both the number and intensity of Atlantic hurricanes. How much do we as a society *want* to promote the availability and affordability of homeowners' insurance policies in places private insurers *already* do not want to write policies? To be pragmatic, a balance must be sought. A NCRC that writes parametrically triggering insurance policies is a market-based solution that would, on one hand, promote the stabilization—and thus availability—of insurance markets in places of high-risk (especially the Atlantic and Gulf coasts), while on the other hand, promoting financial adaptation and hazard mitigation, through the pooling together of those financially interested in the coastal markets. The bills before Congress require that only state residual market entities be eligible for the Consortium. However, these entities are, by definition and statutory decree, "insurers of last resort."[120],[121] If the purpose of the bill is to actually cheapen insurance rates on the coasts, then private insurers should have access to the Consortium for policies written in

[119] "Primary insurance" here is the traditional, indemnity-based insurance offered to individual policyholders.
[120] H.R. 2555 § 101(d); S. 505 § 101(d).
[121] *See, e.g.*, N.C. Gen. Stat. § 58-45-1(b).

areas with a high risk of catastrophe.[122] By doing this, the same coastal residents and business owners are receiving needed insurance coverage and the above-described stabilization would result in reduced rates from private insurers. All coastal insurers then have access to the information-sharing capabilities of the Consortium. If the private insurance market has access to this information, and is contributing to it, the result will be an enhanced ability to accurately price risk. Thus, this will enhance the industry's willingness to voluntarily enter the coastal markets. This joins the purpose of a NCRC with the purposes of state residual market entities, but does so in such a way that can further—not frustrate—financial adaptation and hazard mitigation.

NCRC Would Make Explicit the Common Interest in Hazard Mitigation

The more interests pulled into the CCRIF-like Consortium, the more groundwork is laid for comprehensive hazard mitigation. Several bills, including H.R. 2555 and S. 505, are aimed at increased access to hazard mitigation in the U.S.[123] Several southeastern states have taken on hazard mitigation as an issue central to the states' coastal insurability crises. Florida and South Carolina each have hazard mitigation grant programs related to strengthening homes against wind.[124] Mississippi has passed legislation to study the creation of such a grant program.[125] Louisiana has announced a mandatory wind hazard mitigation insurance discount for all property

[122] These policies, of course, would have to include the catastrophe as a covered peril.
[123] *See*, H.R. 3026 (The Hazard Mitigation for All Act of 2009); H.R. 3027 (Predisaster Hazard Mitigation Enhancement Program Act of 2009); H.R. 3028 (First Responder Innovation and Support Act of 2009). All of these bills were introduced by Rep. Bennie G. Thompson (D-Ms.).
[124] *See*, Fla. Stat. Ann. § 215.559 (http://www.mysafefloridahome.com/); S.C. Code Ann. § 38-75-480 (http://www.scsafehome.sc.gov/).
[125] Miss. Code Ann. § 83-1-191.

insurers to follow.[126] North Carolina has required its residual market entity to create a mitigation discount schedule for the entity's policyholders by May 1, 2010.[127] Insurers have also acknowledged the need for project mitigation through the insurance industry funded Institute for Business and Home Safety's Fortified for Safer Living standards.[128]

Though precise benefit valuation in any cost-benefit analysis is difficult, the debate on hurricane wind hazard mitigation has produced the consensus that damage exposure is reduced when structures and other infrastructure in harm's way are retrofitted or built to certain strengthened parameters.[129] While the beneficial ratio varies from $1.50 in the case of a recent Risk Management Solutions ("RMS") study on the My Safe Florida Home program[130] to $4 on a 2006 analysis of FEMA Wind Hazard Mitigation grants[131], the conclusion holds that certain activities tangibly reduce risk of damage. Because the costs of hazard mitigation are borne upfront, the longer one has a financial interest in the mitigated property, the greater the return on the vested actor's investment. A complication for hazard mitigation is that though it is cost-

[126] La. Reg. § 12701 *et seq.*
[127] N.C. Gen. Stat. § 58-45-45(e) (2009).
[128] *See*, http://www.disastersafety.org/
[129] *See e.g.*, "Travelers Coastal Wind Zone Plan" Travelers Institute, July 2009, p. 9, available at: http://www.travelers.com/iwcm/Trv/docs/TRV_Coastal_Wind_Zone_Web.pdf; "Analyzing Effects of the My Safe Florida Home Program on Florida Insurance Risk" RMS, May 14, 2009, available at: http://www.rms.com/publications/RMS_MSFH_Report_May_2009.pdf; Adam Rose, et al., *Benefit-Cost Analysis of FEMA Hazard Mitigation Grants*, January 24, 2006, available at: http://econ.appstate.edu/RePEc/pdf/wp0602.pdf; Philip T. Ganderton, *Benefit-Cost Analysis of Disaster Mitigation: Application as a Policy and Decision-Making Tool*, 10 Mitigation and Adaptation Strategies for Global Change, 445 (2005).
[130] This study was limited to what *has* been done in Florida thus far. It concludes that the My Safe Florida Home grant program has reduced the PML in the entire state for a "1:100" year storm by $1.50 for every $1 spent. RMS noted that, "less than 1% of the 4.9 million homes in the state of Florida have been retrofitted under the program." That figure increases significantly, if the grant program focuses on mitigating more homes that are at a higher risk of loss.

beneficial to invest in certain proven construction and retrofit techniques, the property owner—especially a homeowner—often does not have the expendable income to invest in retrofitting the property. Additionally, the homeowner may not have the long-term interest seemingly assumed to get a high rate of return on the mitigation project. The coastal structure's current insurer would be hesitant to invest in the mitigation project because of the annual nature of the insurance contract; the insurer could invest in the mitigation project, only to have another insurer steal the policyholder away, reaping the benefits of the first insurer's investment. However, an entity such as the NCRC—particularly acting as a reinsurer with access to both state residual market entities and the private market—helps ameliorate this problem if it is successful in significant participation. Suddenly there would be a market mechanism that not only, in a way, financially tied every coastal property to every property insurer, but as discussed earlier, its role as an information-center and research catalyst could make a National Mitigation Grant Program possible.

The NCRC would be especially useful in a 'tip-of-the-umbrella' role in producing agreement on what hazard mitigation projects improve structural sustainability when catastrophe strikes. The Consortium will also be ideal to bring all vested actors together in researching and developing particularly cost-beneficial *process* mitigation. Whereas project mitigation generally focuses on strengthening individual structures' ability to sustain catastrophe (e.g., strengthening the roof of a particular house), process mitigation looks at the broader community's ability to build sustainable infrastructure and provide consistent vital services during and after catastrophe (e.g., strengthening communication and utility infrastructure to withstand a catastrophe and

strengthening building codes overall).[132] The CCRIF has a direct financial like to process mitigation by virtue of its providing de facto 'business interruption' insurance to participant governments, and the NCRC would have a direct financial link to project mitigation by virtue of its link to residual market entities.[133] However, the NCRC also would have an interest in process mitigation activities, especially if in the business of writing catastrophe reinsurance policies to private insurers as well as state residual market entities. Private insurers—especially large insurance companies—often offer customers more than one type of insurance and many of these, such as business interruption, health, and life—are affected by what happens in a community immediately after a hazard. It is thus in the financial interest of all insurers to ensure that communities are able to respond to catastrophes quickly.[134] The Consortium, as discussed above, has a responsibility to act as an information-sharing mechanism; research regarding effective project and process hazard mitigation should be part of its roles, in conjunction with a separate National Mitigation Grant Program. Hazard mitigation must become a national policy, with all vested parties involved in determining how to effectively strengthen building codes and increase access to the retrofitting of current infrastructure to survive catastrophic events, particularly hurricane winds.

CONCLUSION

Increasing sea surface temperatures substantially threaten to produce frequent and intensifying Atlantic hurricane seasons. U.S. policymakers must be prepared to make difficult

[132] *See, e.g.*, Rose, *supra* at 9-11.
[133] This connection to project mitigation holds whether or not the NCRC is able to write parametric policies as suggested in this paper.
[134] *See, e.g.*, Marty Ellingsworth and Bill Raichle, *It takes a village: Effects of Community Attributes on Insured Loss*, ISO Review, Feb. 2009.

choices with regard to adapting our coastal way of life to the realities of a globally changing climate. Financial adaptation to climate change can occur with an expansion of current catastrophe securities market and through the creation of a National Catastrophe Risk Consortium. Parametric policies have developed in both securities markets and the Caribbean Catastrophe Risk Insurance Facility as a response to the need to limit risk portfolios while providing immediate liquidity to insured entities—governments in the case of the CCRIF and primary insurers in the proposed NCRC. Whether parametric policy writing capabilities are given to the NCRC by Congress as suggested in this paper, or not, the CCRIF should serve as a 'best practice' model to policymakers in developing a NCRC for the U.S., and in innovating financial adaptation and hazard mitigation solutions across the climate changing globe.