NAIC Enhances P/C RBC Formula for Catastrophe Risk Charges

By Anne Obersteadt, CIPR Senior Analyst

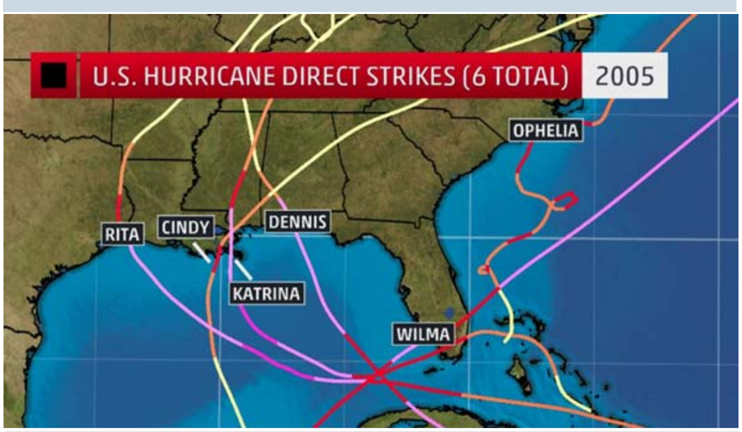
NAIC risk-based capital (RBC) provides a measure of minimum insurer capital adequacy and thus serves as an important part of the U.S. solvency framework. The NAIC RBC formula has undergone a number of enhancements during its use over the past two decades. In recognition of the evolving risk landscape, the NAIC's current focus has been on adding granularity to its reporting categories or expanding the risks quantified in the RBC formula. Among the most significant recent updates is the addition of a charge in the property/casualty (P/C) RBC formula for catastrophe risk from the hurricane and earthquake perils for the 2017 reporting year. This article will focus on how the P/C RBC catastrophe risk charge was developed, the need for it and how its addition has been incorporated into the formula.

◆ Record Catastrophes Heighten Awareness

The 2004 Atlantic hurricane season resulted in record-breaking property damage of more than $40 billion in states from Florida through North Carolina. The season marked the end of a decade of relatively quiet tropical storm activity in the U.S. By the end of the year, 15 storms and 9 hurricanes had impacted the U.S. Of the five hurricanes which made landfall in the U.S., three were category 3 or stronger major hurricanes: Charley; Ivan; and Frances.[1]

The 2004 record was easily surpassed by the 2005 Atlantic hurricane season. In a seven-month span, 28 storms and 15 hurricanes engulfed the Atlantic basin. Six of these hurricanes hit the U.S. in 2005, four of which (Dennis, Katrina, Rita and Wilson) were Category 3 or stronger. Figure 1 displays the U.S. hurricane tracks for 2005. Economic losses from the four major hurricanes which made landfall are estimated to be more than $143 billion, making this season the most destructive in history.[2]

Figure 1: U.S. Hurricane Tracks, 2005



Source: Weather.com

The severity of losses in 2005 resulted in large part from Hurricane Katrina. This hurricane alone caused $108 billion of destruction across seven states (primarily Louisiana, Mississippi and Alabama), making it the costliest U.S. hurricane. Much of the damage actually arose from Hurricane Katrina's storm surge, which reached a record height of 27.8 feet and breached the levees protecting New Orleans. Hurricane Katrina took more than 1,200 lives, making it one of the most deadly hurricanes to date.[3]

The most intense hurricane recorded in the Atlantic Basin, Hurricane Wilma, also occurred in 2005. Its barometric pressure reached a historic low of 882 millibars before making landfall on the U.S.[4] The hurricane resulted in five deaths and damage of $16.8 billion in southern Florida. Hurricane Rita was the year's third Category 5 hurricane, impacting mostly southwestern Louisiana and southeastern Texas. It also produced an estimated 90 tornadoes across the southern states. Hurricane Rita claimed seven lives and destroyed $10 billion in property in the U.S. Hurricane Dennis was the first major hurricane of the season, setting a short-lived record for the earliest arriving major Atlantic hurricane. Luckily, the hurricane moved through quickly and resulted in only $2.2 billion in damages, mostly across the Florida Panhandle, and the loss of three lives in the U.S.[5]

◆ Insurance Industry Responds

Two consecutive record-shattering Atlantic hurricane seasons raised awareness of the hurricane risk in the insurance industry. According to Munich Re, tropical cyclones resulted in global insured losses of $30 billion in 2004 and more than $80 billion in 2005.[6] As illustrated in Figure 2 on the following page, U.S. insured losses from the three costliest hurricanes to make U.S. landfall totaled more than $19 billion in 2004 and more than $57 billion in 2005. Both hurricane seasons were marked by unusually high early-season activity, peak intensity, new tracks and a record number of tropical cyclones.[7]

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[1] Machos, G. (2004). *Summary of the 2004 Season*. Retrieved from *www.hurricaneville.com/2004.html*.

[2] Dolce, C. (2015, June 8). *2005's Record-Breaking Hurricane Season: By the Numbers*. Retrieved from *https://weather.com/storms/hurricane/news/2005-hurricane-season-by-the-numbers*.

[3] Ibid.

[4] Barometric pressure (atmospheric pressure) is used to measure the strength of a hurricane. The lower the pressure in a hurricane, the stronger its winds.

[5] National Hurricane Center (n.d.). *Hurricanes in History*. Retrieved from *www.nhc.noaa.gov/outreach/history.*

[6] Munich Re. (2006). Topics Geo, Annual Review: Catastrophes in 2005. Retrieved from *www.preventionweb.net/files/1609_topics2005.pdf*.

[7] Ibid.

FIGURE 2.
2004–2005 COSTLIEST ATLANTIC HURRICANES

Dates	Hurricane	Affected Area	Overall Loss	Overall Insured Loss	U.S. Insured Loss (000's)
Aug. 2005	Katrina	LA, MS, AL, FL	125,000	62,200	41,100
Oct. 2005	Wilma	BS, CU, HT, JA, MX, USA	22,000	12,500	10,300
Sept. 2005	Rita	FL, LA, MS, TX	16,000	12,100	5,627
Sept. 2004	Ivan	FL, AL, CARGO	23,000	13,800	7,110
Aug. 2004	Charley	FL, CU, JA, KY	18,000	8,000	7,475
Sept. 2004	Frances	FL, BS, CA, KY, TC	12,000	5,500	4,595

Source: Overall Figures: Munich Re, NatCatSERVICE, 2015; U.S Figures: Property Claim Services (PCS).

In response, insurers, regulators, vendors and rating agencies implemented new assumptions and tools into their risk-management frameworks. Among these was more attention to cumulative losses and the impact of multiple storms in a single year. For example, one out of five Florida residential buildings in 2004 was estimated to be damaged from the impact of four hurricanes in the same season.[8] Often, insurance adjusters were unable to assess damage before the next hurricane struck.

State Legislative Changes

The state of Florida passed new legislation in 2004 to address the issues raised by cumulative losses from consecutive storms. The new legislation effectively made policy deductibles aggregate by reimbursing homeowners for multiple deductibles applied in a single season. Beginning with the 2005 season, Florida also restricted insurers to the application of a single deductible. Additionally, Florida passed legislation requiring the Florida Office of Insurance Regulation be given access to insurers' actuarial assumptions and factors before the Florida Commission on Hurricane Loss Projection Modeling (FCHLPM) determined them to be reliable enough to be used in a rate filing.[9]

Insurer Policy and Coverage Changes

Insurers also revised their policy language and underwriting guidelines. The changes reflected lessons learned from the treatment of flood coverage in wind-only policies in the aftermath of storm surge flooding. Often, the ability to distinguish damage from wind or water was difficult, especially in cases of total destruction. Insurers found they were responsible for damage they believed should have been covered under National Flood Insurance Program (NFIP) policies. As a result, insurers reworded policy contracts to better differentiate between wind and water losses or to exclude flood coverage altogether. Higher deductibles and lower wind limits were also common.[10]

Catastrophe Model Changes

Catastrophe model vendors made significant updates to their U.S. hurricane models in 2006. At the time of the 2004–2005 hurricane seasons, catastrophe models were designed to apply demand surge on the occurrence of single events. Demand surge is the inflationary effect of repair costs from a shortage of labor and materials following a catastrophe or series of catastrophes. This single event view resulted in modeled losses drastically underrepresenting the inflationary effect of actual demand surge from multiple events in back-to-back hurricane seasons. Vendors responded by incorporating aggregate demand surge in their catastrophe models, which remains the standard today. Vendors also added near-term views of risk options to incorporate the potential for warm waters to alter historical results. Additionally, many modelers updated their storm surge models and vulnerability functions to include new experience data and building-performance characteristics.[11]

Rating Agency Changes

Rating agencies also took significant steps after these hurricane seasons by revising their rating requirements and expanding the data required from insurers. Fitch Ratings moved from a single-point view of risk to focusing on tail value at risk (TVaR), which is an average measure of all the modeled losses above a specified threshold. A.M Best began requiring insurers to take ancillary lines of business into account. They also required insurers to include options for storm surge, fire following earthquake and demand surge in their loss estimates. Additionally, insurers were required to

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[8] Guy Carpenter. (2004). Ten-*year Retrospective of the 2004 and 2005 Hurricane Seasons*. Retrieved from *www.guycarp.com/content/...content/Ten-Year_Retrospective_of_the_2004_and_2005_Hurricane_Seasons_Part 1_pdf*.
[9] Ibid.
[10] Ibid.
[11] Ibid.

provide exposure information on aggregate insured value. Standard & Poor's (S&P) moved from a 100-year loss to a 250-year aggregate catastrophe loss to assess the capital charge for reinsurers with property catastrophe risk. A.M. Best, S&P and Moody's began to require a near-term view of hurricane event frequency.[12]

NAIC RBC Enhancements

Existing Framework:
State insurance regulators also recognized the need for insurers to hold enough capital to remain solvent in the face of severe catastrophe losses. The NAIC's RBC framework, adopted in 1992, serves as a risk-based measure of capital adequacy relative to the underlying risk of the insurer's business and asset quality. An insurer's RBC ratio is its total adjusted capital assessed against its total RBC; i.e., the amount of capital determined to be adequate for its size and risk.

The RBC framework sets a minimum ratio threshold for regulatory action. When an insurer's RBC ratio is found to be inadequate, state insurance regulators can step in and take various corrective actions to help prevent insolvency. However, prior to the changes coming for year-end 2017 reporting requirements, the P/C RBC formula did not include a charge specific to catastrophe risk. Instead, catastrophe risk was embedded in the underlying data used to develop the formula's underwriting risk charge. As such, the P/C RBC formula may have underrepresented catastrophe risk in 10-year periods of relatively low catastrophe experience, and overrepresented it in 10-year periods of high catastrophe experience.

The absence of an explicit catastrophe risk charge in the P/C RBC formula was largely due to the formula's reliance on annual financial reporting statements. The statements did not separately capture catastrophe loss information or growth or geographical concentration of property exposure. Given losses from hurricanes had remained relatively consistent and low, the associated cost and complexity of adding such a charge did not seem material. The severity of the 2004 and 2005 hurricane seasons changed this perception.

Creation of a Subgroup to Address the Issue:
The NAIC Catastrophe Risk (E) Subgroup was appointed the following year to develop a methodology for including catastrophe risk in the P/C RBC formula. After several years of research, discussion and debate, the NAIC membership adopted changes in 2012 to the P/C RBC formula to incorporate a catastrophe risk charge into the formula. The changes were effective for the 2013 reporting period and required insurers to report their catastrophic risk charges for earthquake and hurricane exposures.

The catastrophe risk charge was reported on an informational basis for four years to allow the Subgroup time to examine the impact of the calculation changes on insurers. Finding no significant concerns, the NAIC membership adopted changes in 2016 to fully implement the catastrophe risk charge (Ref #2016-07-CR). As a result, the 2017 reporting year RBC for P/C insurers will reflect this additional charge.

◆ A CLOSER LOOK AT RCAT

RBC Formula
RBC is, in essence, a measure of risk. As such, each major business line (life, health and P/C) has distinct formulas reflecting its specific risk characteristics. The formulas are calculated on the legal-entity level and, in certain situations, at the group level. RBC is calculated using the following steps: 1) apply risk factors to statutory annual statement figures; 2) sum risk amounts and adjust for statistical independence (using covariance formula); 3) calculate authorized control level (ACL) RBC amount; and 4) compare ACL to total adjusted capital (TAC). Ratios generated by the RBC formula are assessed against five stepped levels of regulatory intervention. Figure 3 illustrates these five action levels.

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[12] Ibid.

FIGURE 3: RBC ACTION LEVELS AND RATIOS

No Neg. Trend, No Action	TAC is at least twice its ACL	>200%
Company Action Level	TAC is at least 1.5 times, but less than twice its ACL	150%-200%
Regulatory Action Level	TAC is at least equal to, but less than 1.5 times its ACL	100%-149%
Authorized Control Level	TAC is at least 0.70 times its ACL but less than its ACL	70%-100%
Mandatory Control Level	TAC is less than 0.70 times its ACL RBC	<70%

Note: RBC ratio is TAC divided by ACL RBC (i.e., actual statutory capital divided by estimated minimum capital, or $2 of capital and surplus for every $1 of "risk" at the 200% RBC level).

Catastrophe Risk (Earthquake and Hurricane)

The Rcat component was added to the existing six major risk factors for the 2017 P/C RBC calculation (Figure 4). It should be noted the final catastrophe charge calculation was amended to combine the R6–Catastrophe Risk – Earthquake and R7–Catastrophe Risk – Hurricane components reported on an informational basis during the prior years into one Rcat component. The change simplifies the covariance adjustment formula by allowing additional catastrophe perils to be added to Rcat in the future.[13]

The ACL RBC is one-half of the total RBC after covariance. The total RBC after covariance formula was updated to apply the covariance to Rcat. The charges and covariance adjustment are applied separately because the hurricane and earthquake perils are not correlated. A separate contingent credit risk charge is also included to account for risk of uncollectible reinsurance in a catastrophe.

The new covariance formula is:

R0 + SQRT(R1^2 + R2^2 + R3^2 + R4^2 + R5^2 + **Rcat^2**) = Total RBC After Covariance

Key Approaches for Calculating Rcat

Of primary importance was establishing the best method to quantify catastrophe risk. A summary of the P/C catastrophe risk charge calculation criteria is illustrated in Figure 5. The Subgroup decided there were too many deficiencies in using historical data to develop accurate catastrophe charges. Historical experience does not account for the geographical location of catastrophes or an increase in loss exposure (such as new construction in risk prone areas). Additionally, historical data can be distorted by infrequent and severe catastrophes. Thankfully, the frequency of major hurricanes is too low to satisfy the requirements for statistical predictability. This statement is even more true for major earthquakes.

FIGURE 4.
P/C RBC RISK FACTORS

R0	Asset Risk – Subsidiary Insurers
R1	Asset Risk – Fixed Income
R2	Asset Risk – Equity
R3	Credit Risk
R4	Underwriting Risk – Reserves
R5	Underwriting Risk – Premiums
RCAT	Catastrophe Risk (Earthquake and Hurricane)

Instead, catastrophe models were chosen for their ability to model future catastrophic losses for an insurer based on expected future frequency of catastrophic events of all severities and the insurer's own current property exposures, policy coverage terms and catastrophe reinsurance structure. Insurers are permitted to calculate the catastrophe charge using the Florida Public Hurricane Loss Model (FPHLM) or an AIR, EQECAT, Risk Management Systems (RMS) or Applied Research Associates (ARA) model. They can also use a blend of these models. These five models were chosen because most have been in use for more than 20 years and have undergone many updates and extensive field testing, including those mentioned previously in this article.

Insurers are allowed to use their own set of assumptions, but must attest the model exposure data input and parameters are the same for their internal catastrophe risk management. Additionally, insurers must include with their RBC filing an explanation for the following modeling options and assumptions used in their calculations: 1) time dependency;

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[13] NAIC. (2016, August). *Property and Casualty Risk-Based Capital Newsletter*. (Vol. 20.1). *www.naic.org/documents/committees_e_capad_prbc_related_newsltr_1608.pdf*.

FIGURE 5.
RCAT AT-A-GLANCE

- ✓ Charge Applied to 1-in-100-Year Modeled Loss, Net of Reinsurance
- ✓ Charge Applied Separately to Each Peril and Each Subject to Covariance Adjustment
- ✓ Contingent Credit Risk Charge of 4.8% applied to Reinsurance Recoverables
- ✓ Aggregate Exceedance Probability (AEP) and Occurrence Exceedance Probability (OEP) Modeled Results Permitted
- ✓ Florida Public Hurricane, ARA, RMS, AIR and EQECAT Models Allowed
- ✓ Value at Risk (VaR)
- ✓ Model Inputs and Parameters Identical to Internal Risk Management

2) demand surge; 3) storm surge; 4) fire following earthquake; and 5) secondary uncertainty.

Catastrophe models work by first developing a geographical grid, and placing every one of the insured properties contained in the insurer's portfolio at its precise location on the grid. Next, a great many hypothetical catastrophic events based on the applicable science (meteorology for hurricanes, seismology for earthquakes) are generated and probabilities are assigned to each one. Next, the degree to which the intensity of each event diminishes with distance from the center of the event's greatest intensity is modeled, and the modeled impact of the event is measured for every insured property on the insurer's geographical grid. Based on construction and other characteristics of each individual property, damage estimates are modeled. Finally, an estimated loss for the property due to the modeled event is calculated from the damage estimate and the property's insurance coverage information.

These estimates are summed over the entire grid to get an aggregate modeled insured loss for the event as a whole. At this point, the modeled events can be sorted by size to form an exceedance probability curve for the probability of a loss exceeding a certain amount in a year. When the exceedance probability is expressed as the number of years between times when such an amount might be exceeded, it is called a "return period." The probability-weighted average of all of the modeled events can also be calculated; this yields the average annual loss (AAL), or the expected loss per year, a value needed for ratemaking applications.

In keeping with the function of RBC as a measure of minimum capital, the catastrophe risk charge is based on the 1-in-100-years' modeled hurricane and earthquake loss level, net of reinsurance. However, there was concern this loss level would be insufficient to contain extensive losses on the level of those experienced during Hurricane Andrew. To address this concern, insurers will also be required to report their modeled losses at the 1-in-250-years' and 1-in-500-years' levels in their annual RBC report on an informational basis.

◆ REMOVING DOUBLE-COUNTING IN THE RBC FORMULA

As mentioned earlier, catastrophe losses are embedded in an insurer's reported loss figures. To avoid double-counting, historical hurricane and earthquake losses must be removed from the industry and company loss numbers used in the Underwriting Premium Risk Charge (R5) portion of the formula. Industry figures will be adjusted using by-line catastrophe loss information from statistical providers. Catastrophe events will be those reported by the Insurance Services Office's (ISO) Property Claim Services (PCS) for the U.S. and SIGMA and NATCAT for those outside the U.S. Insurers are required to collect and report their domestic and non-U.S. catastrophe losses by annual financial statement line and by accident year. The Schedule P pages of the RBC report were updated in 2012 for these additional catastrophe loss columns. Additionally, the industry factors have been updated to reflect the exclusion of catastrophe losses.[14]

◆ FUTURE CONSIDERATIONS

Catastrophic risk exposure continues to rise due to population growth, higher valued construction in risk-prone areas, and climatic changes. Insures face the potential for increased insured losses from catastrophic events, which could have a significant impact on their solvency. As such, it is important for state insurance regulators to help ensure insurers maintain adequate capital to mitigate against severe catastrophe losses. The addition of a catastrophe risk charge to the RBC for P/C insurers is an important step to accomplishing this.

In 2017, the NAIC membership will consider additional enhancements to the P/C RBC catastrophe risk charge. Should partial privatization of the National Flood Insurance Program (NFIP) occur, the potential risk for private flood insurers could be considerable. For this reason, the NAIC membership may consider adding the flood peril to the catastrophe risk charge and will evaluate the potential to add other catastrophe risks, such as severe storm and tornados, wildfire and terrorism. Important considerations in assessing peril additions is the solvency risk potential and modeling capabilities. The NAIC membership may also consider developing procedures for internal catastrophe model use to calculate the catastrophe risk charge. Finally, the NAIC membership will consider expanding the *Financial Condition Examiners Handbook* to include procedures and best practices for insurer catastrophe management.

ABOUT THE AUTHOR

Anne Obersteadt is a researcher with the NAIC Center for Insurance Policy and Research. Since 2000, she has been at the NAIC performing financial, statistical and research analysis on all insurance sectors. In her current role, she has authored several articles for the CIPR Newsletter, a CIPR Study on the State of the Life Insurance Industry, organized forums on insurance related issues, and provided support for NAIC working groups. Before joining CIPR, she worked in other NAIC Departments where she published statistical reports, provided insurance guidance and statistical data for external parties, analyzed insurer financial filings for solvency issues, and authored commentaries on the financial performance of the life and property and casualty insurance sectors. Prior to the NAIC, she worked as a commercial loan officer for U.S. Bank. Ms. Obersteadt has a bachelor's degree in business administration and an MBA in finance.

[14] NAIC Catastrophe Risk (E) Subgroup. (2010, June 23). Draft Proposal for Risk-Based Capital Charge for Property Catastrophe Risk Based on the Results of Catastrophe Modeling. www.naic.org/documents/committees_ex_isftf_100623_capital_req.pdf. id.

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