

Chicago Fed Letter

Do insurers in catastrophe-prone regions buy enough reinsurance?

by Florentine M. Eloundou Nekoul, associate economist, and Alejandro Drexler, policy economist

To protect themselves from catastrophic losses, insurance companies buy insurance, in the same way that people do. These contracts are called reinsurance agreements, and come in two main forms: proportional and nonproportional contracts. In proportional reinsurance contracts, a reinsurer agrees to repay a fixed proportion of losses incurred by the primary insurer. The simplicity of the agreement makes these types of contracts inexpensive and easy to administer. Therefore, they can be ideal risk-management tools for small insurance companies.

Nonproportional reinsurance contracts, simply put, involve an agreement whereby a reinsurer agrees to pay losses exceeding a certain minimum.¹ These contracts are typically written to protect primary insurers from potentially large or catastrophic losses.² In most cases, insurers combine these two types of reinsurance to protect themselves against the risks they face.

In this *Chicago Fed Letter*, we explore whether insurers in regions that are relatively susceptible to large, natural catastrophes purchase more reinsurance than those in regions where such catastrophes are less likely. In addition, we examine whether the payments that insurers receive from reinsurers are enough to insulate them from catastrophes.

The protection provided by reinsurance is not only important from the insurers' perspective, but also fundamental for protecting the interests of policyholders. Indeed, insurance is effective only

Three of the ten largest hurricanes in United States history occurred in 2005, and 22 property and casualty insurance companies suffered losses that exceeded the sum of premiums collected from their policyholders and their capital.

if insurers have sufficient funds to pay policyholders in the event of financial loss. This may be a trivial concern in an average year, when premiums paid by policyholders are enough to cover insured losses. However, when natural catastrophes occur, losses suffered by policyholders can be several times larger than collected premiums, consuming insurers' capital and, if losses are severe enough, potentially jeopardizing claim payments.

For example, three of the ten largest hurricanes in United States history occurred in 2005, and 22 property and casualty insurance companies suffered losses that exceeded the sum of premiums collected from their policyholders and their capital. Without reinsurance, policyholders might have faced losses from the hurricanes that their insurance company would not have had the financial resources to pay.

1. Top 15 costliest U.S. natural catastrophes, by damages, in 2015 (billions of dollars)

Year	Catastrophic event	Affected U.S. Census division(s)	Property damage	Insured losses
2005	Hurricane Katrina	East South Central, South Atlantic, West South Central	\$131.1	\$48.4
2012	Hurricane Sandy	Middle Atlantic, New England, South Atlantic	77.4	19.3
1994	Northridge earthquake	Pacific	70.4	18.4
1992	Hurricane Andrew	South Atlantic, West South Central	44.8	23.8
2008	Hurricane Ike	East South Central, West South Central	32.5	13.7
2005	Hurricane Wilma	South Atlantic	25.5	12.1
2004	Hurricane Ivan	East South Central, South Atlantic	23.6	8.6
2004	Hurricane Charley	South Atlantic	19.0	9.1
2011	Hurricane Irene	Middle Atlantic, New England, South Atlantic	17.4	4.5
2005	Hurricane Rita	West South Central	14.6	6.6
2001	Tropical Storm Allison	West South Central	12.0	2.5
2004	Hurricane Frances	South Atlantic	11.9	5.6
1972	Hurricane Agnes	Middle Atlantic, South Atlantic	11.9	0.6
1989	Loma Prieta earthquake	Pacific	11.5	1.8
1965	Hurricane Betsy	South Atlantic, West South Central	10.7	3.8

SOURCES: National Hurricane Center and Insurance Information Institute.

How much do catastrophes cost?

Natural catastrophes can cause tremendous damage and pose significant risk to property and casualty insurers. In figure 1, we document the value of property damage wreaked by the 15 costliest natural catastrophes in modern U.S. history. The most costly catastrophe by far was Hurricane Katrina. It caused property damage of \$131.1 billion, of which \$48.4 billion (37%) was covered by insurance. This was more than ten times more costly than the 15th-largest catastrophe, Hurricane Betsy, in 1965. Of course, in addition to varying significantly in size and extent of damage, catastrophes are more likely to occur and occur with greater frequency in certain parts of the country. To illustrate the regional concentration of these events, we include the affected U.S. Census regions in figure 1.³

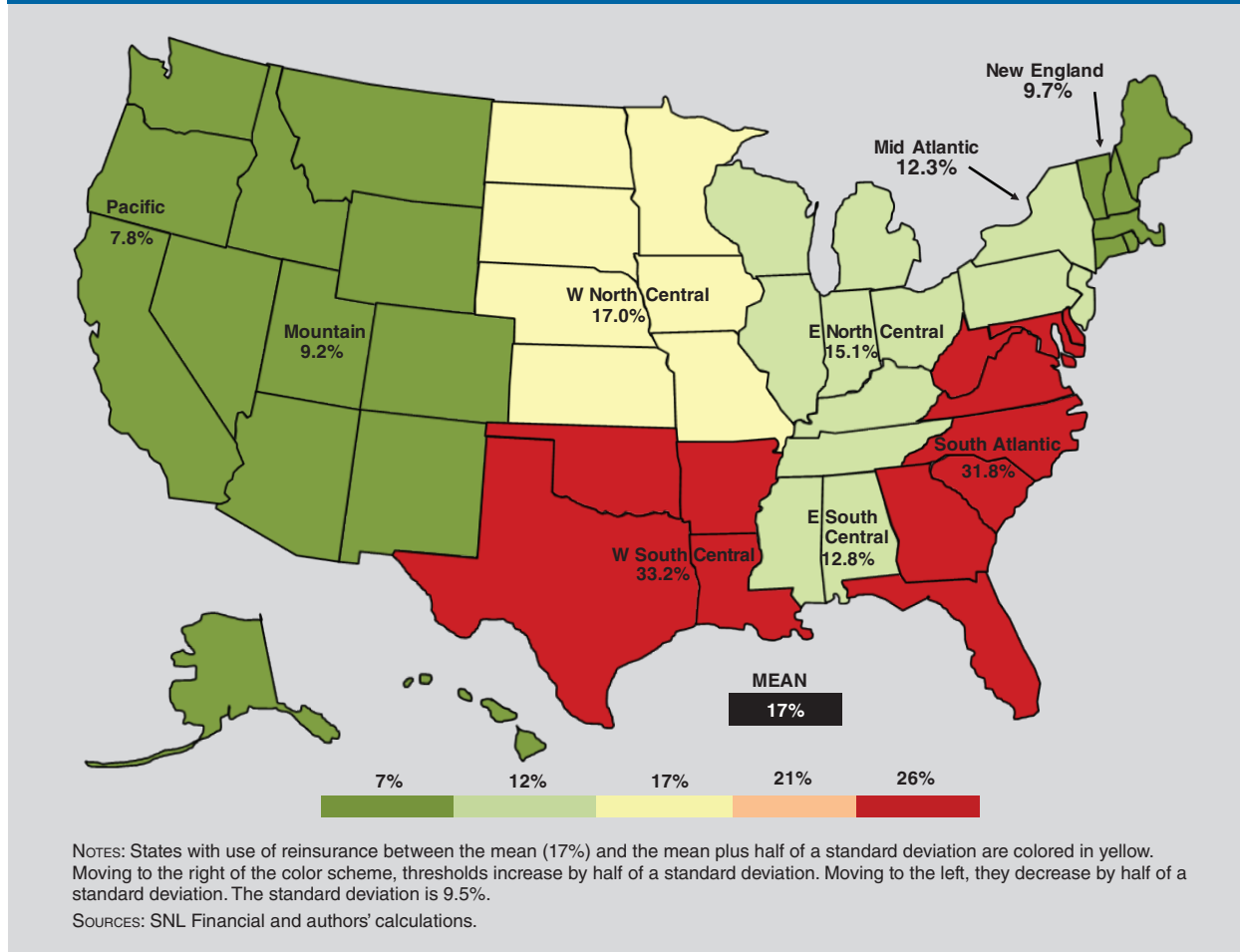
The costliest and most-frequent catastrophic events in U.S. history have been hurricanes. These have been concentrated in the South Atlantic (ten hurricanes) and West South Central divisions (six hurricanes). Given the high incidence of hurricanes, we would expect insurers with a large proportion of their operations in these areas to use the most reinsurance.⁴

How insurers use reinsurance to manage catastrophic risk

To explore how much reinsurance is used in different regions, and specifically to evaluate whether insurers in the South Atlantic and West South Central divisions use more reinsurance, we examine the proportion of insurance premiums that were transferred to reinsurers between 2005 and 2015 in each census division. Because we are interested in firms facing region-specific catastrophe risk, we focus on insurers with more than half of their operations in a single census division.⁵ We do not examine firms that operate across multiple census regions; they are likely to be more diversified, which would tend to reduce their need for reinsurance.

In figure 2, we illustrate the use of reinsurance by insurers with more than half of their operations in a single census division.⁶ We observe that, as expected, insurers with the most operations in the South Atlantic and West South Central divisions used the most reinsurance during this period.

2. Use of reinsurance by census division for insurers with high concentration in one division



Insurers in these regions transferred 32% and 33% of insurance premiums to reinsurers, respectively. Consistently, insurers in census divisions with relatively low risk of catastrophe activity used the least reinsurance. Insurers in the Pacific and Mountain divisions transferred 8% and 9% of insurance premiums to reinsurers, respectively. Given the risk of earthquakes, it might seem surprising that the Pacific division, which includes California, uses so little reinsurance. However, only 10–17% of California residents have earthquake insurance, which means earthquakes can be costly to people, but not so costly to insurers.

How effective is this reinsurance?

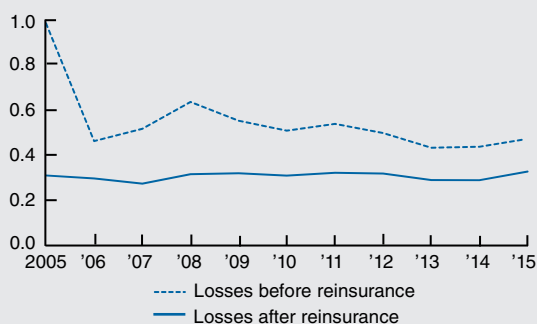
We also examine the extent to which reinsurance is effective in reducing the impact of catastrophes for insurers active in risk-prone areas. To that end, we compare the direct losses experienced by insurers in these areas to the net losses they experience after they receive reinsurance payments. We use the loss experienced by insurers for each dollar of premiums they receive, i.e.:

$$\text{Losses before reinsurance} = \frac{\text{Losses on policies written by the insurance company}}{\text{Premiums written by the insurance company}}, \text{ and}$$

$$\text{Losses after reinsurance} = \frac{\text{Losses on policies written by the insurance company} - \text{transfers from reinsurers}}{\text{Premiums written by the insurance company}}.$$

In figure 3, we plot these measures over time for insurers operating in the two census divisions we identify as having high catastrophic risk, namely the South Atlantic and West South Central divisions. We observe that losses before reinsurance present a great deal of variability—2005 is the year with the most losses for these insurers by far, with 2008 a clear second. On the other hand, after reinsurance,

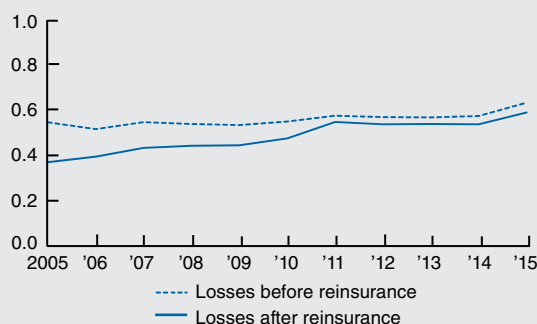
3. Loss ratios for geographically concentrated insurers in risky census divisions, by year



NOTE: Risky census regions are defined as the South Atlantic and the West South Central divisions.

SOURCES: SNL Financial and authors' calculations.

4. Loss ratios for geographically concentrated insurers in safe census divisions, by year



NOTE: Safe census regions are defined as the Mountain, New England, and Pacific divisions.

SOURCES: SNL Financial and authors' calculations.

net losses are much lower and flat. In addition, 2005 is not even the highest net-loss year. This suggests that reinsurance is effective in smoothing the impact of catastrophes for insurers. The fact that losses after reinsurance are a relatively constant share of premiums even when direct losses are large means that reinsurance payments increase more than proportionally with direct losses, highlighting the importance of nonproportional reinsurance in protecting against large losses.

It is also interesting to compare the effect of reinsurance in risky areas with that in low-risk areas. The losses before and after reinsurance in the Mountain, New England, and Pacific regions are presented in figure 4. It is apparent that direct losses in these areas are not nearly as volatile as they are in risky areas. As we would expect, insurers in these areas appear to rely less on reinsurance. However, even when catastrophic risk is low, insurers still use reinsurance. This suggests that reinsurance has a role in risk management beyond its role of smoothing catastrophe losses.

Conclusion

In this article, we provide evidence that the use of reinsurance across the United States is related to the degree of catastrophe risk property and casualty insurers face. Indeed, insurers operating in catastrophe-prone areas use as much as four times more reinsurance than insurers in lower-risk areas.

Our analysis suggests that reinsurance attenuates losses experienced by insurers that are significantly exposed to catastrophes—to the extent that we find no significant differences in net losses between high-catastrophe years and low-catastrophe years. This implies that insurers have transferred significant catastrophic risk to reinsurers.

¹ More-complex nonproportional contracts exist. For example, reinsurers may cover an increasing proportion of losses as higher thresholds are surpassed.

² For more on proportional and nonproportional reinsurance contracts, see Andy Polacek, 2015, “How do property and casualty insurers manage risk? The role of reinsurance,” *Chicago Fed Letter*, Federal Reserve Bank of Chicago, No. 334, <https://www.chicagofed.org/publications/chicago-fed-letter/2015/334>.

³ For more details, see http://www.census.gov/econ/census/help/geography/regions_and_divisions.html.

⁴ While earthquakes are also a frequent cause of severe damage, the proportion of earthquake losses insured is much smaller than the proportion of hurricane losses insured. Therefore, earthquakes represent less of a financial risk for insurers. For example, the proportion of the Northridge earthquake losses covered by insurers was 26% (compared with Hurricane Katrina's 37%).

⁵ We could have looked at state-level concentration. However, insurers with more than half of their operations in a single state are rare, which made this level of analysis impractical for our purposes.

⁶ Regions are colored according to their use of reinsurance. In the dark green regions, the use of reinsurance is between 7% (the mean less one standard deviation) and 12% (the mean less one half of the standard deviation); in the light green regions, it is between 12% and 17% (the mean); in the yellow regions, it is between 17% and 21% (the mean plus one half of the standard deviation); and in the red regions, it is greater than 26%.

Charles L. Evans, *President*; Daniel G. Sullivan, *Executive Vice President and Director of Research*; David Marshall, *Senior Vice President and Associate Director of Research*; Spencer Krane, *Senior Vice President and Senior Research Advisor*; Daniel Aaronson, *Vice President, microeconomic policy research*; Jonas D. M. Fisher, *Vice President, macroeconomic policy research*; Robert Cox, *Vice President, markets team*; Anna L. Paulson, *Vice President, finance team*; William A. Testa, *Vice President, regional programs, and Economics Editor*; Helen Koshy and Han Y. Choi, *Editors*; Julia Baker, *Production Editor*; Sheila A. Mangler, *Editorial Assistant*.

Chicago Fed Letter is published by the Economic Research Department of the Federal Reserve Bank of Chicago. The views expressed are the authors' and do not

necessarily reflect the views of the Federal Reserve Bank of Chicago or the Federal Reserve System.

© 2016 Federal Reserve Bank of Chicago
Chicago Fed Letter articles may be reproduced in whole or in part, provided the articles are not reproduced or distributed for commercial gain and provided the source is appropriately credited. Prior written permission must be obtained for any other reproduction, distribution, republication, or creation of derivative works of *Chicago Fed Letter* articles. To request permission, please contact Helen Koshy, senior editor, at 312-322-5830 or email Helen.Koshy@chi.frb.org. *Chicago Fed Letter* and other Bank publications are available at <https://www.chicagofed.org>.

ISSN 0895-0164