**Executive Summary: The Effect of Catastrophe Events on (Re)Insurance Pricing**

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Insurance and reinsurance pricing has declined strongly in the past few years, with property catastrophe reinsurance contracts seeing double-digit price decreases in most regions of the world during 2014. The steady price decline has coincided with several years of below-average catastrophe losses and strong industry capitalization.

Fundamental to our understanding of insurance markets is the question of how loss events impact pricing. In theory, the price of an insurance contract corresponds to the underlying probability of a loss event and the exposed value, as well as a measure of risk aversion, plus a premium load that comprises operational costs and the cost of capital. Specifically for natural catastrophe events, prices are based on exposure models that incorporate both historical loss averages and simulated future scenarios that provide expected loss; such expectations could change gradually as new and more extreme events increase historical averages. Empirically, however, short-term prices often fall below profitable levels, and may fall more rapidly than would be warranted by natural catastrophe risk modeling alone, thus suggesting that prices are more driven by market forces of demand and supply than by risk expectations.

An important question, therefore, is whether natural catastrophe events directly cause prices to increase, and if so, what mechanisms of demand or supply reactions comprise the effect. On the demand side, a heightened awareness and salience of risk following a major disaster could raise risk awareness and therefore increase insurance demand. On the supply side, the depletion of capital reserves by a major loss can heighten competition among insurers, prompting some to exit the market and leaving the remaining insurers potentially hoping to recoup some of their losses by raising premiums. Furthermore, if catastrophe events do affect prices directly, there may be a threshold of event size that is necessary to "turn the market", depending on the level of industry capitalization.

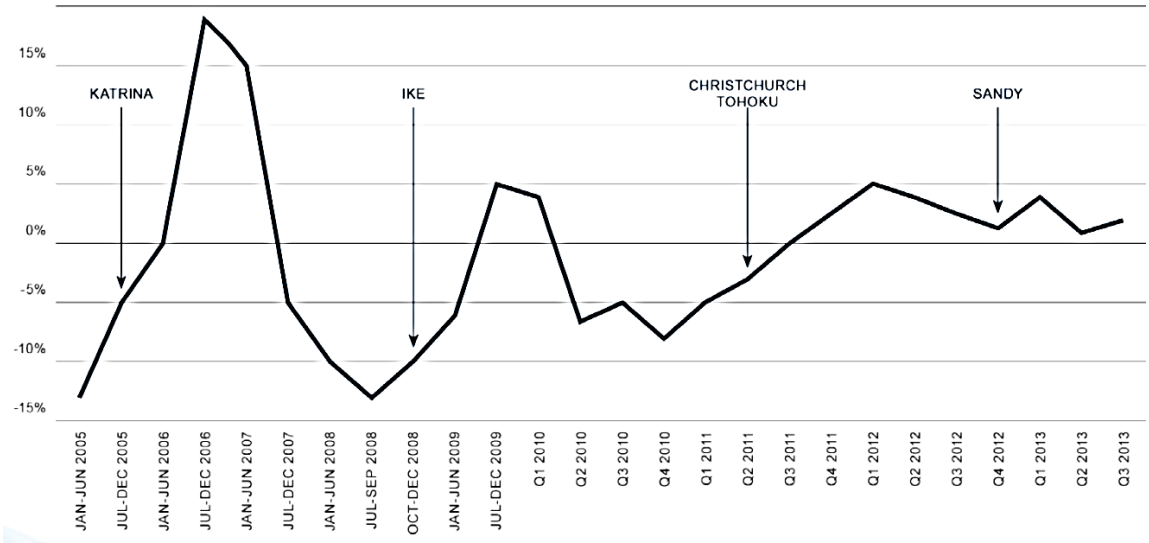


Figure 1: Average Property Insurance Price Changes Across All Industries (2005-2013)

Aggregate data over the past decade show a positive correlation between catastrophe loss events and property insurance pricing. For example, Figure 1 shows strong price increases in the years after Hurricane Katrina, Hurricane Ike, the Christ Church and Tokohu earthquakes, and Hurricane Sandy – some of the most renowned natural catastrophes in recent years. Although such correlations are used by many to describe insurance market behavior, the evidence is highly anecdotal and does not provide insight into the mechanisms underlying pricing decisions. This paper undertakes a more empirical detailed analysis to examine if catastrophe events are indeed the catalysts for pricing cycles, and if so, to what geographic and temporal extent such price shocks occur.

The insurance and reinsurance pricing cycle has certainly been of interest to other authors. Explanations of a cyclical pricing pattern fall into three main schools of thought. First, pricing reflects an equilibrium (or disequilibrium) between supply and demand, and the literature on the reasons for demand-supply equilibrium falls into competition-driven prices (see Wilson, 1981; Stewart, 1984; Radach, 1988; Harrington and Danzon, 1994), capacity constrants (see Niehaus and Terry, 1993; Cummins and Danzon, 1997; Froot and O'Connell, 1997), or naïve rate-making processes (for example, Outreville, 1981; Berger, 1988). Second, general business dynamics influence pricing, and this is reflected through literature on the impact of business cycles (see Grace and Hotchkiss, 1995; Leng and Meier, 2002) or business risk management practices (for example, Cummins, Harrington, and Klein, 1991). Finally, the literature addresses the impact of external shocks on pricing, where the main categories of shocks include interest rate shocks (for example, Doherty and Garven, 1992; Fung et al, 1998), regulatory and accounting lags (for example, Cummins and Outreville, 1987), and catastrophe losses (for example, Harrington and Niehaus, 1999).

More recently, several authors have further explored the effect of catastrophe events on insurance demand, proposing behavioral explanations. Gallagher (2013) shows that residential insurance takeup is significant higher in US post-disaster counties versus non-disaster-affected counties for nine years after a flood event, with communities in the same media markets acting similarly, indicating that disaster impacts on risk perceptions may influence demand. Aseervatham et al (2013) also proposed behavioral explanations for post-disaster insurance behavior, creating a "rational" benchmark of commercial insurance demand to which residential demand can be compared. While this literature indicates that catastrophe losses increase insurance demand for some period after the disaster, the papers are not able to control for pricing changes. Thus, the effect of catastrophes on pricing is an important piece of the puzzle in understanding insurance demand behavior.

Our paper contributes to previous literature by providing a large dataset of prices and contract characteristics over time, which allows a more detailed analysis of pricing drivers than has been possible in previous literature. We are therefore able to test alternative hypotheses that insurance and reinsurance capacity, regulatory lags, external economic factors, or catastrophe losses impact pricing. We also examine whether the impacts vary over time, over geography, and over contract type.

Using data on 315,000 reinsurance transactions over the past decade, we can identify four steps in price setting, which can help us determine the most important drivers of the pricing process. In addition to the realized price, we can see the following elements of price: the production cost (the price level at which economic return is equal to capital cost), the cycle reference price (the price level for which profit is equal to the average profit across the cycle), and the plan reference price (the price level that achieves short-term returns on capital). This allows us to separate the risk-driven component of price from the market-driven component.

We can also identify contracts by date, country, line of business segment, as well as other factors potentially influential on the pricing negotiation process, such as company and underwriter. Controlling for these factors improves our estimate of whether catastrophe losses or external economic factors have impacted pricing, as well as whether such impacts vary by contract characteristics.

Combining the pricing data with external economic data, data on regulatory differences by geography, and data on industry capitalization, we perform a time series regression analysis to test the significant determinants of pricing. Preliminary results indicate that, while catastrophes have a significant effect on pricing, this does not hold for all regions and catastrophe types. Additionally, external economic factors such as interest rate have a strong effect on pricing. The findings of this study will be of great interest to both the pricing and catastrophe literature, as well as an input to further the methodologies of the behavioral demand approaches.