The Impact of Unexpected Natural Disasters on Insurance Markets

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Abstract
In this paper, we examine the impact of unexpected natural disasters on the insurance industry. The industry is exposed to greater risks in states with large populations. Hence we normalize the unexpected disasters with the population of the state. We find evidence that total sales of the insurance industry goes up in response to an unexpected disaster. However, we also find evidence that unexpected disasters lead to higher market concentration. This could either be because some insurance firms becoming insolvent or people preferring to purchase insurance from larger firms.

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I. Introduction

The insurance industry is an important sector for most Americans, as most Americans have some kind of insurance policy. Insurance markets help people manage risks from unexpected events. Hence the health and structure of these markets are vital. In this paper, we investigate the impact of unexpected events (more specifically unexpected natural disasters) on the market concentration and total sales of the insurance industry.

There are concerns that premiums have been going up across all kinds of insurance policies. Higher premiums can affect the accessibility and affordability of insurance. Some studies have pointed out that increase in market concentration could be contributing to an increase in premiums (Dafny et. al., 2012; Trish & Herring, 2015). We find evidence that unexpected natural disasters, normalized by the population of the state, lead to increase in the market concentration in the industry. This could be due to the exit of small insurance firms from the market. We also find evidence that unexpected natural disasters lead to higher total sales or total premiums written by the insurance industry. The impacts from natural disasters are different than other forms of insurance because the catastrophic losses are typically both lumpy and unpredictable (which differs from something like the auto industry).

Our results are consistent with Born and Viscusi (2006) who look at the impact of homeowners' insurance coverage by state to find that unexpected natural catastrophes raise insurance rates and decrease the number of firms writing insurance in those states. Our study expands the work done by Born and Viscusi. They look homeowners' insurance firms by state and firm from 1984 to 2004 whereas we use data from 2001 to 2012, so we update the data with some overlap, but add the ability to employ state-level fixed effects to effectively separate out any state-level impacts that were not being captured in their work. In addition, we also expand

our study to entire insurance industry. When doing so, we find that total premiums increase, especially for states with higher GDPs, and even more for those states that have an appointed Insurance Commissioner (as opposed to an elected insurance commissioner).

II. Data and Methodology

The Federal Emergency Management Agency (FEMA) collects data on major disasters by state and year. To define an event as a disaster, FEMA uses a statutory definition provided by the U.S. Congress. Hence, a disaster is defined as "any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought) or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which, in the determination of the President, causes damage of sufficient severity and magnitude to warrant major disaster assistance under the Stafford Act to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby."[1]

Some states are more prone to disasters as compared to others. Assuming that insurance firms are rational, expected disasters would not lead to the exit of firms and subsequent higher market concentration (although liquidity constraints could impact this). This is because the firms will incorporate the damage from expected disasters in the premiums over a period of time. However, the insurance firms will be adversely affected if the unexpected disasters are greater than the expected disasters, happen more often than expected, or happen early in the firm's life (earlier than expected). To capture this relationship, we create a variable, *Unexpected Disasters*

[1] Robert T. Stafford Act 102; 44 CFR 206.2 and 206.36

per million people. The Unexpected Disasters per million people is defined as the differences between the actual number of disasters per million people and the average number of disasters per million people that occurred in our sample in the last 5 years.

We also normalize the unexpected disasters by the population of the state because, in the event of the occurrence of an unexpected disaster, the insurance industry will face greater losses in states where it has greater exposure to risks. Hence the insurance industry will be more adversely affected if a larger population is exposed to a disaster

To accurately measure the impact of catastrophic events, we gather data on market concentration in the insurance industry and total premiums were written by the insurance industry from the period 2001 to 2012, which is available from the SNL database. Data on Gross Domestic Product (state-wise) for all states in the United States is available at Bureau of Economic Analysis.[2] We also look at the structure of politics impacting the different states, we also collect data on campaign contributions by the insurance industry to fund state-level elections is available from National Institute for Money in State Politics.[3] We also control for the political affiliation of the Governor using a dummy variable which takes the value of 1 if the Governor is from the Democratic Party and 0 otherwise.

Within the different states, the insurance regulator is selected either through appointment (by the Governor) or election (by ballot). The selection method of the regulator can have some influence on the insurance industry (Besley & Coate, 2003). States that elect their insurance regulator are: Washington, California, Montana, North Dakota, Louisiana, Mississippi,

[2] https://www.bea.gov/

[3] https://www.followthemoney.org/

Oklahoma, Kansas, Georgia, North Carolina, and Delaware. This information is available from National Association of Insurance Commissioners (NAIC).[4]

[Table 1]

To assess the impact of these unexpected disasters on the market concentration as well as the total sales by the insurance industry, we use a fixed effects model. We employ both the state and year fixed effects and cluster the errors at the state level. We also control for a variety of factors like the size of the economy, political affiliation, selection method of the insurance commissioner, campaign contributions, and the premium tax rate.

Specifically estimate the following econometric model to assess the impact of unexpected disasters on Market Concentration in the insurance industry (equation 1):

$$\ln(\text{Market Concentration})_{st} = \alpha_0 + \alpha_1 \text{ Unexpected Disasters per capita}_{s,t-1} + \alpha_2 \text{Premium Tax Rate}_{st} + \alpha_3 \text{Appointed Regulator}_{st} + \alpha_4 \text{ Democratic Governor}_{st} + \alpha_5 \ln(\text{GDP})_{st} + \alpha_6 \text{ Campaign Contributions}_{st} + e_{st} \quad (1)$$

We also assess the impact of unexpected disasters on Total Premiums written by the insurance industry; we use the following econometric model (equation 2):

$$\ln(\text{Total Premiums})_{st} = \alpha_0 + \alpha_1 \text{ Unexpected Disasters per capita}_{s,t-1} + \alpha_2 \text{Premium Tax Rate}_{st} + \alpha_3 \text{Appointed Regulator}_{st} + \alpha_4 \text{ Democratic Governor}_{st} + \alpha_5 \text{ GDP}_{st} + \alpha_6 \text{ Campaign Contributions}_{st} + e_{st} \quad (2)$$

III. Results

[4] http://www.naic.org/documents/members_state_commissioners_elected_appointed.pdf

To analyze these impacts, we first look at how unexpected disasters per million people impact the total premiums in Table 2. For all regressions we include state and year fixed effects. In the first column, we look at how unexpected disasters per million people impact total premium without any controls, and we find that they increase the total premiums increase by $208,408, which is marginally significant (at the 10% level). When adding controls, this effect increases in significance, except for the last column (when we include campaign contributions), but decreases in magnitude.

[Table 2]

We also find the R-squared to be relatively high throughout these regressions, especially when adding the appropriate controls. We also find the premium tax rate and democratic governor to be insignificant. State GDP, appointed insurance commissioner, and campaign contributions are all positive and significant. Showing that total increase, especially for states with higher GDPs and even more for those states that have an appointed Insurance Commissioner (as opposed to an elected insurance commissioner). Making at least some argument that the elected commissioners impact the market for homeowners' insurance.

Next, we look at how these unexpected disasters impact the concentrations ratios in this industry. For easier interpretation of the results, use the natural log of the market concentration in the insurance industry. It is hypothesized that having smaller or younger firms in the market would make it difficult for them to bear the cost of a major unexpected disaster. We do find that when there are more unexpected disasters per million people, the market concentration increases (again statistically significant at the 10% level). When adding the appropriate controls, we continue to find that the unexpected disasters do increase the concentration ratio.

[Table 3]

Unexpected disasters per million people have a statistically significant impact on market concentration. For example, one additional unexpected disaster per million people in a state causes the market concentration to go up by 13 percent. The results are consistent across specification.

IV. Conclusion

It has long be stated that concentration ratios are increasing in the U.S. In this study we are able to see how unexpected disasters impact both the market concentration in the insurance industry and total sales by insurance companies. We do find that unexpected disasters lead to higher market concentration and higher sales (or premiums written) by the insurance industry.

Given that decreases in a concentration ratio come when new firms enter the market. However, when a firm enters a market that has lumpy and potentially large payouts, like this market (differing from the auto insurance market, where the payouts are relatively small and more predictable), finding ways to increase new companies would be helpful in reducing the concentration ratio. Thus, in markets that can have large and unpredictable payouts a form on market insurance for young and low-capitalized firms may be warranted.

When doing so, we find that total premiums increase, especially for states with higher GDPs, and even more for those states that have an appointed Insurance Commissioner (as opposed to an elected insurance commissioner). Making at least some argument that the elected commissioners are doing something different that allows for more competitive prices in the homeowners' insurance markets, but they do not have an impact on the concentration ratios in those states.

Works Cited

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Table 1: Summary Statistics

	Observations	Mean	St. Dev.	Min	Max
Natural Disasters	600	2.58	3.92	0.00	57.00
Unexpected Disasters	600	0.45	3.60	-13.50	48.60
Ln (Marker Concentration)	600	2.46	0.43	1.30	4.27
Population (in million)	600	5.86	6.53	0.50	38.00
State GDP (in $ mn)	600	264.35	323.58	18.91	2,100.00
Campaign Contributions	562	188,941	473,384	0	5,400,000
Appointed Regulator	600	0.78	0.41	0.00	1.00
Democratic Governor	600	0.53	0.50	0.00	1.00
Premium Tax Rate	600	1.28	0.57	0.17	2.89

Table 2

	(1)	(2)	(3)	(4)
VARIABLES		Total Premiums		
Unexpected Disasters per capita	208,407*	263,206**	156,785**	153,349*
	(115,279)	(117,463)	(72,460)	(76,849)
Premium Tax Rate		33,701	-1613315	-1608864
		(1,778,160)	(1,344,811)	(1,407,097)
State GDP			62.5***	61.3***
			(20)	(21)
Appointed Insurance Commissioner				13861702***
				(2,642,046)
Democratic Governor				303,968
				(832,892)
Campaign Contributions				0.55*
				(0.28)
Constant	20890476***	21151974***	10147996**	-495,965
	(1,075,234)	(2,885,722)	(5,045,478)	(4,003,235)
State and Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	612	600	600	562
R-squared	0.38	0.38	0.63	0.65
Number of state1	51	50	50	50

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3

VARIABLES	(1)	(2)	(3)	(4)
	ln(Market Concentration)			
Unexpected Disasters per capita	0.16*	0.16**	0.13*	0.11*
	(0.09)	(0.08)	(0.07)	(0.06)
Premium Tax Rate		-0.42**	-0.41**	-0.37**
		(0.16)	(0.16)	(0.16)
Ln(State GDP)			-0.41	-0.46
			(0.3)	(0.3)
Appointed Insurance Commissioner				-0.06
				(0.06)
Democratic Governor				-0.01
				(0.04)
Campaign Contributions				1.60E-08
				(1.80E-08)
Constant	2.26***	2.77***	4.75***	4.97***
	(0.05)	(0.2)	(1.51)	(1.47)
State and Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	612	600	600	562
R-squared	0.18	0.3	0.31	0.31
Number of state1	51	50	50	50

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1