

Three Essays on the Transformation of Homeowner Insurance Markets in Hurricane-Prone
Coastal States in the U.S.

By

Emanuel A. Ubert

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The dissertation is approved by the following members of the Final Oral Committee:

Robert F. Freeland, Professor, Sociology

Chaeyoon Lim, Professor, Sociology

Joel Rogers, Professor, Sociology

Marc Schneiberg, Professor, Sociology, Reed College

Hart Posen, Professor, Management & Human Resources

Abstract

How do mature capitalist markets adapt to intensifying weather shocks? The three stand-alone papers that make up this dissertation explore two processes, government market interventions and organizational learning, that contribute to such adaptation. The markets in question are homeowner insurance markets along the U.S. Gulf and Atlantic coast between 1991 and 2013. The extreme weather shocks are hurricane wind property damage. The main protagonists are state policymakers and private insurance firms. The data the papers draw on consists of an original panel dataset that comprises the entire population of homeowner insurers, all hurricane wind property damage, and relevant state characteristics and policy outcomes over the period as well as rich complementary qualitative data.

The first stand-alone paper traces the contrasting policy responses to comparable wind property damage in Florida and Louisiana following the 2004 and 2005 record hurricane seasons. Faced with insurance market instability, Florida implemented laws that expanded state-coordinated homeowner insurance provision and restricted private insurer flexibility. Louisiana responded in exactly the opposite manner. A qualitative comparison of the policy processes in the two states shows that the broader damage distribution in Florida mobilized homeowners into taking advantage of timely state elections and pressuring policymakers to adapt policies that broke with institutionalized free-market solutions. The more concentrated hurricane impact in Louisiana did not translate into similar political pressure. Louisiana's policymakers instead were free to continue to pursue institutionalized policies favoring private insurance provision. While both policy responses helped stabilize state insurance supply, the logic of the policy responses depended on the scope of the shocks and the electoral pressures it triggered.

The second paper investigates the effect of two forms of organizational learning on homeowner insurers' coastal underwriting and risk-taking behavior. Aggregate firm behavior is the principal driver of homeowner insurance market change over time. In relatively predictable environments, firms learn from performance feedback to guide their risk-taking. Rare environmental shocks complicate such learning. Random intercept models demonstrate that faced with such complications, insurers additionally learned from their local as well as from firm-wide hurricane experiences, independent of any losses they might have suffered from them. Such learning not only directly altered coastal underwriting behavior but also the interpretation and effect of local performance feedback. Corporate-level learning from firm-wide hurricane experiences attenuated the impact of myopic local learning.

The third paper uses stratified frailty survival models to investigate how changes in shared industry-level knowledge about coastal market risks altered insurers' risk of entry into those markets. Besides incumbent firms and state insurers, new entrants are a critical source of homeowner insurance supply and market resilience. The findings suggest that firms' pre-existing direct and indirect knowledge of a focal market only substantially increased their entry risk in a period in which industry-wide understanding of coastal market risks was disrupted and at its most ambiguous. Subsequent industry-wide learning and the restoration of industry-wide understanding of coastal market risks crowded out or reversed the impact of individual firms' pre-entry knowledge. In equilibrium, industry-wide knowledge about mature market risks reduces the likelihood of entry by experienced firms.

Acknowledgments

When I started graduate school, my hope was to link up with a mentor that would engage in enlightening and challenging discussions and offer practical research guidance. Unfortunately, such a mentor never materialized. Instead, I pieced together whatever support I could marshal from a wide variety of sources and ventured onward. I want to acknowledge the most meaningful ones here.

Working with Joel Rogers and Laura Dresser at COWS not only secured the most precious of goods in the U.S., health insurance for my family, but also demonstrated how social science might be leveraged to help make the world a better place. A very special lesson. Tyler Leverty in the Risk Management and Insurance department granted me access to the raw NAIC data that lies at the heart of this project. Kenny Wunder, Junhao Liu, and Anastasia Ivantsova first highlighted the complexities of the underlying data structure and at the same time helped me overcome my panic about it. Countless consulting sessions with Mark Banghart at the Social Science Computing Cooperative developed my data analysis and statistical skills in R to the point that I managed to tackle some of that complexity.

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In the later and more isolated stages of my dissertation, I sorely missed the insightful and lively comments from my early writing group consisting at some points of Boo Hee Min, Trevor Young-Hyman, Michael Roll, Joshua McAuliffe, and Kerem Morgul. My entire time in the upper midwest and all the cultural challenges it presented was also blessed by a group of good friends. In my mind, Nate Ela represents the best the U.S. has to offer. I feel privileged to know him and his family. A deep thank you also to Bob Thomas and Kate Knudson who were co-conspirators in the best adventures that Madison had to offer, including unforgettable short story reading sessions at picnic point fire #3 and shenanigans on and around the terrace. A deep thank you also to Bob Freeland for sharpening my sensibilities around free jazz and for being an all-around good person. Thank you also to all the staff at Mother Fools which, against all my better instincts, became my office for the final months of writing. Apologies to my wife Amy for all the dissertation-related drama. Always forward. Finally, I want to dedicate this work to my late mother, Antonietta Ubert. She died after my first year in the program and I wish she could have witnessed not only the conclusion of this project but also the birth of her grandson.

Table of Contents

CHAPTER ONE - INTRODUCTION	1
1.1 INTRODUCTION	1
1.2 EMPIRICAL SETTING.....	3
1.2.1 Hurricane wind damage.....	3
1.2.2 Homeowner insurance	6
1.3 EXPLANATORY LOGIC AND FRAMEWORK.....	12
1.4 OUTLINE	14
1.5 DATA	19
1.5.1 Qualitative data.....	19
1.5.2 Quantitative data	21
REFERENCES	26
CHAPTER TWO - INVESTIGATING THE DIFFERENCE IN POLICY RESPONSES TO THE 2004 AND 2005 HURRICANE SEASONS AND HOMEOWNER INSURANCE CRISES IN FLORIDA AND LOUISIANA	32
2.1 INTRODUCTION	33
2.2 THEORY	37
2.2.1 Structural-Class Theory (SCT)	38
2.2.2 Interest Group Theory (IGT)	39
2.3 METHODS AND DATA	41
2.3.1 Within-state policy process tracing	41
2.3.2 State comparison	42
2.3.3 Data and measures	46
2.4 PROCESS TRACING OF POLICY RESPONSES RELATING TO HOMEOWNER INSURANCE, 2004-2008	48
2.4.1 Hurricane shocks and insurance market disruptions, 2004-2006	48
2.4.2 Legitimacy crisis and protest, 2005-2006.....	51
2.4.3 Pre-election demands and policy responses, 2005-2006.....	54
2.4.4 State elections, 2006 and 2007	61
2.4.5 Post-election policy directions.....	64
2.5 DISCUSSION AND CONCLUSION.....	66
REFERENCES	71
CHAPTER THREE - HIERARCHICAL LEARNING FROM RARE EVENTS AND ITS EFFECT ON LOCAL RISK-TAKING: COASTAL HOMEOWNER INSURANCE UNDERWRITING CHANGES AMIDST INTENSIFYING HURRICANE SHOCKS.....	75
3.1 INTRODUCTION	76
3.2 PERFORMANCE FEEDBACK AND RISK-TAKING IN STABLE ENVIRONMENTS.....	79
3.2.1 Performance feedback and risk-taking.....	80
3.2.2 Negative performance-aspiration gaps and risk-taking	82
3.2.3 Positive performance-aspiration gaps and risk-taking.....	83
3.3 LEARNING AND RISK-TAKING FOLLOWING RARE SHOCKS.....	84
3.3.1 Learning from rare events and risk-taking.....	86
3.3.2 Learning from rare events and performance feedback	89
3.4 DATA AND METHODS.....	91
3.4.1 Research setting - Homeowner insurance underwriting in hurricane prone states.....	91
3.4.2 Sample.....	95
3.4.3 Measures.....	97
3.4.4 Model specification.....	103
3.5 RESULTS.....	104

3.5.1 Data summary.....	104
3.5.2 Direct effects of performance feedback and hurricane learning (Hypotheses 1-3)	106
3.5.3 Performance feedback and cross-level learning from hurricanes (Hypothesis 4)	110
3.6.1 Direct corporate- and state-level hurricane learning effects on subsidiary risk-taking.....	117
3.6.2 Hurricane-learning effects on positive performance feedback.....	118
3.6.3 Hurricane learning effects on negative performance feedback.....	120
3.7 POST HOC ANALYSIS – FINANCIAL SLACK.....	123
3.8 CONCLUSION.....	125
3.8.1 Summary of findings	125
3.8.2 Contribution.....	126
3.8.3 Limitations and future research opportunities	129
APPENDIX	142
CHAPTER FOUR - POPULATION-LEVEL LEARNING FROM ENVIRONMENTAL SHOCKS AND ITS EFFECT ON ORGANIZATIONAL-LEVEL LEARNING: EVIDENCE FROM HOMEOWNER INSURANCE ENTRY INTO HURRICANE-PRONE STATES	147
4.1. INTRODUCTION	148
4.2 RESEARCH SETTING	151
4.3 PRE-ENTRY EXPERIENCE AND MARKET ENTRY	155
4.3.1 Direct pre-entry experience	155
4.3.2 Indirect pre-entry experiences and vicarious learning.....	158
4.3.3 Population knowledge	160
4.4 DATA AND METHOD	164
4.4.1 Sample and Data.....	164
4.4.2 Dependent Variable.....	165
4.4.3 Independent Variables.....	166
4.4.4 Controls.....	168
4.4.5 Model Specification	171
4.5 RESULTS.....	172
4.6 DISCUSSION.....	176
4.6.1 Population-level knowledge disruption and subsequent learning	176
4.6.2 Population-level knowledge effect on direct and indirect learning.....	178
4.7 CONCLUSION.....	181
4.7.1 Summary of findings	181
4.7.2 Contribution.....	182
4.7.3 Limitations and further research	184
REFERENCES	186
CHAPTER FIVE - CONCLUSION.....	196
5.1 FINDINGS.....	196
5.2 CONTRIBUTION	198
5.3 LIMITS.....	200
5.4 NEXT STEPS.....	202
REFERENCES	204

Chapter ONE - Introduction

1.1 Introduction

This dissertation is part of a broader project that seeks to understand whether and when climate change disruptions can engender more equitable and sustainable forms of economic coordination. The first part of the project, and the one this dissertation starts to address, is to better understand how existing capitalist markets and their participants adapt to large and unexpected extreme weather shocks. Such an understanding informs the second, future, part of the project, namely the study of when and why such adaptation involves more just and sustainable forms of economic organization and coordination (Wright 2010). At the center of this undertaking is an acknowledgement of the effectiveness and flexibility with which modern business and market systems organize human cooperation. In my mind, better forms of organizing will not arise from the ashes of these old systems but evolve from them. Hence, studying how organizations and their markets have adapted to large shocks in the past is a necessary first step in understanding whether and how they will evolve in response to larger shocks in the future, and whether and when such evolutions will take a more equitable form or not.

Each of the three stand-alone articles that make up this dissertation studies a set of distinct processes that contribute to market adaptation to rare exogenous shocks. The empirical setting is homeowner insurance markets in coastal U.S. states between 1991 and 2013. The outside shocks are (record) hurricane shocks. The main protagonists are policymakers and private homeowner insurance firms. The first article studies government market interventions, the second and third articles study different forms of organizational learning.

In capitalist market economies, private firms supply most societally critical goods and services. Legislators and regulators set, monitor, and enforce the property rights and price mechanisms that govern firm behavior and market coordination. Social scientists have long understood that informational imperfections, externalities, and other frictions endogenously generate private market (supply) failures (e.g. Keynes 2018; O'Connor 1979; Stiglitz and Greenwald 2015). Government interventions are necessary to maintain market stability and functions (Jessop 2015; Offe 1984; Therborn 1980). Such market interventions are thus the natural first place to turn to understand how private market supply adapts to and survives big outside shocks.

The focus of the second and third article (chapters three and four) is on different forms of organizational learning and their effect on firm-level behavior. Subject to their legislative, resource, and institutional constraints, organizations alter their behavior to adapt to perceived environmental changes. Contrary to crude neoclassical conceptions of organizations, however, firms are not black boxes that optimally and continuously adapt their input-output matrices.

Cognitive limits, information imperfections, and a variety of inertial forces and institutional frictions prevent firms from perfectly monitoring their environment and from accordingly optimizing their resource allocations and behavior (Simon 2013; Stinchcombe 1965). Instead, firms simplify their decision environment using formal and informal rules and routines. These structures allow boundedly rational managers to make sense of the world and to reach collective agreements about the perceived (second best) course of action (Argote and Greve 2007; Cyert and March 1963; March and Simon 1958). The most pertinent such rules govern how organizations learn, i.e. how they acquire, store, and disseminate new knowledge and translate it into action (Argote 2012; Huber 1991; Levitt and March 1988; Stiglitz and Greenwald 2015).

Organizational learning is therefore critical to firm and, by extension, overall market adaptation to outside shocks.

The remainder of this chapter outlines the empirical setting of the dissertation, clarifies the underlying substantive question and the functional logic that tie together the three individual papers, and summarizes the data sources used.

1.2 Empirical setting

1.2.1 Hurricane wind damage

Hurricane activity in the North Atlantic and Gulf coast is largely governed by cycles in tropical climate patterns near the equator. These cycles create alternating 20 to 30-year seasons of above or below historical average hurricane frequency. The precise contribution of climate change to hurricane frequency and intensity is subject to ongoing debate (e.g. Holland and Webster 2007, Pielke et al. 2005). There is, however, growing consensus that greater sea water temperature increases the intensity of hurricanes (Elsner, Kossin, and Jagger 2008; Nordhaus 2010). The most recent high frequency cycle started in 1995 (Holland and Webster 2007) and coincided with sustained growth in coastal population density and wealth (Climate Central and Zillo 2018; Crossett et al. 2013). Together with these demographic and socio-economic dynamics, more frequent and larger storms have substantially increased hurricane property damage since the early 1990s. Hurricane damage is also predicted to continue to grow in the future (IPCC 2012; Mendelsohn, Emanuel, and Chonabayashi 2011; Nordhaus 2010).

Figure 1 below plots the temporal and geographic distribution of hurricane wind property damage in contemporaneous dollars in the U.S. Eight out of the ten largest catastrophes have been hurricanes, six of which have occurred since the early 2000s (Insurance Information Institute 2012).

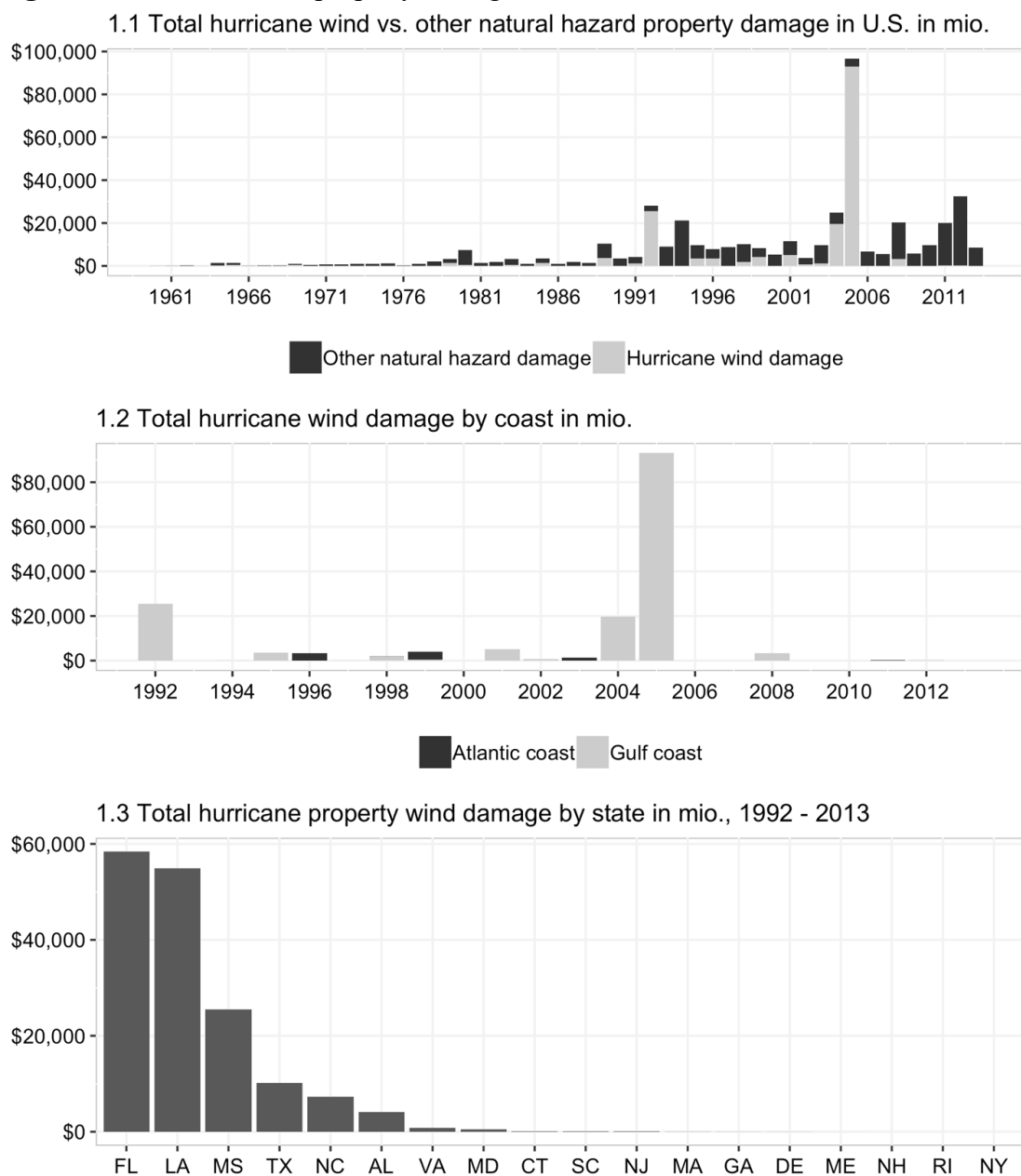
Figure 1: Hurricane wind property damage

Figure 1.1 highlights the disproportionate share of property damage from hurricane wind as opposed to all other types of natural disasters in the U.S. between 1961 and 2013. Annual hurricane property damage escalated starting with Hurricane Andrew in 1992. At the time, Andrew was the costliest natural disaster in U.S. history in terms of insurance payouts to homeowners. The record damages and eleven insurer insolvencies in its wake alerted the

homeowner insurance industry to the possibility of broader changes in the underlying distribution of hurricane losses along an increasingly densely populated coastline (McChristian 2012; Snyder 1993). Figure 1.2 plots the geographic distribution of hurricane wind property damage across the Atlantic and Gulf coast between 1992 and 2013. Even though all coastal states experienced some wind and hurricane damage over the period, hurricane frequency and intensity were strongly concentrated in the extended Gulf of Mexico. Figure 1.3 breaks down that damage by state for the same period.

In modern capitalist economies such as the U.S., homeownership is the primary storage of household wealth and a significant source of financial security (Di, Belsky, and Liu 2007; Johnson, Rogers, and Tan 2001). After controlling for other drivers, homeownership is positively and significantly associated with household wealth accumulation over time (Di et al. 2007). Low- and moderate-income homeowners experience greater short-run increases in net worth, assets, and non-housing net worth than renters do (Grinstein-Weiss et al. 2013; Turner and Luea 2009). When social protections are weak and welfare is asset-based, homeownership serves as important source of retirement insurance (e.g. Conley 2001; Doling and Ronald 2010). Serious hurricane damage to residential housing stock not only reduces household wealth but can also have lasting negative impacts on the stability of the wider political economy. The physical damage and its aggregate negative wealth effects can create consumption or investment shocks on the demand side and divert resources from more productive investments on the supply side (Batten 2018; Mejia et al. 2018).

Covering 203 jurisdictions over a 41-year period, von Peter and colleagues (2012) show that major uninsured natural disasters have large and significant negative effects on economic activity in the short and longer run. In contrast, sufficiently insured losses from such events have no consequential economic impact. With regards to hurricane and windstorm damage in

particular, Hsiang and Jina (2014) analyze every country's exposure to the universe of tropical cyclones between 1950 and 2008. They find robust evidence that the national incomes in both rich and poor countries decline relative to their pre-disaster trend and do not recover within twenty years. Losses are greater in countries with less historical hurricane experience, indicating a role for experiential learning from such shocks in reducing negative economy-wide repercussions in the long run. Nordhaus (2010) finds that annual hurricane costs in the U.S. from 1950–2008 averaged 0.07 percent of GDP. Variability was high, however, with damage from Hurricane Katrina close to 1 percent of GDP in 2005. Deryugina (2013) finds that transfer payments are critical in buffering the negative wider economic impact of hurricane shocks on U.S. county earnings. In the case of wind damage to residential housing units, the most important source of such financial transfers is homeowner insurance. Insurance policies transfer individual risks to financial markets that (generally) diversify them and thereby reduce the overall societal risks born. Homeowner insurance plays a critical role in buffering households from wealth destruction and the wider economy from temporal and longer-lasting negative shocks.

1.2.2 Homeowner insurance

Homeowner insurance typically covers damage from wind, lightning, hail, snow, and other perils. The most common type of homeowner multi-peril insurance policy covers the costs of the rebuilding of an entire structure as well as the replacement of much of a home's content.

Coverage for windstorm includes losses resulting from hurricane winds but not from flooding.

The latter is separately insured by the federal National Flood Insurance Program. This project

only focuses on wind damage and homeowner insurance. Some insurance contracts limit

coverage for hurricane wind losses or require that a higher deductible be purchased specifically

for the hurricane peril. Most hurricane-prone states also offer government-coordinated insurance

policies or “residual” insurance of last resort. Residual insurance policies provide hurricane wind coverage to home owners who are unable to obtain insurance through the private (or “voluntary”) market (Cole, Macpherson, and Maroney 2009; Hartwig and Wilkinson 2014; Newman 2010). Traditionally, residual insurance has been designed to be non-competitive with private homeowner policies (but see chapter 2).

The U.S. Property and Casualty (“P&C”) sector in which the homeowner insurance line is situated is mature, competitive, and consists of a healthy mixture of large and highly diversified national groups, smaller regional multi-state firms, and state as well as insurance line specialists. Homeowner insurance markets are tightly regulated on a state-by-state basis (Klein 2013; Meier 1988). Every insurer is separately licensed in each state in which it operates (Klein 2012; Randall 1999).¹ Homeowner insurance is quasi-mandatory in the sense that banks require mortgage-financed homes to be insured. Absent any unexpectedly large changes to their policies, residential insurance demand is relatively inelastic. Homeowners generally roll over their annual insurance policies rather than shopping for new ones. In stable conditions, critical determinants of whether homeowner insurers extend existing policies or underwrite new ones are strategic considerations, underwriting expenses, expected losses from claim payments, and capital costs (Klein 2009a). In stable markets, past conditions are a good predictor of the future and underwriting behavior.

The rare occurrence of hurricanes, the size and local correlation of their damage, and the uncertainties surrounding their future frequency and intensity make it challenging for private firms to offer homeowner insurance in hurricane-prone regions. Homeowner insurance provision

¹ State legislatures mandate residential insurance regulators to, first, safeguard insurance supply “by limiting the risk that insurers might not be able to meet their financial obligations because of financial distress or insolvency,” and second, to maintain market competitiveness and fair pricing and policy writing practices (Klein 2007:8). Both mandates are designed to guarantee the efficient and fair operation of insurance markets and their risk-spreading function.

is viable for private insurance firms if four conditions are fulfilled (Gollier 1997; Jaffee and Russell 1997; Kousky 2015). First, the loss distribution associated with a firm's underwritten portfolio must be thin-tailed. This condition ensures that the insurer is confident in the probability of any individual loss becoming negligible at extreme values. Second, the correlation between individual losses must be low. This condition guarantees that the average claim payments for all policies approach the expected value. Together, the first two conditions allow insurers to effectively pool risks, i.e. to spread financial risks evenly among a large number of ideally uncorrelated contributors and thereby make the impact of any single policy largely irrelevant to overall performance. Third, insurers must be able to set their policy premiums at a level that equals the true expected value of their claim payments and that covers the costs of their capital. Failure will result in losses in the long run. Fourth, losses must be measurable and verifiable in order for insurance companies to calculate the correct claim payouts. The occurrence of hurricanes inevitably violate the first two conditions, regulatory and judiciary reactions to hurricanes can violate the last two. Large and unexpected hurricane shocks threaten private homeowner insurance supply stability.

The non-linear dynamics of the climate system, its complex interaction with the built environment (Elsner et al. 2008; Holland and Webster 2007; IPCC 2012), the small number of historical hurricane events, and the historically low resolution of predictive climate models have made it challenging if not impossible for insurers to predict the precise timing and local distribution of future hurricane losses (Cole, Macpherson, and McCullough 2010; Daipha 2015; Daron 2011; Grossi and Kunreuther 2005; Tolwinski-Ward 2015). Hurricane losses are also highly geographically correlated. Both of these loss characteristics prevent insurers from effectively pooling risk and from using the law of large numbers to determine the expected future risk exposure of their underwriting portfolio and appropriately price new policies (Kunreuther

1989; Kunreuther et al. 1995; Kunreuther, Pauly, and McMorrow 2013). Regulatory constraints can, in principle, also block the increases in policy premiums necessary for insurers to cover their expected losses and greater capital costs (Born and Klein 2015; Grace and Klein 2007; 2009; Klein 2009b). Finally, legal challenges focusing on the source of property damage—wind covered by homeowner insurance policies and federally covered flooding damage—routinely prevent the accurate estimation of already incurred hurricane-related claims (Cohen and Rosenberg 2008; Conway 2007; King 2007; Knox 2006). These underwriting problems have triggered systematic insurer retrenchment and exit from hurricane-prone coastal states.

Figure 2: Homeowner insurance underwriting and market share evolution

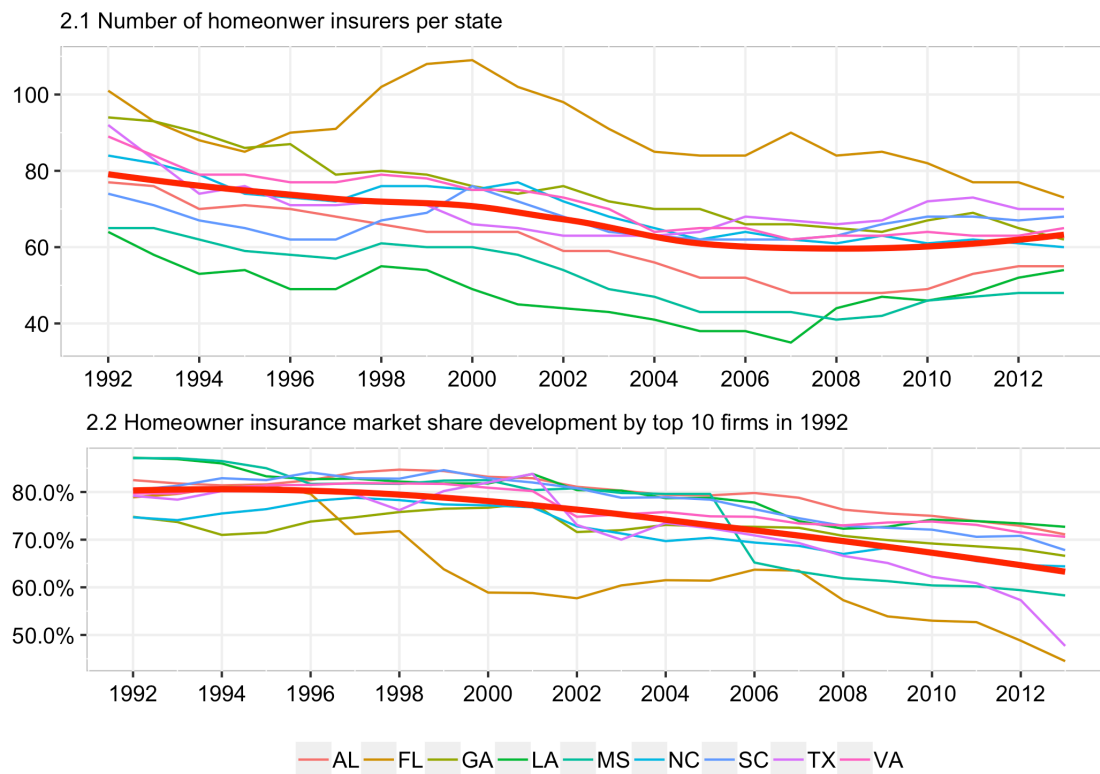


Figure 2 above illustrates the extent of homeowner insurer exit and retrenchment in the most hurricane-prone coastal states between 1992 and 2013. The red lines in each graph are locally estimated smoothers (loess) for all annual states. Figure 2.1 plots the declining total number of

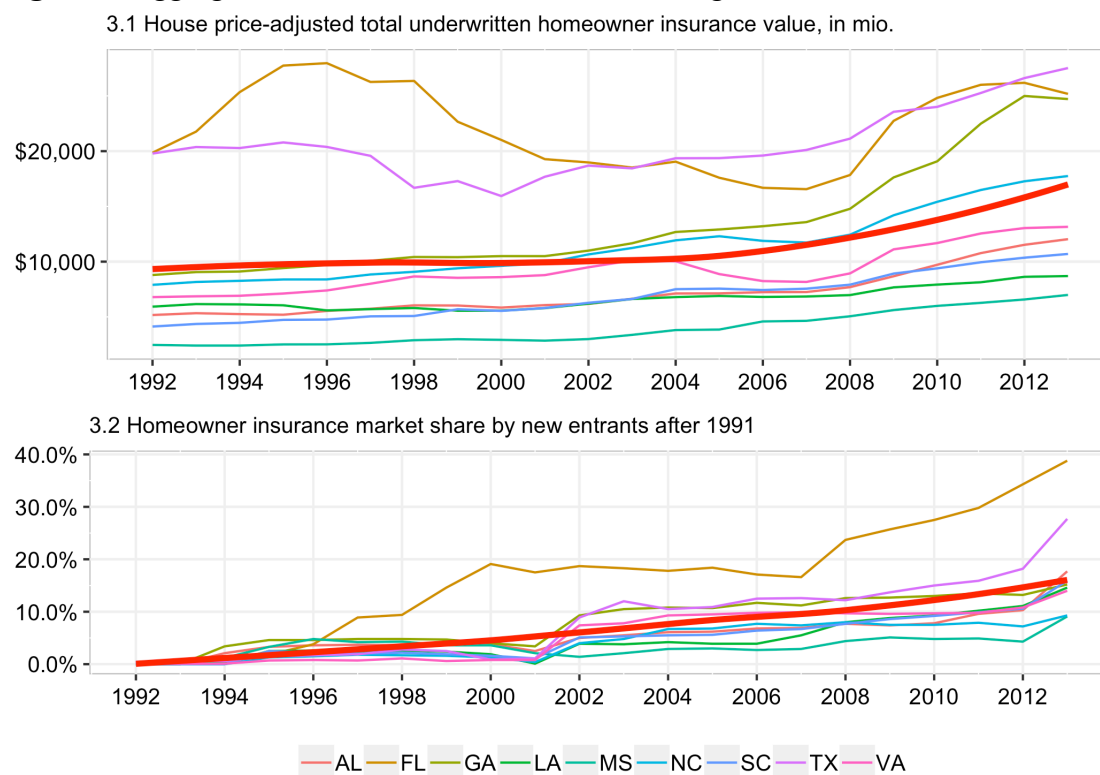
homeowner insurers in each state. Figure 2.2 shows that the ten largest homeowner insurers in each state as of 1992 continuously lost market share over the period, with the most dramatic fall in Florida and Texas.

The economic insurance literature has described and explained above patterns in greater detail. Born and Viscusi (2006) analyze the underwriting responses of every insurer in the U.S. to a variety of natural disasters between 1984 and 2004. They find that the occurrence of natural disasters on average reduces the net number of firms writing insurance coverage in exposed states and increases the likelihood of insurer state-exit. These effects are greatest for firms that are least able to withstand the financial shock of a catastrophic event. In a follow-up study, Born and Klimaszewski-Blettner (2013) more closely investigate the drivers of insurer retrenchment in and exit from states affected by natural catastrophes between 1984 and 2007. They find that higher loss ratios increase the probability of insurer exits and underwriting reductions, that extraordinary catastrophe damage also reduces underwriting independent of firms' underwriting performances, that the unexpectedness but not the frequency of such shocks increases the risk of exit, and that stricter price regulation and greater state involvement through the residual market also increase insurer retrenchment. Aseervatham and colleagues (2016) show that negative supply responses to extreme hurricanes are more pronounced than to extreme tornadoes. Qualitative case studies of insurer responses to the record 2004 and 2005 hurricane seasons in the Gulf of Mexico describe insurer retrenchment and regulatory responses in more detail (Grace and Klein 2006; 2007; Klein 2009a; Kunreuther et al. 2013).

Despite the underwriting problems caused by hurricane shocks and supply retrenchment, Figure 3 indicates the relative stability of *aggregate* homeowner insurance supply in the most hurricane-prone coastal states between 1992 and 2013. Figure 3.1 demonstrates that most such states saw gradual increases in total underwritten homeowner insurance premiums adjusted for

average state-wide home-price changes between 1992 and 2013.² Florida and Texas experienced some fluctuations. Figure 3.2 additionally highlights that homeowner insurers that entered a state after 1992 on average increased their market share over the period, dramatically so in the case of hurricane-prone Florida, Texas, Alabama, and Louisiana. Despite the incumbent underwriting retrenchment and uncertainties caused by record hurricane shocks, enough homeowner insurers expanded their underwriting in coastal states to prevent sustained market failures and to maintain overall supply of homeowner insurance.

Figure 3: Aggregate homeowner insurance underwriting resilience



² Total premiums underwritten are the product of the policy rate and the number of exposure units insured. An exposure unit can be expressed in terms of what it costs to replace a house if it is destroyed. The more valuable the house, the larger the exposure unit. This graph is only indicative as it does not control for insurance policy rate changes.

1.3 Explanatory logic and framework

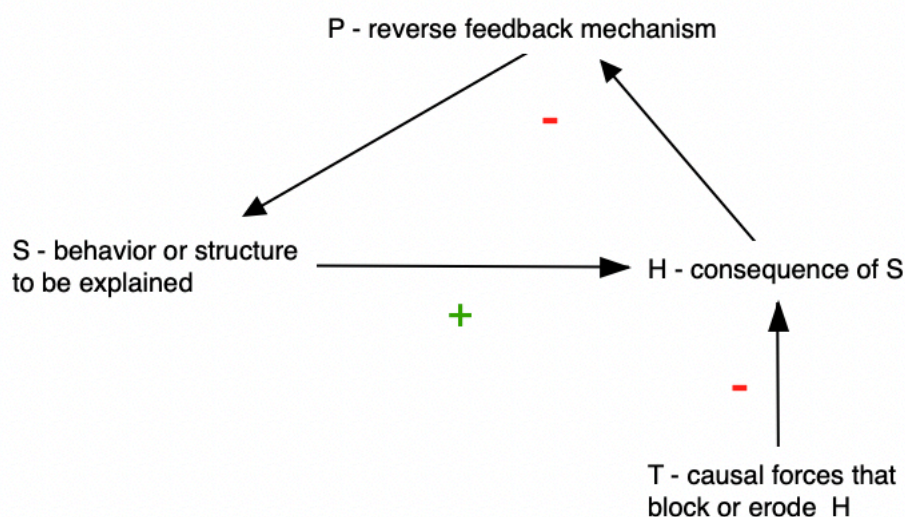
What explains this resilience of coastal homeowner insurance supply amidst record hurricane shocks, market uncertainty, and the associated underwriting difficulties? Why did some insurers continue to provide or even expand homeowner insurance in these risky coastal states? The three stand-alone empirical papers that constitute this dissertation start to empirically answer parts of these questions.

Inevitably, any explanation of the resilience and reproduction of behavioral or structural patterns in the context of exogenous shocks involves some form of functional logic (Stinchcombe 1987). Functionalist explanations generally vacillate between two different claims (Kincaid 2011). The first is that society is composed of component parts with specific functions. The homeowner insurance market, for example, fulfills the function of insulating homeowners and the wider economy from hurricane wind losses. The second, stronger, functional claim is that there is some kind of mechanism or process that ensures that those social parts continue to exist to serve their functions. For example, there are specific and identifiable processes that ensure the continued supply of homeowner insurance in the face of large and unexpected hurricane shocks that threaten that supply. The overall explanatory logic of this project loosely invokes the second and stronger functional claim. The individual stand-alone papers investigate whether and to what extent state market interventions and organizational learning contributed to the adaptation and resilience of homeowner insurance supply in hurricane-prone coastal states.

Figure 4 below illustrates the functional logic underlying such explanations in their most ideal form (Pettit 1996; Stinchcombe 1987). Functional arguments go something like this. Certain structures or behavioral patterns (S) create a certain consequence (H). The consequence, H, in turn plays a critical role in the maintenance of S. In other words, the structure or behavior to be explained (S) exists because of its consequence or function (H). The critical element in

such an explanation is to identify the reverse feedback processes (P) that causally link the consequence H back to its cause S. Stinchcombe (1987:80-98) argues that the impact of these reverse feedback mechanisms becomes stronger when the consequence (H) is not maintained, i.e. when other causal forces (T) erode H. Since the impact of the reverse feedback P decreases when H is maintained, P carries a negative causal force from H to S.

Figure 4: Logic of functional explanation



There are two broad classes of reverse feedback mechanisms or processes that are particularly relevant to arguments about the stability of homeowner insurance supply: maximizing and selectionist processes (Elster 2015). Maximizing processes assume that individual actors do the best they can subject to their constraints. Doing so creates certain behavioral patterns or structures that persist because they benefit the maximizing individual. Selectionist processes describe the guided variation (and replication) of behavioral patterns or structures. What gets selected for replication is based on its consequences. Such processes cannot be universally characterized because they are highly dependent on the context in which selection takes place. While blind selection, e.g. by market or cultural selection, certainly plays a role in

the social realm (e.g. Freeman and Hannan 1989), in the context of environmental market disruptions and uncertainty, such selection often becomes more deliberate or guided. Faced with disruptions of the status quo and uncertainty about its viability in the future, social actors often become more reflexive and deliberately learn in order to guide selection of their behavior (e.g. Cyert and March 1963; Joas 1996; Whitford 2002). In this type of guided selectionist process, actors make judgments about the ability of different types of behavior or structures to promote specific innate or learned standards and then select them accordingly. Learning rules structure the differentiated transmission of behavior patterns and social structures over time (Mesoudi 2011; Richerson and Boyd 2008).

While functional explanations of behavioral or structural stability and non-functional causes are often treated as mutually exclusive, they need not be (Kincaid 2011:225). Functional explanations are a form of causal explanation of the persistence of S and its consequence H that involves picking out salient or theoretically interesting aspects of a complex causal field (P). There might be other (non-functional) causes in that field that complement any explanation P of the persistence of S and H. In this dissertation, the individual papers make no claim to offer comprehensive explanations but only investigate theoretical and empirical questions that are pertinent in their own right. The next section builds on the analytical framework constructed here to present an overview of the three papers and how the invocation of a somewhat crude functional logic connects them.

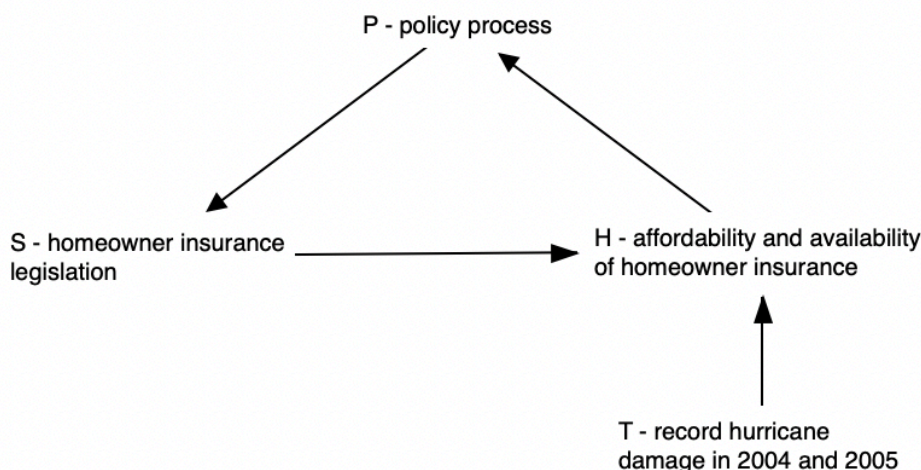
1.4 Outline

The functional logic outlined above ties together the three stand-alone papers that make up this dissertation. Each paper explains distinct outcomes (S) that (partially) contribute to the maintenance of overall state or individual firm homeowner insurance coverage (H) in the context

of negative hurricane shocks (T). Each paper hypothesizes and tests different reverse feedback processes (P) that partially link the overall or individual provision of homeowner insurance (H) back to the antecedent (partial) causes (S) of that provision. As already stressed above, the individual papers follow their own theoretical, empirical, and methodological logic and do not explicitly invoke functional arguments. Their inherent functional logic is somewhat “crude” in that the relevant reverse feedback processes are suboptimal (Zuckerman 2003). They might reward (punish) a significant amount of the very behavior that they are supposed to discourage (encourage). Tying these individual crude functional arguments together offers an initial insight into the processes involved in market adaptation to large exogenous shocks.

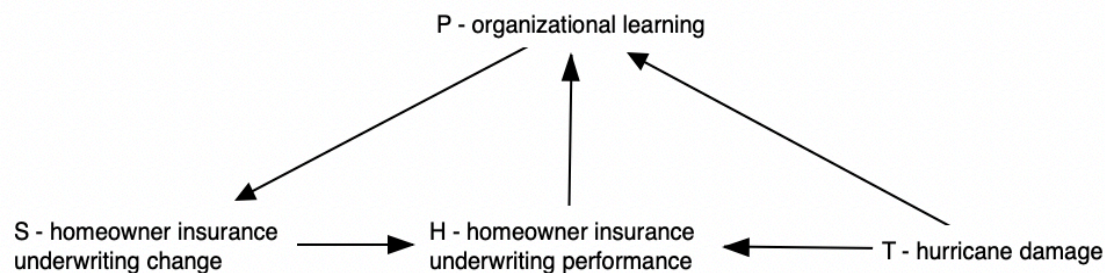
Article one (chapter two) is a comparative case study that investigates the policy processes (P) that altered the legal and regulatory rules governing private (voluntary) and public (residual) homeowner insurance provision (S) in Florida and Louisiana following the record 2004 and 2005 hurricane seasons (T). Figure 5 below summarizes the crude and implicitly functional logic. This and the other figures below serve illustrative purposes only and do not represent a full-blown causal diagram (Morgan and Winship 2014).

Figure 5: Chapter two logic



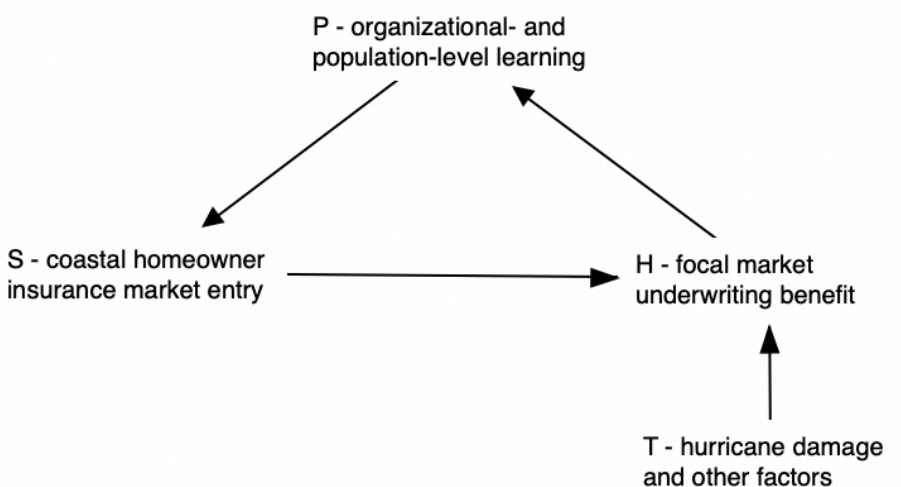
Despite comparably sized total hurricane wind property damage, the two states responded differently to the associated pressures (T) on homeowner insurance affordability and availability in the two markets (H). Florida implemented legislation that expanded state-subsidized residual homeowner insurance and constrained private homeowner insurance supply. Louisiana passed legislation designed to actively promote private market supply and restrict residual market growth. Differences in the hurricane damage concentration (T) and the associated homeowner insurance market pressures (H) triggered differentiated political pressures and electoral and legislative processes (P) that, ultimately, adjusted policy outcomes (S) in a way that helped alleviate the original homeowner insurance supply pressures (H). The outcome of the policy process (P) helped to compensate for the hurricane disruptions and to maintain local homeowner insurance supply.

Articles two and three (chapters three and four) focus on private insurers roles in maintaining aggregate homeowner insurance supply and, in particular, on reverse feedback processes involving organizational learning. In the U.S., private homeowner insurance is the principal source of insurance supply and private firm underwriting behavior a fundamental driver of market change. Chapter 3 investigates how existing insurance firms adjusted their annual underwriting and risk exposure in coastal states (S). It statistically examines how insurer learning (P) from local as well as firm-wide hurricane experiences (T) and from their relative local underwriting performances (H) affected their local homeowner insurance underwriting (S). Graph 6 below illustrates the chapter's crude and implicit functional logic.

Figure 6: Chapter three logic

The paper shows that, faced with a local hurricane shock and the subsequent underwriting complications it can trigger (T), insurers learned from their local relative underwriting performances that might or might not have been affected by the hurricane damage, from the broader characteristics and repercussions of the local shock itself, and from previous firm-wide hurricane experiences (all P) to adjust their local underwriting and risk-taking (S). The specific effects on local underwriting depended on the type of relative performance as well as on its interactions with local and firm-wide hurricane experiences.

Article three (chapter four) statistically examines the likelihood of existing P&C insurers to enter into coastal homeowner insurance markets (S). As we saw in Figure 3.2 above, new market entrants gained a considerable market share between 1992 and 2013 and as such played an important role in maintaining coastal homeowner insurance supply. This paper focuses on an important subset of those entrants, namely already existing insurance firms. In particular, the paper investigates how potential entrant as well as collective insurance industry learning (P) about the known benefits of entry into a focal market (H) and its changes (T) altered individual firms' likelihood of entry into hurricane-prone homeowner insurance markets. Figure 7 illustrates the chapter's crude and implicit functional logic.

Figure 7: Chapter four logic

In 1992, Hurricane Andrew disrupted the insurance industry’s collective understanding of coastal underwriting risks (T). The subsequent diffusion and institutionalization of catastrophe models updated such understanding and legitimized it over time. The paper shows that firms’ direct and indirect pre-entry knowledge had their strongest effect on entry risk in the period following that disruption. Post-Andrew, collective industry-wide learning reduced the impact of firms’ direct pre-entry experiences with the focal market or with hurricane shocks. It reversed the impact of learning from the observation of focal markets’ exit rates or their incumbent performances.

Taken together, the three papers trace two sets of processes that are critical in homeowner insurance market adaptation to hurricane shocks —legislative market interventions and organizational learning. The individual papers explore these contingent processes in greater detail.

1.5 Data

The individual papers draw on qualitative and quantitative data sources. This section provides a summary of those sources. Each paper separately discusses which subset of this data and what methods it uses.

1.5.1 Qualitative data

The qualitative data consists of 27 semi-structured in-depth interviews with insurance professionals as well as a wide array of media, industry, and official regulatory and government reports. This data directly structures the comparative case analysis in chapter 2 and indirectly informs the design and interpretation of the statistical analyses in chapters 3 and 4.

I used no systematic sampling frame to conduct the interviews. Owing to their importance in highlighting the legislative and regulatory process in chapter 2, the focus of the interviews was on regulatory and industry agency executives, particularly in Florida and Louisiana. As customary in the industry, virtually all interviewees with positions in the public or non-for-profit sector had previously held often very senior positions in a variety of private insurance firms, thus offering additional and somewhat more distanced information about the operation of such firms and their and the wider industry's evolution. I followed relevant UW-Madison IRB protocols (ID: 2016-0846). Table 1 below lists the different interview sources.

Besides these more formal interviews below, I had numerous informal conversations about the industry with professors in the Risk and Insurance Department of the UW-Madison Business School as well as participants of the 3rd Annual conference of the Center for the Economic Analysis of Risk at Georgia State University in 2016, and participants of a conference on natural disasters and property insurance organized by the National Association of Insurance Commissioners and the Center for Insurance Policy and Research in 2018. To gain greater

insights into catastrophe modeling practices, I also participated in two online seminars about catastrophe modeling oriented at industry professionals organized by the International Society for Catastrophe Managers.

Table 1: Interview sources

Institution	Interviewee function
Allstate Insurance	State Manager
BMS Reinsurance	Executive Vice President Catastrophe Analytics
California Department of Insurance	Rate Lawyer
Century Mutual	State Manager
Florida Citizens Property Corporation	Chief Risk Officer
Florida Hurricane Catastrophe Fund	Chief Operating Officer
Florida Office of Insurance Regulation	Data Research Unit
Florida Office of Insurance Regulation	Insurance Commissioner
Independent Insurance Agents and Brokers of LA	Chief Executive
Insurance Information Institute	President (retired)
Insurance Information Institute	Chief economist
LA Realtors	President
Louisiana Department of Insurance	Assistant Deputy Commissioner
Louisiana Department of Insurance	Insurance Commissioner (retired)
Louisiana Department of Insurance	Insurance Commissioner
Munich Re	Senior Research Scientist Meteorology Unit
National Association of Insurance Commissioners	Sr. Property & Casualty Insurance Specialist
National Association of Insurance Commissioners	Director Center for Insurance Policy & Research
North American Insurance Management Association	Vice President of Public Policy
PIPSO	President (retired)
PIPSO	Vice President
Property Casualty Insurers Association of America	Research Director
Property Insurance Report	Editor
Reinsurance Association of America	State Regulatory Inquiries

The other part of the qualitative data used consists of a large list of documentary sources. I obtained relatively fine-grained accounts and contextual detail of important homeowner insurance market developments from local (state) newspaper reports sourced from the database Factiva. I also heavily relied on the database LexisNexis to trace key legal and regulatory developments in coastal homeowner insurance markets. For the even more detailed qualitative analyses of the procedural history of specific laws, associated voting records, and legal digests

and commentaries in chapter three, I additionally consulted Florida and Louisiana’s state legislatures’ online archives. A variety of market analyses and reports offered additional insights as well as statistical data. Particularly sources of note that I used throughout are the “Annual Factbooks” and the “A Firm Foundation” reports as well as topical white papers by the Insurance Information Institute, the Property Insurance Report published by Risk Information Inc., and various regular and special topical insurance research reports by A.M. Best, the National Association of Insurance Commissioners, and the individual state regulatory agencies. The Property Insurance Plans Service Office (PIPSO) is the exclusive collector of state (residual) insurance market data and made its reports and the underlying raw data (see below) freely available to me. Finally, the insurance economics literature centered around the Journal of Risk and Insurance provided additional complementary theoretical arguments and empirical analyses.

1.5.2 Quantitative data

The quantitative data used for the statistical analyses in chapter three and four are sourced from the National Association of Insurance Commissioners (NAIC), the Spatial Hazard Events and Losses Database for the United States (SHELDUS) at the University of South Carolina, PIPSO, and various other public state-level data sources. I extracted and cleaned the raw data from these sources and combined them into two original and comprehensive industry-wide long-format panel datasets, one for each of the two chapters. I used the statistical software R to do so. Below I describe in greater detail the different data sources and the work involved in processing them. The individual papers describe the relevant individual original databases in greater detail.

NAIC

As per its website, the NAIC is

the U.S. standard-setting and regulatory support organization created and governed by the chief insurance regulators from the 50 states, the District of Columbia and five U.S. territories. Through the NAIC, state insurance regulators establish standards and best practices, conduct peer review, and coordinate their regulatory oversight. NAIC staff supports these efforts and represents the collective views of state regulators domestically and internationally. NAIC members, together with the central resources of the NAIC, form the national system of state-based insurance regulation in the U.S.

As part of their mission, all state-licensed insurers are required to submit detailed annual financial data to the NAIC. The NAIC then licenses out that data. It is the standard data used in the insurance economics literature, including the aforementioned studies on the impact of natural disasters on insurer retrenchment (e.g. Aseervatham et al. 2016; Born and Klimaszewski Blettner 2013). I obtained access to the underlying raw data through the UW-Madison business school. The format of this raw data is extremely unwieldy. Each year, each licensed insurer submits a c. 200-page financial report to the NAIC. The NAIC then compiles each page into a separate electronic file. So, for example, for each year, there will be a single file that contains each licensed insurers' balance sheet, income statement, or other detailed data at the national level. Each file's content, data structure, and format can change year-to-year.

In order to generate a .csv file of *one single financial report page for a single year* for all insurers from the raw data, I followed following steps:

1. Consult the index in the "Data Element Guide" to find the individual financial statement page I am interested in (e.g. balance sheet, income statement, etc.),
2. Inspect that actual page in that year's blank financial statement to find out what data is included in it,
3. On the relevant annual data disk, open the file index to find the name of the electronic file that matches the page from the physical report (2.). These electronic names and locations change from year-to-year,

4. Open the “layout” file of the underlying electronic file to get an overview of what lines from the physical report are included in the underlying electronic file. The content and order of each page and file can change from year to year,

5. Download the underlying file.

6. If necessary, transform the electronic page-file into a format that can be read by my statistical program of choice (R). This involved writing code in SAS that transformed SAS files into R-readable .csv format,

7. Compare and homogenize the data structure of each annual electronic page-file across each of the available years (1991 - 2013)

8. Compile each annual electronic page-file into one single dataset. The output here is one long-form panel dataset that includes, for example, balance sheet variables for all P&C insurers in the U.S between 1991 and 2013. Each page from the original financial statement is converted into such a dataset.

9. Clean 8.

10. Combine all relevant individual page-file datasets of interest into a single long-format panel dataset.

11. Combine 10. with the other data sources summarized below e.g. with the annual state hurricane wind property damage dataset from SHELDUS.

Using above procedure, I compiled following eight page-files from the raw NAIC data: Assets, Liabilities, Income Statement, Cashflow, Demographics, Schedule T, Underwriting Investment Exhibit Part 2B (UIE2b), and Page 14. The Demographics page includes information on the location, age, and other corporate details of each firm. The Schedule T page lists limited insurance-line specific underwriting data such as premiums written, or dividends paid, and UIE3

lists firm-wide reinsurance data. Page 14 is the central file of the dataset and includes basic line-by-line underwriting volume and loss information at the state level. All other data is usually aggregated at the national level. Taken together, the NAIC data maps a comprehensive financial and demographic picture of the full population of licensed P&C insurers in the U.S. between 1991 and 2013.

SHELDUS

I obtained all hurricane wind property damage data from the SHELDUS database (version 15.2) from the University of South Carolina. The database covers the period from January 1960 to December 2015. The database contains information on the date of an event, affected location (county and state) and the direct losses caused by the event (property and crop losses, injuries, and fatalities) as well as insured crop losses (indemnity payments). It includes data on practically all natural disasters. The data for hurricane wind and tropical storm damage is sourced and curated from National Centers for Environmental Information (formerly National Climatic Data Center) Storm Data and Unusual Weather Phenomena database. I combine the annual state-level hurricane and tropical storm damage data with the above NAIC insurance dataset.

PIPSO

All state-coordinated or “residual” insurance corporations provide PIPSO with annual underwriting and related financial data. PIPSO aggregates the data and uses it to publish residual market summary and penetration reports, the only source of such data to the industry in the nation. PIPSO kindly provided me with the annual data underlying these reports dating back to 1985. I used the data and integrated it into my overall panel dataset to construct measures of the

relative size of the residual homeowner insurance market in coastal states and, by extension, the level of direct annual state involvement in the provision of homeowner insurance.

Other data sources

I used other publicly available quantitative data sources. These sources include the followthemoney.org database for data on financial electoral contributions, the Inter-University Consortium for Political and Social Research database no. 43297 for state legislative election results, Bureau of Economic Analysis data to obtain annual (per capita) state GDP, census and inter-census estimates of annual housing unit construction, and data from the Federal Housing Agency for state-wide estimates of seasonally adjusted housing price changes.

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Chapter TWO - Investigating the Difference in Policy Responses to the 2004 and 2005 Hurricane Seasons and Homeowner Insurance Crises in Florida and Louisiana¹

Abstract

In 2004 and 2005, a series of hurricanes caused record homeowner insurance losses in Florida and Louisiana. Despite comparably sized losses, the two states responded differently to these shocks. Florida expanded state-subsidized homeowner insurance, breaking from a free market response, whereas Louisiana actively promoted private market supply. Comparing the two policy processes reveals that the politics and transformation of homeowner insurance evoked by extreme weather events depend on how concentrated the hurricane impact is and whether it effectively mobilizes homeowners into electoral politics. The broader distribution of losses in Florida prompted homeowners to exert sufficient electoral pressure to influence policy responses, fostering political dynamics emphasized by interest group theories of policy and a break from the market. The more concentrated hurricane impact in Louisiana blocked homeowners from doing the same, leaving Louisiana's policymakers free to draw on the institutionalized free-market logic to guide their response and producing trajectories expected by structural-class theories. The findings highlight the contingency of different approaches to the politics of markets and policy, suggesting that the dynamics highlighted by the two theories depend on the distribution and political impact of the problems and shocks involved.

¹ Ubert, Emanuel. 2017. "Investigating the Difference in Policy Responses to the 2004 and 2005 Hurricane Seasons and Homeowner Insurance Crises in Florida and Louisiana." *Socio-Economic Review* 15(4):691–715.

2.1 Introduction

Extreme weather events are a growing source of economic losses. Today there exists “high confidence, based on high agreement and medium evidence, that economic losses from weather- and climate-related disasters have increased” (IPCC 2012:268). Losses from Atlantic hurricanes in particular have grown over the last three decades (Elsner, Kossin, and Jagger 2008). Eight out of the ten largest U.S. catastrophes have been hurricanes, six of which have occurred since the early 2000s (Insurance Information Institute, 2014). Hurricane-related losses are also predicted to grow in the future (Holland and Webster 2007; IPCC 2012). Florida and Louisiana are the two states with the greatest hurricane exposure. In the record 2004 and 2005 hurricane seasons, the two states suffered the greatest total damage and insured losses in the U.S. Florida incurred an estimated \$19 billion insurance loss from four named hurricanes in 2004 and an estimated \$12 billion loss from four storms in 2005. Louisiana incurred \$29 billion in estimated losses from two hurricanes in 2005. Despite these comparable costs, the two states pursued different insurance policies in response to the 2004 and 2005 hurricane seasons: Florida expanded the public provision of homeowner insurance while Louisiana deepened private insurance provision. This paper explains why the two states responded differently and suggests that the politics of insurance is more generally contingent on the level of concentration of unexpected extreme weather events.

Homeowner insurance plays a critical role in insulating the wider economy from extreme weather cost shocks. Uninsured damages from natural disasters tend to permanently reduce economic activity in the jurisdiction in which they occur. Insured damages create only temporary GDP shortfalls (von Peter *et al.* 2012). Homeowner insurance protects against wind damage from hurricanes, which, besides flooding, has the greatest economic impact on the value of

residential housing structures.² In 2007, construction, real estate, and rental activities constituted 24% and 14% of state GDP in Florida and Louisiana respectively (Bureau of Economic Analysis, 2016). The large weight of the housing sector in state GDP means that uninsured hurricane reductions of housing values have the capacity to significantly impact a state's overall economic performance and stability (Liu and Emrath 2008).

Two distinct but interrelated types of organizations provide homeowner insurance coverage in Florida and Louisiana: private profit-maximizing or *voluntary* insurers, and state-coordinated or *residual* insurance corporations. While relying on voluntary insurers to provide the majority of homeowner insurance, Florida and Louisiana each launched their own residual insurance corporation—Florida Citizens Property Insurance Corporation (“Florida Citizens”) and Louisiana Citizens Property Insurance Corporation (“Louisiana Citizens”)—in 2003 and 2004 respectively. Residual insurance programs differ from private insurance in two critical aspects: price and supply levels are generally not market determined and costs from residual exposure are spread over a larger share of the population.

Florida and Louisiana commissioned residual programs to exclusively offer “insurance-of-last-resort” to homeowners who could not obtain coverage from private insurers (Insurance Information Institute, 2015). Both residual insurance organizations’ policy terms and rates were originally set so as to render them uncompetitive with voluntary insurers. In that sense, the price and supply level of residual insurance in both states is politically rather than market-set.

Besides being non-market entities, residual insurance also distributes the costs of unexpectedly large, uncovered claims to a broader section of the population than private insurance. In contrast to their voluntary counterparts, Florida Citizens and Louisiana Citizens do

² The federal National Flood Insurance Program writes all insurance against flooding damages. Because I focus on the shifts between private and state-coordinated insurance provision, flooding damages and their federal insurance are bracketed in this paper.

not accumulate any capital reserves; they rely on retained earnings to pay out insurance claims. When residual insurers incur unexpectedly large claims, as they did after the 2004 and 2005 hurricane seasons, they fall back on direct government bailouts or on the bond market to pay their policy holders. In the latter case, state governments, on the residual insurer's behalf, levy special "assessments" or surcharges on all voluntary homeowner insurance policyholders in the state to pay off the bonds. All homeowner insurance policyholders and, in case of direct bailouts, state taxpayers back residual insurance risk and pay for its extraordinary costs.³ In that sense, residual insurance extracts cross-subsidies from all homeowner insurance policyholders and taxpayers. Greater residual insurance coverage shifts hurricane risks and costs to a larger share of a state's population.

In response to the 2004 and 2005 record hurricane disruptions and the subsequent 2006 state elections, Florida's legislators adopted laws designed to systematically expand the provision of residual homeowner insurance. Louisiana, in contrast, passed laws designed to support and expand the provision of private homeowner insurance leading up to and following its own state elections in 2007. In light of a broader shift away from public insurance in the rest of the U.S. economy (Hacker 2006) and given the comparable free-market and anti-government ideologies in the two states, Florida's expansion of state-coordinated homeowner insurance provision is puzzling. Following the record 2004 and 2005 hurricane seasons, why did Florida turn to the state to become the primary provider of homeowner insurance in high hurricane-risk regions, while Louisiana turned to the private insurance market? The paper uses two theories,

³ Insurers' stockholders cover voluntary insurance risk and voluntary insurers' creditors in the rare case of insolvency; in the very last instance, State Guarantee Funds cover any policyholders' outstanding claims. State Guarantee Fund Associations pay many of the claims not covered by an insolvent voluntary insurer's assets by assessing the solvent insurers still operating in the state. The owners of surviving insurers bear the administrative costs associated with assessment; they also retain those costs that cannot be shifted to their customers (Barrese and Nelson 1994).

interest group theory (“IGT”) and structural-class theory (“SCT”), to guide the comparative tracing of the policy processes that link the 2004 and 2005 hurricane cost shocks to the different legislative responses in Florida and Louisiana in 2007. The paper argues that the type of policy process and outcome in response to unexpected record hurricane shocks depends on the timing and distribution of the hurricanes’ property damages and the timely presence of political openings.

In Florida, the worst destruction from eight hurricanes over the course of two years affected a mostly White majority of the population. That majority managed to publicly frame growing insurance premiums as a problem of market fairness and to delegitimize private insurance provision. The resulting politicization of homeowner insurance affordability during the 2006 state election pressured legislators to reject taken-for-granted free-market solutions to the insurance affordability crisis. In 2007 the incoming state government instead adopted the anti-market policies demanded by homeowner groups.

In Louisiana, two geographically concentrated hurricane shocks within one month of each other most greatly affected a relatively disenfranchised segment of the population that could not politically mobilize as effectively as homeowners in Florida. Concerned about the wider economic effects of private insurance market disruptions, lawmakers instead continued to pursue their already existing policy of deepening and expanding the private homeowner insurance market and limiting state involvement in the provision of insurance before and after the state election in 2007. They understood the adopted free-market policies to be the best means not only to reduce insurance prices but also to stabilize the wider economic system.

In Louisiana, the narrower distribution of hurricane losses triggered a policy process best characterized by SCT. In Florida, the worst hurricane damages and subsequent homeowner insurance affordability and availability problems triggered the kind of policy process and

outcome theorized by IGT. These case-specific findings suggest that a shift from market to greater public provision of insurance in response to extreme weather events more generally, and the policy process proposed by IGT as opposed to SCT, depend on a greater distribution of extreme weather event costs at the conjunction of political opportunity. The argument proceeds as follows: First, the paper outlines the policy processes and outcomes theorized by IGT and SCT. After describing the methods and data employed, the paper traces and compares the policy responses to the 2004 and 2005 hurricane shocks in the two states. The paper concludes by discussing the findings, making a general claim based on the case-specific findings, and briefly outlining future directions of research to refine and test that claim.

2.2 Theory

No existing studies unequivocally explain the different insurance policy outcomes in Florida or Louisiana. Insurance economists have carefully described market and regulatory adjustments to the 2004 and 2005 hurricane shocks in the Gulf of Mexico (Grace and Klein 2009; Klein 2007; 2009), but have not theorized the factors and processes responsible for the different state responses. SCT and IGT have been successfully employed to explain different policy processes and outcomes in the substantively close field of worker-compensation insurance, including the adoption of state as opposed to private insurance systems (Fishback and Kantor 1996; 1998; Pavalko 1989). Similar to homeowner insurance, worker-compensation insurance can have significant economic consequences for the insured as well as the wider economy. Additionally, while private firms have historically provided worker-compensation insurance in most states, some state governments adopted state-backed programs that, similarly to residual homeowner insurance in Florida and Louisiana, did not exclusively rely on market forces. The findings in the worker-compensation studies and the associated theoretical insights by SCT and IGT help

identify what kind of insurance policy processes and outcomes one might expect in our two states and thereby guide the comparative process tracing analysis in section 4. The following section outlines the key theoretical claims made by SCT and IGT regarding policy processes and outcomes, summarizes their relevance to the adoption of worker-compensation insurance systems, and, by extension, to homeowner insurance policy responses to unexpected record hurricane disruptions in Florida and Louisiana.

2.2.1 Structural-Class Theory (SCT)

SCT explanations of policy outcomes (Offe 1984; Poulantzas 1978; Przeworski 1985; Therborn 1980) focus on how capital accumulation and the resulting social relations shape actors' political preferences, political opportunity spaces, and the role of the state in harmoniously reproducing capitalist relations. Under stable political-economic conditions, hegemonic material and social practices tend to sanction ideologies that filter out individuals' beliefs and values that threaten to block the reproduction of existing class relations. Many of those practices are directly or indirectly sanctioned by the state. Crises that disrupt the smooth reproduction of the status quo open up the potential for struggles over the structure of the existing political-economic system itself. Faced with such crises and in order to preempt challenges to the status quo, the semi-autonomous capitalist state intervenes on behalf (but not on behest) of the typically fragmented capitalist class and adopts policies designed to restore economic stability (Offe 1984).

SCT policy processes played a central role in the timing of the adoption of worker-compensation insurance systems in the U.S. According to Pavalko (1989:593), "macro-indicators that shaped politician's perceptions of the need for workman's compensation, the range of possible decisions, and the consequences of their actions and inactions" were more relevant to the relative timing of state adoption of worker-compensation insurance programs than interest

group competition, existing bureaucratic capacities of the state, or electoral politics (pp. 606-608). The adoption of “workmen’s compensation went beyond the specific interests of employers or workers to remove a threat to the long-term accumulation of capital” (p. 600). State economies with high levels of mechanization of work processes had the most to lose from growing work-accident costs and were consequently the fastest to adopt worker compensation insurance (p. 609).

Similar to the case of worker-compensation insurance, SCT would expect state actors as opposed to competing interest groups to take the lead in changing homeowner insurance policy when it became clear that hurricane disruptions threatened the stability of the wider economy. In ideologically pro-market and anti-statist Florida and Louisiana, such policies should generally have a pro-market bias in the sense of reducing regulatory restrictions of private insurance markets and the strengthening of the private as opposed to the public provision of homeowner insurance.

2.2.2 Interest Group Theory (IGT)

IGT explanations of policy outcomes (Dahl 2005; Lowi 2009; Meier 1988) focus on interest group competition and influence over government decision-making. Theories in this tradition generally assume that semi-autonomous legislators make political decisions to maximize their own political support. Policy outcomes therefore reflect the interests of those groups that can offer most political support to policymakers. Policymakers consequently act on behest and not on behalf of the most influential groups. The perspective takes as given the democratic environment that structures political group competition and incentives. Efforts to systematically transform capitalist dynamics and class relations lay outside the theory.

Regarding the adoption of worker-compensation insurance, labor, agricultural and insurance groups all supported the establishment of worker insurance systems to avoid the looming cost crises of the existing court-based negligence liability system (Fishback and Kantor 1998). No agreement existed, however, on whether those systems should primarily be market- or state-coordinated. Insurance and agricultural groups actively opposed the establishment of exclusively state-funded insurance programs and successfully used their greater political clout to persuade state legislatures to implement private insurance systems in most states. Only politically strong labor unions or broader progressive coalitions managed to overcome agricultural and insurance group influence and persuade a handful of state governments to adopt state-run insurance programs (Fishback and Kantor 1996:811). Political contests between opposing interest groups characterized the policy process and determined which type of worker compensation insurance system states adopted.

Unexpectedly large hurricane shocks impose different costs on different societal groups. Similar to the conflicts surrounding the type of worker insurance program adoption, IGT would expect political competition among the most affected groups to characterize the policy process generating the observed policy outcomes in Florida and Louisiana. The different outcomes ultimately would reflect the different political demands of the most resourceful and politically effective groups in each state. Contrary to SCT, the policy process theorized by IGT is more politicized and its outcomes are not necessarily biased towards the reproduction of the existing capitalist economic order. In the context of contemporary Florida and Louisiana, IGT would expect pro-market policy outcomes comparable to those predicted by SCT in case insurance companies and allied groups have relatively greater political influence (Meier, 1988). The adoption of policies designed to expand regulation or other means to constrain or even replace private with state-coordinated homeowner insurance would be more likely if homeowners and

their allies more effectively organized and lobbied state officials (also see Schneiberg and Bartley 2001; Schneiberg and Soule 2005).

2.3 Methods and data

In order to explain the shift from private to public insurance in Florida but not in Louisiana in 2007, the paper employs a comparative process tracing analysis of the homeowner insurance policy processes in the two states between 2005 and 2008. Process tracing leverages the theoretical insights of SCT and IGT to explain the policy outcomes in each of the two states. The complementary comparison of the two states helps account for the difference in the policy outcomes and allows for contingent generalizations of the case-specific explanations. This section elaborates these two methods and outlines the data they draw on.

2.3.1 Within-state policy process tracing

Process tracing is a historical within-case-study method that seeks to identify the causal process linking independent, intervening, and dependent variables (George and Bennett 2005:206). In our context, the dependent variables of interest are the homeowner insurance policy outcomes in Florida and Louisiana around 2007. The hurricane shocks of 2004 and 2005 constitute the key independent variables. The identification of the process linking these two with relevant intervening events offers a better explanation for the policy outcomes in the two states than other methods. Unlike statistical approaches or exclusive case-comparisons, for example, process tracing can effectively test theories and inductively generate hypotheses in an environment marked by multiple, complex, and inter-temporal interaction effects⁴—the environment

⁴ The large number of possible explanatory factors and the small number of cases causes problems of explanatory under-determination. Relatedly, a comparison of the two cases alone cannot confirm that all of the possible relevant factors have been identified or that the ones that

characterizing the political economy of homeowner insurance markets in Florida and Louisiana following the 2004 and 2005 record hurricanes.

Leveraging these advantages, the explanation of the insurance policy outcomes combines deductive and inductive approaches to within-state process tracing (Bennett and Checkel 2014:7-8; George and Bennett 2005:217-218; Mahoney and Thelen 2015:229-234). To the extent to which SCT and IGT provide sufficiently concrete and observable predictions, I employ process tracing to assess how well they characterize the process that connects hurricane shocks and the insurance policy outcomes in Florida and Louisiana. Depending on the concrete moment in the policy process under consideration, such tests will either take the absence or presence of theorized sequences of (inter)actions by key actors and contextual factors as evidence for the explanatory relevance of either SCT or IGT.⁵ More concretely, this involves describing the reaction of key interest groups and state officials to the state-specific hurricane disruptions, to each other, and how they affected homeowner insurance policies in the two states between 2005 and 2008. To the extent to which theoretical guidance from SCT and IGT breaks down because the theories' predictions are unobservable or not sufficiently specified, the analysis relies on inductively generated evidence to fill the gaps in the process or modify the theoretical predictions.

2.3.2 State comparison

The study complements the within-state process tracing with a comparison of the two states' background conditions. Following a "logic of difference," the comparison eliminates shared

have are indeed necessary or sufficient.

⁵ In a "hoop test", the hypothesized event or intervening variable must be present in order for the hypothesis not to be eliminated. In a "smoking gun test," the existence of an event or intervening variable offers proof that a hypothesis is correct (Mahoney and Thelen 2015:231-232).

conditions as potential explanatory factors or events for the different policy outcomes in the two states (Mahoney and Thelen 2015:225-226). In addition to the theoretical guidance of SCT and IGT, the identification of these factors or events offers empirical structure to the process tracing analysis. The combination of the process tracing with the case comparison analysis offers three advantages: first, it protects against explanatory spuriousness {George:2005vg pp. 156-160, 254}; second, it can establish the explanatory necessity or sufficiency of the identified factors in both states; third, it can highlight the dependence of the policy processes on state-specific background conditions. A better understanding of the latter makes possible contingent generalizations about the conditions under which the different identified policy processes, and the theories that characterize them, explain insurance policy responses to extreme weather events. Practically, the comparative step in the analysis involves the identification of homeowner insurance-related structural and institutional differences between the two states, and the incorporation of the identified factors into the process tracing exercise. Next, I briefly outline the three key areas of difference.

Despite their location in the “deep South,” comparable politically conservative, anti-government and pro-market ideologies, structurally market-coordinated economies, and similarly sized hurricane insurance losses in 2004 and 2005, Florida and Louisiana differ in some key dimensions with regards to homeowner insurance provision and hurricane shocks. Table 1 below lists the most relevant differences (and some similarities) between the two states around the time of the policy divergence (i.e. in 2007).

Table 1: State characteristics

	Florida	Louisiana
Hurricane exposure & coastal development		
2004/2005 estimated insured hurricane damage, in \$mio	30,900	28,837
Total no. of hurricane landfalls, 2004/2005	8	2
Counties with at least \$1bn in total damage	17	6
Share of total property damage	94%	69%
Share of total population	53%	26%
Share of Whites	82%	69%
Average population density per square mile	486	619
Median occupied house value, in \$	201,700	172,400
Average housing occupancy	58%	58%
Median per-capita income, in \$	27,561	23,069
Poverty rate	7%	8%
Insurance market		
Value of residential insured coastal hurricane exposure, in \$mio	2,458,600	224,400
Coastal P&C insurance exposure as percentage of total insurance, 2007	79%	35%
Top 10 (3) voluntary P&C market share, 2007	66% (43%)	83.8% (56%)
Residual market share, 2007	18%	10%
Homeowner premiums written, 2007, in \$mio	6,402	1,218
Auto premiums written, 2007, in \$mio	9,203	3,592
Politics		
State election	2006	2007
Gubernatorial party shift	No	Yes
Gubernatorial party, 2007	Republican	Republican
Majority shift in either legislative chamber during election	No	No
Legislative majority party, 2007	Republican	Democrat
Real estate sector election contribution to legislature, in \$	3,239,218	868,951
Insurance sector election contribution to legislature, in \$	1,841,321	758,408
Homeowner insurance a major theme in state election	Yes	No
Post-election special legislative session addressing homeowner insurance issues	Yes	No
Criticism of voluntary homeowner insurance providers by governor (elect), 2007	Yes	No

Sources: American Community Survey 2005-2009, AIR Worldwide, Insurance Information Institute, followthemoney.org, Property Claims Services, SHELDUS.

Although the 2004 and 2005 hurricane seasons caused comparable insurance losses in both states, Florida's worst property damage was temporally, geographically and demographically more spread out than in Louisiana. In Florida, seventeen counties with approximately 50% of the state's total, though predominantly White, population each suffered more than \$1 billion in total property damages—more than 90% of the total damages created in both hurricane seasons. In Louisiana, only two hurricanes—hurricane Katrina and Rita—occurred within a month of each other in 2005 and caused more than \$1 billion in damages in only six parishes surrounding and

including New Orleans. Compared to Florida, these most damaged counties contained only a quarter of the overall state population and were more densely populated, less affluent, and less White.

The two states also differed in terms of their property insurance market structures. Florida's property and casualty insurance market were less concentrated and significantly more exposed to coastal hurricane risk. Absent any hurricane shocks, Florida's considerably larger market size, including a larger lucrative auto insurance segment, make it more attractive for private insurers to operate in. Partly due to its small market size, Louisiana historically has had difficulties attracting voluntary insurers to the state. Based on these structural market characteristics, private insurers have, by default, more to lose from exiting Florida than Louisiana. Regulators and legislators therefore, at least nominally, had greater leverage over voluntary insurers in Florida than in Louisiana.

Politically, both states held state elections within two years of the 2005 hurricane season. While state congressional majorities remained unchanged in both states, in Louisiana, Republican Bobby Jindal succeeded Democratic Governor Blanco who did not seek reelection post hurricane Katrina. The real estate sector contributed relatively larger amounts of funding to the state congressional elections in Florida; it contributed roughly the same as the overall insurance sector in Louisiana. Finally, homeowner insurance availability and affordability issues received greater legislative attention in Florida than in Louisiana during the election and immediately after.

Above differences in hurricane damage distributions, property insurance market structures, and in electoral politics identify factors that potentially condition policy processes in a way that accounts for Florida's but not Louisiana's shift to greater residual homeowner insurance provision in 2007. Section 4 incorporates these factors into the process tracing analysis and pays

special attention to how they condition residential insurer, homeowner, regulator and key legislators' (inter)actions leading up to the policy divergence in 2007.

2.3.3 Data and measures

The comparative process tracing approach requires fine-grained measures of all the intervening events and the mechanisms that link them and the eventual policy outcomes in 2007: the initial size, timing, and geographic distribution of the hurricane property damages; the two states' insurance market responses to record hurricane losses; the effect of those changes on different interest groups' policy demands, as well as policymakers' assessment towards the stability of the existing homeowner insurance (and wider economic) order; and the success of the former in influencing the latter.

I obtained hurricane property damage data from the Spatial Hazard and Losses Database for the United States ("SHELDUS"). Data for the changing property insurance market structures came from the existing insurance economics literature and a variety of public and private data sources including the U.S. Census Bureau, the Insurance Information Institute ("iii"), the Property Insurance Plans Service Office ("PIPSO"), AM Best's special and statistical reports, the National Association of Insurance Commissioners ("NAIC"), and the two state regulators' annual reports. To trace the prevailing institutional environments in which the policy process played out, including the legitimacy of the dominant and competing insurance market logics and associated state interventions, I drew on opinion polls and on newspaper reports about the homeowner insurance market and related policy proposals and debates obtained via keyword searches from Factiva. Regional newspapers in particular reported extensively on the impact and broader societal and political repercussions of the 2004 and 2005 hurricane shocks and offered

rich insights into popular expectations and attitudes toward the economic and political fall-out from the hurricanes.

Insurer, real estate, and other interest groups' political goals and demands were inferred from their publicized policy proposals, from public comments by their officials, and from their policy papers designed to influence the legislature. The political resonance of the latter as well as the different groups' official financial electoral contributions served as an additional measure of their political influence. Official financial electoral contributions are compiled on the comprehensive followthemoney.org database. State legislative election results were obtained from the Inter-University Consortium for Political and Social Research database no. 43297. Regulators' policy positions were inferred from their written policy recommendations, official public comments, and their actual regulatory responses to hurricane shocks. State officials' positions and strategies were reconstructed from public comments and speeches by key officials involved in insurance policymaking, their legislative activity surrounding homeowner insurance, and from their voting records. Data regarding all other aspects of the political and legislative processes were directly obtained from the respective state legislatures' online archives in the form of the procedural history of each law, its voting record, and legal digests and commentaries.

I triangulated all of above sources with fourteen in-depth interviews with leading insurance regulators, legislators, and interest group executives involved in critical aspects of the policy processes in both states, industry experts' written commentaries such as the "Property Insurance Report," and the insurance economics literature describing the market and regulatory responses to the 2004 and 2005 hurricane seasons.

2.4 Process tracing of policy responses relating to homeowner insurance, 2004-2008

The 2004 and 2005 hurricane landfalls only indirectly affected the observed homeowner insurance legislation in 2007. Taking as guidance the theoretical expectations of SCT and IGT and the structural and institutional differences between the two states identified in Table 1, this section traces the processes that link the 2004 and 2005 hurricane damages and those intervening events that together generated the different policy outcomes in Florida and Louisiana: the hurricane shocks to homeowner insurance market failures (section 2.4.1) and the associated insurance legitimacy crises (2.4.2), the various interest groups' political demands to solve the perceived crises and the pre-election policy responses (2.4.3), the eventual electoral impact of the crises (2.4.4), and the legislators' policy decisions in response to the electoral pressures and their own preferences (2.4.5).

2.4.1 Hurricane shocks and insurance market disruptions, 2004-2006

The 2004 and 2005 hurricanes caused private homeowner insurance market failures that triggered the political process that culminated in the contrasting insurance policy changes in the two states in 2007. There exists widespread evidence that, other things being equal,⁶ voluntary property insurers tend to overweigh recent events and refuse to extend or offer new coverage in response to unexpectedly large hurricane losses (Aseervatham et al. 2016; Born and Klimaszewski Blettner 2013; Burt et al. 2009; Kunreuther, Pauly, and McMorro 2013:175). Property insurers also tend to charge actuarially excessive premiums when the risks of future losses are ambiguous (Kunreuther et al. 1995; 2013), as they are in the case of hurricanes. In response to the unexpectedly severe 2004 and 2005 hurricane shocks, private insurers in both

⁶ For example, assuming no changes in regulatory restrictions on insurance rate setting or other exogenous market shocks.

states decreased their high-risk coastal coverage as old policies ran out and actively sought to increase insurance premiums on outstanding insurance contracts.⁷ These market changes created voluntary homeowner insurance affordability and availability crises in their respective states.

Following the record damages caused by Hurricane Andrew in 1992, property insurers along the Gulf of Mexico had adopted forecasting models designed to help refine their forecasts of future hurricane losses (Grossi and Kunreuther 2005). In line with these models, they gradually increased insurance rates and adjusted their risk exposure. By the early 2000s, property insurance markets had stabilized and insurers as well as regulators saw them as sufficiently prepared to absorb future hurricane shocks (Cummins, Doherty, and Lo 2002; Grace and Klein 2006:2). Climate models can predict increases in hurricane frequency and intensity but cannot predict exactly where and when hurricanes will hit and what degree of destruction they will cause (Melillo, Richmond, and Yohe 2014:27).⁸ The intensity and location of the 2004 and 2005 hurricane shocks caught all market participants by surprise. In response to the heightened uncertainty (Knight 1921) regarding their long-term profitability and even survival, leading private homeowner insurers in both states scaled back their exposure and sought to increase prices on the policies they continued to write in both states.

Owing to the original role of residual programs as insurer-of-last-resort, the size and growth of the residual market is the best available measure of voluntary homeowner insurance availability in Florida and Louisiana (Grace, Klein, and Zhiyong 2005:21; Klein 2009:71)⁹.

⁷ Whether the price increases were in fact actuarially justified or not is of no direct relevance to the argument here. What matters is whether market participants, and especially homeowners and lawmakers, regarded them as justifiable or not.

⁸ The inherent complexity of catastrophe models, the limited scientific knowledge regarding hurricanes, and a lack of historical data “leave open several possible and competing explanations for the parameters, data, and mathematical models underlying each of the components in a catastrophe model” (Grossi and Kunreuther 2005:70).

⁹ Throughout the 2004 and 2005 hurricane seasons and in their immediate aftermath in 2006, neither regulatory nor legislative nor demographic changes significantly altered the original

Florida's residual market share climbed from 10% in 2003 to 16% in 2006 and in Louisiana from 5% to 8%. A year later, in 2007, the share rose to 18% in Florida and to 10% in Louisiana.¹⁰ This growth in both states was predominantly driven by voluntary insurance supply retrenchment in high-risk coastal counties. The difference in growth rates mainly reflects Florida's relatively larger coastal insurance exposure and suggests a relatively greater state-wide voluntary homeowner insurance availability problem in Florida than in Louisiana in the immediate aftermath of the 2004 and 2005 hurricane seasons (Klein 2009:73-75).

When it came to voluntary insurance affordability, regulators in both states did not meaningfully resist significant homeowner insurance premium hikes, in Florida at least not until late 2006. Between 2003 and 2007, average statewide homeowner insurance premiums increased by 89% in Florida and 44% in Louisiana (Insurance Information Institute 2012). Florida's greater coastal exposure again largely explains the growth differentials. In both states, many high-risk coastal counties suffered dramatically larger increases, sometimes by up to 300% (Grace and Klein 2006:31-40; Klein 2009:59-67).

Together, Florida and Louisiana's private insurance supply and especially price shocks disrupted the pre-2004 and 2005 insurance equilibrium and caused significant economic hardship to homeowners seeking to renew their insurance in both states in 2005 and 2006, creating widespread concerns regarding the potential wider negative economic repercussions. The insurance disruptions in turn triggered insurance legitimacy crises and increasingly organized public calls for a reform of the insurance system in Florida, though not in Louisiana.

insurer-of-last-resort role of residual insurance providers in either state.

¹⁰ At the time of the 2005 hurricanes, a consumer protection statute that prevented insurers from canceling or non-renewing homeowners' policies that had been in force for more than three years governed Louisiana's insurance markets, limiting their flexibility in shedding these policies.

2.4.2 Legitimacy crisis and protest, 2005-2006

The second step in the process connecting the material hurricane damages to the policy outcomes of interest consists of the impact of voluntary insurance market disruptions on the legitimacy of the overall homeowner insurance system and associated protests. In Florida, the exposure of the majority of the population to insurance price hikes challenged the legitimacy of the existing insurance order. In contrast, the worst of Louisiana's homeowner insurance market disruption affected a smaller and more marginalized segment of the population. The public's attention instead focused on the perceived failure of the federal and local state to prevent the flooding of New Orleans and the city's subsequent rebuilding. Consequently, the state's crisis management and not the existing voluntary insurance order suffered legitimacy problems in Louisiana.

Schneiberg and Bartley's (2001) study of fire insurance regulation adoption indicates that private insurer-induced legitimacy crises can help consumer groups to organize. In line with this finding, the legitimacy crisis in Florida aided the political mobilization of homeowners and their allies. No such comparatively effective mobilization took place in Louisiana.

Florida

In Florida, the eight hurricane landfalls in 2004 and 2005 had the most damaging effect on counties with a majority of the state's (White) population. Most Floridians were consequently either directly or indirectly exposed to the subsequent homeowner insurance cost increases and supply reductions. The state's media systematically discussed insurance matters and market developments, further raising the public salience of hurricane-related homeowner insurance affordability and availability challenges along the coast. In 2006, media reports of the return to profitability of the voluntary homeowner insurance sector in the absence of new hurricane

shocks (Klein 2009:81) solidified the evolving public perception that the insurance sector was acting unfairly and opportunistically.

The associated erosion of the legitimacy of the existing insurance order provided the impetus for more organized political action. Starting in early 2006, homeowner groups and residential developers mobilized not only against price increases but against the overall homeowner insurance order. The grassroots insurance advocacy group “Homeowners against Citizens,” for example, formed in March 2006 to lobby for affordable residual insurance premiums. Later that year, however, the group changed its mission and name to “Having Affordable Coverage Florida,” because “it became evident that most of the problems that Citizens Insurance had was not because of Citizens but because of legislation that Citizens had to follow” (Florida Homeowners Insurance Information, 2006a). Like these groups, others evolved from protesting insurance price increases to demanding more systematic insurance market reform. A series of Florida Chamber of Commerce surveys during 2006 consistently ranked homeowner insurance prices as the top public concern. Regarding concrete solutions to this concern, 63% of voters backed an expansion of subsidized property insurance coverage of the residual insurer Florida Citizens according to a Quinnipiac University poll in late 2006. In other words, during the course of the state’s election year, a majority of Florida’s public became concerned about rising insurance prices and started to support an expansion of (subsidized) state-backed insurance as solution. The “fairness” of the existing insurance system consequently became a central issue in the state elections.

Louisiana

In contrast to Florida, in Louisiana, the public response to insurance market disruptions was significantly less pronounced. Homeowner insurance affordability and the organization of its

provision were conspicuously absent from the public discussion in the aftermath of hurricanes Katrina and Rita. Instead, the public's attention focused on the responsibility of all three levels of government for the extensive flood damage from the two hurricanes, the state's perceived inadequate, delayed, and racially biased rebuilding efforts, and private insurers' seemingly opportunistic claim payouts (Brunsma, Overfelt, and Picou 2010; Squires and Hartman 2013).

Hurricane Katrina, the costliest natural disaster in U.S. history, made landfall close to New Orleans. The accompanying storm surges caused extensive flooding that submerged 80% of the city and large parts of the neighboring parishes (McCarthy et al. 2006). A month later, Hurricane Rita further aggravated this flooding. As a result, 72% of the 188,251 housing units in New Orleans were damaged, with 56% having major or severe damage, mostly from flooding (US Department of Homeland Security 2006). The flooding damage triggered the evacuation of about 70% of the residents in New Orleans (Frey, Singer, and Park 2007). The hardest hit neighborhoods with the greatest overall population losses and slowest return rates were those with predominantly minority populations. The constituency that was worst affected by private homeowner insurance coverage shortages and price increases was therefore also small relative to the state's overall population.

The broader public's attention consequently centered on issues other than homeowner insurance affordability and availability. Most prominently, public discussion focused on the perceived state and government failure to prevent the flooding damage in the first place and to help the hardest-hit neighborhoods to rebuild. Secondly, because voluntary or residual homeowner insurance only covers wind damage, private insurers systematically delayed homeowner claim payouts. Insurance companies initially refused to meet the 1.2 million Katrina-related property insurance claims resulting from wind-driven hurricane flood damage (Hartwig and Wilkinson 2014). To a lesser degree, public attention therefore also focused on voluntary

insurers' claim-making processes. The ensuing lawsuits and the resistance of private insurers to pay their customers created considerable public and legislative misgivings about voluntary insurance behavior, although not about the overall insurance order as such. According to a Louisiana State University survey, only a few months before the state elections in May 2007, primary public attention had shifted away from issues surrounding the rebuilding of New Orleans but had not yet coalesced on another issue, certainly not on the fairness or general order of the existing homeowner insurance market system.

In summary, the state-specific geographic and temporal distributions of hurricane landfalls, the type of hurricane damage, and the racial and socio-economic characteristics of the worst affected populations were critical factors in creating different legitimacy crises in the two states. In Florida, the temporally and geographically more widely distributed costs from private insurance price increases, as well as the sector's widely reported return to profitability, challenged the legitimacy of the existing homeowner insurance market system. In Louisiana, public scrutiny rested on the state's capacity and willingness to prevent and help residents recuperate from flooding-related hurricane damage in New Orleans, as well as private insurers' perceived opportunism regarding claim payments. Public attention did not focus on the fairness of the existing insurance order as such.

2.4.3 Pre-election demands and policy responses, 2005-2006

What concrete political demands did different interest groups make in response to the voluntary insurance market disruptions and related legitimacy crises in the two states? How did legislators react to these demands, and what policies did they implement before the state elections in Florida in late 2006 and in Louisiana a year later? Political demands arising from the insurance market disruptions and the associated legitimacy crises, and the immediate policy responses to them,

constitute the next steps in the process that links the 2004 and 2005 hurricane shocks to the policy outcomes in 2007. In Florida, a critical and organized mass of homeowners demanded concrete insurance market reforms that would weaken the reliance on private market homeowner insurance provision. Despite these public demands and broader public pressure, Republican legislators continued to follow the prevailing free-market and pro-voluntary insurance provision orthodoxy. In Louisiana, where there was an absence of comparable public challenges and legitimacy crises to the existing insurance system, legislators continued to follow the pro-voluntary market policy logic that the state had adopted before the 2005 hurricane shocks.

Florida

Starting in 2005, coastal homeowner protest groups were “popping up everywhere” to highlight the affordability crisis in Florida’s homeowner insurance system and its negative effects on the wider economy (Zucco 2006). The aforementioned group, Having Affordable Coverage Florida, counted 1,000 members by late 2006. Another group, Fair Insurance Rates in Monroe, grew from its original 32 members in 2006 to 3,000 members today. Both joined a wider coalition of homeowner groups comprising, by their own accounts, over one million members (Florida Office of Insurance Regulation 2006; HACF 2006).¹¹ Leading up to the state elections in late 2006, these groups used town hall meetings, letter-writing campaigns, and protest rallies to systematically lobby legislators and regulators and propose concrete solutions to what they framed as an unfair insurance system.

¹¹ Other member groups included the Florida Consumer Action Network, Florida Justice Association, Cyber Citizens for Justice, ACORN, Florida Public Interest Research Group, Coalition of Florida Condominium Association, the Consumer Federation of the Southeast and the Florida AFL-CIO.

With respect to escalating insurance prices, the key demand was the replacement of the existing use-and-file rating system that allowed voluntary insurers relatively large pricing flexibility with a more restrictive prior-rate approval system that would give regulators greater discretion over insurance rate changes.¹² Protest groups also proposed the transformation of Florida Citizens into a fully competitive insurance provider that could offer subsidized or, in their mind, fairly priced insurance to everyone who applied—not just to homeowners who could not obtain coverage in the private market.

Voluntary homeowner insurance associations and lobbying firms framed insurance affordability problems as an issue of regulatory-induced market inefficiency that aggravated the ongoing voluntary insurance supply retrenchment. They argued, in line with the prevailing free-market economic logic, that homeowners' demands for greater state intervention would impede rather than promote competition, reduce voluntary insurance supply, and therefore further increase prices and harm homeowners in the long run. Using widely disseminated studies, direct lobbying, and testimonials before legislative committees, insurers consequently proposed a transition to a market-based rate-making system to create greater pricing flexibility. According to them, this kind of deregulation of the homeowner insurance market combined with additional monetary incentives to attract new private insurers to the state would eventually increase voluntary insurance supply and lower insurance rates (AM Best 2005; Harrington 2005). In legislative sessions leading up late 2006, the Republican majority in both state houses sidelined homeowner demands for greater state repression of private insurance market forces and instead

¹² Prior approval rating systems require insurers to file their planned rate changes and await approval from regulators before they come into effect. File-and-use systems require insurers to file their rate changes with regulators but can use them immediately after, unless the regulator blocks them within a given time period.

opted to adhere to the prevailing free-market logic, although not to extent demanded by insurance groups.

The legislative session in early 2005 created a 12-member task force to determine whether, following the record 2004 hurricane season, Florida had sufficient private insurance capacity to ensure the continuation of a healthy, competitive marketplace, and to identify the future demands on Florida's hurricane insurance markets. In the wake of the second set of record hurricane landfalls in 2005 and a day before the opening of the 2006 legislative session, the task force recommended that "maintaining and expanding competitive conditions in the Florida private sector property insurance market is critical to the economic viability of the state" (Florida Office of Insurance Regulation 2006:6). In particular, it argued that rate increases and greater pricing certainty were critical in attracting new and expanding existing voluntary insurance in Florida, and therefore safeguarding healthy levels of market provision of homeowner insurance.

In the subsequent 2006 legislative session, Republican lawmakers in both houses worked to implement these recommendations. Their majorities allowed them to essentially ignore the Democrats' support for homeowner demands (Ostrowski 2996). Eventually, the House and Senate compromised on an insurance bill (SB1980) that, among other provisions, made it more difficult for the state regulator to reject voluntary rate increases.¹³ It also created the Insurance Capital Build-Up Incentive Program that incentivized coverage expansion by existing or new voluntary homeowner insurers. The law additionally required the residual insurer to base its future rates on hypothetical reinsurance costs, thereby locking in residual rate increases to 20% from 2007 onwards. William Stander, regional manager for the insurance lobby group Property

¹³ The bill required the Florida insurance regulator to approve ratings that guaranteed insurers a reasonable rate of return commensurate with the risk of covering hurricane losses. Crucially, the bill placed the burden of proof of voluntary rate excess on the regulator. The net effect of this was to make it more difficult for regulators to reject voluntary rate increases.

Casualty Insurers Association of America, called the bill “a good start,” even though some of the insurer demands such as a move to a full market-based rate making system had been watered down (AM Best 2006). In short, leading up to the state elections in late 2006, the Florida state legislature pursued the kind of free-market solutions that were favored and formulated by the insurance industry and taken for granted in Florida’s wider political economy.

Louisiana

In Louisiana, the legislature continued to pursue a pro-voluntary insurance policy advocated for by the state’s insurance regulator and supported by leading legislators and the governor even before the 2005 hurricane season. A coalition of business groups which included homeowner insurers, though only as junior partners, actively supported this policy direction and provided concrete policy suggestions starting in 2006. Due to the large emigration of New Orleans’s hardest hit hurricane victims, homeowner mobilization against rate increases and for an expansion of subsidized residual insurance provision never became as widespread, organized, or effective as in Florida.

Mainly due to its small market size and widely perceived restrictive and even corrupt regulatory and legislative environment, Louisiana historically had difficulties in attracting sufficient voluntary homeowner insurance supply and reduce market concentration.¹⁴ In this context, starting in 2000, incoming Insurance Commissioner Wooley started to lobby the legislature and the governor to clean up the state’s insurance governance regime, attract more voluntary insurers to the state, and minimize regulatory and state intervention in and exposure to

¹⁴ Between 1972 and 2000, for example, every single Louisiana Insurance Commissioner was indicted for bribery, extortion, or related charges and eventually went to prison. The two largest property insurers in the state, Allstate and State Farm commanded a combined market share of 53% in the homeowner insurance market in 2005.

the insurance market. He also engaged in a systematic outreach campaign to rebuild the trust of private insurers in the state. He did so because “government does not do a good job running things” and “if we do what’s right, everything else will take care of itself.” “What’s right” here refers to the deepening and widening of private insurance market provision and the reduction of the state’s role in it. By eliminating government and regulatory rent seeking and by establishing more transparent and uniformly enforced rules, the state could establish an environment which would increase private insurance market competition and efficiency. This would eventually maximize aggregate societal benefits. Leading legislators and Governor Blanco were sympathetic to this approach and, as a first concrete step, created Louisiana Citizens as strict and uncompetitive insurer-of-last-resort in 2004.

The absence of any voluntary insurance insolvencies and a relatively low exodus of voluntary insurance from the market led to Louisiana’s voluntary homeowner insurance supply remaining relatively more stable than Florida’s post-2005. The largest private insurers did not take any concrete steps to exit the state.¹⁵ According to the regulator, industry representatives, and legislators directly involved in the decision-making at the time, the governor and the most influential legislators all interpreted this relative stability as a success of Commissioner Wooley’s previous trust-building efforts. This warranted the continuation of the pro-voluntary market approach initiated before 2005. In contrast to post-2006 Florida, scattered homeowner demands received no significant legislative attention or support.

The 2005 special legislative session following hurricanes Katrina and Rita did not directly engage with the issues of voluntary homeowner insurance affordability or availability. Most crucially for our purposes, legislators adopted a state-wide building code (SB44) that

¹⁵ This was not the case in Florida where State Farm threatened to leave the market following a regulator rejection of a 47% price increase in 2009. The company remained after a compromise was reached with the regulator.

Commissioner Wooley had long argued would increase voluntary insurer willingness and ability to expand homeowner insurance in the state. Moreover, none of the legislative sessions during the following year adopted policies that concretely expanded or restricted the residual or voluntary homeowner insurance markets either.

Starting in 2006, however, business concerns grew about the potentially negative effect of affordability and availability problems in the voluntary homeowner insurance markets for the ongoing rebuilding effort and wider economic performance. In close coordination and cooperation with Louisiana's insurance regulator, and in line with the pro-voluntary approach favored by the governor and leading legislators, a large and diverse group of businesses—the Coalition to Insure Louisiana—acted on these concerns and developed a detailed 15-point plan to render the voluntary homeowner insurance market more attractive to outside insurers, reduce insurance rates, and ultimately aide the rebuilding efforts. Bankers, realtors, and homebuilders spearheaded the Coalition. The insurance industry participated but did not lead its efforts to formulate concrete pro-voluntary insurance policy proposals. In the eyes of the leading legislators and Governor Blanco, the broad scope of the Coalition rendered it essentially representative of wider economy. Its testimonies in support and refinement of the state's existing free-market course not only helped to dismiss the few lingering demands for the expansion of subsidized residual insurance by some homeowners and their Southern lawmakers; it also signaled to lawmakers that more concrete pro-voluntary legislative interventions were required to shore up the wider economy.

In the subsequent 2007 legislative session, lawmakers adopted most of the regulator and Coalition's proposals. Policymakers created the Insurance Louisiana Incentive Program (HB678) that, similar to the 2006 incentive program in Florida, matched committed voluntary insurance coverage with state grants, while requiring grant recipients to absorb some of the existing

residual insurance coverage. The state also sought to limit the role of the residual homeowner insurer by requiring Louisiana Citizens to charge even less competitive rates (HB962) and streamlined the process by which voluntary insurers could take over residual policies (SB153). All three laws were deliberately designed to attract more voluntary insurers and facilitate the shift of hurricane risks from the state to the private insurance market. Regarding homeowner insurance prices, legislators opted to increase private insurers' pricing flexibility by abolishing the Insurance Rating Commission that had previously reviewed every rate increase above 10% (HB960).

In summary, for all practical purposes, Florida and Louisiana adopted very similar homeowner insurance policies designed to strengthen and deepen the voluntary market provision of insurance. Leading up to their state elections in late 2006 and 2007 respectively, legislators responded to hurricane-induced homeowner insurance market disruptions by following the free-market logic that was institutionalized in the wider political economy in both states. Florida did so amidst significant public criticism of the existing insurance system. Louisiana faced no comparable public opposition. To the extent that the largest insurance groups influenced these policy decisions, they did by collaborating with pro-market legislators and by offering concrete policy suggestions rather than threatening to exit the market.

2.4.4 State elections, 2006 and 2007

While both states sought to strengthen and deepen voluntary homeowner insurance provision in direct response to the 2004 and 2005 hurricane damages, the subsequent state elections changed the policy direction in Florida but not in Louisiana. In Florida, the 2006 state elections offered homeowner and real estate groups the structural opening to more effectively and successfully pressure legislators to alter the existing insurance provision system. In Louisiana, issues of

homeowner insurance affordability or availability never became a salient electoral topic. The state's existing strategy of expanding voluntary homeowner insurance in order to strengthen the overall economy was never effectively challenged and persisted after the elections.

Florida state elections, 2006

Between 2005 and 2007, the free-market policies pursued in Florida failed to prevent a 42% increase in state-wide average homeowner insurance premiums, as well as continued voluntary insurance retrenchment. By the end of 2006, homeowners' political lobbying combined with sizable electoral contributions from residential developers and real estate groups rendered homeowner insurance affordability issues sufficiently salient to turn them into the central pillar of the gubernatorial election and, more generally, into one of the central themes of the 2006 state election.

Republican gubernatorial candidate State Attorney General Charlie Crist set the tone of the election by tapping into the public anger surrounding homeowner insurance pricing and built much of his campaign on attacks on the insurance sector, portraying private insurers as profit-hungry and exploitative. With financial backing of \$2.5 million from the real estate sector and only \$433,200 from the insurance industry (out of a total of \$24.2 million), Crist won the race with a comfortable 7% margin. Real estate agent and developer electoral contributions also trumped those of property insurers and insurance agents in Senate and House races (see Table 1 above) and helped to at least marginally shift power in the legislature. While Republicans retained control of the House and Senate, Democrats, who had been more willing to align themselves with homeowner and real estate demands for a reform of the insurance system to achieve lower rates, rid the GOP of its two-thirds House majority. This election outcome meant that the Republicans could no longer ignore Democratic proposals and generally gave

homeowners and developers a greater voice in the legislative process. Additionally, by criticizing the pro-market insurance bill (SB1980) that came out of the Republican Senate in 2006, the Democrat Alex Sink beat Republican Senate president Tom Lee to the office of Chief Financial Officer of the state, becoming the first Democrat to win a statewide race since 1998.¹⁶

Louisiana state elections, 2007

In Louisiana by mid-2006, the slow return-migration of residents and widespread dissatisfaction with the state government's rebuilding efforts made it increasingly doubtful whether the Democratic Party would be able to amass the 100,000-vote margin it traditionally needed for statewide victory.¹⁷ The 2007 election also marked the first time policymakers would be vacating their House seats as a result of a 1995 law that enacted a 12-year legislative term limit. As a result, Republicans and their business allies saw the 2007 elections as a unique opportunity to take over the House and governorship (Barnes 2006). Crucially, however, neither party regarded voluntary insurance affordability as a sufficiently salient issue to prioritize in the elections. Instead, issues of government ethics, construction, health care, education, transportation, and workforce training dominated electoral debates. Ultimately, the GOP failed to gain the majority of the House or Senate as hoped. Still, Republican Bobby Jindal succeeded in wresting the governorship from Democrats, while incumbent Insurance Commissioner Donelon's landslide

¹⁶ Among other duties, the CFO has administrative oversight over the offices that handle banking and insurance regulation and therefore has great influence over the day-to-day operation of insurance markets.

¹⁷ Only roughly half of New Orleans's population had returned and the African-American percentage of the total state population was down to 58% from 67% before Hurricane Katrina (Boher 2007). New Orleans mayor Nagin at one point suggested that a conspiracy kept African-Americans from returning to New Orleans in an effort to change the power structure. He won reelection against a White candidate in 2006.

reelection likely resulted in a large part from his perceived leadership in the creation of the voluntary market-oriented insurance incentive program earlier that year.

In summary, homeowner and real estate groups in Florida successfully propelled the homeowner insurance affordability crisis to the center of the electoral debate, where their framing of the existing insurance order as unfair was embraced by important winning campaigns. In Louisiana, a similar mobilization did not occur and the institutionalized policy focus on private insurance market efficiency was never electorally challenged.

2.4.5 Post-election policy directions

The final step in the process that links the 2004 and 2005 hurricane landfalls to the 2007 insurance policy outcomes consists of the policy decisions made by legislators following the state elections in 2006 and in 2007. In Florida, electoral pressures influenced lawmakers' decisions to expand subsidized residual insurance provision and restrict voluntary insurers' flexibility. In contrast, Louisiana saw legislators continuing to follow the prevalent and institutionalized free-market and pro-voluntary insurance policies.

A month after the Florida elections, House members met for three days to discuss the upcoming special session on homeowner insurance reform called by Governor-elect Crist. In a significant turnaround from pre-election attitudes, leading Republican lawmakers concluded that a much larger role for the state in homeowner insurance provision had become inevitable (Diamond 2006; Stockfisch 2007). Republican Senator Atwater, for example, noted that "the financial risk associated with Florida's fiercest forces of nature can no longer be borne by the homeowner alone" (Stockfisch 2007). The incoming Republican head of the Senate's Banking and Insurance Committee publicly stated that he did not look forward to government getting more involved in insurance but just saw no alternative. Lawmakers publicly justified this

turnaround by stressing that they had previously been misled by the insurance sector.¹⁸ They claimed that contrary to the claims of voluntary insurers based on their catastrophe models, the existing voluntary insurance rate increases were not necessary for voluntary insurers' survival and the associated health of the insurance market. The return to positive profits in the absence of new hurricane landfalls in 2006 and 2007 proved that voluntary rate increases occurred at the expense of coastal homeowners; homeowners had thus been correct in claiming that private insurers were acting opportunistically.

During the ensuing special legislative session, the House and Senate debated the form of the curtailing of voluntary insurance markets and the bailing out of homeowners. While a part of the Republican-dominated House continued to favor free-market options, by the end of the session lawmakers approved bill CS/HB1A, which involved the expansion of de-facto subsidized residual homeowner insurance. The bill rolled back the earlier Florida Citizens rate increase and froze its rates at arguably artificially low levels until January 2009; it also offered access to residual insurance to anybody who received a voluntary insurance quote that was more than 15 percent above the residual rates and forced voluntary insurers to write homeowner insurance if they participated in the lucrative auto insurance sector. Some House Republicans commented that the bill was socialist. However, in a speech marking the passage of the bill, Republican Governor Crist again attacked the insurance industry for exploiting "every crack and crevice they can contemplate to rip more money from the pockets of our people" and thanked lawmakers for putting "the nail in the coffin of the industry that was hurting our people" (Follick and Dunkelberger 2007).

¹⁸ Some Senate leaders even discussed placing insurance executives under oath when testifying before legislative committees. House speaker Marco Rubio, for example, threatened to subpoena private hurricane forecasting companies in order to establish the soundness and fairness of their pricing methodology.

In Louisiana, the absence of any significant electoral pressure regarding homeowner insurance meant that legislators continued to draw on free-market policy prescriptions to strengthen insurance affordability and availability. The 2007 elections introduced no substantial changes in policymakers' attitudes toward the homeowner insurance market. The main homeowner insurance bill (SB160) in the legislative session following the election enabled greater voluntary insurer rate discrimination in 2008.

2.5 Discussion and conclusion

Following the record 2004 and 2005 hurricane seasons, why did Florida turn to the state to become the primary provider of homeowner insurance in high hurricane-risk regions, while Louisiana turned to the private insurance market? In Florida, temporally stretched-out hurricane-induced housing damages and the subsequent growth of homeowner insurance prices affected a larger, geographically more dispersed, and predominantly White segment of the overall population than in Louisiana. The widely distributed hurricane impacts triggered political mobilization by coastal homeowner groups and their allies, ultimately resulting in the popular reframing of insurance market disruptions as an issue of fairness rather than a lack of market efficiency. As demonstrated by the pre-election, pro-voluntary insurance policy adoptions in Florida, the mobilization was, however, only necessary but not sufficient for lawmakers to abandon institutionalized free-market policies. Political opportunity was additionally required to allow homeowners and their allies to translate their political demands into tangible legislative outcomes. The 2006 state elections provided such an opportunity. In Louisiana, even before the 2005 hurricane shocks, the insurance regulator, with support from the governor and key legislators, were actively pursuing a campaign to deepen and strengthen the private insurance market and to minimize what they perceived as harmful state interferences with it. After the 2005

hurricane disruptions, leading lawmakers faced a relatively unorganized public backlash against growing insurance prices that never systematically challenged the existing policy stance. A broad coalition of businesses that highlighted potential threats of homeowner insurance affordability and availability problems to the reconstruction effort signaled to state officials that more direct pro-market interventions were required to support the wider economy.

The policy dynamics and processes emphasized by IGT and SCT played a key role in generating policy responses in both states. The comparison of the two states indicates, however, that different dynamics and processes emerged in the two settings, supporting a more general claim regarding states' insurance policy responses to hurricane disruptions. The type of homeowner insurance policy response to larger-than-expected hurricane shocks and the associated homeowner insurance market disruptions depends on the temporal, geographic, demographic, and socio-economic distribution of the shocks at the conjunction of political, and especially electoral, opportunity. A broader distribution of the largest disaster costs across relatively more resourceful homeowners should trigger political mobilization that is able to use timely elections to initiate policies that challenge the institutionalized free-market policy logic. A narrower distribution of the largest disaster costs should fail to generate politically significant group opposition and allow the capitalist state to reproduce institutionalized free-market policies, even if timely electoral openings should arise.

The differences in homeowner insurance market structures in the two states seem to have had less of an impact on the different policy outcomes than state officials' adherence to institutionalized free-market policy prescriptions and the distribution of hurricane losses and timely state elections. In Louisiana, the relatively smaller size of the insurance market in principle allowed the largest insurers to make credible threats to leave the state altogether, and thereby to influence rule-making. Although the legislative outcomes in the state were supportive

of the private insurance sector, the evidence does not indicate that exit-threats or other direct pressures from private insurance groups significantly affected the observed legislative outcomes. In Florida, the substantially larger homeowner insurance market and the lucrative auto insurance market, together with the smaller insurance market concentration, made potential exit threats less credible. The widespread public opposition to the existing free-market insurance logic suggests that lawmakers could have relatively easily adopted less market-friendly policies in support of homeowners in the run up to the election in 2006. Florida's legislators did not do so, but instead sought to strengthen private insurers. The tracing of the policy processes in the two states suggests that SCT processes, mainly in the form of legislators' adherence to comparable free-market policy solutions to insurance affordability crises, figured centrally in both states before 2007. IGT processes in the form of effective homeowner group electoral pressure explain the break with pro-market policies in Florida in 2007.

Pavalko (1989) used SCT to explain the timing of the adoption of worker insurance compensation programs; the factors and processes highlighted by this theory also seem to explain Louisiana policymakers' continued adherence to free-market insurance policies. They did so not primarily because of interest group pressure, but mainly because these policies constituted what leading lawmakers believed to be the most effective means to address perceived homeowner insurance market frictions and failures that threatened the wider economy. While business groups supported this course post-hurricanes Katrina and Rita, they did not initiate it.

IGT was employed in Fishback and Kantor's (1996) explanation of the adoption of state-only worker insurance programs in the U.S. This theory also captures the situation in Florida, where interest groups composed of homeowners and their allies challenged taken-for-granted free-market economic policy prescriptions. This challenge was, however, not sufficient to convince legislators to abandon the institutionalized free-market legislative agenda they pursued

throughout 2006. Only the occurrence of state elections allowed homeowners to exert sufficient electoral pressure to change legislative behavior.

These analyses and findings suggest one avenue for theoretical synthesis. IGT and SCT both help explain states' responses to hurricane shocks. But as the analysis indicates, which dynamics and processes emerge and which theory applies depend on factors outside those theories—the shocks' temporal, geographic, demographic, and socioeconomic distributions and the timely opening of political opportunities. SCT applies when shocks are relatively concentrated. IGT applies when the cost shocks affect a broader part of the population and the opening of political opportunities allow the affected groups to persuade legislators to address their grievances outside the institutionalized policy prescriptions.

Two outstanding questions offer opportunities for future research. What exactly constitutes a broad as opposed to a narrow distribution of unexpected hurricane or other extreme weather cost shocks? How big do those shocks have to be to trigger effective political group mobilization and systematic change? In order to adequately test the contingent claim made here, future studies should address these two questions. They could, for example, conduct comparative analyses of the effects of varying distributions of extreme weather cost shocks on the likelihood of successful political and electoral mobilizations against institutionalized policy responses; these can be examined in the context of both political openings and blockages. Additional research could investigate the limits of possible structural transformation of homeowner insurance systems in response to weather-related political mobilization in capitalist economies. Sufficiently large future weather-related shocks might not only overwhelm the capacity of voluntary insurance markets to cover the resulting costs (Cummins *et al.*, 2002), but also conceivably surpass individual states' ability to reproduce the dominant economic order. An expansion of subsidized residual insurance provision to ease insurance affordability crises and their negative

effects on the wider economy might not be possible in response to truly extreme weather shocks. Amidst the growing frequency and intensity of extreme weather events, a better understanding of the capacity of existing insurance systems to absorb such shocks and of the processes that lead to the adoption of policy innovations will be critical for building not only a more resilient but also a fairer future.

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Chapter THREE - Hierarchical learning from rare events and its effect on local risk-taking: coastal homeowner insurance underwriting changes amidst intensifying hurricane shocks

Abstract

This paper investigates how organizational learning from rare events across different hierarchical levels alters local risk-taking. The empirical context is homeowner insurer underwriting change in hurricane-prone coastal states between 1992 and 2013. The statistical analysis of all coastal homeowner insurers indicates that learning from performance feedback at the state-subsidiary level is a good predictor of changes in local risk-taking in relatively stable market environments. Rare local hurricane shocks complicate such learning. Faced with such shocks, firms additionally rely on local as well as firm-wide explorations of hurricanes to alter their local risk-taking. Corporate-level learning from firm-wide hurricane experiences attenuated the more pronounced effects of more myopic learning from local shocks and from local performance feedback. The findings contribute to efforts to better understand the contingency of distinct but complementary learning processes across different organizational levels, to the literature on learning from rare events, and extends behavioral theories of risk-taking to analytically challenging scope conditions.

3.1 Introduction

Organizations learn when their experience systematically alters their knowledge and behavior (Argote and Miron-Spektor 2011; Huber 1991; Levitt and March 1988). Organizational learning comprises several distinct processes (Baum and Dahlin 2007; Bingham and Davis 2012; Miner and Anderson 1999; Schulz 2001), takes place at different hierarchical levels (Cyert and March 1963; Ingram and Baum 1997; Schwab 2007), and is shaped by idiosyncratic organizational hierarchies and structures (Bunderson and Reagans 2011; Gaba and Joseph 2013; Puranam and Maciejovsky 2017). There is evidence that one particular learning process, namely learning from performance-aspiration gaps or performance feedback, systematically alters organizational risk-taking (Bromley, Miller, and Rau 2001; H. R. Greve 1998; Kacperczyk, Beckman, and Moliterno 2015). Yet, the occurrence of rare negative shocks complicates this essentially backward-looking form of learning (Lampel, Shamsie, and Shapira 2009; March, Sproull, and Tamuz 1991; Starbuck, A. Greve, and Hedberg 1978).

This paper empirically tests how learning from rare shocks at the corporate and subsidiary firm-level directly alters local risk-taking as well as the interpretation and effect of learning from local performance feedback. Doing so integrates insights from different learning theories across different levels with behavioral theories of risk-taking. The paper shows how such a combination helps to explain the relation between organizational learning and (local) risk-taking in scope conditions that pose analytical problems to feedback-based learning models.

Following convention, I define organizational risk as the (expected) variance in performance outcomes. In stable and relatively predictable environments, learning from performance-aspiration gaps alters organizational risk-taking (Bromley et al. 2001; H. R. Greve 2003; Nickel and Rodriguez 2002). Performance deviations from organizational aspirations trigger search for new resource allocations and behavioral strategies that intentionally or unintentionally alter the

firm's risk exposure (Kacperczyk et al. 2015). Rare environmental shocks complicate learning from performance feedback (March and Olsen 1975; Starbuck 2009). Ambiguities surrounding the frequency and intensity of similar future shocks in firms' vicinities mean that inferences from performance-aspiration gaps can no longer be soundly generalized. Past relative success no longer reliably predicts future relative success. In such situations, performance feedback becomes an unreliable source of new knowledge about the adequacy of a firm's risk exposure and the need and direction to change it (Kunreuther and Useem 2017; Lampel et al. 2009; Levitt and March 1988).

Organizational learning from sources other than performance feedback also shapes adaptive behavior (e.g. W. M. Cohen and Levinthal 1990; Haunschild and Miner 1997; Madsen and Desai 2010). Firms can learn from information outside their organization, for example by observing and exploring aggregate market or industry-level phenomena (Ingram and Baum 1997; Schwab 2007). Such cross-level learning does not only involve different sources of new information. Different hierarchical levels within an organization such as the corporate office or subsidiaries are likely to have different learning motivations, biases, and decision-making processes (Gaba and Joseph 2013). Further, idiosyncratic organizational characteristics that govern the aggregation, analysis, and dissemination of knowledge distributed across the firm will also influence multi-level decision-making and local risk-taking (Argote and Miron-Spektor 2011). I argue that, in contexts in which rare shocks limit the reliability of local performance feedback, cross-level organizational learning from these shocks themselves not only directly alters local risk-taking but also moderates learning from and the effect of local performance feedback.

The empirical setting of the study is homeowner insurance underwriting in coastal states amidst record hurricane wind damage between 1991 and 2013. In exchange for the regular payment of premiums, homeowner insurance offers policyholder protection from covered wind

damage. Unexpectedly severe hurricane shocks focus local insurers' attention on the risk of large claim-payments and reduce the reliability of past local underwriting performances to guide adequate changes in their risk-exposure. In response to record-breaking wind damage in 1992, coastal insurers adopted and subsequently updated forward-looking catastrophe models — “technologies of rationality” (March 2006) involving simulations of loss scenarios rooted in the experience of real-world hurricanes. These tools enabled insurers to meaningfully explore and learn from local exposure to hurricane shocks even if their performances were not directly affected.

The analysis of a newly created dataset of the population of coastal homeowner insurance underwriters in the U.S. between 1992 and 2013 suggests that insurers indeed altered their local risk-taking not only based on their subsidiaries' performance feedback but also based on what they learned from local as well as firm-wide hurricane experiences. Particularly, less myopic learning at the corporate level attenuated the impact of more myopic local learning from recent large shocks and its interactions with local performance feedback. An additional post-hoc analysis confirms that this distinct learning process was not confounded by insurers' concerns about their lack of financial reserves and the associated risk of insolvency. In summary, learning from large environmental shocks at the local and global organizational level plays an important role in local risk-taking and alters the interpretation and effect of local performance feedback. In particular, corporate-level learning from firm-wide shock experiences attenuates the effect of more myopic local learning on local risk-taking.

The paper makes three major contributions. First, it contributes to recent efforts in the organizational learning literature to better understand the contingency of different learning processes and their impact. Second, the paper extends the behavioral learning theory of risk-taking to consider the importance of multi-level and multi-process learning in scope conditions

that theoretically stretch the original theory. Third, the paper contributes to the literature on learning from rare events.

3.2 Performance feedback and risk-taking in stable environments

One can distinguish three types of organizational risk-taking (Kacperczyk et al. 2015). First, risk-taking that is conflated with organizational change. New activities and routines are often more unreliable than established ones (Baum et al. 2005; Hannan and Freeman 1984). Changes in a firm's form or behavior then produce greater organizational risk. Second, firms can change their resource allocations or expand existing activities that intentionally alter their risk exposure (H. R. Greve 1998; Labianca et al. 2009). Third, exogenous changes in the environment can change the riskiness of existing resource allocations and strategies. In such a case, altered levels of risk exposure are not the result of deliberate organizational choices but of "postdecision surprises" (Harrison and March 1984).

In all three cases, such risk-taking or exposure is not confined to the entire organization or the most senior managers. Different performance benchmarks, biases, and decision-making processes at different organizational levels mean that decisions involving changes in risk-exposure are motivated by multiple and potentially inconsistent or contradictory interests (Gaba and Joseph 2013; Kacperczyk et al. 2015). Senior managers' central role in resource allocation and strategy-making (Bower and Gilbert 2005; Noda and Bower 1996) means that they play an important role in shaping firm-wide and local risk-taking. At the same time, subunits inevitably produce new local knowledge. The extent to which corporate offices systematically aggregate local knowledge, analyze and modify it, and redistribute their insights across the firm, and the extent to which the codification and sharing of such knowledge ultimately affect local and firm-wide risk-taking, also depends on firm-internal learning structures and power and status

networks (Argote and Miron-Spektor 2011; Bunderson and Reagans 2011; Contu and Willmott 2003; Schulz 2001).

This paper asks four questions. First, how does positive and negative performance feedback at the subsidiary level change local resource allocations and the associated risk-taking?¹ Second, how does corporate learning from rare shocks across the entire firm and at the local subsidiary level directly alter local risk risk-taking? Third, how does corporate learning from such shocks condition local learning from local shocks? Fourth, how do both types of learning moderate the empirically ambiguous association between local performance feedback and local risk taking.

3.2.1 Performance feedback and risk-taking

In stable environmental conditions, firms typically perceive existing levels and destinations of resources as low-risk (H. R. Greve 2003:82-87; March 1991). Because the “outcomes from novel initiatives generally have greater variability, longer lead times, and lower average expectations than do outcomes from known best alternatives“(March 2006:206), firms favor the status quo over novelty, i.e. they are risk averse. Deliberate changes in organizational risk-exposure is contingent on perceived changes in the existing or expected payoff of current resource allocations (March and Shapira 1992; Miller and Chen 2004). The behavioral theory of the firm (March and Simon 1958) takes seriously the notion that boundedly rational managers lack the cognitive capacities to continuously monitor and adjust their firms’ risk exposures. Instead, they simplify their decision environment using organizational rules and routines. This simplification enables managers to learn from their own or others’ experiences and to form consistent expectations about the future performance outcomes of different resource allocations

¹ In this sense, the study examines both “risky change” and “risk” (Kacperczyk et al. 2015:231).

{March:1993v1}. Both subsequently allow managers to make sense of the world and to collectively agree on deliberate changes in their firm's resource allocations and associated risk-exposure.

The most common rules that simplify firm-level decision-making and govern collective risk-taking involve the categorization of behavioral outcomes and organizational performances into successes or failures (Bromley et al. 2001; H. R. Greve 2003). Firm-specific 'aspirations' provide the reference points that distinguish both (Shinkle 2012). 'Historic performance aspirations' provide firms with summaries of past achievements and 'social performance aspirations' summarize the performance of their reference groups. These two forms of aspirations typically operate simultaneously, either in the form of different managerial arguments, different foci of attention, or a combination of both (Blettner et al. 2015; Bromiley and Harris 2014; Washburn and Bromiley 2012). In complex modern organizations, what constitutes such formal and informal aspirations differs across hierarchical levels, divisions, and functional lines (A. D. Chandler Jr 1977; Williamson 1975). Corporate offices, for example, are typically more concerned with the health of the overall firm whereas business units or subsidiaries focus on the health of their own more limited domain (Gaba and Joseph 2013; Simon 1962).

The main claim of the behavioral theory of the firm and performance feedback theory with respect to risk taking is that, everything else constant, performance-aspiration gaps change organizational risk propensities and trigger search for alternative organizational resource allocations and associated changes in risk exposure (Kacperczyk et al. 2015; March and Shapira 1987). A wide range of studies have examined the role of performance relative to historical and/or social aspirations on risk taking. Overall, the empirical evidence broadly supports the behavioral claim that risk taking is variable and a function of organizational performance relative to historical and social aspirations. Evidence about the direction and size of performance

feedback on organizational risk-taking is, however, mixed. Evidence about the effect of such behavioral rules at the local level is extremely sparse.

3.2.2 Negative performance-aspiration gaps and risk-taking

In line with the behavioral theory of the firm's problem-driven search (Cyert and March 1963) and prospect theory's predicted individual risk-taking (Kahneman and Tversky 1979), a range of studies find a positive association between negative performance feedback and organizational risk-taking. Gooding et al. (1996), for example, find that firms with performance in the lowest quintile took more risks in response to performance declines. Greve (1998) finds that decreases in performance increased radio broadcasters risk-taking, but that this effect was weaker for underperforming firms. Miller and Chen (2004) find that organizations sought greater risks the worse their relative performance-aspiration gaps.

Fewer studies report a negative relationship between relative performance shortfalls and organizational risk-taking. Miller and Bromiley (1990) find that performance deterioration decreases the risk-taking of low performers. Bromiley (1991) shows that performance relative to aspirations has a significant and negative effect on subsequent risk-taking. Moderators, particularly in the form of firm size and financial slack that insulate underperforming firms from insolvency threats, have been invoked to account for these contradictory findings (Audia and H. R. Greve 2006; Chen and Miller 2007; March and Shapira 1992). Absent clear theoretical and empirical guidance, I argue that business units and subsidiaries generally pay less attention to corporate insolvency and therefore are more likely to push for increases in risk-taking following performance shortfalls.

Business units are under pressure from their corporate office to achieve unit-specific performance targets. At the same time, greater local knowledge and typically loose coupling with

other parts of the organization provide unit managers with some level of discretion in their local resource allocation and risk-taking in response to relative underperformances (S. J. Chandler 2001; Simon 1962; Williamson 1975). In the mobile device sector, for example, Gaba and Joseph (2013) find that negative business unit performance feedback increases the rate of inherently risky new product introductions. Similarly, in relatively stable environments and absent subsidiary losses that threaten the solvency of the entire firm, it is conceivably rational for managers to increase resource allocation to risky products or services in response to underperformances.

Hypothesis 1 (H1). *As the subsidiary performance–aspiration gap below aspirations increases in a specific product-line, resource allocation to that line increases.*

3.2.3 Positive performance-aspiration gaps and risk-taking

There exist fewer studies but greater empirical consensus about firms' risk-taking responses to positive performance feedback. Firms generally seem to interpret positive performance-aspiration gaps as signal that existing risk management practices are effective and thus reinforce existing resource allocations or even reduce their risk exposure (Audia, Locke, and K. G. Smith 2000; H. R. Greve 1998; Iyer and Miller 2008). Increases in risk-taking following positive performance feedback have been much less observed. Such a positive association potentially reflects managerial over-confidence (Levitt and March 1988; March 2010) or increases in slack that encourage more risky resource allocations and looser organizational controls (Baum et al. 2005; Bromley et al. 2001; Chen and Miller 2007). Both forms of biased learning are likely to play a role in subsidiaries' responses to local overperformances.

Business units and their managers compete with each other for resources (Bower 2016; Williamson 1970). Relative overperformances not only trigger overconfidence in subsidiary managers, they also allow them to portray themselves as successful managers, to justify their demands for greater resources and expansions of their operations, and to downplay potential downside risks associated with doing so (Audia et al. 2000; Kunda 1999). Observing business unit's relative success is also likely to increase corporate officers' confidence in local managers' capabilities and risk-management skills that make it easier to ignore risks associated with allocating more resources to them (e.g. Fiske and Taylor 2016; Sitkin and Pablo 1992). Despite these considerations, Gaba and Joseph (2013), in line with the wider empirical evidence, find that performance above aspirations for a business unit does not materially affect the number of new product introductions. Following this evidence but mindful of the tendency for overconfidence, I thus expect local over-performances at the very least not to decrease local risky activities.

Hypothesis 2 (H2). *As the subsidiary performance–aspiration gap above aspirations increases in a specific product-line, resource allocation to that line does not decrease.*

3.3 Learning and risk-taking following rare shocks

The reliability and accuracy of performance feedback in guiding organizational risk-taking depends on environments that are relatively stable and have well-defined risk-return distributions (Alvarez, Afuah, and Gibson 2018; Lampel et al. 2009; March 2010; Starbuck 2009). In such environments, average past performance is a relatively good predictor of future performance and the performance of reference groups a good indicator of a firm's relative standing. Consequently, firms “adjust their behavior in response to their [performance] experience rather than acting on their expectations of future states of the world” (Lant and Shapira 2008:60). The unexpected

occurrence of rare exogenous shocks with potentially but not necessarily large realized negative consequences diminish the value of learning from such backward-looking performance experiences and turns attention to the future (Gavetti, Levinthal, and Ocasio 2007; Levinthal and Rerup 2006; Starbuck et al. 1978). In particular, these shocks introduce and highlight “paucity of experience problems” that make performance feedback an “inadequate experience relative to the complexities and instabilities of history” (Levitt and March 1988:333). The rarity of the events prevents firms from making generalizable inferences from their own performance and other experiences with those shocks and learn from those generalizations (Kunreuther and Useem 2017; Lampel et al. 2009). Managers might also simply overlook unexpected events or believe that they can negotiate or maneuver the organization away from the adverse effect (Shapira 1995; Starbuck et al. 1978).

In this section, I nevertheless argue that firms can learn from such local shocks by experiencing them “richly” (Beck and Plowman 2009; March et al. 1991) and that such learning affects subsidiary risk-taking as well as learning from performance feedback. I restrict the analysis to geographically limited “reinterpretative rare events” (Lampel et al. 2009:839). Such events do not necessarily have large direct performance consequences for firms in their vicinity. They do, however, trigger sufficient concerns about future performances and even organizational survival in the affected region to motivate closer explorations of the observed event and the reinterpretation of conceived wisdom based on the gained knowledge (Birkland 1997; Lampel et al. 2009:839). Large natural disasters are a prime example of such events (e.g. Ballesteros and Kunreuther 2018; Kelman et al. 2016). Such disasters focus collective attention on the shock occurrence within the exposed region and trigger experiential learning and adaptation independent of their impact on individual performances (also see Hoffman and Ocasio 2001).

3.3.1 Learning from rare events and risk-taking

Faced with the challenge of making generalizable inferences and learning from rare events, firms can pursue two principal strategies to better assess the adequacy of their existing risk exposure and the need to adjust it (Levitt and March 1988; March et al. 1991): a richer exploration of different dimensions and consequences of the (local) shock (Beck and Plowman 2009) and the abstract simulation of counterfactual or hypothetical histories (March 2006).

The deliberate exploration of single large events and their wider consequences can reduce the informational paucity of rare events. Richer explorations involve observing more aspects of the shock, including about how the event unfolds at the time and the collection of many interpretations of the shock and its outcomes (March et al. 1991). Both require a certain extent of managerial vicinity to the region exposed to the shock (Beck and Plowman 2009).

There exists some evidence that firms do indeed learn lessons from such richer explorations of large natural disasters in their (temporal and spatial) vicinity and that they translate those lessons into concrete steps to better cope with similar future shocks (Webb, Tierney, and Dahlhamer 2000). Madsen (2009) finds that firms in the U.S. coal-mining industry learned from their own as well as from other disastrous accidents to reduce their own likelihood of future disaster. Surveys indicate that businesses in the areas hard hit by the Loma Prieta earthquake and Hurricane Andrew, for example, improved their preparedness over pre-disaster levels {Webb:2000bi, p. 85}. Learning from such events and associated crisis management efforts can additionally help firms to mitigate negative repercussions of rare shocks {Dahlhamer, 2000, Oetzel:2014dm}. Birkland (2006) finds evidence of hurricane-related learning among emergency managers and state policymakers that resulted in a host of hurricane mitigation measures in Florida and North Carolina.

The second and complementary strategy of learning from rare shocks involves the use “technologies of rationality” to simulate and analyze hypothetical histories of rare events (Jarzabkowski and Kaplan 2014; March 2006; March et al. 1991). The computational simulation of a series of hypothesized past events virtually expands their small sample size. Such larger virtual sample size circumvents the paucity of experience associated with rare events, increases firms’ power of inference, and allows them to make more sound statistical assessments of their current and future risk-exposures. Technologies of rationality consist of strategic tools that capture this virtual historic data, identify sets of variables and their causal structures, and provide decision rules that consider alternatives in terms of their expected consequences (March et al. 1991:203). Such technologies typically improve the efficient exploitation of existing resource allocations and activities in stable environments.

In highly complex and ambiguous situations such as those introduced by the kind of reinterpreted rare shocks considered here, the use of virtual histories carries the potentially catastrophic risk of model-misspecification (March 2006). However, the lack of alternative formalized and thus transferable means of learning often justify their use. I argue that amidst the falling costs of “big data” and access to computational power and expertise, firms will choose to rely on such technologies as long as they are legitimized. For managers, these technologies provide additional decision-making heuristics that might enhance the lessons learned from more conventional explorations of rare events (Mezias and Starbuck 2008). I treat both forms of learning from rare shocks, i.e. their richer direct and virtual exploration, as one learning process. In practice, one informs the other and it is therefore impractical to analytically separate them (Tamuz and Lewis 2009).

Learning from rare events can potentially directly identify local risk-taking opportunities or encourage reductions in existing risk exposure. However, as in the case of learning from

performance feedback, the encoding of new knowledge, its exploration, and its exploitation will not be uniformly distributed across an organization. Beck and Plowman (2009:912) argue that middle managers in particular are better positioned to richly explore rare shocks “because they likely see more and different aspects of a rare and unusual events than either top-level or front-line managers.” Similarly, corporate offices are structurally better positioned to aggregate information from local shocks across the firm, to use that knowledge to update and refine learning aided by technologies of rationality, and to use the newly produced knowledge to inform local and firm-wide resource allocations, strategy, and risk-taking behavior.

The codifiable knowledge produced by rich local explorations of rare shocks flows up to the corporate office that analyses the relevant knowledge and then distributes the resulting insights across the organization (also see Argote, McEvily, and Reagans 2003; Grant 1996; Schulz 2001). Local exploration and learning itself is thus influenced by the context of corporate knowledge (Argote and Miron-Spektor 2011; Hansen 2002). It is however, not reduced to it, as there always exists some tacit knowledge that informs subsidiaries’ interpretation of the world. Together with different cross-level interests, the distributed organizational learning from rare shock justifies separately assessing the effect of local and corporate-level learning. How exactly these multi-level learning and conflicts of interest interact directly and interactively alter local risk-taking is an empirical question. I therefore only hypothesize the existence of such direct and interactive effects.

Hypothesis 3a (H3a). *Corporate-level learning from rare events alters risk-taking at the subsidiary level.*

Hypothesis 3b (H3b). *Subsidiary-level learning from a rare event in its vicinity alters its risk-taking.*

Hypothesis 3c (H3c). *Corporate-level learning from rare events conditions the effect of subsidiary-level learning from local rare events on subsidiary risk-taking.*

3.3.2 Learning from rare events and performance feedback

There exists some evidence that market disruptions and environmental factors more generally moderate the effect of learning from performance feedback on organizational risk-taking (see Shinkle 2012:436-437 for a brief overview). Richer explorations and learning of rare shocks could conceivably condition firms' interpretations of performance feedback in a similar manner.

Deepphouse and Wiseman (2000) find that performance feedback has a significant positive effect on risk taking during turbulent environments but no significant impact during growth periods. Gooding and colleagues (1996) show that economic conditions across time and industry moderate the association between performance-aspiration gaps and risk taking. In an empirical test of different risk-taking models, Palmer & Wiseman (1999) find evidence that it is managerial responses to attainment discrepancies that link environmental changes to organizational risk-taking. Simulations of adaptive organizational search shed further light on the underlying mechanisms involved in this moderating effect. Levinthal and March (1981:307) suggest that exogenous environmental change, uncertainties, and learning rates combine to influence aspiration levels. Gavetti and Levinthal (2000) use simulations to argue that model-based or "offline" learning about existing and future risks and backward-looking "online" performance-based learning affect each other. Simulated future scenarios seed the statistical interpretation of

rare feedback signals in hypothetical probability distributions while feedback itself serves as impetus to update model parameters and, ultimately, changes in organizational risk-taking.

Broadly in line with these findings, I argue that the rich exploration of rare shocks at the subsidiary and corporate level also enrich and thereby alter the interpretation of and response to subsidiary performance feedback. Just as organizations with little direct failure experience may be unable to draw lessons from other firms' losses (Madsen and Desai 2010), firms without richer experiences of rare events might be unable or unwilling to learn the same lessons from their local performance-aspiration gaps as firms with them. In particular, richer knowledge about the local unfolding of the shock, the distribution of similar shocks, and subsidiaries' exposure to them goes some way in correcting the inadequacies of the information provided by performance feedback in the context of rare events.

The additional information allows firms to more intelligently assess whether performance-aspiration gaps indicate problems independent of recent or likely future shocks or not. This greater intelligence also helps firms to understand to what extent local deviations from average past performance are a good predictor of future performance and whether the local performance deviation from reference groups indicate a firm's relative standing. The intelligence obtained from the separate exploratory learning process can also enrich a firm's knowledge about how to avoid exposure to future shocks as well as about how to take advantage of new opportunities. In short, equipped with greater knowledge about rare local shocks, firms conceivably alter their response to local performance feedback more intelligently compared to the absence of such knowledge. As before, I limit myself to hypothesize that interactions between multi-level learning from rare shocks and local performance feedback exist and that they have meaningful effects on subsidiary risk-taking. The direction of such effects is a context-specific empirical question.

Hypothesis 4a (H4a). *Corporate-level learning from rare events alters the association between subsidiary performance feedback and risk-taking.*

Hypothesis 4b (H4b). *Subsidiary-level learning from a recent rare event in its vicinity alters the association between its performance feedback and risk-taking.*

Hypothesis 4c (H4c). *Corporate-level learning from rare events conditions how subsidiary-level learning from a recent rare event alters the association between subsidiary performance feedback and risk-taking.*

3.4 Data and Methods

To test the hypotheses, I conduct a statistical analysis of changes in homeowner insurance underwriting in all 18 states along the Gulf of Mexico and Atlantic coast between 1992 and 2013. Interviews with insurance professionals as well as the analysis of industry and media reports enrich the description of the empirical setting and the interpretations of its statistical analysis.

3.4.1 Research setting - Homeowner insurance underwriting in hurricane prone states

Three aspects make homeowner insurance underwriting in coastal states a good case to test the effects of learning from performance feedback and rare shocks and their interactions on organizational risk-taking. First, homeowner insurance underwriting is inherently risky; second, performance feedback-type rules play an important role in changing underwriting portfolios in state subsidiaries; third, local hurricanes in this period were sufficiently salient to motivate

organizational learning from and about them independent of their impact on individual firms' performances.

Homeowner insurer risk-taking behavior and performance feedback

Homeowner insurance policies protect residential houses against some contractually pre-specified amount of wind damage. A policy typically lasts one year. To manage their annual claims payout risks, insurers use historical data to classify underwriting risks into homogenous categories and assign policyholders to these categories (Frees 2015). Policyholders within a category have similar risk profiles and pay the same insurance price. Risk pooling — the spreading out of insurance coverage among a large number of uncorrelated risk categories— and the law of large numbers enable insurers to cover claims from individual policy losses without going bankrupt. The more policies an insurer underwrites in a specific state or risk-category, and the more insurance premiums the firm receives, the larger the potential maximum *absolute* payments it has to make in case of damage claims. Yearly changes in the volume of homeowner insurance premiums received thus indicate changes in a firm's maximum risk exposure in any given state.

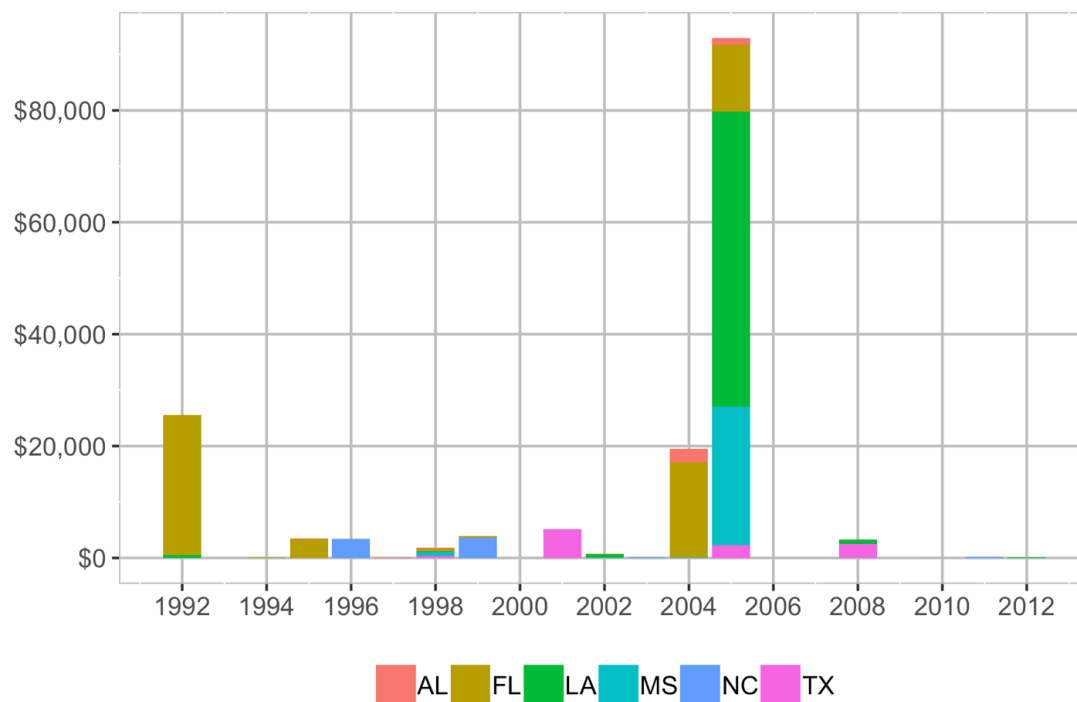
Typical homeowner insurer underwriting- and risk-taking behavior can be characterized as relatively centralized and goal-driven. A central risk committee at the corporate level, typically comprising the CEO, chief actuary, general counsel, and senior marketing and risk officers, sets the overall risk-adjusted profit (or loss) goals (or aspirations) —the “profit provision”— for different insurance lines and units in different regions and states. The committee then allocates capital and instructs regional and subsidiary managers to meet the goals using that capital. A state manager's influence over the final line-specific underwriting allocation and associated risk exposure varies across insurers.

Both historic and social performance aspirations play a central role in guiding insurers' underwriting and risk-taking behavior at the state subsidiary level. Regarding historic performance goals, owners and investors recognize the inherent volatility in homeowner insurance losses and expect insurance firms to generate reasonable local profits over the span of typically five years (Grace and Klein 2009; Klein 2009a). The typical historic performance goal therefore requires state subsidiaries to meet or exceed their average historical performances in a given insurance line. The goal is monitored and enforced by senior managers at the corporate level and quantified by insurance actuaries using historical firm data (Frees 2015). To remain competitive, especially local managers also compare their subsidiaries' insurance line performances to the market leaders in a given insurance line and state. Their careers are tied up with their units' relative local performances (e.g. Barnett, Baron, and Stuart 2000; Baron and Bielby 1990). Significant underperformances stall their internal advance and market reputation. Additional social and somewhat less informal performance goal thus motivate state managers to meet or exceed the average annual performance of the insurers with the largest state market share. While larger firms have dedicated units that actively monitor these leaders, smaller firms obtain this competitive information from the media, trade publications, professional conferences, and personal networks.

Hurricane shocks as rare events

Greater coastal population density, wealth, and warming sea surface temperatures have been increasing hurricane intensity, property damages, and associated state-specific performance uncertainties along the Gulf coast since the early 1990s (Elsner, Kossin, and Jagger 2008; Gettelman et al. 2017; Holland and Webster 2007; Pielke et al. 2005). Figure 1 below plots the timing, size, and location of annual hurricane wind damage along the East and Gulf coast.

Figure 1: Hurricane property wind damage along the Gulf and Atlantic coast, in mio.



Starting with Florida in 1992, each Gulf coast state plus North Carolina experienced a hurricane season with at least one billion hurricane wind-related property damages. Each such hurricane season represents a “reinterpretative” rare event. Independent of local firms’ actual claim payments related to the hurricane wind damage, such seasons are large enough to focus both corporate and local subsidiary attention to the uncertainty surrounding the frequency and intensity of future hurricanes in that state and a firm’s potential exposure to them (Birkland 1997; Hoffman and Ocasio 2001).

Catastrophe models as technology of rationality

In 1992, Hurricane Andrew, the costliest natural disaster in U.S. history in terms of insurance payouts to homeowners at the time, focused the entire insurance industry’s attention on the dangers and uncertainties surrounding modern hurricane landfalls in coastal states (McChristian 2012; Snyder 1993). The sparse historical data about hurricanes limited the practical value of

richer explorations of individual hurricanes to predict the changing distribution of hurricane frequency and intensity and their impact on individual firms' future claims payments. To better assess their existing and future risk exposure and amidst the necessary technological and computational advances, the industry adopted forward-looking catastrophe models in the decade following Andrew.

Catastrophe models are technologies of rationality in the sense outlined above. They use existing hurricane data to simulate a large number of historic and future loss scenarios involving different hypothetical hurricane damage and underwriting portfolios (Daron 2011; Grossi and Kunreuther 2005; Kunreuther, Pauly, and McMorrow 2013:166-168; NAIC 2011). These hypothetical loss scenarios allow actuaries to map the likelihood of different risk-return ratios across different states of the world and to estimate 'optimal' risk-adjusted underwriting portfolios on a state-by-state basis. Insurers typically triangulate different model outputs. Most insurer learning from such shocks occurred with the help of catastrophe models. As one former state manager of a nationally leading insurance group put it to me, "nothing changes [in terms of underwriting changes and risk taking] unless cat[astrophe] models change."

3.4.2 Sample

The insurance-related financial and demographic data in the statistical analysis comes from the annual regulatory statements filed by all licensed insurers with the National Association of Insurer Commissioners (NAIC).² Each licensed insurer is statutorily required to annually submit a comprehensive financial and organizational statement to the NAIC. The statements contain

² Each licensed insurer is statutorily required to annually submit a more than 200 page long financial and organizational statement to the NAIC. The NAIC compiles these reports, offering a census-like annual mapping of the insurance market on the national and individual state level in the U.S.

financial and demographic information for individual insurance firms at the national level and state subsidiary level. Information for the latter is more limited than for the national level but contains a breakout of annual underwriting, loss, and earning data by insurance line. The NAIC electronically reads in the individual pages of the submitted financial statements of each licensed firm and compiles each page in an individual data file. I collected the pages relevant to the analysis, cleaned them, and combined them into one multilevel panel dataset indexed at the state-year-firm level.

The final dataset contains all 365 unique firms directly underwriting more than \$100,000 of annual homeowner insurance at some point in the 18 Gulf and Atlantic coast states between 1991 and 2013. The reason for this lower cut-off point for inclusion is the desire to capture genuine homeowner insurers, i.e. insurers that consider underwriting homeowner insurance a meaningful part of their business. Insurers with less than \$100,000 in annual homeowner insurance underwriting per state represent either legal constructs, underwriting that is done as a special favor to clients but not as a viable operational focus, or firms that entered the market but either left shortly thereafter or never expanded their underwriting scale. The resulting 1,475 omitted observations make up 6% of all observations in the coastal states over the time period. In terms of underwriting they are, however, immaterial. The 22,603 state-year-firm level observations in the final dataset represent 99.991% of all homeowner insurance premiums underwritten in the period. For all practical purposes, the dataset is thus a census of all true homeowner insurers licensed in the coastal states between 1991 and 2013.

Annual hurricane wind property damage data on a state-by-state basis comes from the Spatial Hazard Events and Losses Database for the United States (SHELDUS). The dataset is based on raw data from the National Center for Environmental Information of the National Oceanic and Atmospheric Administration. Data for all socio-economic and regulatory control

variables at the national and state-year level were obtained from relevant public data sources. I assembled and cleaned the yearly pages of the annual NAIC reports and merged them with the hurricane damage and control variable data sources to create an original unbalanced panel dataset.

3.4.3 Measures

Dependent variable

I operationalize the dependent variable, *log HO underwriting growth*, as the annual difference in the natural logarithm of the total dollar amount of direct homeowner insurance premiums written by an insurer state subsidiary (also see Epermanis and Harrington 2006:1525). The direct written premium on a homeowner insurance policy in a given state is the product of the insurance policy rate and the value of coverage purchased for the property. That value of the policy rate is directly proportional to the perceived risk underlying the insured property. The higher the risk, the higher the rate conditional on regulatory approval. Similarly, the higher the value of the covered property unit, the higher the potential insurance pay-out. A year-to-year increase in the value of a firm's total underwritten homeowner insurance premiums therefore reflects an expansion of the firm's absolute risk exposure in that line and state. The natural logarithm of each year's underwriting value adjusts for outliers in the rate of expansion.

Independent variables

Performance feedback. The performance feedback variables are constructed as the difference between a firm's historic and social performance aspiration and its actual performance. I operationalize an insurer's lagged performance as the loss ratio, $P_{i,k,t-1}$, at the state-year level. The metric is central to insurers' underwriting decision-making and is comparable across different firms. The loss ratio is the annually incurred loss divided by the earned premium for a

homeowner insurance line in a given state and year. I include both lagged historic and social aspirations, $A_{i,k,t-1}$, in the models. Senior managers typically compare their subsidiaries' loss ratios last year to their historic five-year loss ratio. Consequently, I operationalize historic performance goals as the five-year average loss ratio in a firm's homeowner insurance line in a given state. Subsidiary (and to a lesser extent senior) managers also compare their own subunit's losses to the average losses of the market leaders in their respective state and year. I therefore operationalize the social aspiration (Labianca et al. 2009) as the average loss ratio of the three insurers with the largest homeowner insurance market share in a given state and year.

I operationalize performance above and below the two aspiration levels as separate variables by multiplying the performance feedback variables by two separate indicators, I_t and $(1 - I_t)$ (Chen 2008:613; Chen and Miller 2007:373- 374). Managers make underwriting decisions for the current year on the basis of performance-aspiration gaps last year. The variable I_t is coded as one if firm i 's current performance exceeds its (historic or social) aspiration, i.e. if its loss-ratio today falls *below* that of its historic or social level. $(1 - I_t)$ indexes under-performing firms. To minimize endogeneity problems and to reflect the yearly policy renewal cycle, I lag all performance feedback indicators in the model by one year. The lagged *historic* or *social over-performance feedback* variable then takes the form $I_t (P_{i,k,t-1} - A_{i,k,t-1})$ and *historic and social under-performances* $(1 - I_t) (P_{i,k,t-1} - A_{i,k,t-1})$. H1 and H2 are rejected for any performance feedback measure that has a negative effect on annual underwriting growth.

Hurricane experiences. Two measures of insurer hurricane experiences, represented by the vector $H_{k,t}$ in the model below, capture the hierarchical nature of insurer learning from the exploration of local hurricane shocks—one at the corporate national insurer level and the other at the state-subsidary level. The first indicator, *corporate hurricane experience*, is the lagged cumulative number of an insurer's state subsidiary-years that were exposed to total hurricane

wind damage greater than one billion dollars since 1991. Corporate offices might ignore, do not systematically store, or code state subsidiary learning from less damaging hurricane seasons that did not also involve direct performance repercussions. In other words, this measure assumes that the corporate office only accounted for lower hurricane seasons through their impact on state-subsidiaries performance-aspiration gaps and did not separately and more richly explore them. One billion dollar plus seasons are typically highly salient even to insurers whose claims payments are not directly affected by the damage. Corporate offices with subsidiaries in states exposed to such large hurricane seasons explore their potential impact independent of their actual performance impact and deliberately make efforts to update their firm-wide catastrophe models. The greater the number of subsidiaries with exposure to such seasons, the richer the sample to learn from. H3a is rejected if corporate hurricane experience has no direct impact on annual state subsidiary underwriting growth.

I additionally construct a categorical *state hurricane property wind damage* variable that measures lagged annual state hurricane wind property damage. The damage represents a state-wide phenomenon that, depending on its size, encourages local hurricane learning. The larger the annual damage, the greater the incentive for local insurers to learn about it. I divide the variable into three bins of damage— 0 - \$100mio, \$100mio - \$1bn, and > \$1bn. The first category serves as baseline, so the other categories measure the difference in the impact of learning compared to it. Here, the underlying and simplifying assumption is that H3b is rejected if the state hurricane damage variable has no direct impact on annual state subsidiary underwriting growth.

To test the conditioning of the local hurricane learning by corporate learning, I interact both variables. H3c is rejected if the interaction term has no effect on state subsidiary underwriting growth. To test whether either corporate or subsidiary-level learning from hurricane shocks conditions the impact of performance feedback on subsidiary risk-taking, I interact each

hurricane damage learning indicator with each performance feedback measure. H4a and H4b are rejected if the relevant interaction terms have no significant impact on subsidiary underwriting expansion. Finally, to test H4c, i.e. whether corporate learning conditions the impact of subsidiary hurricane learning on the association between subsidiary performance feedback and risk-taking, I construct a three-way interaction between *corporate hurricane experience*, *state hurricane damage*, and the different *performance feedback* measures.

Control variables

State subsidiaries of the same parent firm share organizational characteristics and information, including institutionalized learning and risk-taking processes. This means that annual underwriting changes by state subsidiaries are not independent of each other. I control for this dependence by treating firms as random effects in the statistical model (see below). The additional inclusion of state fixed effects controls for unobserved time-invariant heterogeneity across states. Year fixed effects adjust for annual unobserved state or firm-invariant heterogeneity. Additionally, I control for observable time-varying confounders at the state, national firm, and state subsidiary level.

At the state level, overall economic activity, new homeowner insurance demand, changes in housing prices, state insurance market concentration, and regulatory restrictiveness affect subsidiaries' willingness to change their underwriting levels. I control for these factors by adding variables that measure the *per capita GSP*, annual constructed *new housing units*, yearly changes in the seasonally adjusted annual *state housing price change*, the homeowner insurance *market Herfindahl–Hirschman Index*, and the *residual market share*. The Herfindahl-Hirschman Index is a standard measure of market concentration. Residual insurance is provided by state-coordinated insurance programs that offer “insurance-of-last-resort” to homeowners who cannot obtain coverage from private insurers (Insurance Information Institute 2015). The less supportive the

regulatory environment, the less willing private insurers are to underwrite homeowner insurance in the state, and the larger the residual market share.

I control for whether a homeowner insurance subsidiary is of going concern by including the dummy variable *active subsidiary* that is coded zero if the firm is active and one if it is being wound down in some form. Relatedly, I include the dummy *HO exit* that takes the value of one if the firm is exiting the homeowner insurance line in that state for any reason and a dummy *HO entry* coded one if the firm entered the line that year. Line entry and exit could influence subsidiary homeowner insurance underwriting expansion and risk-taking for reasons unrelated to learning from performance feedback or hurricane socks.

At the national firm level, portfolio diversification, corporate structure, financial slack, overall homeowner insurance underwriting performance, and a subsidiary's relative underwriting importance are also likely to affect a firm's willingness and capacity to alter its state subsidiary's annual risk-taking. National insurance groups can legally separate subsidiaries for different insurance lines and states to obtain limited liability for other state entities and the overall group. In principle, this allows the "walled off" subsidiaries to take greater risks. The dummy variable *group* controls for this effect. I also add a lagged indicator of a firm's policyholder surplus as measure for its *financial slack*. Greater slack can increase risk-taking (Audia and H. R. Greve 2006; Chen and Miller 2007; Iyer and Miller 2008; Latham and Braun 2008; Miller and Chen 2004; Singh 1986). Policyholder surplus is the difference between an insurer's admitted assets and liabilities and is a common measure for an insurer's financial strength and capacity to write new business.

I use the *geographic Herfindahl–Hirschman Index* to measure a firm's homeowner insurance underwriting geographic concentration and the *product Herfindahl–Hirschman Index* to estimate its level of underwriting diversification across different property and casualty

insurance lines.³ I control for a state unit's strategic importance to the firm by including the indicator *subsidiary importance*, measured as the ratio of the state subsidiary's to the overall firm's total amount of homeowner insurance premiums underwritten. A greater underwriting contribution is likely to garner greater attention from senior management and provide subsidiary managers with a greater voice in capital allocation decisions (also see Gaba and Joseph 2013:1106-1107). I also control for a state subsidiary's local underwriting diversification by adding the variable *subsidiary HO concentration* that measures the percentage of the unit's portfolio allocated to the homeowner insurance line.

Finally, state subsidiaries' local experience, specialization, and market weight also affect their annual risk-taking. To control for local experience, I add the indicator *subsidiary HO experience* that measures the number of years the firm has underwritten homeowner insurance in a specific state using 1991 as the base year. To capture potential left-censoring, I add the dummy *subsidiary left censored* that is coded as one for all state homeowner insurers that existed before 1992. To control for homeowner insurance line specialization, I add the variable *subsidiary HO concentration* that measures the percentage of the subsidiary's state P&C insurance portfolio that is allocated to the homeowner insurance line. The indicator *HO subsidiary market share* controls for state subsidiary's local market weight.

³ The Geographic Herfindahl–Hirschman Index is calculated as the sum of the squared percentage of homeowner insurance premiums written in each state for each firm and year. The index measures the geographic (state) concentration of each insurer's written premiums. The higher the index averaged over all homeowner insurers in a state and year, the more concentrated the average insurer's written premiums in a few single states. The Product Herfindahl–Hirschman Index is calculated as the sum of the squared share of premiums written in each P&C line for each firm and year across states. The index measures the product (insurance line) concentration of all premiums written. The higher the index averaged over all homeowner insurers in a state and year, the more concentrated the average insurer's written premiums in a few lines.

3.4.4 Model specification

To test the hypotheses, I estimate a random-intercept repeated measures model that treats firms as a random effect and states and years as fixed effects (Raudenbush and Bryk 2002; Singer and Willett 2003; Snijders and Bosker 2011). This model specification explicitly accounts for the lack of independence across firms and time as well as for systematic state and time effects. I use the statistical software R and the package lme4 to run the regressions. The random firm intercept can be interpreted as the national firm's impact on different state subsidiaries' yearly underwriting changes that is left unexplained by the non-random explanatory and control variables in the model. Introducing the random effect as intercept into the model assumes that individual insurance firms, through their idiosyncratic strategic outlooks and unmeasured organizational characteristics, have different inherent propensities to alter their state subsidiary underwriting and risk exposure, but that the rate at which these idiosyncrasies affect the changes are comparable across firms. This is not an unreasonable assumption. Model diagnostics indicate that the model is well-specified (see Appendix).

The full random intercept model (Model 7 below) includes individual and interactive performance feedback and hurricane experience effects and takes the form:

$$\begin{aligned}
 y_{i,k,t} = & \beta_0 + \beta_1 Year + \beta_2 State + U_i + \\
 & \beta_3(1-I_1)(P_{i,k,t-1} - A_{i,k,t-1}) + \beta_4 I_1(P_{i,k,t-1} - A_{i,k,t-1}) + \\
 & \beta_5 H_{i,t} + \beta_6(1-I_1)(P_{i,k,t-1} - A_{i,k,t-1})H_{i,t} + \beta_7 I_1(P_{i,k,t-1} - A_{i,k,t-1})H_{i,t} + \\
 & \beta_8 H_{i,k,t} + \beta_9(1-I_1)(P_{i,k,t-1} - A_{i,k,t-1})H_{i,k,t} + \beta_{10} I_1(P_{i,k,t-1} - A_{i,k,t-1})H_{i,k,t} + \\
 & \beta_{12} H_{i,t} H_{i,k,t} + \beta_{13}(1-I_1)(P_{i,k,t-1} - A_{i,k,t-1})H_{i,t} H_{i,k,t} + \beta_{14} I_1(P_{i,k,t-1} - A_{i,k,t-1})H_{i,t} H_{i,k,t} + \\
 & \beta_{15} X_{i,k,t-1} + \beta_{16} X_{i,t-1} + \beta_{17} X_{i,k} + \beta_{18} X_{k,t} + \varepsilon_{i,k,t} \\
 U_i \sim & N(0, \sigma_u^2) \\
 \varepsilon_{itk} \sim & N(0, \sigma^2)
 \end{aligned} \tag{1}$$

where the subscript i denotes an individual firm, t the year, and k the state. $Y_{i,k,t-1}$ is the yearly difference of the natural logarithms of direct homeowner insurance premiums written by a firm

in each state. *Year* and *State* are fixed effects for years and states respectively. U_i specifies the random effect, i.e. the unobserved individual firm-level effects. $P_{i,k,t-1}$ is the measure of state subsidiary underwriting performance, i.e. the homeowner insurance loss ratio for firm i in state k at time $t-1$. $A_{i,k,t-1}$ denotes a state subsidiary's historic or social aspiration level. I_1 and $(1 - I_1)$ index over- and under-performing firms respectively. $I_1(P_{i,k,t-1} - A_{i,k,t-1})$ denotes positive social or historic performance feedback, $(1 - I_1)(P_{i,k,t-1} - A_{i,k,t-1})$ negative feedback. $H_{i,t}$ denotes the firm-wide hurricane experience variable and $H_{i,k,t}$ the state-specific record hurricane index. The X variables represent controls at different levels of abstraction.

For purposes of clarification, Table 1 below summarizes the hypothesized effects in terms of the model coefficients.

Table 1: Hypotheses summary

	Hypotheses	Model coefficient	Direction
H1	As the subsidiary performance–aspiration gap below aspirations increases in a specific product-line, resource allocation to that line increases.	β_3	> 0 (Positive effect)
H2	As the subsidiary performance–aspiration gap above aspirations increases in a specific product-line, resource allocation to that line does not decrease.	β_4	≤ 0 (Non-negative effect)
H3a	Corporate-level learning from rare events alters risk-taking at the subsidiary level.	β_5	Significant effect
H3b	Subsidiary-level learning from a rare event in its vicinity alters its risk-taking.	β_8	Significant effect
H3c	Corporate-level learning from rare events conditions the effect of subsidiary-level learning from local rare events on subsidiary risk-taking	β_{12}	Significant effect
H4a	Corporate-level learning from rare events alters the association between subsidiary performance feedback and risk-taking.	β_6 & β_7	Significant effect
H4b	Subsidiary-level learning from a recent rare event in its vicinity alters the association between its performance feedback and risk-taking.	β_9 & β_{10}	Significant effect
H4c	Corporate-level learning from rare events conditions how subsidiary-level learning from a recent rare event alters the association between subsidiary performance feedback and risk-taking.	β_{13} & β_{14}	Significant effect

3.5 Results

3.5.1 Data summary

Table 2 lists the summary statistics and pairwise correlations for the unscaled variables. The median logged annual premium underwriting growth was 5.4 percent with a very large standard deviation of 62 percent. Rows 19-24 summarize the explanatory variables. The categorical

variable *state hurricane wind property damage* is summarized as a continuous variable. Owing to the inclusion of the North Atlantic coastal states, the median year-state in the dataset experienced no hurricane wind damage. The average insurer had 3 state subsidiary-years that experienced hurricane shocks exceeding one billion dollars in property wind damage.

Table 2: Summary statistics and pairwise correlations

Variable	Mean	Median	S.D.	Max	Min	1	2	3	4	5	6	7	8	9
1. Log HO underwriting growth	.065	.054	.618	11.019	-6.249									
2. New housing units (in '000s)	40.277	23.297	46.743	287.250	.700	-.028								
3. Per capita GSP (in '000s)	42.460	42.332	12.027	71.155	18.416	.021	-.074							
4. Housing price change	.029	.030	.063	.230	-.260	-.009	.243	.116						
5. Residual market share	.035	.011	.052	.283	.000	-.010	.396	.005	-.021					
6. Market Herfindahl Hirschman Index	.121	.119	.048	.263	.046	.018	.090	-.213	-.046	-.079				
7. Active subsidiary (yes = 0)	.006	.000	.075	1.000	.000	-.038	-.006	-.061	-.022	-.020	-.034			
8. HO entry (yes = 1)	.009	.000	.092	1.000	.000	.109	.017	.018	.004	.012	.001	-.007		
9. HO exit (yes = 1)	.044	.000	.206	1.000	.000	-.199	.033	.002	.002	.034	.015	.090	.027	
10. Firm Geographic Herfindahl Hirschman Index	.269	.134	.280	1.000	.036	.060	.105	.076	.001	.047	-.099	.076	.014	.040
11. Firm Product Herfindahl Hirschman Index	.228	.191	.141	1.000	.076	.092	.039	.016	-.042	.090	-.030	.029	-.015	.012
12. Group (yes = 1)	.913	1.000	.281	1.000	.000	-.003	-.032	-.063	-.002	.040	.011	.023	.008	-.005
13. Financial slack (in \$ bn)	4.133	.692	9.086	79.778	.000	-.017	-.037	.084	-.050	.044	.050	-.029	-.019	-.054
14. Subsidiary importance	.038	.000	.113	1.000	.000	-.001	.122	.089	-.017	.124	-.089	.033	-.007	-.005
15. Subsidiary HO concentration	.225	.147	.234	1.000	.000	.017	-.003	.060	-.060	.105	-.014	.018	-.030	.006
16. Subsidiary HO experience (years)	9.563	8.000	6.065	23.0	1.000	-.106	-.058	.474	-.059	.149	.064	-.065	-.131	-.052
17. Subsidiary left censored (yes = 1)	.820	1.000	.384	1.000	.000	-.137	-.055	-.146	.080	-.148	-.073	.025	-.010	-.094
18. Subsidiary HO market share	.017	.003	.043	.476	.000	-.018	-.034	.005	-.010	.005	.032	-.021	-.028	-.061
19. Positive social performance feedback	-.153	-.030	.539	.000	-10.720	-.036	-.075	.101	-.011	-.032	-.117	-.017	-.003	-.012
20. Negative social performance feedback	.179	.000	1.513	152.2	.000	.117	.002	-.007	.007	.027	.019	.002	.128	.019
21. Positive historic performance feedback	-.135	.000	.571	.000	-42.970	-.004	-.049	.023	.019	-.108	-.075	.004	-.011	-.009
22. Negative historic performance feedback	.232	.010	1.298	105.7	.000	.129	.020	-.042	.016	.040	.049	.008	.110	.018
23. Corporate hurricane experience (year-state)	4.343	3.000	4.324	13.0	.000	-.007	-.049	.367	-.191	.227	.147	-.060	.032	-.003
24. State hurricane wind property damage (in \$ mio)	390.1	.000	3,055.7	52,739.1	.000	.004	.192	-.051	.138	.190	.134	.005	.003	.010

Table 2: Summary statistics and pairwise correlations - continued

Variable	10	11	12	13	14	15	16	17	18	19	20	21	22	23
11. Firm Product Herfindahl Hirschman Index	.298													
12. Group (yes = 1)	-.338	-.258												
13. Financial slack (in \$ bn)	-.259	-.159	.138											
14. Subsidiary importance	.564	.394	-.395	-.133										
15. Subsidiary HO concentration	.224	.649	-.264	-.134	.408									
16. Subsidiary HO experience	-.103	-.075	-.047	.238	.037	.069								
17. Subsidiary left censored	-.194	-.193	-.014	.104	-.055	-.139	.287							
18. Subsidiary HO market share	-.166	-.070	.120	.612	-.033	.000	.141	.121						
19. Positive social performance feedback	-.002	-.013	-.004	.040	.019	.016	.079	.022	.059					
20. Negative social performance feedback	.021	.011	.009	-.006	-.019	-.019	-.030	-.025	-.032	.034				
21. Positive historic performance feedback	-.012	-.027	-.012	-.012	.019	.010	-.001	.032	.016	.017	.008			
22. Negative historic performance feedback	.017	.019	.014	-.008	-.023	-.020	-.068	-.038	-.025	-.043	.931	.042		
23. Corporate hurricane experience (year-state)	-.342	-.153	.165	.325	-.236	-.079	.590	-.062	.115	.015	.027	-.045	.016	
24. State hurricane wind property damage (in \$ mio)	.001	.018	.007	.001	.008	.010	-.008	-.015	.003	-.610	.075	.012	.289	.046

3.5.2 Direct effects of performance feedback and hurricane learning (Hypotheses 1-3)

Table 3 and 4 below list the random intercept regression results. Both omit the fixed *Year* and *State* variables. All continuous estimates are scaled to make the size of the variable coefficients comparable. The logarithmic scale of the dependent variable means that model coefficients measure the average impact of a one standard deviation change on the annual percentage change in underwritten homeowner insurance premiums. The measure for over-performance, i.e. the loss ratio below the historic or social aspiration, takes a negative value. A positive coefficient on that variable therefore indicates a negative effect, a negative coefficient a positive one. This is slightly confusing. I will refer back to this relation throughout the discussion below. As is recommended for random intercept models, I rely on the conservative Satterthwaite approximation of t-test statistics to assess the significance of individual coefficients (Giesbrecht and Burns 1985; Kuznetsova, Brockhoff, and Christensen 2017). Because the underlying sample virtually covers the entire population of coastal homeowner insurers between 1991 and 2013, high statistical significance indicates relatively large effects with low variance. In other words, in such situations the estimated effect is a good measure of the average percentage change.

The models in Table 3 below test Hypotheses 1-3. The table also lists all the estimated control variables. * before a variable indicates its interaction with the next full variable above it.

Model 1 is the control model. Model 2 adds the hypothesized social and historical performance feedback variables. Model 3 adds the state and corporate-level hurricane experience variables. Model 4 adds the interaction of the two, i.e. the indicator of how corporate learning from very large firm-wide hurricane experiences alters subsidiary learning from local hurricane seasons in the previous year. H1 and H2 address the direct effect of subsidiary performance feedback on annual changes in subsidiary underwriting, H3a-c the direct and interactive effects of corporate and subsidiary learning from hurricane state-years.

Table 3: Regression Models 1-4

Models	1	2	3	4
EXPLANATORY VARIABLES				
Corporate hurricane experience			-.008 (.014)	-.005 (.014)
State hurricane damage = \$100mio - \$1 bn			-.052* (.022)	-.059* (.030)
* Corporate hurricane experience				.014 (.035)
State hurricane damage > \$1 bn			-.098*** (.027)	.017 (.041)
* Corporate hurricane experience				-.128*** (.035)
Positive social performance feedback		-.017*** (.004)	-.022*** (.005)	-.020*** (.005)
Negative social performance feedback		-.001 (.011)	-.012 (.012)	-.016 (.012)
Positive historic performance feedback		-.002 (.004)	-.002 (.004)	-.002 (.004)
Negative historic performance feedback		.070*** (.011)	.083*** (.012)	.088*** (.012)
D.f.	58	62	67	71
Log Likelihood	-19,559	-19,392	-19,383	-19,376

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 3: Regression Models 1-4 - continued

Models	1	2	3	4
CONTROLS				
New housing units	-.013 (.013)	-.018 (.013)	-.008 (.014)	-.005 (.014)
Per capita GSP	.145* (.073)	.153* (.072)	.128 (.073)	.111 (.073)
Housing price change	.029*** (.008)	.024** (.008)	.027*** (.008)	.028*** (.008)
Residual market share	-.025* (.012)	-.029* (.012)	-.029* (.012)	-.024* (.012)
Market Herfindahl Hirschman Index	.102** (.038)	.042 (.038)	.059 (.039)	.051 (.039)
Active subsidiary (yes = 0)	-.204** (.072)	-.202** (.072)	-.202** (.072)	-.202** (.072)
HO entry (yes = 1)	.539*** (.044)	.466*** (.044)	.469*** (.044)	.468*** (.044)
HO exit (yes = 1)	.639*** (.020)	-.643*** (.020)	-.643*** (.020)	-.642*** (.020)
Firm Geographic Herfindahl Hirschman Index	.174*** (.014)	.169*** (.014)	.169*** (.014)	.169*** (.014)
Firm Product Herfindahl Hirschman Index	.131*** (.019)	.127*** (.019)	.126*** (.019)	.125*** (.019)
Group (yes = 1)	.018 (.039)	.015 (.039)	.017 (.039)	.015 (.039)
Financial slack (in \$ bn)	.021 (.011)	.019 (.011)	.021 (.011)	.020 (.011)
Subsidiary importance	.052*** (.007)	-.050*** (.007)	-.050*** (.007)	-.051*** (.007)
Subsidiary HO concentration	.090*** (.010)	-.085*** (.010)	-.085*** (.010)	-.085*** (.010)
Subsidiary HO experience	.250*** (.019)	-.235*** (.019)	-.234*** (.019)	-.233*** (.019)
Subsidiary left censored (yes = 1)	-.056** (.021)	-.056** (.021)	-.056** (.021)	-.056** (.021)
Subsidiary HO market share	-.002 (.007)	-.001 (.007)	-.001 (.007)	-.001 (.007)
Constant	-.184* (.075)	-.156* (.075)	-.165* (.075)	-0.14 (.075)
D.f.	58	62	67	71
Log Likelihood	-19,559	-19,392	-19,383	-19,376

* p < .05, ** p < .01, *** p < .001

Models 2-4 partially support hypotheses 1 and 2 about the direct effect of subsidiary performance feedback on local risk-taking. They do not support the hypotheses because *negative*

social and *positive historical performance-aspiration gaps* had a negligible direct effect on annual changes in subsidiary homeowner insurer underwriting. They support H1 because *positive social performance feedback*, i.e. subsidiaries with loss ratios that were lower than the average loss ratio of the state's market leaders, did not reduce underwriting but instead had a sizable positive effect. In line with H2, *negative historic performance feedback*, i.e. loss ratios larger than the subsidiary's average ratio over the previous five years, also had a large positive impact, one 2-3 times larger than that of *positive social performance feedback*.

Models 3-4 also partially support hypotheses 3 about the direct impact of corporate and subsidiary learning from state hurricane seasons and their interaction. H3a is rejected because the direct effect of learning from *corporate hurricane experience* was negligible in size. H3b about the relevance of local subsidiary learning from rare events is supported. When only considering their direct effects (Model 3), subsidiary learning from *state hurricane damage above \$100mio.* on average reduced homeowner insurance underwriting compared to state-years with damage below that amount. Learning from *damage above \$1bn* almost doubled that annual reduction. This large direct negative effect disappears, however, if we also take into account the conditioning effect of corporate level learning from the largest annual hurricane damage (Model 4).

Model 4 considers how learning from *corporate hurricane experience* conditions individual state subsidiary hurricane learning.⁴ It partially supports H3c. State-wide hurricane *wind damage between \$100mio and \$1bn* negatively affected annual changes in subsidiary

⁴ Adding the interaction term changes the interpretation of the direct hurricane experience effects. Now *corporate hurricane experience* measures the impact on subsidiaries in states subject to less than \$100mio. in hurricane damage in the previous year. Both *state hurricane damage* factors now measure the relative impact (compared to states with damage less than \$100mio.) on subsidiary underwriting changes without any previous *corporate hurricane experience*.

underwriting independent of the subsidiary's *corporate hurricane experience*, leading to a rejection of H3c. But subsidiary learning from annual billion-dollar-plus hurricane damage had no significant impact on changes in local risk-taking absent any previous corporate experience with such hurricane shocks. In line with H3c, the very large and negative effect of subsidiary hurricane learning effect was conditional on previous *corporate hurricane experience*.

3.5.3 Performance feedback and cross-level learning from hurricanes (Hypothesis 4)

Table 4 below lists the models including the hypothesized two- and three-way interactions between the *performance feedback* and *corporate and local hurricane experience* variables. The table omits the control variables. They do not substantially change compared to Table 3.

Hypotheses 4a-b test whether *corporate* and *subsidiary learning from hurricane damage* alters the interpretation and effect of learning from subsidiary *performance feedback*. Hypothesis 4c tests whether *corporate hurricane experience* conditions the way subsidiary-level learning from *state hurricane damage* alters *performance feedback*. As in Table 3, * before a variable indicates its interaction with the next full variable above it. Two nested * indicate a three-way interaction. The models themselves are listed in increasing order of complexity and fit.

Model 5 adds two-way interactions between the *performance feedback* variables and *corporate hurricane experience* to test H4a.⁵ To test H4b, model 6 adds the two-way interactions between the *performance feedback* and *state hurricane damage* variables to Model 5. Model 7 adds the three-way interaction between the two cross-level hurricane and performance feedback learning variables and tests whether and how *corporate hurricane experience* conditions the

⁵ Now the direct *corporate hurricane experience* variable measures the effect of previous corporate hurricane experience on subsidiaries that met their performance aspirations in states with less than \$100mio. in hurricane damage exposure last year. The direct performance feedback variables measure the impact on state subsidiaries of firms without any previous corporate hurricane experience.

effect of the interaction between learning from *state hurricane damage* and *performance feedback* (H4c). To clarify all these rather complex interaction effects, Table 5 add the end of this section additionally lists the regression results of the full Model 7 in a more digestible format.

The next section then additionally plots and discusses the results of that full model only.

Table 4: Regression Models 5-7

Models	5	6	7
EXPLANATORY VARIABLES			
Corporate hurricane experience	.010 (.014)	.013 (.014)	.028 (.015)
State hurricane damage = \$100mio - \$1bn	-.065* (.030)	-.082* (.037)	-.081 (.048)
* Corporate hurricane experience	.022 (.035)	.027 (.036)	.025 (.055)
State hurricane damage > \$1bn	-.108* (.045)	.072 (.048)	.246*** (.053)
* Corporate hurricane experience	-0.01 (.040)	-0.02 (.040)	-.177*** (.046)
Positive social performance feedback	-.027*** (.006)	-.178*** (.015)	-.217*** (.020)
* Corporate hurricane experience	-.002 (.007)	.009 (.007)	.052** (.019)
* State hurricane damage = \$100mio - \$1bn		.043 (.037)	.130* (.053)
* Corporate hurricane experience			-.139* (.062)
* State hurricane damage > \$1bn		.169*** (.014)	.214*** (.021)
* Corporate hurricane experience			-.051* (.021)
Negative social performance feedback	.056* (.025)	.038 (.029)	-.050 (.033)
* Corporate hurricane experience	-.004 (.016)	-.046** (.016)	.043* (.021)
* State hurricane damage = \$100mio - \$1bn		-.331** (.105)	-.264 (.160)
* Corporate hurricane experience			-.120 (.226)
* State hurricane damage > \$1bn		.019 (.031)	.146** (.052)
* Corporate hurricane experience			-.105** (.038)
D.f.	71	79	87
Log Likelihood	-19,249	-19,117	-19,077

* p < .05, ** p < .01, *** p < .001

Table 4: Regression Models 5-7 - continued

Models	5	6	7
EXPLANATORY VARIABLES			
Positive historic performance feedback	-.019** (.007)	-.013 (.008)	-.016* (.008)
* Corporate hurricane experience	.015** (.006)	.011 (.006)	.013* (.006)
* State hurricane damage = \$100mio - \$1bn		.060 (.046)	-.046 (.085)
* Corporate hurricane experience			.120 (.067)
* State hurricane damage > \$1bn		.039 (.024)	.098** (.038)
* Corporate hurricane experience			-.078 (.059)
Negative historic performance feedback	.176*** (.023)	.231*** (.026)	.358*** (.032)
* Corporate hurricane experience	-.097*** (.016)	-.063*** (.016)	-.181*** (.023)
* State hurricane damage = \$100mio - \$1bn		.150 (.080)	.118 (.112)
* Corporate hurricane experience			.015 (.117)
* State hurricane damage > \$1 bn		-.153*** (.026)	-.415*** (.047)
* Corporate hurricane experience			.214*** (.033)
D.f.	71	79	87
Log Likelihood	-19,249	-19,117	-19,077

* p < .05, ** p < .01, *** p < .001

Support for H4a is mixed. The results in Model 5 indicate that *corporate hurricane experience* neither significantly altered the positive impact of social over-performances nor the negative effect of social under-performances. In line with H4a, such corporate-level learning from firm-wide hurricane experiences of the largest hurricane seasons reduced the positive impact of both historic under- and over-performances.

Model 6 adds the two-way interactions between the *performance feedback* and learning from *state hurricane damage* variables to Model 5. The interactions assess whether and how subsidiary learning from different levels of hurricane property damage in their state in the

previous year alters the interpretation and the impact of learning from subsidiary performance feedback.⁶

Absent any corporate hurricane experience, Model 6 suggests that subsidiary learning from preceding medium-sized hurricane seasons did not substantially alter interpretations of any positive performance feedback. Subsidiaries with such local hurricane experience reduced their risk-taking in response to both social and historic performance shortfalls. In line with H4b, subsidiary learning from the largest hurricane seasons affected the interpretation and the impact of social over- and historic under-performances. In both cases, richer local explorations of very large hurricane seasons in the state the year before reduced but did not eliminate the greater risk-seeking response to both forms of performance feedback.

Model 7, the best-fitting model, adds three-way interactions between *performance feedback*, *state hurricane damage*, and *corporate hurricane experience* to Model 6. The addition allows for tests of H4c, i.e. whether learning from *corporate hurricane experience* conditions local subsidiary learning from different *state hurricane damage* and its effect on the association between subsidiary *performance feedback* and risk-taking.⁷

For greater clarity, Table 5 below summarizes the regression results of Model 7 another time. The rows list the different main effects, the columns the relevant interaction effects. The

⁶ The coefficients on the negative or positive *performance feedback* variables now estimate the effect for firms without any previous substantial corporate hurricane experience and in states exposed to less than \$100mio in hurricane damage in the previous year. The coefficients on the *corporate hurricane experience* variable now measure the effect of corporate learning from the largest hurricanes on subsidiary risk-taking in states without any significant hurricane damage in the previous year.

⁷ The inclusion alters the interpretation of the two-way interactions between *performance feedback* and *corporate hurricane experience* and *state hurricane damage*, respectively. The former interaction now estimates the effect of performance feedback on subsidiaries with corporate experience in states without any sizable hurricane damage in the previous year. The latter estimates the effect of performance feedback on subsidiaries without corporate experience but operating in states subject to meaningful hurricane damages last year.

**state hurricane damage* column lists the two-way interaction with the *performance feedback* rows, assuming corporate hurricane experience is zero. The **corporate hurricane experience* column on the very right lists the effects of the three-way interactions with the relevant *state hurricane damage* column and *performance feedback* rows. Remember that negative coefficients on positive performance feedback variables indicate underwriting increases and positive coefficient effect-decreases.

Table 5: Model 7 summary

Estimated effects	* State hurricane damage < \$ 100mio.	* Corporate hurricane experience
Corporate hurricane experience	.028	
State hurricane damage		
= \$100mio - \$1bn	-.081	.025
> \$1bn	.246***	-.177***
Positive performance feedback		
Social	-.217***	.052*
Historic	-.016*	.013*
Negative performance feedback		
Social	-.050	.043*
Historic	.358***	-.181***
	* State hurricane damage = \$100mio - \$1bn	* Corporate hurricane experience
Positive performance feedback		
Social	.130*	-.139*
Historic	-.046	.120
Negative performance feedback		
Social	-.264	-.120
Historic	.118	.015
	* State hurricane damage > \$1bn	* Corporate hurricane experience
Positive performance feedback		
Social	.214***	-.051*
Historic	.098**	-.078
Negative performance feedback		
Social	.146**	-.105**
Historic	-.415***	.214***

A few results stand out. The first panel, i.e. the one listing interactions with *state hurricane damage < \$100mio.* represents the direct baseline effects of the relevant state hurricane damage and performance feedback variables. As per the first row in the table, learning from *corporate hurricane experience* by itself had no meaningful effect on subsidiaries' risk-taking in low-hurricane damage states and seasons. The direct effect of subsidiaries exploring medium-sized

hurricane damage on risk taking was not significantly different from previously experiencing no meaningful damage. The large positive coefficient in the row *state hurricane damage > \$1bn* in the first panel indicates that subsidiary learning from the exploration of the most damaging state-hurricane seasons directly increased local risk-taking compared to seasons without any meaningful hurricane exposure and related learning opportunities. However, as per the second column, greater *corporate hurricane experience* reduced but did not eliminate this local learning effect.

The second panel lists the effects of *corporate hurricane experience* on learning from *performance feedback* for subsidiaries that explored *state hurricane damage* between \$100mio and \$1bn in the previous year. The lack of statistical significance indicates that all effects are characterized by relatively large variances, reducing the insight of average effects. *Corporate hurricane experience* essentially eliminated any effect of subsidiary learning from these medium-sized hurricane seasons on the interpretation of *positive social performance feedback*. The combined effect of corporate and local hurricane learning on the interpretation of *positive historic performance feedback* was also negligible. For subsidiaries with negative social performance feedback, both local and corporate hurricane learning materially reduced subsequent risk-taking but marginally increased it following relative historic performance shortfalls.

In states experiencing the most destructive type of hurricane season in the previous year, *corporate hurricane experience* essentially countered any way in which learning from the local *state hurricane damage* altered the interpretation and effect of local *performance feedback*. The conditioning effect of corporate learning was most pronounced for the interaction between local hurricane learning and negative performance feedback. Learning from *corporate hurricane experience* reduced the large negative effect of historic underperformances but exacerbated risk-

aversion in response to social underperformances. The next section graphically illustrates and discusses these results.

3.6 Discussion

This section plots the direct and indirect effects of Model 7 and discusses the results in greater depth. The results and graphs highlight four key findings.

First, in stable markets and absent any previous corporate hurricane experience, learning from subsidiary performance-aspiration gaps alters that subsidiary's annual risk-taking. The effects differ, however, depending on the type and direction of the feedback. Positive social and negative historic performance feedback significantly increase subsidiary risk-taking, positive historic over-performance only marginally increases risk-taking, and social under-performance marginally reduces it.

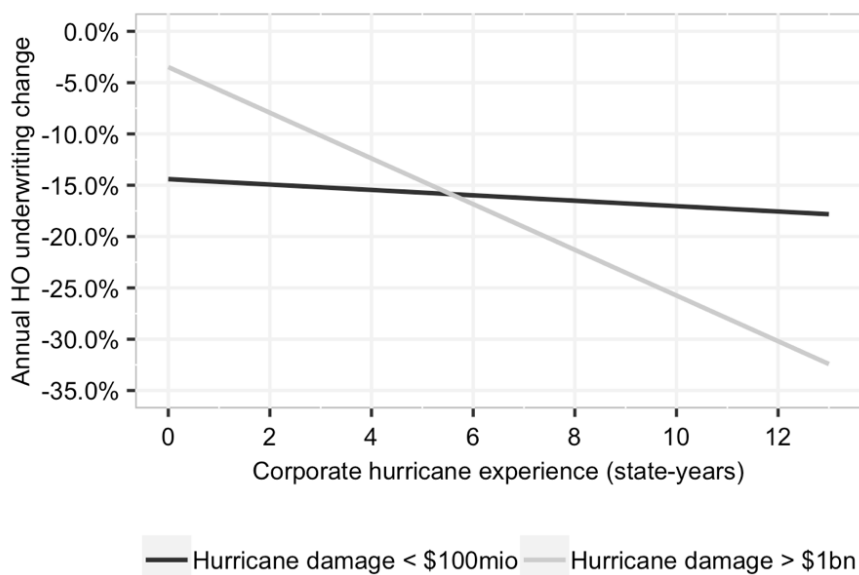
Second, absent any previous corporate hurricane experience, subsidiary learning from very large preceding hurricane seasons increases local risk-taking. Corporate learning from large firm-wide hurricane experiences by itself has no direct effect on local risk-taking in states that did not experience similar shocks in the previous year. Previous corporate-level hurricane experience does, however, systematically reduce direct local hurricane learning effects.

Finally, both corporate-level and local learning from and about rare shocks alters the effect of performance feedback on local risk-taking. Corporate-level experience also conditions the way local subsidiary learning from hurricanes changes the effect of subsidiary performance feedback on local risk-taking. Corporate knowledge systematically attenuates more myopic local learning.

3.6.1 Direct corporate- and state-level hurricane learning effects on subsidiary risk-taking

Figure 2 below plots the marginal effect of corporate learning from large hurricane seasons on underwriting changes in states with minimal as well as record-breaking hurricane damage in the previous year. The figure plots the two-way interactions with the value of all other variable values set to their mean. The dark line in the plot only marginally decreases as the number of state-years of corporate hurricane experience increases. Direct corporate-level learning from previous hurricane learning had a negligible effect on subsidiary risk-taking following no significant hurricane seasons. The light line demonstrates that greater corporate level experience reduced subsidiary risk-taking in states exposed to record hurricane damage in the previous year. The more extensive the corporate experience with similar hurricane shocks, the more negatively the previous record hurricane season was interpreted and the more aggressively the subsidiary cut back its homeowner insurance risk exposure in the state the next year.

Figure 2: Direct corporate- and state-level hurricane learning effects on subsidiary risk-taking



3.6.2 Hurricane-learning effects on positive performance feedback

Figure 3 and 4 below plot the predicted marginal effects of the interaction terms involving corporate- and subsidiary-level hurricane learning and local performance feedback in Model 7. The x-axes in both figures index the historic and social performance feedback values, i.e. either the difference between the average subsidiary's loss ratio and its own past five-year average loss ratio or the average loss ratio of the leading three local insurers. Over-performances for both types of feedback have a negative sign because the firm's loss ratio is lower than the aspired one. The y-axes indicate the approximate annual percentage change in underwritten homeowner insurance premiums. The left panels plot the effect of performance feedback in states exposed to negligible hurricane season property damage in the previous year. The right panels plot how subsidiary learning from record hurricane seasons in the previous year alters the effect of historic and social performance feedback on subsidiary risk-taking.

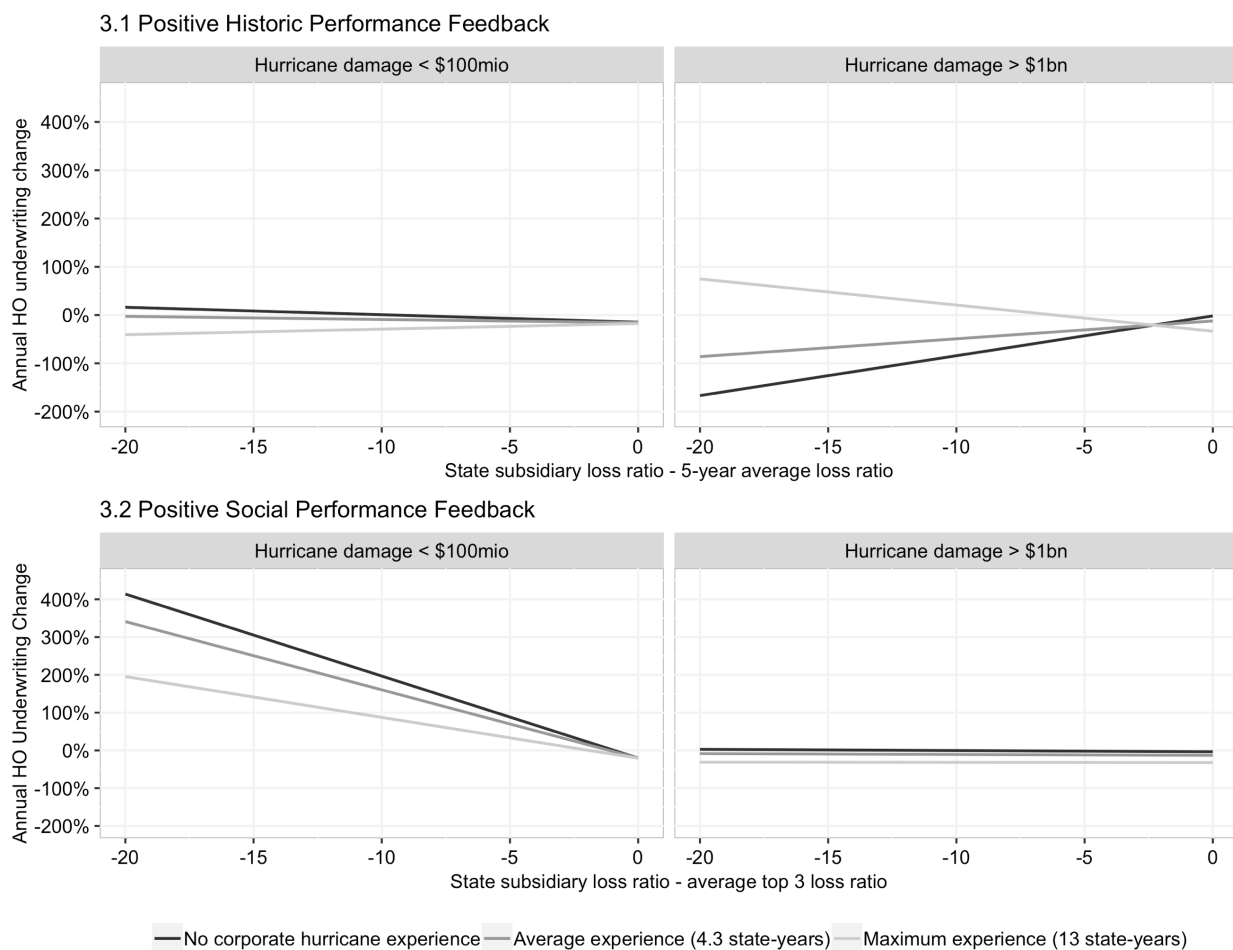
The different line shades indicate the different levels of corporate hurricane experience. The lighter the shade, the greater the corporate hurricane experience. The black line plots the effect for subsidiaries without any previous corporate hurricane exposure, the lightest-shaded line plots the marginal effects for firms with the maximum possible experience (13 state-years), and the line in between the effects for subsidiaries with the average amount of corporate hurricane experience (4.3 state-years). The dark line in the "Hurricane damage < \$100mio" panels on the left thus plots the predicted marginal risk-taking responses to performance feedback by subsidiaries without any corporate hurricane experience and in states without any material hurricane shocks in the previous year and with all other variables set to their mean.

Figure 3 below summarizes the predicted marginal effects of learning from positive historic and social performance-aspiration gaps. Comparing the left and right panes highlights how richer local explorations of record hurricane seasons strongly conditioned the way insurers

interpreted their subsidiaries' historic and social overperformances and adjusted state underwriting risk in response.

As per Figure 3.1, absent any corporate hurricane experience (black lines), local learning from the largest hurricane seasons materially reduced risk-taking following historic overperformances. Absent any previous firm-wide experience with similar shocks, relatively myopic local learning led insurance firms to interpret their existing homeowner insurance underwriting portfolios and the historic overperformances they generated as too risky and scaled them back.

Figure 3: Corporate- and state-level hurricane learning effects on positive performance feedback



Notably, as indicated by the lighter lines in the right panel of Figure 3.1, greater corporate hurricane intelligence and the less myopic interpretation of the local shock attenuated those effects. I interpret that result as indicating that greater corporate hurricane experience and the technologically-aided learning from it offered more nuanced assessments of local underwriting opportunities in the context of large shocks and local over-performances.

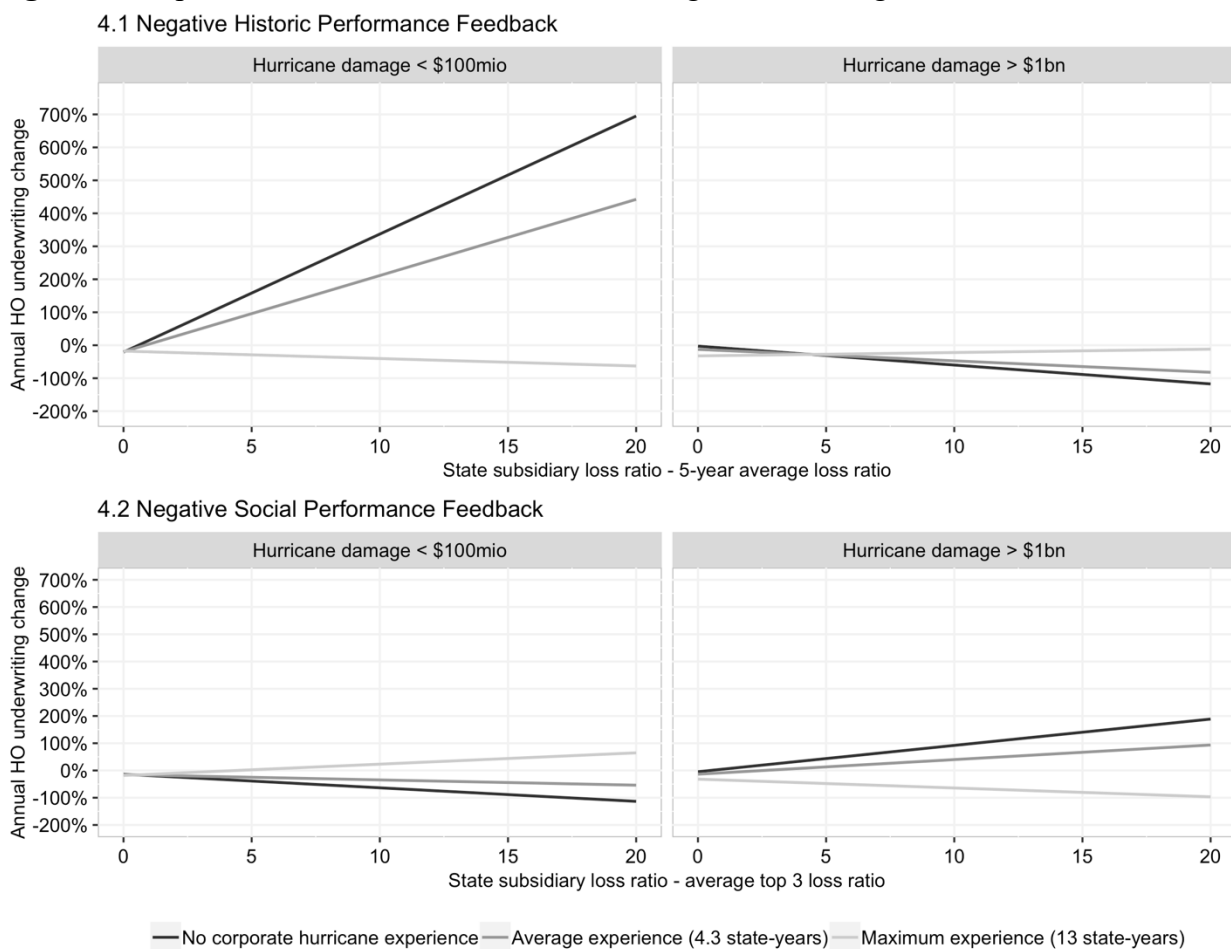
In the case of positive social performance-aspiration gaps (Figure 3.2), the knowledge gained from exploring the preceding local record hurricane season was so poignant that it eliminated any meaningful impact of learning from performance feedback and from any previous corporate experience (right panel). To the extent to which social overperformances induce superstitious learning driven by local managers' aspirations, the local exploration of very large local hurricane damage generated sufficient additional knowledge and corporate attention to negate it. In the absence of any local shocks, it was corporate-level learning from large hurricane shocks that attenuated biased superstitious learning from social overperformance and its effect on subsidiary risk-taking (left panel).

3.6.3 Hurricane learning effects on negative performance feedback

Figure 4 below summarizes the predicted marginal effects of learning from negative historic and social performance feedback. As in the case of positive performance-aspiration gaps above, learning from local record hurricane shocks in the previous year had a dramatic effect on the interpretation and the impact of both types of feedback. Corporate-level learning from large firm-wide hurricane experiences again attenuated the effect of myopic local learning. The richer local exploration of record hurricane seasons reversed greater subsidiary risk-taking in response to negative historic performance feedback absent such shocks (Figure 4.1).

Greater corporate hurricane experience attenuated this reversal to the extent that it practically eliminated the negative historic performance feedback on subsidiary risk-taking in the year after a record hurricane season. The directions of the corporate and local hurricane learning effects here mirror the ones for positive historic performance feedback. Subsidiary learning from the largest local shocks reduced risk-taking following deviations from historic performance aspirations but less myopic corporate hurricane learning attenuated that local risk-aversion. Global (firm-wide) learning systematically reduces the risk-taking impact of more myopic local learning.

Figure 4: Corporate- and state-level hurricane learning effects on negative feedback



The conditional learning effects from negative social performance feedback are more difficult to interpret and to reconcile with its effects on positive social performance feedback (Figure 4.2). In the years following no significant hurricane seasons, social underperformances had an essentially negligible effect on subsidiary risk-taking (left panel). Somewhat counterintuitively, local learning from very large local hurricane shocks increased subsidiary willingness to take greater risks in response to the same social performance feedback (right panel).

This contrasts to the case of social overperformances in which learning from such large shocks significantly reduced subsidiaries' greater risk-taking. In the absence of any corporate experience, the impact of local explorations of very large hurricane damage on the interpretation of social performance feedback differs depending on whether subsidiaries over- or underperform the local market leaders. One possible explanation has to do with the relative informal and local nature of social aspirations in the homeowner insurance context and the distinct and more myopic nature of local interests. Following large social underperformances, subsidiary managers might be eager to take greater risks to align their performance with market leaders non-withstanding the potential risks. In the case of social over-performances following the same large shocks, no such need for greater risk-taking from the subsidiary perspective exists. The addition of less myopic knowledge in the form of corporate hurricane learning counteracts this local perspective and the greater local risk seeking. Greater firm-wide intelligence might rein in local recklessness.

3.7 Post Hoc Analysis – Financial Slack

I perform an additional post hoc analysis to assess whether financial slack and corporate concerns about insolvencies rather than learning from hurricane experiences alter the impact of subsidiary performance feedback on local risk taking.

The insurance economics literature as well as behavioral learning theories both suggest that financial slack and distance from insolvency play a critical role in firms' willingness to take risks. Insurance economists have highlighted the potential importance of insolvency thresholds in constraining insurer risk-taking (Kunreuther 2006:102-105, Stone 1973). The threshold consists of the capital reserves required to cover unexpectedly severe natural disaster damage and to protect the firm from insolvency. According to this 'safety first' model, insurers prioritize keeping their risk exposure below that threshold. The lower the available capital reserves, the lower the insolvency threshold, and the lower insurers' capacity to expand their homeowner insurance coverage. The estimated models above control for the direct impact of firm-wide *financial slack*, as measured by firm-wide policyholder surplus. The variable's effect size falls from 0.02 in model 1 to 0.01 in model 7 (not displayed in Table 4 above). A one standard deviation, \$9 billion, increase in financial surplus at the national firm level increased average subsidiary homeowner insurance underwriting by 1 percent. The direct effect of firm-wide financial slack on subsidiary changes in risk-taking is practically negligible. Critically, controlling for this effect does not alter the findings.

Financial slack also potentially indirectly alters organizational risk-taking. Performance feedback studies across a variety of industries have built on March and Shapira's (1987; 1992) model of variable risk preferences to empirically demonstrate that financial slack can moderate the impact of performance feedback on risk-taking (e.g. Audia and H. R. Greve 2006; Chen and Miller 2007; Iyer and Miller 2008; Latham and Braun 2008; Miller and Chen 2004; Wiseman

and Bromiley 1996). High levels of financial slack buffer managers from the threat of bankruptcy, thereby rendering them more willing to take greater risks following under-performances. Relatively little financial slack compared to the size of the under-performance tends to shift managerial attention away from traditional performance goals and toward the greater perceived threat of insolvency. Instead of indicating repairable gaps, historic aspiration-performance gaps amidst low financial slack signal a threat to overall firm survival. As a result, underperforming firms with low levels of financial slack tend to reduce the effect of historic under-performances on their risk-taking.

To test this proposition, I estimate a series of additional models that include interaction effects between performance feedback and the financial slack indicator. Financial slack does not substantially alter the direct effects of performance feedback or the two hurricane learning variables in any configuration of those models, i.e. neither when added in place of the interaction between hurricane learning and performance feedback nor when added to the full estimated Model 7. While the direction of this interaction effect is negative as theorized (lower slack reduces the impact of performance-aspiration gaps on risk-taking), its size is negligible. What's more, the addition of these interactions to the full model 7 does not substantially alter the original effects of multi-level hurricane shock learning. I conclude that firm-wide financial slack had no significant direct or indirect impact on subsidiary risk-taking and does not confound the direct and indirect effects of the two hypothesized learning processes. In other words, the direct and indirect effects of state-wide hurricane damage on changes in underwriting do not reflect insurer concerns about imminent insolvency.

3.8 Conclusion

3.8.1 Summary of findings

We know that different learning processes across different organizational levels can guide firms' adaptive behavior and that while learning from rare events is challenging, it is possible. We also know that learning from performance-aspiration gaps systematically alters firm-wide risk-taking. Building on these three sets of insights, the paper theorizes and models the effect of learning from subsidiary performance feedback as well as from corporate and subsidiary-level local hurricane shocks on changes in local risk-taking. The main theoretical focus is on how the latter two cross-level learning processes directly and indirectly affect local risk taking. Doing so takes a step toward building a more integrated learning theory of organizational risk-taking. The empirical context is annual changes in homeowner insurance underwriting in hurricane-prone coastal U.S. states between 1992 and 2013. The study finds a complex multi-level process of learning and local risk-taking. Local learning from the rich exploration of recent large hurricane seasons and from local performance feedback and the interaction between both alter subsidiary risk-taking. Corporate-level learning from analyzing firm-wide hurricane shocks attenuates the local learning effects.

Consistent with previous findings at the overall-organizational level, in relatively stable market environments, state subsidiaries expanded their underwriting risk in response to negative historic or positive social performance feedback. Negative social and positive historic performance feedback had a negligible impact in such environments. The novel findings of the study involve the impact of subsidiary as well as firm-wide learning from rare hurricane shocks and their interaction with performance feedback. Local learning from large hurricane seasons directly expanded local risk-taking if the local subsidiary had no local performance-aspiration deviation and no previous corporate-level hurricane experience. Local learning from the largest

hurricanes lowered subsidiary risk-taking following all but one type of performance-aspiration gap. Most notably, it all but eliminated overconfident learning in response to social overperformances and reversed local risk-seeking following historic underperformances. The one exception was its effect on social underperformance. I speculate that the greater risk-seeking response is explained by myopic subsidiary managers ignoring locally generated hurricane knowledge in favor of high-risk career advancement and a lack of corporate experience to oppose such risk-seeking.

Corporate-level learning from the catastrophe model-aided aggregation and analysis of locally-generated hurricane knowledge had a negligible direct effect on annual changes in subsidiary-level risk-taking. It did, however, systematically and consistently attenuate the direct and indirect risk-taking impact of subsidiary learning, i.e. local explorations of the most recent market shock and local historic, social performance feedback, and their interactions. The broader corporate knowledge base constrains both forms of myopic local learning (also see H. R. Greve and Zhang 2016; Levinthal and March 1993). Homeowner insurers' relatively centralized and hierarchical decision-making structures and greater cultural receptiveness to formalized risk assessments facilitated the translation of corporate knowledge into local risk-taking practices.

3.8.2 Contribution

The paper contributes to organizational learning theory by showing how multiple processes and levels of organizational learning in the context of rare events can alter adaptive organizational behavior. It contributes to the behavioral theory of risk-taking by demonstrating how these insights can better explain risk-taking in the context of rare negative environmental shocks.

Multiple learning processes (Bingham and Davis 2012), including learning from their own relative performance experiences as well as from aggregate phenomena in their environment

(Ingram and Baum 1997; Schwab 2007), can guide firms' adaptive behavior. This study demonstrates that firms do not exclusively rely on learning from performance feedback to adjust a particular type of such adaptive behavior, i.e. local risk-taking. I theorize and empirically demonstrate that in ambiguous environments in which reliance on relative performances alone becomes problematic, firms also turn to richer explorations of recent shocks to inform adjustments in their local risk exposure. In that context, the new knowledge can also alter the interpretation of potentially less reliable local performance feedback.

Contrary to received wisdom, large negative shocks do not only affect organizational risk-taking through their impact on performance-aspiration gaps or their reductions of a firm's financial slack and increased risk of insolvency. Instead, the findings here suggest that environmental disruptions by themselves, independent of their effect on relative performances or financial reserves, can be salient enough to trigger supplemental learning processes. In the context of such disruptions or broader environmental ambiguity, explanations of organizational risk-taking that do not take such processes and their direct and indirect effect into account run the risk of mis-specifying the impact of performance feedback and of mischaracterizing organizational adaptive behavior.

The behavioral theory of the firm and performance feedback theory have treated organizations as unitary actors and learning processes as playing out at the senior managerial level. Recently, scholars have started to interrogate this assumption and to theoretically explore the impact of hierarchies and asymmetric knowledge and interests on organizational learning processes and its consequences (Argote and Miron-Spektor 2011; Bunderson and Reagans 2011; Puranam and Maciejovsky 2017). Gaba and Joseph (2013) empirically demonstrate that corporate and unit-levels have different behavioral responses to their idiosyncratic aspirations and performance deviations. They conclude that corporate responses to their own goals constrain

business unit capacity to take risks in the form of new product introductions. This paper extends this insight to a different learning process, namely learning from rare environmental shocks. In contrast to relatively myopic subsidiary learning from local shocks, corporate level learning draws on a larger and, potentially, virtually-expanded sample of such shocks. Rather than constraining local learning, I argue that the less myopic knowledge generated at the corporate level attenuates the more excessive subsidiary responses to learning from local experiences.

The paper also contributes to the literature on learning from rare events by empirically demonstrating that such learning takes place across different organizational levels and by highlighting corporate level learning as key factor in integrating and disseminating local knowledge from rare events across a firm. The sparse evidence provided by rare events complicates learning from (local) performance feedback-based learning (Lampel et al. 2009; Starbuck et al. 1978). Qualitative case studies support theoretical arguments that firms can indeed learn from rare high-impact disasters in their vicinity, potentially even if their performance has not been directly affected by them (e.g. Hoffman 2001; Webb et al. 2000).

This study provides systematic statistical evidence that such rare shocks trigger multi-level learning processes involving the richer exploration of local shocks. While Beck and Plowman (2009) argue that middle managers' involvement in local disaster learning plays a critical role in enriching firm-wide rather than just local knowledge about rare events, the horizontal dissemination of subsidiary knowledge about local shocks to other subunits is generally problematic (Oetzel and Oh 2014; Schulz 2001; D. Smith and Elliott 2007; Szulanski 1996). The insurance case analyzed here suggest that locally generated disaster knowledge requires potentially technologically-aided codification, aggregation, analysis, and dissemination by central corporate actors to alter learning and risk-taking in other subsidiaries or localities (also see Hansen 2002; Schulz 2001).

3.8.3 Limitations and future research opportunities

Several limitations offer avenues for further research. The study does not directly measure multi-level learning from external shocks. Instead, I use annual state-wide hurricane property damage—a broadly-conceived form of collective experience—as indicator of state-subsidiary learning. Learning is then inferred from the comparison of the direct and indirect effects of these collective experiences. It does not indicate whether that learning is correct or erroneous.

The use of proxies to capture learning inputs and outcomes is consistent with contemporary learning research (Argote 2012). Theoretical arguments and existing empirical evidence that firms do indeed learn from rare shocks justify the use of this particular indicator. Yet, the measure has two key weaknesses. First, it conflates the two strategies of experiential learning from such shocks—direct “online” and model-aided “offline” learning from the shock. While the former strategy is practically limited to local managers, the latter is likely the purview of senior management and the corporate office. This measurement conflation prevents a clean distinction between the organizational levels involved in learning from local shocks and how exactly the different levels affect local behavioral outcomes. More fine-grained and qualitative tracing of the process and practice of learning from environmental shocks and its local outcomes is needed.

Another limitation of the proxy for learning is that it assumes learning from hurricane damage to be uniform and inevitable within a given state and year. In the model specification used here, the different categories of state-wide damage trigger the same amount of learning in every insurer in the state independent of its realized or potential exposure to the damage. In reality, firms will vary in their willingness and capacity to explore and learn from such shocks. Variation of the effect of that learning on local risk-taking is accounted for by the interaction of

the hurricane variables with the performance feedback measures and the different state and firm-variables included in the models. While this limitation is defensible in terms of explaining changes in organizational risk-taking, further research is needed about the antecedents of multi-level organizational exploration and learning from rare events.

The second major limitation of the study concerns the interpretation of the dependent variable—the logged annual change in underwritten homeowner insurance. I argue that, after controlling for relevant organizational characteristics, the dependent variable indicates a state subsidiary's change in local risk-taking, and, more precisely, the deliberate change in organizational resource allocations that alter a firm's expected performance in that specific insurance line and state. This measure is imperfect in the sense that it conflates the pricing and quantity of risk-taking. To the extent to which higher pricing compensates for the greater quantity of risk, an increase in the direct amount underwritten might not reflect an increase in relative local risk-taking. I justify the measure by noting that even price increases on average reflect absolute local risk increases. Insurers more-often-than-not have to justify rate increases to regulators by highlighting such increases in risk in some form or another. Also, no alternative systematic state-level data exists to measure local state subsidiary underwriting changes and the associated risk. Studies of the effect of multi-level and multi-process learning on local risk-taking in other empirical contexts could further test and refine the findings presented here.

Another avenue of productive research addresses the role of intra-organizational power and status differences and the way they alter firm-wide and local learning and risk-taking outcomes. The current study does not separate the effect of hierarchical power from multi-level learning. It assumes that greater corporate authority means that learning and knowledge at that higher level is systematically translated into local decision-making. In the case of relatively centralized and

hierarchical homeowner insurance decision-making processes, this is not an unreasonable assumption.

Yet, the study also notes that while historical performance aspirations are generally set and monitored at the corporate level, social performance aspirations might be more relevant to the subsidiary level. This divergence in aspirations and hierarchical power to pursue them might play a role in some of the observed differences in the impact of historical and social performance feedback and their interaction with hurricane learning. Data and space limitations prevent a deeper exploration of these issues. More generally, power and status differences might significantly structure how organizational aspirations are set and how hierarchical and horizontal knowledge flows and translates into local risk-taking behavior.

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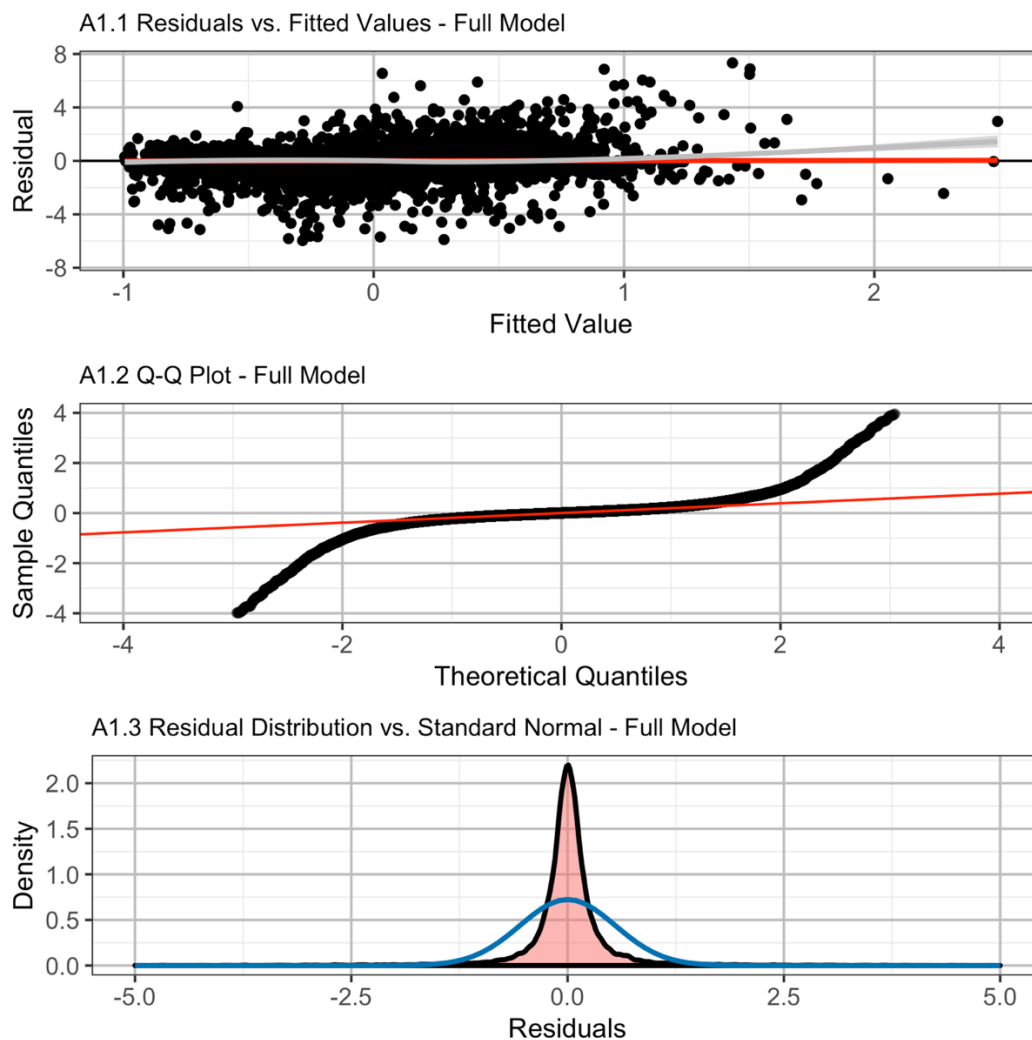
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Appendix

In the estimated models, both the number of randomly specified units (365) as well as the observations (22,603) are 'large.' We can therefore expect asymptotic linear regression results to apply. To generate consistent and unbiased estimates, the linear random intercept model has to fulfill the standard OLS assumptions. Additionally, its random effects have to be independent of the means of the model's fixed effects (Raudenbush and Bryk 2002:255; Snijders and Bosker 2011:55). This section checks both sets of assumptions.

Figure A1 below lists the key OLS assumptions for Model 7. Figure A1.1 plots the full model's residuals against the fitted values on the response scale. The light trend line maps the local polynomial regression fit ("loess"), the red line the OLS regression. For the mass of the fitted values, the residuals are symmetrically centered around zero. A relatively small number of observations explains the upward deviation on the right extreme. Overall, the plot does not indicate any systematic pattern in the residuals, thus suggesting that the overall model is well specified. The absence of a systematic pattern also shows that heteroskedasticity is not a problem.

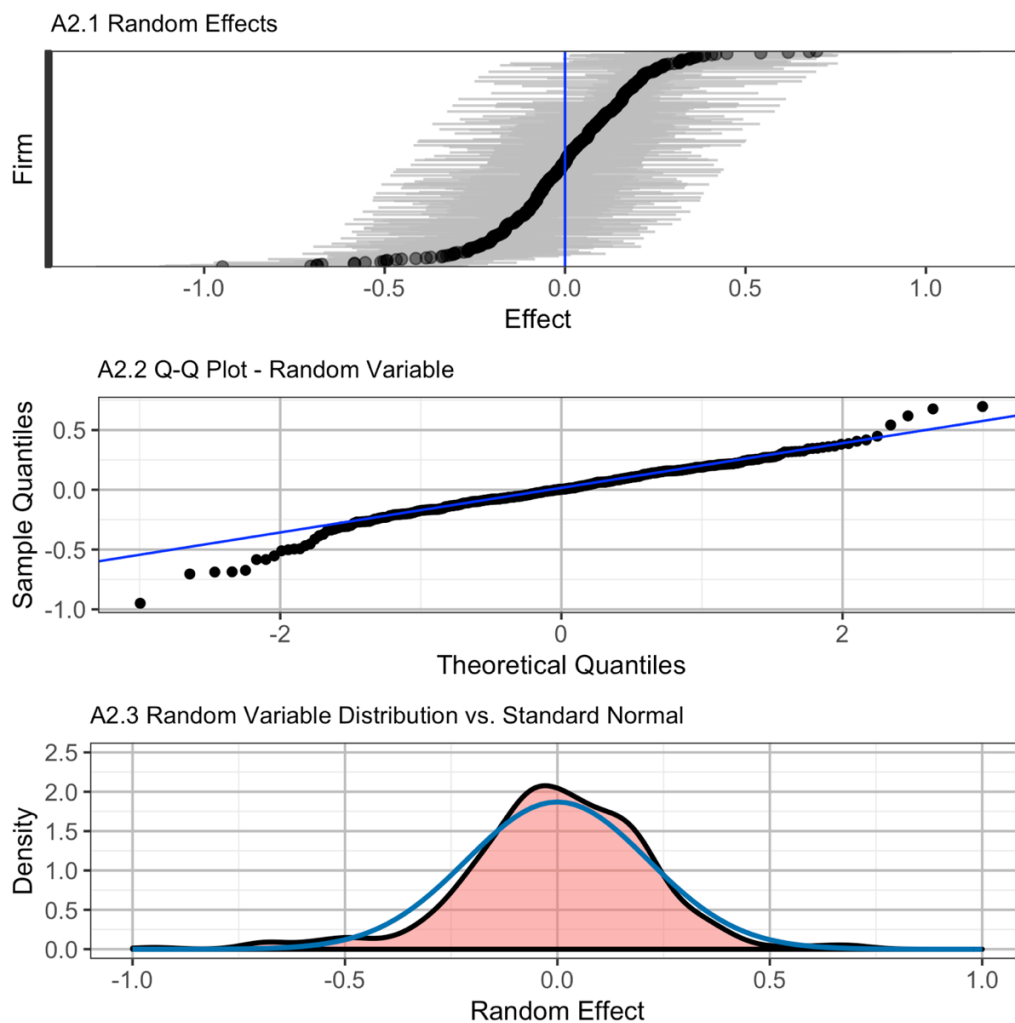
To assess the normalcy of the full model's residual distribution, I construct Q-Q and residual density plots. Significant deviations from linearity of the observations or non-symmetric scales in the Q-Q plot indicate a deviation from normality of the residuals. The Q-Q plot in Figure A1.2 below exhibits relatively symmetric deviations at both extremes of the residual distribution. Figure A1.3 shows that the residual distribution of the full model (in red) is symmetric and uni-modal but not normal (blue). As long as the mixed model correctly models the correlation structure of the data, the random intercept standard errors will be consistent despite the non-normalcy.

Figure A1: Full model residual distribution (N = 22,603)

The inspection of the correlation structure of the random effects and tests of the independence of the groups and predictors shows that the mixed model adequately models the correlation structure. Figure A2 below inspects the distribution and normalcy of the random intercepts. Figure A2.1 plots the Best Linear Unbiased Predictors (BLUP) of the random intercepts and the associated 95% confidence intervals. There exist a handful of outlier effects. The variance in confidence intervals reflects the different number of firm observations in the data. A firm offering homeowner insurance in only a handful of states for a few years will have a larger variance than one that is present in all coastal states and years. The Q-Q plot for the predicted random effects (Figure A2.2) indicates a more robust normal distribution than for the

overall model residuals. The comparison of the density of the predicted random effects to the hypothetical normal distribution in Figure A2.3 confirms the relatively small number of outliers and the close normal approximation of the predicted random effects.

Figure A2: Random effect distribution (N = 365)



The final assumption required for the model to be adequately specified is that the random effects are independent of the means of the model's fixed effects. The assumption assures that there is no omitted variable bias generated by not directly estimating the random effect.

The most common test in the econometrics literature, the Hausman test, is not a test of the adequacy of random effect model specifications as such (e.g. Bell and Jones 2014; Snijders and

Bosker 2011:57). It merely indicates whether the within- and between-group effects are similar to each other. The test here suggests that there is some similarity and thus some regression between the effects. This in itself does, however, not disqualify the model. Adding group-level means of relevant variables to the original model corrects for such correlation (Bafumi and Gelman 2006; Bell and Jones 2014; Snijders and Bosker 2011:56-60). If such correction alters the outcomes of the original model, the dependence problems are sufficiently serious to call into question the random-effect specification.

Table A1 below lists the key explanatory variables of the original Model 7 and of a new version that additionally includes group means of all relevant explanatory variables.

Table A1: Dependence check

Models	Model 7	+ group means
EXPLANATORY VARIABLES		
Corporate hurricane experience	.028 (.015)	.020 (.015)
State hurricane damage = \$100mio - \$1bn	-.081 (.048)	-.083 (.048)
* Corporate hurricane experience	.025 (.055)	.027 (.055)
State hurricane damage > \$1bn	.246*** (.053)	.234*** (.053)
* Corporate hurricane experience	-.177*** (.046)	-.167*** (.046)
Positive social performance feedback	-.217*** (.020)	-.215*** (.021)
* Corporate hurricane experience	.052** (.019)	.052** (.019)
* State hurricane damage = \$100mio - \$1bn	.130* (.053)	.129* (.053)
* Corporate hurricane experience	-.139* (.062)	-.137* (.062)
* State hurricane damage > \$1bn	.214*** (.021)	.213*** (.021)
* Corporate hurricane experience	-.051 (.021)	-.050* (.021)
Negative social performance feedback	-.050 (.033)	-.047 (.033)
* Corporate hurricane experience	.043* (.021)	.044* (.021)
* State hurricane damage = \$100mio - \$1bn	-.264 (.160)	-.272 (.160)
* Corporate hurricane experience	-.120 (.226)	-.119 (.226)
* State hurricane damage > \$1bn	.146** (.052)	.138** (.052)
* Corporate hurricane experience	-.105** (.038)	-.098** (.038)

Table A1: Dependence check - continued

Models	Model 7 + group means	
Positive historic performance feedback	-.016*	-.017*
	(.008)	(.008)
* Corporate hurricane experience	.013*	.014*
	(.006)	(.006)
* State hurricane damage = \$100mio - \$1bn	-.046	-.044
	(.085)	(.085)
* Corporate hurricane experience	.120	.117
	(.067)	(.067)
* State hurricane damage > \$1bn	.098**	.087*
	(.038)	(.038)
* Corporate hurricane experience	-.078	-.066
	(.059)	(.059)
Negative historic performance feedback	.358***	.364***
	(.032)	(.032)
* Corporate hurricane experience	-.181***	-.187***
	(.023)	(.023)
* State hurricane damage = \$100mio - \$1bn	.118	.119
	(.112)	(.112)
* Corporate hurricane experience	.015	.017
	(.117)	(.117)
* State hurricane damage > \$1 bn	-.415***	-.414***
	(.047)	(.047)
* Corporate hurricane experience	.214***	.215***
	(.033)	(.033)

* p < .05, ** p < .01, *** p < 0.001

The effect sizes and directions in this corrected model practically do not change from the original Model 7. This indicates that any dependence in the original model does not seriously compromise the original results.

Chapter FOUR - Population-level learning from environmental shocks and its effect on organizational-level learning: evidence from homeowner insurance entry into hurricane-prone states

Abstract

This paper investigates how collective learning at the organizational population-level alters the impact of individual firms' direct and indirect pre-entry experiences on their risk of entry into mature markets. The empirical context is existing homeowner insurer entry into hurricane prone coastal states between 1992 and 2013. In 1992, Hurricane Andrew disrupted the insurance industry's collective understanding of coastal underwriting risks. The subsequent diffusion and institutionalization of catastrophe models gradually restored that understanding. A statistical survival analysis of the entire population of property and casualty insurers shows that firms' direct and indirect pre-entry knowledge had their strongest effect on entry risk in the years after the original disruption. Subsequent collective learning reduced the positive effect of direct pre-entry knowledge of the focal market and the negative effect of previous experience with hurricane shocks. It reversed the positive effects of vicarious pre-entry learning from focal market exit rates and recent entrants' performances. The findings suggest that, in stable periods in which mature market risks are well-understood, direct pre-entry knowledge plays a relatively smaller and indirect knowledge a qualitatively different role than in periods characterized by industry-wide ambiguity about those markets. The findings contribute to efforts to better understand cross-level learning as well as the ecology and evolution of mature markets.

4.1. Introduction

Organizational learning from experience shapes adaptive and strategic firm behavior (Cyert and March 1963; March 1991; Zollo and Winter 2002). Organizational learning is the process of acquiring, translating, and enacting new knowledge that systematically alters subsequent behavior (Argote and Miron-Spektor 2011; Huber 1991; Levitt and March 1988). The most commonly studied learning processes involve firms learning from their own direct experience (Greve 2003; Madsen and Desai 2010; March and Shapira 1992), indirect or vicarious learning from other organizations or the environment (Baum, Li, and Usher 2000; Haunschild and Miner 1997; Kim and Miner 2007; Posen and Chen 2013), or a combination of both (e.g. Baum and Dahlin 2007). This paper investigates how learning and the associated changes in knowledge at the analytically distinct organizational population level moderate these direct and indirect learning processes and thereby affect a highly consequential firm decision —whether to expand into established product markets or not.

Most work that invokes population-level learning to investigate organizational-level behavioral outcomes in fact focuses on vicarious firm-level learning from salient industry-level phenomena (e.g. Ingram and Baum 1997; Madsen and Desai 2018; Schwab 2007; Sorenson 2000). Individual firms' deliberate explorations of such phenomena as well as other firms' reactions to them alter their internal knowledge structures. When aggregated, such transformations contribute to changes in population-level knowledge. They do not, however, constitute or define such knowledge. In contrast, population-level knowledge as conceived here “represents a sociological fact that characterizes a collective entity, not its individual members” (Miner and Anderson 1999:7). As social fact, population-level knowledge and the associated collective interpretation of industry- as well as organizational level phenomena are not equal to

and potentially inconsistent with individual firms' interpretations of them (Gavetti and Warglien 2015).

The theoretical focus of the study is the association between existing firms' pre-entry experiences and the likelihood of their expansion into mature markets in the context of rare industry disruptions. This setting allows the (indirect) identification of changes in population-level knowledge. Organizational and management scholars have identified pre-entry experience and knowledge as an important factor in explaining firm entry into new and emerging markets (e.g. Huber 1991). New or emerging markets exhibit dynamics that are not well-understood by population members. Population-level knowledge about the risks of young focal markets is relatively low, contested, and ambiguous. Amidst such collective ambiguity, managers can turn to their pre-existing knowledge of related products and markets to better understand focal market risks (King and Tucci 2002; Qian, Agarwal, and Hoetker 2012). Related pre-entry knowledge can also encourage entry and improve post-entry learning and performance (Chen et al. 2012; Dencker 2009; Posen et al. 2013). In contrast, owing to their older age, the risks and dynamics of mature markets are well understood and accepted by population members.

In stable environmental conditions, idiosyncratic configurations of direct and indirect pre-entry knowledge offer existing firms relatively little additional insight about focal market risks beyond what is already established at the industry level. In the context of stable and mature focal markets, idiosyncratic pre-entry knowledge by itself should therefore play a relatively negligible role in overcoming entry barriers and incumbent market power, and in persuading existing firms to enter (Caves and Porter 1977). At the same time, the lack of variation in population-level knowledge about such market risks in stable environments makes it practically impossible to measure. Unexpectedly large and exogenous disruptions of mature markets can, however, introduce variation by reducing the reliability of population-level knowledge about those

markets' viability and entry risks (Anderson and Tushman 2001; A. D. Meyer, Brooks, and Goes 1990; Oetzel and Oh 2014; Tushman and Romanelli 1985; Wholey and Brittain 1989). The paper leverages the occurrence of such a regime-changing shock and its aftermath to qualitatively identify disruptions and subsequent periods of change in that knowledge. It then statistically estimates whether and how that change moderates the effect of pre-entry knowledge of focal markets on existing firm's entry risk.

The empirical setting of the paper is homeowner insurer entry into hurricane-prone coastal states in the U.S. between 1992 and 2013. Survival regression analysis of an original census of such entry demonstrates that changes in population-level knowledge about coastal market risks altered the effect of direct and indirect pre-entry experiences on entry rates. Following the disruption of population-level understanding of such risks, differences in pre-entry experience explained a greater percentage of firm entry variation. As the subsequent institutionalization of technologies of rationality (March 2006) gradually restored population-level knowledge of coastal hurricane and underwriting risks, the impact of direct organizational-level pre-entry experience declined and that of indirect experience changed direction. The findings suggest that in stable environments, population-level knowledge suppresses the effect of direct organizational knowledge on whether to enter an established product market or not and reverses that of vicarious learning.

The study contributes to organizational learning theory by identifying changes in population-level knowledge as an independent force that moderates the effect of more traditional learning processes (Schwab 2007). The study also contributes to findings that pre-entry experience encourages the new formation of firms or firm entry into new emerging niches (Cao and Posen 2018). It complements such studies by highlighting the role of pre-entry experience in existing firms' entry into mature markets. It extends them by identifying the lack of a coherent

population-level understanding about focal markets as giving greater prominence to such knowledge.

The paper is structured as follows. First, it briefly outlines the empirical case of homeowner insurance in the context of intensifying hurricane shocks. It then develops testable hypotheses about the effect of direct and indirect pre-entry knowledge on existing firm entry and the role of population-level knowledge. It then discusses the dataset, measurements, and the specification of the statistical model used to test the hypotheses. The paper ends by presenting the results, discussing them, and proposing future avenues of research.

4.2 Research Setting

The homeowner insurance sector in hurricane-prone states post-1992 offers a good case to study how changes in population-level knowledge moderate direct and indirect learning and the combined effect on existing firms' entry into established markets. A record hurricane in 1992 disrupted the industry's epistemological consensus surrounding the underwriting risks in historically hurricane-prone coastal states. Waves of subsequent record hurricanes in the region subsequently triggered an industry-wide effort to better understand those risks. These qualitative ruptures and subsequent collective efforts allow us to quantitatively capture changes in population-level knowledge.

The U.S. homeowner insurance market is competitive and consists of a mixture of large and diversified national companies, smaller regional multi-state firms, and insurance-line specialists (Cummins and Dionne 2008; Insurance Information Institute 2017; Meier 1988). Homeowner insurance markets are clearly delineated by state-level regulatory and licensing requirements (Federal Insurance Office 2013; Klein 2013; Meier 1991). Every insurer is separately licensed in each state in which it operates (Klein 2012; Randall 1999). Incumbent market power, saturated markets, and relatively tight state-regulatory oversight are the main

barriers to entry. The National Association of Insurance Commissioners (NAIC) acts as the private de-facto industry regulatory body at the federal level. It creates model regulations and standards, monitors state regulators, collects and analyzes industry wide data, and provides industry coordination and educational services. Three annual NAIC conferences and several smaller more specialized meetings act as the central venue of fostering industry exchange and knowledge diffusion.

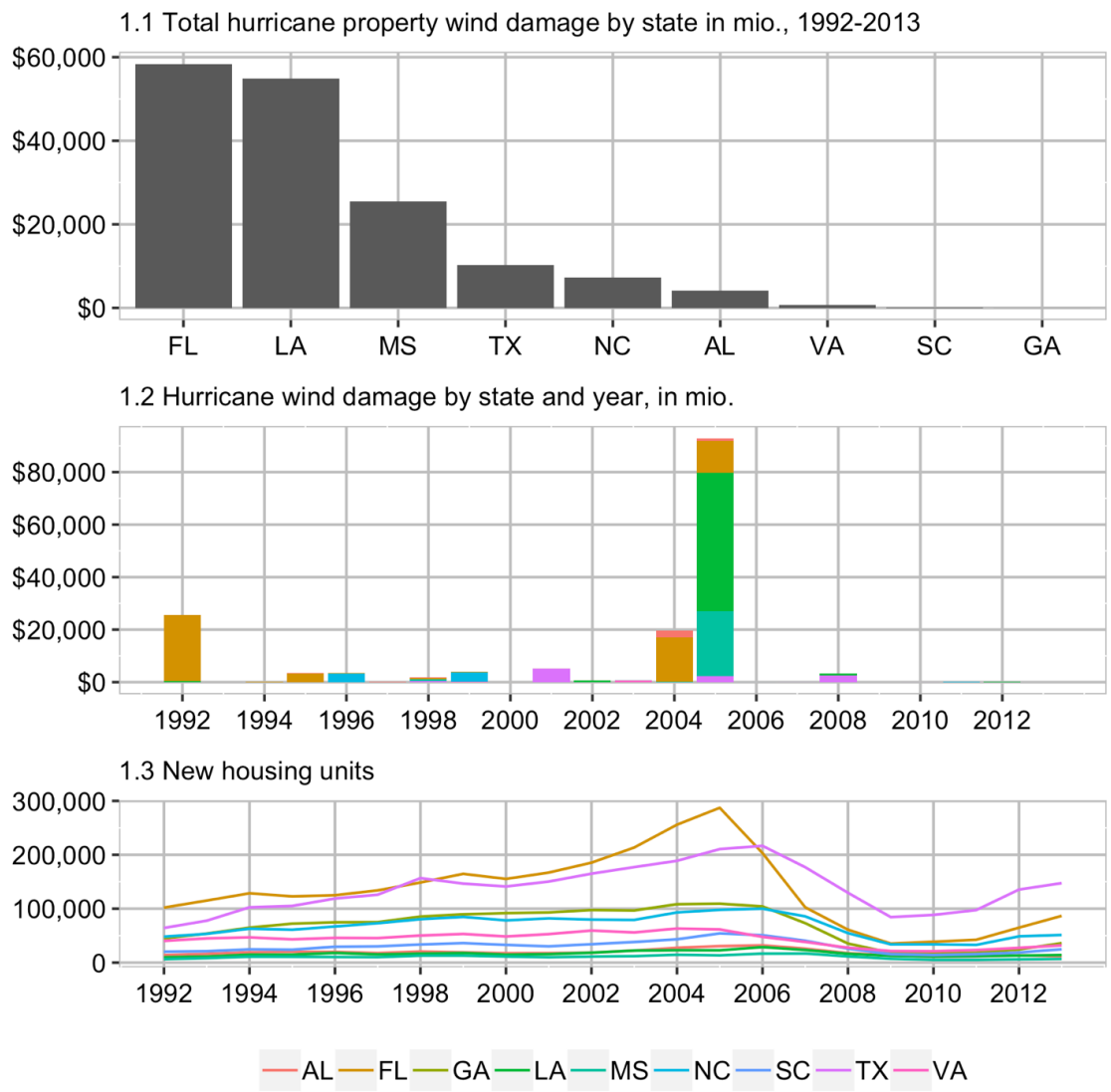
Insurance firms' business models and day-to-day activities are structured around managing risk. At the group level, a central risk committee consisting of the CEO and other senior manager makes strategic and underwriting expansion decisions. Standard homeowner insurance policies typically cover wind damages.¹ The drivers of pooled revenues and returns are well-understood and past payout patterns are generally a good predictor of the future. Homeowner insurance is quasi-mandatory in the sense that banks mandate mortgaged homes to be insured. Annual new housing completion is the best indicator of homeowner insurer market expansion and new underwriting opportunities. Besides new housing supply, demand is relatively inelastic. Absent any unexpectedly large changes to their policies, homeowners typically roll over their yearly insurance policies rather than switch providers.

Figure 1 below plots the distribution of total hurricane property wind damage in the historically most hurricane-prone states between 1992 and 2013, their temporal and geographic distribution over the period, and the annual construction of new houses in those states. Every state along the Gulf of Mexico as well as North Carolina and Virginia experienced some meaningful if-not record-breaking hurricane season in the time period. Until the subprime crisis,

¹ The other major source of hurricane property damage is flooding and is covered separately by the federal National Flood Insurance Program.

all states also experienced moderate to dramatic housing construction growth and the associated increase in mandated homeowner insurance demand.

Figure 1: Hurricane damage and new housing



In 1992, Hurricane Andrew’s landfall in Florida and Louisiana became the costliest natural disaster in U.S. history in terms of insurance payouts to homeowners. The hurricane caused 11 insurer insolvencies. Prior to Hurricane Andrew, insurers simply adjusted recent history to reflect current trends to estimate the size of future losses. Previous projections failed, however, to

adequately account for the possibility of Andrew-sized hurricane damage as well as for population density growth and increasing construction and property values along the coastlines. Confronted with these shortcomings in existing underwriting and forecasting practices, the industry turned to catastrophe (cat) models to quantify shifting hurricane distributions and frequencies, and to optimize the risk-return characteristics of their underwriting portfolios (Frees 2015; Grossi and Kunreuther 2005; NAIC 2011). This shift to a more sophisticated model-based assessment of coastal market risks and its refinement over subsequent hurricane seasons marks a fundamental epistemic shift in the industry. I argue that this shift changed the insurer population's collective understanding of market risks.

Three companies, AIR, EQCAT, and RMS, act as the principal providers of such models to the majority of the industry (Simplitium 2018). Only the largest insurers and a few regulators started to develop their own in-house models. In practice, insurers often use and compare different models to identify underwriting opportunities and changes. The models serve as the quantitative basis of their decision-making. Models simulate thousands of sample hurricane events, track them across land with various wind speeds, assign probabilities to storm scenarios and landfall locations, and incorporate an insurer's actual or planned policy count and locations. Taken together, this information produces estimates of insured losses for an average event and a worst-case scenario. Insurers use past hurricane and housing density data to calibrate model parameters. Models themselves occasionally change when the science surrounding storm analysis improves. The diffusion of these models, their subsequent updating with new hurricane and other market data, and their endorsement by regulators, rating agencies, and reinsurers changed underwriting practice and played a critical role in the evolution of collective industry understanding of coastal market risks (Grossi and Kunreuther 2005; Kenealy 2012; Kunreuther and Useem 2017).

4.3 Pre-entry experience and market entry

4.3.1 Direct pre-entry experience

Learning from direct organizational experience that is relevant to entry decisions produces procedural knowledge, i.e. practical knowledge about the dynamics of the focal market and how to best enter it. Firms generate such knowledge by repeatedly solving concrete problems inside and outside the focal market. Codifying and storing that knowledge allows firms to iteratively improve these solutions (Argote 2012; Yelle 1979). By selecting and transferring that knowledge, firms can help solve problems in other areas (Argote and Miron-Spektor 2011; Argote, McEvily, and Reagans 2003; Cohen and Levinthal 1990), including with regards to the question of geographic expansion and market entry. Analytically, this type of firm-specific experiential learning takes place parallel to and independent from other firms. I argue that a similar learning-by-doing process underlies the generation of procedural knowledge that informs market entry decisions. In particular, I hypothesize three dimensions of direct experience that generate relevant knowledge to inform entry decisions: past experience with entering other homeowner insurance markets, previous operations in the focal market, and past exposure to severe market disruptions.

Entry momentum

Organizations that recently expanded to previously unserved markets gain experience and generate practical knowledge about the process of expansion itself. In particular, greater entry experiences have been shown to increase organizational capacity to search and exploit disparate information about unexplored opportunities, refine and institutionalize relevant information processing routines, and accumulate knowledge about best expansion practices and opportunities (Chang 1996; Erramilli 1991; Sorensen and Stuart 2000). All facilitate expansion into new

geographic markets. Exploitation biases of such knowledge can lead to firms' over-reliance on expansion as strategic solution to organizational problems (Greve 2000). Especially when time lags between market entry decisions and their outcomes are large, firms are more prone to repeat entry-decisions without giving sufficient weight to other information. The resulting entry momentum can lead to expansions irrespective of the decision makers' or the focal markets' characteristics (Amburgey and Miner 1992; Kelly and Amburgey 1991).

Expansions into homeowner insurance niches require insurance firms to assess target market opportunities, to negotiate licensing with state insurers, and to implement the roll-out of their local line-specific underwriting operations. Greater experience with these tasks grows firms' procedural knowledge about how to navigate them elsewhere and will, other things equal, increase the likelihood of subsequent entry into other states.

Hypothesis 1a (H1a). *The larger the number of a firm's recent entries into homeowner insurance markets, the greater the likelihood of subsequent expansion.*

Target market familiarity

The second dimension of direct experience relevant to market entry is a firm's pre-existing focal market familiarity. Such experience builds a firm's capacity to better evaluate the potential and downside risks of further product expansion in that market (Chang 1996; Henisz and Delios 2001). Sub-units already operating in specific markets learn to manage local idiosyncratic risks and opportunities and produce relevant procedural knowledge (Argote 2011; Gupta and Govindarajan 2001; Ingram and Baum 1997). For example, in the context of entry into international markets, focal country-specific knowledge helps firms that are operating outside their home countries to overcome the liability of foreignness (Luo and Peng 1999). The

procedural knowledge generated by direct experiences in target countries also tends to increase firms' priorities for projects in that country compared to investment options elsewhere (e.g. Davidson 1980; Yu 1990).

In the case of homeowner insurance underwriting on the subnational state level, state-specific regulatory, competitive, and demand idiosyncrasies can constitute significant barriers to entry (Berry-Stölzle et al. 2012; Klein 2013). Previous focal market underwriting experience in other insurance lines and established relations with regulators and customers generate fine-grained knowledge about local risks and opportunities related to potential homeowner insurance expansion. This direct knowledge allows firms to make more informed decisions about whether and when to expand into the homeowner insurance line in that state than outsiders. In stable market conditions, greater knowledge about how to leverage local economies of scope should therefore increase the likelihood of homeowner insurance line expansion into that market.

Hypothesis 1b (H1b). *The greater a firm's previous presence in the focal market, the greater the likelihood of expansion to another product niche in that market.*

Previous shock experience

There is some evidence that organizational experience with previous disasters is associated with higher levels of responsiveness and preparedness, which eventually improves a firm's capability to recover from disasters (Dahlhamer and D'Souza 1997; Webb, Tierney, and Dahlhamer 2000). There is also some limited evidence that previous exposure to shocks additionally helps firms to take advantage of their experiences and expand their operations in the affected country (Oetzel and Oh 2014). Based on this evidence, learning from shock exposure can be conceptualized as starting with reactive strategies and working toward creating anticipatory strategies. Through

repeated and radical experience, a disaster moves to the center of the decision-making process. As is the case with significant technological change (Cohen and Levinthal 1990), greater investment in disaster preparation and recovery capacities developed in one region conceivably allows firms to more accurately assess the opportunities created by disruptions in related markets and take advantage of them before less experienced outsiders or shell-shocked incumbents do.

After 1992, insurers' experience with local hurricane winds provided them with more fine-grained data to improve their cat models, stress-test their coastal underwriting strategies, and refine their risk-management and recovery processes. To the extent to which the resulting procedural knowledge could be used to assess homeowner insurance underwriting opportunities in other hurricane-prone markets, more hurricane exposure in the past should increase the likelihood of coastal market expansion.

Hypothesis 1c (H1c). *Past exposure to unexpected discontinuous market disruptions increases the likelihood of that firm's expansion into markets at risk of similar shocks.*

4.3.2 Indirect pre-entry experiences and vicarious learning

Besides relying on their own direct knowledge, firms can learn about the attractiveness of focal markets from the experience of others. They do so by directly observing and learning from market developments themselves (Ingram and Baum 1997), by observing competitors and incumbent market participants (Baum and Ingram 1998; Gittelman and Kogut 2003; Haunschild and Miner 1997), by attending industry conferences or related social forums (e.g. Keeble and Wilkinson 2010), or by benefitting from informational leakages that can cause unintended spillovers of experience (e.g. Zollo and Reuer 2010). The type of knowledge generated from such vicarious learning is declarative in nature, i.e. it enables firms to describe the idiosyncrasies

of the target market, the relative performance of incumbent firms, and perhaps how to imitate them post entry. Firms use this knowledge to construct focal market analyses (e.g. Porter 2003) that represent frameworks that managers use to assess market attractiveness on top of their direct pre-entry experiences. Declarative and procedural knowledge do not readily translate into each other, justifying the analytical distinction between a firm's indirect and direct experiences.

Two sources of declarative knowledge seem to be particularly pertinent to market entry decisions. The first source consists of knowledge about the focal market's overall performance and attractiveness experience (Ingram and Baum 1997; Sinkula 1994). Vicarious learning from such aggregated information has the advantage of avoiding biased inferences from individual firm performances. In this regard, net exit rates are particularly objective and attractive knowledge sources. The association between new firm founding and market net exit rates is empirically well established (e.g. Haveman 1993; Tucker, Singh, and Meinhard 1990). Sorenson (2000) argues that in mature markets greater levels of firm retention, i.e. lower net exit rates, signal the availability of sustainable resource spaces and subsequently increase market entry. I adopt this reasoning here.

Hypothesis 2a (H2a). *A positive net-exit rate has a negative effect on de-alio firm entry into that focal market.*

The value of individual incumbent firms' experiences for learning depends on comparability; the more comparable the organizations, the more similar the situations they face, and the greater the potential relevance of their experience to the observer (Baum et al. 2000; Greve 1998). The second form of indirect pre-entry experience relevant to new market entrants is therefore that of incumbents in similar positions to the ones potential new entrants would find themselves in.

Given the stability of underwriting portfolios, prying business from incumbents is challenging. New entrants therefore tend to position themselves in peripheral market niches or to underwrite newly constructed houses that are not served by established insurers (Carroll, Dobrev, and Swaminathan 2002; Negro, Visentin, and Swaminathan 2014). Although most visible, recent performance experiences of the leading incumbent insurers will therefore not have much value for potential entrants. Instead, the performance of recent new entrants with pre-entry experience is the most comparable incumbent firm group for new entrants. Positive market performance of these recent entrants provides a narrower but also potentially more biased indicator of overall attractiveness of the focal market.

Hypothesis 2b (H2b). *Better performance of recent entrants into the focal market increase the likelihood of market entry.*

4.3.3 Population knowledge

There exists a third source of knowledge that informs pre-existing firms' decisions to enter into mature markets that is situated at the organizational population or industry level. I use the terms industry and organizational population interchangeably. I argue that this changing knowledge moderates population members' interpretations of their direct and indirect organizational (pre-entry) experience and knowledge.

I define population-level knowledge about market risks as the (legitimate and technical) knowledge believed to be true and known by all population members. Complex systems of interaction can produce emergent properties that cannot be predicted by their individual components (Baronchelli 2018; Holland 2000; Simon 1962). I understand population-level knowledge as such an emergent phenomenon. In that sense, it resembles the group-level concept

of collective intelligence (Lee and J. P. Davis 2016; Levy 1999; Malone 2015; Miorandi et al. 2014) and is related to the concept of a public frame (DiMaggio 1997; Gamson and Modigliani 1989; Wood et al. 2018). It is not reducible to individual knowledge and conceptually distinct from the sum of all individual knowledge. The type of legitimacy foregrounded by organizational institutionalism (Greenwood et al. 2008; Scott 2013) contributes to the production of population-level knowledge but is not confined to it.

Two broad processes produce this shared knowledge about the attractiveness of regions and local markets. Vicarious inter-organizational learning diffuses and aggregates individual firm knowledge and practices into an aggregate pool of industry-wide knowledge (Haunschild and Miner 1997; Kim and Miner 2007; Madsen and Desai 2010; Sorenson 2000). At the same time, population-level actors such as regulatory agencies, trade associations, or nongovernmental organizations shape and legitimize collective industry knowledge within their jurisdictions (Dobbin and Dowd 1997; Gilad 2014; Hiatt and Park 2013; Wade, Swaminathan, and Saxon 1998). These actors may use their central positions to aggregate and distribute individual member information, to construct new knowledge, interpret industry events, impose rules that shape direct experiential and vicarious learning, and legitimize such learning and its outcomes (Johnson, Dowd, and Ridgeway 2006; Madsen and Desai 2018).

In both processes, technological or managerial tools play a central role in managing experience and knowledge (Jarzabkowski and Kaplan 2014:541-542; March 2006). It is the complex interaction between the bottom-up aggregation of vicarious learning and the top-down editing and dissemination of that knowledge that produces population-level knowledge and renders it irreducible to its individual contributing elements. Conceptually, this production combines the generation of new technical knowledge and its legitimization (Baum and Powell 1995; Hannan and Carroll 1995).

In relatively stable environments in which this industry background knowledge does not change, the population-level understanding of market risks and opportunities is taken-for-granted by population members. It is relatively uniformly encoded in their practices, beliefs, expectations, and, by extension, the interpretation of their pre-entry experiences (DiMaggio and Powell 1983; Durand and Thornton 2018; J. W. Meyer and Rowan 1977; Scott 2013). Unlike in the case of organizational institutionalism, however, what is taken-for-granted is not organizational forms, practices, or logics, but the assessment of the (risks of) business opportunities in mature markets. Every active member of the organizational population broadly understands the basic risk and opportunity of entering a specific market. This understanding, I argue, has no direct effect on entry decisions but moderates firms' interpretations of their direct or indirect organizational (pre-entry) knowledge.

Sufficiently salient technological disruptions, unexpectedly dramatic regulatory tightening, sudden shifts in consumer preferences, or large natural disasters such as hurricanes can call into question this industry-wide understanding of market (entry) risks (Lampel, Shamsie, and Shapira 2009; March, Sproull, and Tamuz 1991; Ramanujam 2003; Romanelli and Tushman 1994). Material market shocks do not inevitably disrupt collective understanding. Indeed, individuals and firms often ignore external shocks and stick to established understandings and frames (R. Meyer and Kunreuther 2017; J. M. Mezas and Starbuck 2008; Starbuck 2009; Tamuz 2001). The shocks referred to here are assumed to be "reinterpretative rare events" (Lampel et al. 2009:839) that trigger sufficient concerns about the future to also disrupt population-level knowledge.

I argue that it is in such periods of weakened collective understanding of market risks that the size of the moderating effect of industry-level knowledge decreases and more myopic direct and indirect pre-entry experiences take on a more prominent role in entry decisions. As collective

understanding suddenly and unexpectedly loses its reliability and legitimacy, firms revert back to their own more visceral experiences or the knowledge of their reference group to understand market risks and to assess entry possibilities (Levinthal and March 1993; March 2010). Over time, as collective actors and population members make renewed sense of the disrupted and potentially changing environment, learn from each other, and update collective understanding of (altered) market risks (Maitlis and Christianson 2014; Maitlis and Sonenshein 2010), the impact of pre-entry knowledge on existing firms' entry rates should revert to the stable-state equilibrium.

The case of hurricane shocks to homeowner insurance models illustrates the two interwoven processes of collective sensemaking, change, and restoration of population-level knowledge. Following the historic disruption of Hurricane Andrew, the diffusion of hurricane models and the associated collective sensemaking efforts by insurance firms and collective industry actors gradually restored industry-wide consensus about coastal underwriting and hurricane risks. At the individual firm level, cat models act as “technology of rationality” (March 2006) that allowed insurers to better forecast and explore coastal underwriting risks. Population-level actors instituted these models as a ‘collective device of calculation’ (Callon and Muniesa 2016) that established an industry consensus about how to assess regional hurricane and underwriting risks (Cummins and Trainor 2009; Lewis and P. O. Davis 1998; Niehaus 2002). From a cultural sociological perspective, the institutionalization of cat models created public frames that, in this context, activate concrete procedures to assess focal market risks (DiMaggio 1997; Wood et al. 2018).

Over time, insurer rating agencies required insurers to use cat models to quantify their hurricane exposure risks, reinsurers and catastrophe bond issuers incorporated cat model estimation into their own underwriting and pricing practices, and regulatory and other

government bodies integrated model projections into their decision-making, monitoring, and standard-setting processes (Grossi and Kunreuther 2005). The embracing of cat models by this set of population-level actors legitimized their use and, in principle, allowed firms to secure the capital and reinsurance required to cover potential hurricane-related payouts. The refinement of these predictive models and their institutionalization over time systematically altered collective understandings of coastal underwriting risks and with it the interpretation of firms' pre-entry experiences.

Hypothesis 3 (H3). *The disruption of population-level knowledge increases the effects of direct and indirect pre-entry experiences on entry rates. The restoration of population-level knowledge decreases them.*

4.4 Data and Method

4.4.1 Sample and Data

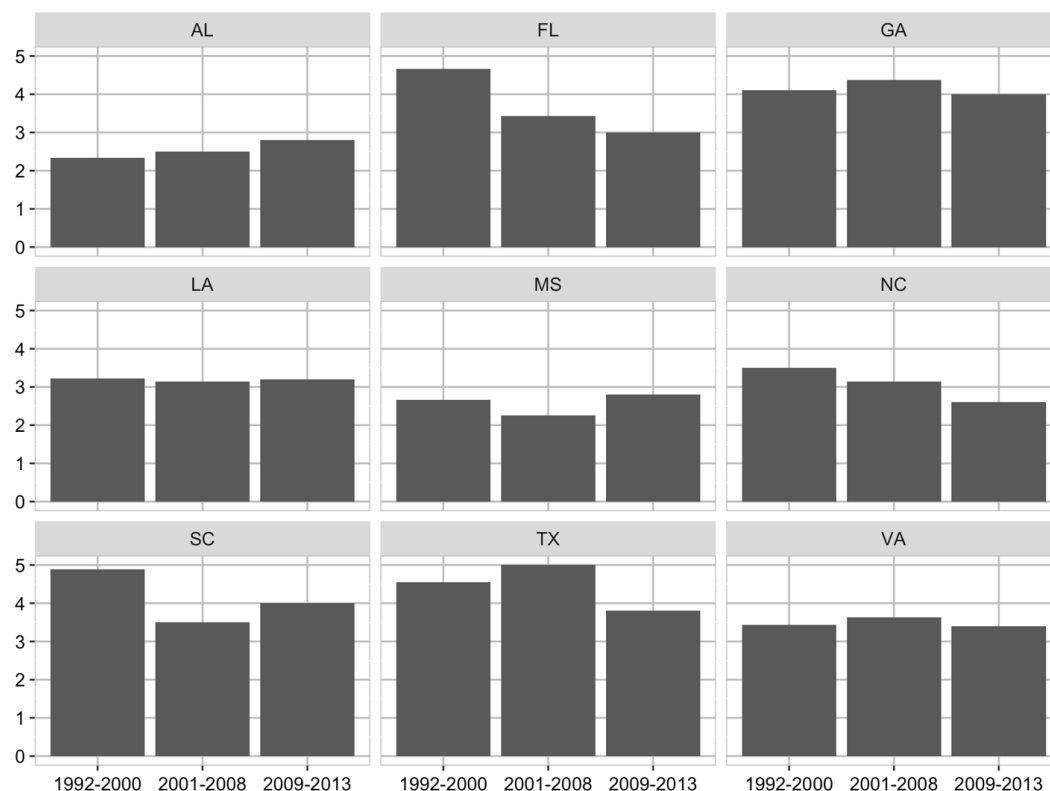
In any year, the set of firms at risk of expanding their homeowner insurance underwriting to a previously unserved state consists of all licensed property and casualty (P&C) insurers in the U.S. after 1991. Entries before Hurricane Andrew in 1992 are treated as left censored. The available data ends after 2013 which marks the point of right censoring. The set of potential target markets consists of the historically most hurricane-prone states in the Gulf of Mexico plus North- and South Carolina, Georgia, and Virginia. Between 1992 and 2013, the average annual number of firms at risk of expansion into the homeowner insurance line in one of these nine states was 1,070. The full dataset includes 199,903 firms-state-year spells. All firm-level data used for the construction of relevant independent and control variables are obtained from the annual statements that all state-licensed insurers are required to report to the National

Association of Insurance Commissioners (NAIC). Annual state-by-state hurricane wind property damage data comes from the Spatial Hazard Events and Losses Database for the United States (SHELDUS). That dataset is based on raw data from the National Center for Environmental Information of the National Oceanic and Atmospheric Administration.

4.4.2 Dependent Variable

The dependent variable is P&C insurer expansion into the homeowner insurance line in any one of the nine hurricane-prone states in any year. I record such an expansion as having occurred in the year in which a firm first reports a positive amount of homeowner insurance underwriting. Figure 2 below plots the average annual number of otherwise pre-existing new entrants into coastal homeowner insurance markets in distinct periods between 1992 and 2013 (see below for a justification of these periods).

Figure 2: Average annual number of new entrants into the homeowner insurance line



4.4.3 Independent Variables

Entry momentum. To capture a firm's entry momentum, I measure the average number of homeowner insurance state markets that the firm has entered during the previous five years. Five years are a common planning time-window in the industry. This count is then updated annually. H1a is rejected if the coefficient on this variable is negative.

Market Familiarity. Any measurement of pre-entry market familiarity faces the problem of potentially conflating learning from pre-entry market experience with material factors that affect entry decisions such as lowered entry costs. Larger or more diversified pre-existing operations in a focal market, for example, not only indicate focal market experience but can also capture potential entry cost savings. To minimize this measurement noise, I measure focal market familiarity as the lagged number of years a firm has underwritten non-homeowner insurance in the state since 1991. This measure captures each firm's experience in the focal market starting in 1992 independent of the scope or success of pre-existing local operations. H1b is rejected if the coefficient on this variable is negative.

Past shock experience. To measure the effect of an insurer's previous exposure to and experience with hurricane shocks, I count the number of its subsidiaries in states that were exposed to hurricane wind damage that exceeded one billion dollars since 1991. Insurers in states with smaller hurricanes might ignore their occurrence if they did not directly incur underwriting losses. In total, 13 states-year and 6 distinct states (AL, FL, LA, MS, NC, TX) experienced such "billion-dollar events" in the dataset. H1c is rejected if the coefficient on the variable is negative.

Net exit. I measure every focal market's net exit rate as the lagged difference between the number of new homeowner insurance firms and the number of firms that stopped underwriting the line that year. Different model specifications indicated no significant non-linearity in this variable.

Incumbent entrant loss ratio. I measure incumbent homeowner insurer performance as the lagged average loss ratio of homeowner insurers who have been active in the focal state for no more than three years. After three years, firms are generally sufficiently established to not be considered new entrants anymore. The loss ratio is the annually incurred loss divided by the earned premium for a homeowner insurance line in a given state and year. H2a is rejected if the coefficient on the variable is positive.

Population knowledge. The organizational literature has identified organizational characteristics involved in translating experience into knowledge and the subsequent retention and transfer of that knowledge at the firm-level (e.g. Argote and Miron-Spektor 2011; Grant 1996; Kogut and Zander 1992) and at the intra- and inter-organizational level (e.g. Cohen and Levinthal 1989; Hansen 2002; Strang and Soule 1998). To infer whether changes in knowledge and learning have taken place, scholars traditionally test the impact of these characteristics on behavioral outcomes such as management practices (Schwab 2007) or subsidiary location decisions (Belderbos, Olffen, and Zou 2011). Knowledge change and learning are only indirectly measured. Miner and Andersen (1999) argue that systematic changes in the nature and mix of industry-wide routines, strategies, or practices indicate population-level learning outcomes, i.e. changes in population-level knowledge. As outlined above, I concur with this approach but emphasize that a reduction of (changes in) population knowledge to the processes that produce it misses the emergent nature of such knowledge.

After Hurricane Andrew, the diffusion of cat models, vicarious learning, and the intervention of population-level actors combined to transform market and underwriting risk assessments in the (coastal) homeowner insurance sector. I rely on qualitative evidence that describes distinct periods of complex combinations of all three drivers of that change and the resulting industry-wide knowledge regimes. I then interact these time-period indicators with the hypothesized pre-

entry experience variables. Statistically meaningful interactions measure temporal variation in these direct and indirect experience effects on the likelihood of existing firm expansion. Net of appropriate controls, I interpret such variation as indicative of changes in the industry-wide assessment of coastal underwriting risks. H4 is rejected if the interacted variable exhibits no strong effect. A weak interaction means that direct and indirect pre-entry experiences have a relatively constant effect on entry risk. The dispersion and evolution of cat models and what that means for the industry-wide understanding of coastal market risks does not alter the interpretation of those experiences and how it affects the likelihood of firm entry.

Qualitative evidence in the form of interviews with insurance professionals and regulators, industry and news reports, and the insurance literature broadly identify three distinct periods of cat model evolution, institutionalization, and emergent changes in the industry-wide understanding of local homeowner insurance market risks —1992 to 2000, 2001 to 2008, and 2009 to the end of the sample period in 2013. The first period describes the immediate aftermath of Hurricane Andrew that is dominated by the disruption of existing collective knowledge of coastal underwriting risks and first efforts to reconstitute such an understanding using cat models. The second period between 2001 and 2008 describes the full institutionalization and further refinement of these collective model-driven assessments. The third period reflects a period of normalization with no significant updates in cat models and industry understanding of hurricane-related underwriting risks along the Gulf of Mexico and the lower Atlantic coast.

4.4.4 Controls

To isolate the hypothesized effects, I directly control for organizational characteristics that shape entry decisions and potentially confound the effect of pre-entry experiences. The model

specification discussed in the next section accounts for state-level characteristics that affect the likelihood of firm entry and potentially confound population-level learning.

To separate the experiential effect of market familiarity from that of entry cost advantages, I control for a pre-exiting firm's local market involvement. *Firm focal market size* measures a firm's lagged P&C underwriting volume in a given target state. The higher the volume, the larger potential savings on start-up costs relative to other entrants. A firm's overall size might also affect its likelihood of geographic expansion. Over time, and especially in mature markets, greater relative organizational size conveys competitive advantages and lowered mortality rates (e.g. Delacroix and Swaminathan 1991; Ranger-Moore 1997). In the case of homeowner insurance, these advantages might stem from scale economies in underwriting activity, the pooling of risks, or from disproportionate influence over regulators and insurance agents. Large outside firms might enjoy related scale advantages relative to incumbents that motivate them to enter a market. I measure *firm size* as the lagged value of a firm's total underwritten P&C premiums.

Besides national and local scale, greater diversification can generate economies of scope that encourage organizational expansion (Kogut and Zander 1992; Teece 1980). I adjust for two dimensions of organizational scope—a firm's national homeowner insurance specialization and the geographic diversification of its homeowner (HO) insurance underwriting. I measure *HO underwriting specialization* as the yearly percentage of a firm's total direct premiums underwritten in the homeowner insurance line. The direct written premium on a homeowner insurance policy is the product of the insurance policy rate and the value of coverage purchased for the underlying property. I use the lagged geographic Herfindahl–Hirschman Index as measure of a firm's *geographic concentration*. The Geographic Herfindahl–Hirschman Index is calculated as the sum of the squared percentage of P&C insurance premiums written in each state and year.

I additionally control for a firm's financial slack. It is well documented that managers in firms with large stocks of resources are more willing to experiment, search for new opportunities, and take risks (e.g. Audia and Greve 2006; Singh 1986). Other things equal, a firm with relatively greater slack can afford to experiment by expanding existing products into new geographic markets (or introduce new products) (Wally and Fong 2000). *Financial slack* is measured as a firm's overall lagged policyholder surplus. Policyholder surplus is the difference between an insurer's admitted assets and liabilities. It is a common measure for an insurer's financial strength and capacity to write new business. The last firm-level control adjusts for a firm's overall operational performance. I measure *firm performance* as its lagged net underwriting gain, i.e. the excess of insurance premiums over claims. The measure is an indicator for how well an insurance firm handles its underwriting policies or the viability of its insurance business. Firms might seek to solve performance problems by looking for new markets as revenue generators.

At the state level, socio-economic, demographic, and political entry barriers and incentives exert significant selection and differentiation pressures on firm entry (Aldrich and Ruef 2010; Amburgey, Davin, and Kelly 1994; Baum and Oliver 1996; Dowell and Killaly 2009; Russo 2001; Sine, Haveman, and Tolbert 2005; Wholey and Sanchez 1991). The importance of these state level factors on existing firms' entry rates is accentuated in mature and tightly regulated homeowner insurance markets {Born:2013jo, Cummins:2008jc, Meier 1988, Paudel:2012gw}. The estimation of these variables is only of importance to the extent to which it allows for the correct identification and estimation of the hypothesized organizational-level variables. To avoid the considerable identification and measurement problems associated with these state-level variables, I control for them by stratifying the statistical model by state.

4.4.5 Model Specification

I test the hypotheses by estimating Cox proportional hazard models that are stratified by state and include firms as frailty terms (Allison 1984; Box-Steffensmeier and Jones 2004; Hosmer and Lemeshow 1999; Singer and Willett 2003). These types of model offer enough flexibility to address questions of entry timing while allowing to control for state- and firm-specific confounders. While the timing of a firm's expansion to a new state is continuous, i.e. entry could happen at any moment in time, the available data limits the observation of entry to yearly increments. The models thus count continuous time in annual increments, indexing each observation at the firm-year-state level.

This data structure means that a firm's annual risk of entry into any given state can be interpreted as a counting process in which years march onwards and we observe the annual entries for each firm into different states (Andersen and Gill 1982). I estimate the model's hazard function (see (1) below) using a partial log-likelihood estimation procedure and conduct the relevant statistical tests using the `survival()` package and `coxph()` routine in R. The implemented partial likelihood estimation accounts for annual tied firm entries by using the Efron method. The estimated models designate an annual baseline hazard of firm entry into any of the coastal states that is modified by firm-specific and time-varying covariates.

To account for unobserved heterogeneity at the firm level, I include a shared "frailty" term that designates for each individual firm the same basic risk of expansion to a new state (Hosmer and Lemeshow 1999:297). Technically, the frailty term is treated as an unobserved random factor with a Gamma distribution that multiplicatively modifies the hazard function of each firm over time. I also stratify the models by state to control for the universal annual risk of entry into each state. I hypothesize that, net of the different controls, temporal non-proportionality of the explanatory variables measures the moderating effect of changes in population-level knowledge

about market risks. To capture this effect, restore the necessary proportionality condition, and correct for the resulting estimation biases, I estimate and compare two models (Model 3 and 4). The first interacts the relevant explanatory variables with a continuous time indicator (using the `tt()` procedure of the `survival()` package in R), the second interacts them with discrete time-period strata (Licht 2017; Therneau, Crowson, and Atkinson 2019:15-20).

The estimated hazard of homeowner insurance expansion by firm i into state k in year t is given by:

$$h(t,x,\beta,z) = h_{k0}(t) z_i \exp(\beta x(t-1)T_z) \quad (1)$$

$h(t,x,\beta,z)$ denotes a firm's hazard of homeowner insurance expansion into a given state in a given year; $h_{k0}(t)$ denotes the non-parametric baseline hazard of entry into state k for every firm in the risk-set; z_i is the frailty term that accounts for firm i 's overall risk of homeowner insurance expansion; $x(t-1)$ represents all lagged time-varying covariates and controls and β its coefficients. T_z represent the continuous (or discrete) time indicator (for period z). In this formulation of the hazard function, the product $h_{k0}(t) z_i$ denotes the annual baseline hazard of entry into state k for any population member at risk of entry. This baseline hazard is then modified by firm-specific and time-varying covariates and their potential time-dependent coefficients in the exponential term. The likelihood of expansion in any relevant coastal state in any given year is thus ultimately modeled as a function of a state's annual firm-specific entry-risk score that is adjusted by the firm's period-contingent pre-entry experiences and controlled-for characteristics.

4.5 Results

Table 1 below reports the descriptive statistics for the 669 entry events and the 199,903 firm-state-year spells (with 23,533 distinct firm-year pairs). A few of the descriptive statistics are

worthy of attention. Expansion into a coastal homeowner insurance market was relatively rare for P&C insurers. On average, only 2% of firms in the risk set did so in any given year. The maximum value for entry momentum indicates that a firm started to underwrite homeowner insurance in 24 new states in the previous year. Such large expansions are unusual in the time period. Of all 5,263 entries into new homeowner insurance state-markets at the national level, only 2% involved entry into more than 20 states, and only 7% into more than 10 in any given year between 1991 and 2013. The median entrant had no target market or past hurricane experience. The average potential entrant had a focal market experience of 1.9 years and previously experienced 1.5 hurricanes with a total wind damage of over 1 billion dollars.

Table 1: Descriptive statistics

Variable	Mean	Median	S.D.	Max	Min
1. HO market entry	0.02	0.00	0.14	1.00	0.00
2. Entry momentum (mean no of states)	0.16	0.00	0.86	24.00	0.00
3. Target market experience (years)	1.87	0.00	4.40	23.00	0.00
4. Past hurricane experience (state-years)	1.53	0.00	2.96	13.00	0.00
5. Net exit (no of firms)	0.87	1.00	3.62	11.00	(11.00)
6. Incumbent entrant loss ratio	1.00	0.57	1.43	9.14	0.00
7. Firm geographic concentration (HHI Index)	0.67	0.89	0.37	1.00	0.03
8. Firm HO underwriting concentration	0.11	0.00	0.21	1.00	0.00
9. Firm performance (in mio)	(2.51)	(0.06)	100.85	3,720.80	(3,444.77)
10. Firm size (in mio)	1,739.18	17.72	9,654.53	252,278.50	0.00
11. Firm focal market size (in mio)	18.87	0.00	237.60	19,797.12	0.00
12. Financial slack (in mio)	235.31	13.76	2,367.15	157,704.61	0.00

The results of the Cox proportional hazard model estimation are listed in Table 2 below. The reported estimates are exponentiated and thus measure the net effect of a variable's one-unit change on entry hazard. To facilitate the interpretation and comparability of the estimated effects, I center and scale all explanatory variables. Units are thus measured in standard deviations from the respective population means. Because the dataset consists of the census of the licensed P&C insurer population between 1992 and 2013, all estimated effects are "true" effects. Standard

errors and confidence intervals measure the true variability of the effect. Highly significant variables describe effects that have relatively low variability and relatively large effect sizes. Stratification by state and the inclusion of firms as frailty term means that the state and firm specific hazards of entry are only implicitly modeled.

Model 1 only contains the control variables. Model 2 estimates the hypothesized effect of direct and indirect pre-entry experience on the likelihood of market entry (H1 and H2). Models 3 and 4 additionally test H3 —the interactive effect of the passage of time and the associated changes in population-level knowledge about coastal underwriting risks. Model 3 adds a continuous time variable (*Year*) and interacts it with the explanatory variables. A stand-alone coefficient then indicates the time-independent effect of the hypothesized explanatory variable while the coefficient on the interactive term estimates the change in that effect due to the annual passage of time and incremental industry learning. Model 4 interacts the explanatory variables along three discrete and empirically motivated time period strata. The coefficients on these interacted variables indicate the average effect for the experiential variable for that discrete time-period. The latter approach generates a better model fit than the former.

Entry momentum had the smallest effect on insurer expansion likelihood of all pre-entry experiences. According to Model 2, when ignoring temporal and collective learning effects, a firm with just under 1 more entry than the average P&C insurer over the previous five years was only 3% more likely to enter one of the hurricane-prone states between 1992 and 2013. The finding thus (weakly) supports H1a. The passage of time and the associated collective change in knowledge about coastal underwriting risks has a slight positive effect (Model 3), mainly due to the greater impact of past entry momentum between 2001 and 2008 (Model 4). The size of these temporal changes is, however, relatively minor, leading me to reject H3 with respect to entry momentum.

Table 2: Regression results

Model	1	2	3	4		
<i>Time period</i>	<i>1992 - 2013</i>	<i>1992 - 2013</i>	<i>1992 - 2013</i>	<i>1992-2000</i>	<i>2001-2008</i>	<i>2009-2013</i>
EXPLANATORY VARIABLES						
Entry momentum		1.03** (0.01)	0.98 (0.04)	1.04* (0.01)	1.09*** (0.02)	1.03* (0.02)
Entry momentum * Year			1.03* (0.01)			
Target market experience		1.35*** (0.06)	3.94*** (0.23)	3.9*** (0.13)	1.68*** (0.09)	1.29** (0.10)
Target market experience * Year			0.67*** (0.09)			
Past hurricane experience		0.22*** (0.07)	0.00*** (0.43)	0.06*** (0.24)	0.45*** (0.09)	0.64*** (0.11)
Past hurricane experience * Year			4.87*** (0.15)			
Net Exit		1.15*** (0.05)	1.58*** (0.14)	1.75*** (0.08)	1.20 (0.10)	0.7** (0.13)
Net Exit * Year			0.83*** (0.06)			
Incumbent entrant loss ratio		0.87* (0.06)	1.26 (0.11)	1.19* (0.08)	0.68* (0.20)	0.88 (0.09)
Incumbent entrant loss ratio * Year			0.84** (0.06)			
CONTROLS						
Firm geographic concentration	0.66*** (0.09)	0.74** (0.11)	0.65*** (0.11)		0.43*** (0.09)	
Firm HO underwriting concentration	1.02 (0.06)	0.92 (0.07)	1.02 (0.07)		1.45*** (0.06)	
Firm performance	0.99 (0.02)	1.04 (0.02)	1.04 (0.02)		1.00 (0.02)	
Firm size	1.02 (0.03)	1.06 (0.03)	1.07* (0.03)		1.06* (0.03)	
Financial slack	1.03 (0.04)	1.08* (0.04)	1.06 (0.04)		1.06 (0.04)	
Firm focal market size	0.98 (0.01)	0.99 (0.01)	0.99 (0.01)		0.99 (0.01)	
D.f.	1,678	2,004	2,025		1,474	
Log Likelihood	-4,227	-3,763	-3,691		-3,499	

* p < .05, ** p < .01, *** p < 0.001

Model 2 to 4 all indicate strong positive effects of target market experience on entry likelihood, lending strong support to H1b. Model 3 demonstrates that this positive effect is significantly reduced by the passing of time and the implied restoration of population-level understanding. Whereas firms with 4.4 more-than-average years of focal market experience were 394% more likely to enter that homeowner insurance market, each passing year reduced that effect size by an average of 33%. Model 4 highlights this decline of the positive effect over the three time periods indicating different regimes of population-level knowledge. For this effect, the

evidence fails to reject H3 —changes in industry-level knowledge about coastal market risks negatively moderated the positive impact of focal market experience.

Models 2 to 4 also show a very strong impact of past hurricane experience on coastal homeowner insurance market expansion, albeit a negative one. Contrary to H1c, firms with P&C underwriting activity in a more than average number of states with large hurricane shocks were significantly less likely to expand their underwriting activities to homeowner insurance markets along the hurricane-prone coast. In support of H3, the passage of time significantly moderated this negative effect. Whereas firms exposed to roughly five billion-dollar-plus hurricane seasons between 1992 and 2001 were 94% less likely than firms with the average exposure of 2 seasons to enter another coastal homeowner insurance market, firms with the same number of previous state-year exposures were only about 38% less likely to do so after 2008.

The statistical models also reject H2a but support H2b. Net exit rates had an overall positive effect on the likelihood of market entry over the entire period (Model 2). In line with H3, however, this effect was significantly reduced over time (Model 3) and reversed direction between 2009 and 2013. In line with H2b, greater average losses of recent entrants into the focal market also decreased entry rates into coastal homeowner insurance markets over the entire period (Model 2). Also, in line with H3, the size of this effect was time-dependent. Whereas between 1992 and 2000 recent entrants' losses attracted homeowner insurers to coastal states, they reduced them afterwards.

4.6 Discussion

4.6.1 Population-level knowledge disruption and subsequent learning

The diffusion of catastrophe models, vicarious learning, and the intervention of population-level actors combined to transform population-level interpretations of coastal market risks as well as

organizational-level pre-entry knowledge of those markets. The years immediately following Hurricane Andrew were characterized by the first systematic effort by the insurance industry to integrate cat models into their underwriting and risk-assessment processes. The gradual diffusion of the use of model-based risk assessment and pricing also gave rise to the first (largely unsuccessful) experiments in pricing and trading weather-linked securities (Cummins 2008; 2012; Garmaise and Moskowitz 2009). Another substantial hurricane season in 1995, widely regarded as the start of a more active part in the Atlantic hurricane cycle, reinforced insurers embrace of these technologies, allowed them to further stress-test their use, and allowed the wider industry to coalesce around them as the legitimate tool for assessing coastal underwriting risks.

The creation of the Florida Commission on Hurricane Loss Projection Methodology in 2001 marks the full institutionalization of catastrophe models as the industry's principal mean to understand coastal underwriting and market entry risks. Together with Florida's insurance regulator, the commission was mandated to monitor catastrophe modeling firm activities and approve cat model projections by insurers and reinsurers in the state. Owing to its position at the epicenter of coastal risk management efforts (e.g. Grace and Klein 2009), this commission model approval practically legitimized and standardized industry-wide model use as well as collective expectations about future coastal hurricane risks. Relatedly, in 2004, FEMA integrated a module for estimating potential wind and flooding losses into its publicly available earthquake model.

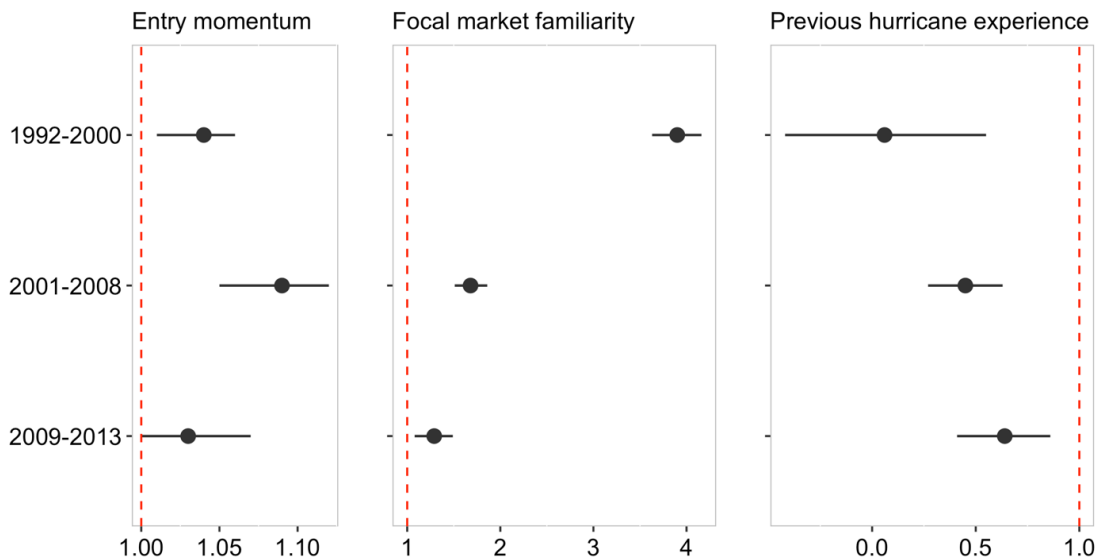
The record hurricane seasons in 2004, 2005, and 2008 did not trigger the same fundamental industry-wide rethinking of coastal risks witnessed after Hurricane Andrew. Instead, the industry updated its expectations based on the adaptation of existing cat models and further expansion and refinement of their use. Third-party providers rolled out major updates to their hurricane models and individual insurers refined theirs. Additionally, rating agencies expanded their consideration

of hurricane risks in their rating processes and capital market's willingness to securitize hurricane risks grew as witnessed by rising volumes of catastrophe bonds and other insurance-linked securities (Culp:2013id, Cummins:2012vw, Grossi:2005ty, Johnson:2011wt}. The Gulf of Mexico and the lower Atlantic coast experienced no significant hurricane activity and gradual recovered from the subprime crisis after 2008.

4.6.2 Population-level knowledge effect on direct and indirect learning

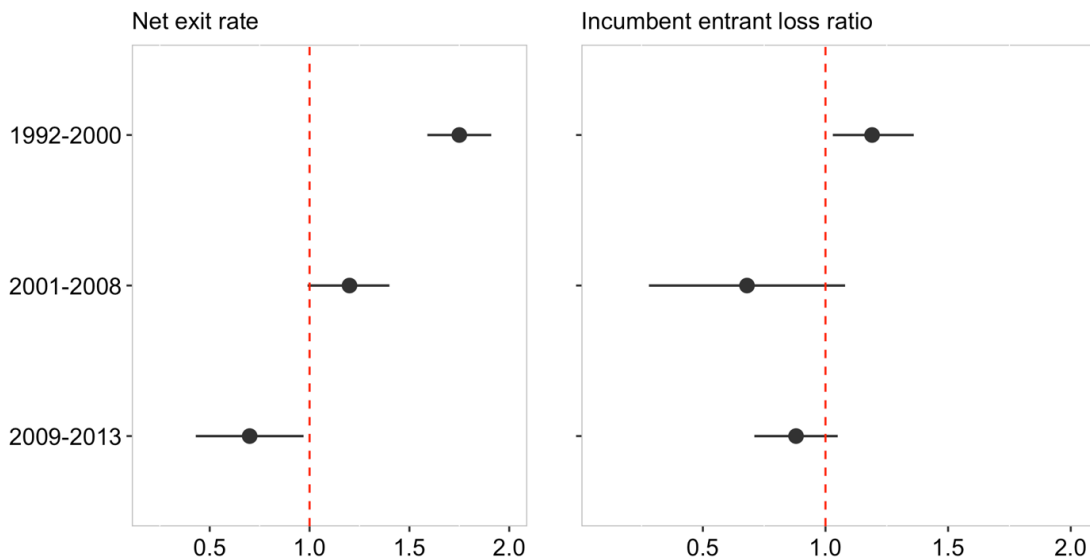
Figure 3 and 4 below summarize the results of the full Model 4 and the temporal pattern of the effects of the two types of pre-entry knowledge. The overall pattern clearly demonstrates that the gradual dispersion and institutionalization of catastrophe models after 1992 and the associated transformation of population-level knowledge outlined above reduced the impact of direct pre-entry knowledge and reversed the effect of indirect knowledge.

Figure 3 below suggests that the procedural knowledge gained by learning from direct pre-entry engagement with coastal target markets and the fallout from large hurricane shocks had their biggest impact on entry decisions in the period characterized by the greatest population-level ambiguity about coastal homeowner insurance market risks. With the past no longer a good guide to future market viability, and the industry struggling to gain a better understanding of coastal underwriting risks, direct pre-entry knowledge about focal markets strongly encouraged expansion into them.

Figure 3: Direct pre-entry effects (Model 4)

Relatedly, exposure to large hurricane seasons dramatically reduced entry into coastal markets. Absent yet fully institutionalized hurricane models, such experiences likely triggered organizational risk and ambiguity aversion associated with coastal markets. Interestingly, temporal changes in population-level knowledge did not meaningfully alter the impact of entry momentum. The over-exploitation of such experiences and the crowding out of the exploration of other solutions to organizational problems might explain the insensitivity of this type of procedural knowledge to changes in industry-wide background knowledge (also see Lant and S. J. Mezias 1992; Levitt and March 1988; March et al. 1991).

Insurers' vicarious learning produces declarative knowledge that is considerably more abstract than the procedural knowledge generated by direct pre-entry experience. Figure 4 below demonstrates the considerable impact of the evolution of population-level knowledge on this type of learning.

Figure 4: Indirect pre-entry effects (Model 4)

Between 1992 and 2000, the period of the greatest population-wide ambiguity about coastal market risks, positive net exit rates and greater-than-average recent entrants' loss ratios encouraged existing insurer entry. None-withstanding or maybe because that disruption in industry-wide understanding and amidst a continuous expansion of coastal housing construction (Figure 1), firms seem to have interpreted greater incumbent exit rates and recent entrants' underperformances as indicating underwriting opportunities that justified expansion. After 2008, amidst a more statistically refined collective understanding of coastal hurricane risks and the housing crisis behind them, insurers interpreted greater net exists and losses as indicative of local risks that did not justify entry.

Taken together, I interpret these patters as representing an equilibrating process driven by population-level learning. As the diffusion of cat models and their institutionalization by collective actors stabilized and refined population-level understanding of coastal market risks following Hurricane Andrew, the impact of market-related pre-entry knowledge on entry decisions converged to its relatively subordinated role in entry decisions. Relatedly, evolving population-level knowledge rendered the average interpretation of vicarious learning from focal

market dynamics more pessimistic. Amidst collective ambiguity, firms interpreted focal market underperformances as opportunity but saw them as problem following the institutionalization and refinement of catastrophe models.

4.7 Conclusion

4.7.1 Summary of findings

Does knowledge situated at the population level alter direct experiential and vicarious learning that takes place at the organizational level? The case of existing homeowner insurer entry into hurricane-prone coastal states suggests that it does. Looking at the hurricane-prone period from 1992 to 2013, both direct and indirect pre-entry knowledge about focal coastal market risks played a substantial role in existing firms' decisions to enter those markets. Learning from direct pre-entry experience in the form of entry momentum and existing operations in the focal market increased the likelihood of entry; past exposure to hurricane shocks consistently decreased it. The effect of vicarious learning from indirect pre-entry experience was more varied. Over the entire period, net homeowner insurer exits from focal markets encouraged greater entry into those markets while recent focal market entrants' under-performances discouraged it. The study shows, however, that these effects significantly changed over concrete time-periods that, net of relevant state- and firm-level confounders, represent distinct population-level knowledge regimes. Changing knowledge shared by all homeowner insurers about coastal market risks systematically altered the effect of organizational learning from idiosyncratic pre-entry knowledge on the likelihoods of entry.

In the years following the historic disruption of population-level knowledge about coastal market risks, existing firms' individual direct and indirect pre-entry knowledge of those markets exerted its strongest effect. The subsequent industry-wide institutionalization of technologies of

rationality in the form of catastrophe models gradually restored the shared collective understanding about hurricane and coastal market risks. This population-level learning and its emergent knowledge outcomes moderated firms' idiosyncratic interpretations of their own more myopic pre-entry knowledge. A more systematic recourse to catastrophe models and collectively established ways to apply and interpret them significantly reduced the relative importance of direct focal market knowledge and exposure to previous hurricane shocks in existing firms' entry decisions. Population-level learning even reversed the interpretation of vicarious learning from focal markets' net-exit rates and recent entrants' performances. The knowledge generated by the population- and organizational-level learning were inconsistent. The former discouraged entry into coastal states indicating incumbent under-performances, the latter encouraged it.

4.7.2 Contribution

The study contributes to organizational learning theory by identifying changes in population-level knowledge as independent causal force that moderates the effect of more traditional learning processes. Direct experiential as well as vicarious learning do not shape important firm decisions in a vacuum but in the context of collectively shared knowledge. The findings suggest that how firms interpret the outcomes of their direct and indirect learning depends on both the legitimacy and content of that context. Theories and studies of direct and indirect learning processes should consequently more systematically take account of this effect, especially amidst meaningful population knowledge changes over time or in the context of large cross-sectional differences in such shared knowledge (also see Stiglitz and Greenwald 2015). Learning from the same experience by the same firm does not necessarily have the same effect on important strategic decisions at different times or in different locations.

The paper also contributes to recent efforts to better understand cross-level learning processes (Schwab 2007). Contrary to previous research that invokes population-level learning but in fact studies vicarious learning from industry- or market-level phenomena (e.g. Ingram and Baum 1997; Madsen and Desai 2018; Sorenson 2000), the paper argues that emergent population-level knowledge itself exerts indirect causal force on important strategic decisions. Change in population-level knowledge alters organizational behavior by changing firm-level learning. This type of cross-level learning differs from the traditionally-studied learning from salient aggregate phenomena. The observed reversal of the effect of vicarious learning from focal market and incumbent behavior caused by changes in population-level knowledge demonstrate the significance of this process.

While learning from pre-entry experience is an important factor in the formation of new ventures or entry into new market niches (Cao and Posen 2018), this, to my knowledge, is the first study that systematically investigates its role in existing firms' entry into fully established markets. The findings regarding the moderating role of population-level knowledge highlight a previously under-appreciated parallel between the effect of pre-entry experience on the risk of entry into new and mature markets. The insurance case suggests that rather than voiding the value of existing organizational knowledge (e.g. Gavetti and Levinthal 2000; Tushman and Anderson 1986), significant disruptions of population-level knowledge can increase the relevance of direct and indirect pre-entry learning in mature market entry decisions. Just as in the case of entry into new or emergent market niches, it is precisely the absence of a fully institutionalized shared understanding of market risks that increases firms' reliance on the procedural organizational knowledge generated by past direct knowledge. This absence also materially alters the interpretation of declarative knowledge acquired by vicarious learning from indirect experience. Such knowledge is more abstract than the procedural knowledge generated

by learning from direct pre-entry experience and its interpretation might be more sensitive to changes in industry-wide knowledge.

4.7.3 Limitations and further research

The limitations of the study and related opportunities for further research revolve around the measurement of population-level knowledge and the mechanisms underlying its moderating effect.

The paper has argued that, as emergent phenomenon, (changing) population-level knowledge is not reducible to its generative processes, namely the diffusion and aggregation of organizational-level knowledge and practices and the institutionalization of both. Measures relying on a reductive logic fail to capture this critical supra-organizational character of (changes in) population-level knowledge. Instead, this paper has identified qualitatively informed time-periods to delineate distinct temporal regimes of population-level knowledge. While this measure is very broad and inevitably noisy, it has the relative advantage of capturing a homogenous effect on firms' behavioral reactions to their direct and indirect pre-entry experiences. If one accepts temporal change as a second-best indicator, at least in the context of Cox-proportional model estimation, it has the additional advantage of turning statistical non-proportionality tests into direct tests of the adequacy of the operationalized time-period indicator. No doubt, better measures exist that avoid the somewhat fuzzy qualitative judgments involved in this operationalization, but I am not sure what they would look like. Advances in this measurement problem would greatly improve empirical studies and theoretical development in this area.

The data employed in this study is too coarse-grained to answer why and how exactly population-level learning and knowledge moderate direct and indirect learning processes. Further empirical research might trace the connection between changes in shared population

understanding about risks, the use of knowledge management and related technologies, and the role of experiential learning in strategic decision making. Doing so might also allow for the productive integration of theories of industry belief systems (Porac, Ventresca, and Mishina 2005), public framing (Wood et al. 2018), and models of collective interpretation (Gavetti and Warglien 2015) with the theory of population-level learning (Miner and Anderson 1999). A deeper theoretical exploration of the connection between organizational institutionalism (Greenwood et al. 2008; Scott 2013) and population-level learning also offers a very exciting avenue for further theory development regarding the systematic effect of environmental change on organizational behavior and the stability of existing market systems.

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Chapter FIVE - Conclusion

5.1 Findings

Article one (chapter two) traces and compares the two homeowner insurance policy responses to the record 2004 and 2005 hurricane seasons in Florida and Louisiana. In Florida, more frequent hurricane-induced housing damage and homeowner insurance price pressures affected a larger, geographically more dispersed, and proportionally Whiter segment of the overall population than in Louisiana. These more widely distributed hurricane impacts triggered political mobilization by coastal homeowner groups and their allies, ultimately resulting in the popular reframing of insurance market disruptions as an issue of fairness rather than of market efficiency. State elections in 2006 provided the political opening that translated those demands into concrete policy changes, namely the expansion of state-coordinated residual insurance at the expense of private insurance flexibility. In Louisiana, a relatively unorganized public backlash never systematically challenged the pre-existing policy stance of widening and deepening private homeowner insurance provision.

From the crude functional perspective outlined in the introduction (chapter one), these policy processes constitute reverse feedback processes that link sufficiently severe past and anticipated disruptions of homeowner insurance supply to local government market interventions designed to restore supply. The key insight of the article is that the outcome of the policy feedback process is contingent on the temporal, geographic, demographic, and socioeconomic distribution of the underlying market problem triggered by the outside shock as well as on the timely opening of political opportunities. The case comparison suggests that only sufficiently widespread problems and the timely opening of political opportunities engender a policy feedback that qualitatively alters the underlying logic of the provision of goods and services—in this case of homeowner insurance. More concentrated shocks and market problems combined with political openings also

trigger policy feedback, but its outcomes will be unlikely to break with the dominant market logic. In the end, both interventions helped to prevent full insurance market supply failures.

Article two (chapter three) investigates the effect of two organizational learning processes on changes in incumbent state subsidiary underwriting volume and absolute risk-taking. In relatively predictable environments, learning from performance feedback generally guides firms' risk-taking. When recent exogenous shocks complicate such learning, insurers also directly explore their local and firm-wide hurricane experiences. While corporate-level learning from firm-wide experiences had no substantial direct effect on annual changes in local risk-taking, it conditioned the impact of learning from local performance feedback and from recent hurricane shocks. Local learning from the largest hurricanes without previous corporate experience also strongly affected changes in subsidiary risk-taking. Notably, variation in firms' overall financial reserves and the associated risk of insolvency did not substantially alter these results.

The findings paint a rather complex picture with regards to the role of learning in maintaining existing private homeowner insurer supply in hurricane-prone coastal states. Learning from the performance effects of homeowner insurance underwriting as well as from multi-level hurricane experiences did not unequivocally increase or decrease local underwriting. The ultimate effect was contingent on the specific configuration of experiential learning and the knowledge created.

Article three (chapter four) investigates how emergent learning at the industry-level alters the impact of existing firms' pre-entry experiences on their likelihood of entry into mature coastal homeowner insurance markets. Besides incumbent firm supply, new entry is an important source of market supply and change. The paper demonstrates that collective knowledge about coastal market risks reduced the impact of direct pre-entry experiences and reversed the impact of indirect experiences.

Hurricane Andrew disrupted the industry-wide understanding of coastal market underwriting risks. In the years following that disruption, firms with direct engagement with the focal markets were substantially more likely to enter their homeowner insurance sector. Firms with previous exposure to hurricane shocks were less likely to enter. Net homeowner insurer exits from focal markets as well as recent focal market entrants' underperformances encouraged greater entry. The institutionalization of catastrophe models following Hurricane Andrew and the associated collective learning about hurricane shocks gradually restored a shared industry-wide baseline understanding of coastal underwriting risks. The restoration of that collective knowledge systematically crowded out the relevance of firms' direct pre-entry experiences and reversed the effect of their indirect experiences.

From a functional perspective, organizational-level learning from pre-entry experiences also constitutes a crude reverse feedback mechanism. In periods in which collective industry knowledge about market risks is at its most ambiguous and contested, indirect learning from target market behavior as well as from direct pre-entry engagement with the focal market encourages existing firm market entry. As reliable collective understanding of target market risks is restored, the effect of such organization-level learning fades or reverses. With regards to experienced firm-entry into mature insurance markets, established industry-wide knowledge about those markets' risks thus seems to act as form of barrier to entry that erodes any potential pre-entry knowledge advantages that might encourage entry into less-well understood markets.

5.2 Contribution

Article one identifies an avenue for theoretical synthesis of two competing theories of policy change —interest group theory and structural class theory. The paper suggests that their explanatory leverage is contingent on factors outside those theories, namely on exogenous shocks' temporal, geographic, demographic, and socioeconomic distributions as well as on the

timely opening of political opportunities. Structural class forces and institutionalized policy prescriptions are more relevant when shocks are relatively concentrated and political blow-back limited. When the shocks directly affect a broader part of the population and there exists a timely electoral opening, affected groups can exert political pressure and persuade legislators to address their grievances outside the dominant policy logic.

Article two contributes to organizational theories of learning and risk-taking by demonstrating that firms draw on multiple complementary learning processes across different hierarchical levels to adjust their risk exposure following rare environmental disruptions. Contrary to received wisdom, large negative shocks do not only affect organizational risk-taking through their impact on performance-aspiration gaps and related concerns about overall firm insolvency. Independently of such concerns, direct local and firm-wide learning from those shocks alters local supply behavior and risk-taking. The process of learning matters to organizational adaptation even in circumstances in which global generalizations from local inferences are problematic.

Article three contributes to organizational theory by identifying changes in collective population-level knowledge as an independent force that moderates the effect of organizational-level learning from direct and indirect experiences. The findings suggest that learning from the same experience by the same firm does not necessarily affect major strategic decisions to the same degree and in the same way at different times or in different locations. Changes in industry-wide knowledge alter firm behavior by changing the impact of organizational-level learning on important strategic decisions such as entry into new markets. The findings also suggest an underlying reason why pre-entry experience seems to play a larger role in decisions to enter new or emerging as opposed to more established markets. Collective uncertainty about the risks and viability of the focal market renders such organization-level experience and learning more

pertinent. Publicly well-understood market risks crowd out the relevance of individual firm knowledge.

Taken together, the three papers suggest that state policy-responses as well as organizational and industry-wide learning processes play a central role in how mature markets adapt to extreme weather events. Each process serves as a crude functional reverse feedback process that links the (anticipated) behavioral consequences to the behavior that helped cause them. Policy interventions regulate the affordability and availability of overall market supply, learning from local performance feedback and from local as well as from firm-wide shocks regulate local incumbent supply behavior, and collective and individual experiences that inform the assessment of focal market risks alter the likelihood of entry into those markets. To the extent to which those individual processes encourage private supply increases, they strengthen the resilience of overall market supply. Organizational- and population-level learning does, however, not unequivocally increase such resilience.

5.3 Limits

By virtue of their stand-alone objectives and logics, none of the articles directly account for the determinants of overall market resilience or for the main drivers of market evolution. The first article focuses on changes in the rules of the game. Those rules only indirectly alter market supply and stability by changing the relative costs of private and public homeowner insurance provision. The second and third article focus on how learning processes contribute to individual underwriting changes and, by extension, to aggregate market supply. The papers control for other factors and processes that also contribute to private firm and overall market supply.

The firm-level control variables in article two suggest that, independent of their relative performance and hurricane experiences, less locally experienced and more geographically- and

product-concentrated incumbent firms on average expanded their underwriting at a greater annual rate than other firms. Further, at the state-level, greater state interventions marginally reduced private supply while greater market concentration marginally increased it (Table 3 in Article 2).

The control variables in article three suggest that geographically diversified homeowner insurance specialists were more likely to expand to new hurricane-prone states (Table 2 in Article 3). The paper also ignores the importance of newly formed instead of pre-existing firms in stabilizing coastal homeowner insurance provision. At least in the case of Florida, such “de novo” firms exerted a significant underwriting role at least after 2007. The paper also does not address the actual contribution of new entrants to market stability over time. While Figure 3 in the introduction (1.3) suggests that new entrants together expanded their market shares in coastal states after 1991, a greater share of more fragile homeowner specialists in particular might reduce the overall market resilience in the long run.

Another missing but critical element in the discussion of homeowner insurance adaptation and resilience is the tighter coupling of the insurance industry to financial markets. Insurance economists generally find that the insurance sector itself poses no systematic risk to the financial sector (e.g. Cummins and Weiss 2014; Weiss 2010). The causation seems to run in the other direction. Chen and colleagues (2014), for example, find that ever-closer interconnections between banks and insurance firms cause systematic risks in the insurance but not the banking sector. Insurance firms that also engage in banking-like activities are more sensitive to shocks emanating from financial markets, potentially weakening their ability to buffer future weather-related shocks.

Climate-related shocks to reinsurance markets can also directly or indirectly weaken primary insurance supply resilience. Reinsurance protects insurance firms from limited amounts

of unexpectedly large insurance claims. In response to very large atmospheric shocks, the price of reinsurance usually spikes, and the supply of coverage may be restricted, reducing its contribution to overall market supply resilience (Cummins and Trainar 2009). As a result, the greater availability of reinsurance starting in the 2000s does not seem to have halted supply retrenchment by the most established insurers. The opaque counter-party arrangements governing reinsurance contracts make contagion in the global reinsurance market a real possibility (Davison et al. 2016). A truly catastrophic hurricane event such as the (possible) leveling of Miami could dramatically weaken global reinsurance as well as financial markets and thereby indirectly reduce longer-term resilience of homeowner insurance to even milder future shocks (Dembick 2019). Finally, while the development of new financial instruments such as insurance-linked securities or catastrophe bonds might play a much greater role in the future (Bouriaux and MacMinn 2009; Cummins 2007), they might also increase broader systematic risks that might undermine homeowner insurance resilience in the long run.

5.4 Next steps

The preceding discussion suggests that a more comprehensive understanding of market adaptation to large climate shocks requires the dynamic tracking of many interconnected variables and feedback processes across multiple levels. The type of comparative case studies and regression analyses conducted in the three stand-alone papers are useful in exploring specific parts of those dynamics such as legislative and incumbent firm responses to shocks or overall demographic changes in local market populations. Yet, these types of studies cannot capture all moving parts that collectively determine a system's overall stability and evolution in response to large outside shocks. I therefore believe that adopting a (complex) adaptive systems perspective and the simulation of such systems and different shock scenarios holds the greatest promise in

better understanding the resilience and evolution of contemporary capitalist markets faced with the worsening repercussions of climate change and extreme weather events in particular.

A system is an “interconnected set of elements that is coherently organized in a way that achieves something” (Meadows and Wright 2008: 11). The behavior of a market system, its responses to outside shocks, and its evolution over time are latent within its structure. When dependencies among its constitutive elements are sufficiently strong to render the system non-decomposable to its constituent parts, endogenous behavior can give rise to unpredictable emergent or non-linear outcomes (see for example Holland 2000; Miller and Macy 2009). Partial studies of the type conducted here are inherently incapable of answering any system-level questions.

The simulation of system responses to outside shocks using, for example, agent-based models (Bruch and Atwell 2015; Dubbelboer et al. 2017; Taylor, Besa, and Forrester 2016) or recently developed Bayesian dynamic system models (Ranganathan et al. 2014; Spaiser et al. 2015) offers the exciting prospect of identifying the existence of potential system tipping points and of quantifying the threat of critical regime shifts in such market and organizational population systems (Barash, Cameron, and Macy 2012; Granovetter 1978; Milkoreit et al. 2018). Related empirically-informed simulation exercises across different markets or disaster contexts also hold the promise of identifying generalizable patterns in modern capitalist market systems’ responses to such shocks and to draw on those insights to further develop theory and inform policy-making (Davis, Eisenhardt, and Bingham 2007; Simon 1962; West 2017).

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