Asymmetric Information in the Florida Homeowners Insurance Market

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Abstract: The home insurance market in Florida is struggling, with premiums skyrocketing and insurance providers no longer offering coverage in the state. We examine the role of informational asymmetries on this market unraveling. Specifically, we look at Citizens Insurance's policy changes, which required an inspection when insured property met specific age thresholds. We find that asphalt roofs, which must be inspected when the roof reaches 25 years, were more likely to be replaced at the time of the inspection. For tile roofs, which have a 30-year inspection requirement, we find that recently-inspected homes were less likely to file a claim after Hurricane Irma. However, homes that did not yet have an inspection-but were due for one in the near future- were significantly more likely to file a claim. Overall, our results suggest that inspections find under-maintained roofs and correct the moral hazard problem in this market. However, we also find that known inspection times lead to increases in the likelihood of filing a claim prior to a storm.

Keywords: homeowners insurance; hurricanes; informational asymmetries; moral hazard

JEL Codes: G22; G52; R30

1. INTRODUCTION

Since 2017, six insurance companies that previously offered property and casualty insurance in Florida liquidated.[1] In July of 2023, Farmer's Insurance and AAA Insurance were the most recent to announce that they would no longer provide home owner's insurance in Florida.[2] The Insurance Information Institute projects that, on average, insurance premiums in Florida will increase by 40% from 2022 to 2023.[3] While there were signs of stress on the insurance market prior to 2017, the increasing frequency and intensity of hurricanes in the Atlantic since the 2017 hurricane season amplified the financial difficulties of living in coastal areas. Consequently, there are concerns that the Florida homeowners insurance market is on the edge of collapse. These concerns gave rise to special legislative sessions in May and December of 2022 to try to address the problem.

In this paper, we examine how informational asymmetries exacerbate problems with the homeowners insurance market in Florida.[4] Asymmetric information has been studied by economists for decades (Borch, 1962; Arrow, 1963; Pauly, 1974; Rothschild and Stiglitz, 1976; Wilson, 1977; Crocker and Snow, 1985; Chiappori and Salanie, 2000). One way asymmetric information presents itself in the insurance market is through moral hazard, where individuals take fewer preventative steps when they have insurance (Arrow, 1963; Shavall, 1979; Arnott and Stiglitz, 1988). When studying how this manifests in insurance markets, extensive research has focused on health insurance (Cardon and Hendel, 2001; Fang et al., 2008; Powell and Goldman, 2021) and car insurance (Cummins and Tennyson, 1996; Cohen, 2005; Hoyt et al., 2006; Saito, 2006; Spindler et al., 2014). Fewer studies have looked to homeowners insurance, which contains a different set of issues primarily due to the capitalization of

[1] https://www.myfloridacfo.com/division/receiver/companies

[2] https://www.usatoday.com/story/money/personalfinance/2023/07/19/florida-home-insurance-aaa-farmers-policy-reduction/70427062007/

[3] https://www.iii.org/sites/default/files/docs/pdf/triple-i_trends_and_insights_florida_pc_02152023.pdf

[4] Grace and Klein (2009) examined the impact of the 2004-2005 hurricane season on insurance premiums in Florida and the southeast.

insurance premiums into house prices.[5] For example, Nyce et al. (2015) found that the insurance premiums in Florida conveyed information about risk that is capitalized into house prices.[6] Alternatively, there could be adverse selection in the market, where the seller has better information than the buyer on the condition of the home. Aarbu (2017) found evidence of adverse selection, but not moral hazard.

There are two main mechanisms through which asymmetric information is likely to contribute to the problems in the homeowners insurance market in Florida. One explanation is moral hazard: homeowners defer maintenance due to the likely chance that a severe storm will damage the home – specifically the roof – and the needed upgrades will be covered by insurance. In Florida, if at least 25% of the roof is damaged due to a storm, the insurance company is responsible for the full replacement cost of the roof, not an adjusted value based on the estimated remaining roof life.[7] Thus, homeowners may delay repairing a worn roof with the hope that a storm and subsequent insurance claim will cover the expense. This situation is the standard moral hazard problem in insurance markets, where individuals do not take preventative steps (i.e. home maintenance) because they have insurance (Laffont, 1995; Einav and Finkelstein, 2018; Konetzka et al., 2019). In addition, a growing literature has shown that moral hazard due to insurance and aid packages may cause development in high risk areas, such as work by Baylis and Boomhower (2019) that found that fire protection leads to development in high risk areas. Previous research has also found that moral hazard is more likely to be present the higher the probability an event occurs (Mol et al., 2020). All of this research suggests that this problem may become worse as more extreme weather events occur.

[5]Homes in coastal regions typically have flood insurance as well, which is examined in a growing literature (Collier et al., 2021; Wagner, 2022). This type of risk and insurance may also be capitalized into house prices (Bin and Polasky, 2004). Flood insurance is a separate, unique market with a variety of distinctive attributes that we do not consider in our analysis.

[6]Insurance claims may also result in price increases as claims can reveal information about the area. In Florida, this type of research commonly includes sinkhole insurance claims, such as Dumm et al. (2020)

[7]Note that this was adjusted in the May 2022 special session. In the updated ruling, so long as the roof met the 2007 Florida building codes, only the damaged portion of the roof needed to be replaced. See http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=0500-0599/0553/Sections/0553.844.html for more information.

A second explanation for the problems in the Florida home insurance market is that individuals are filing excessive and fraudulent claims. Many believe that this is specifically driven by roofers and lawyers, who "find damage" on the roof after a storm and promise a "free roof" to the homeowner. Homeowners are then asked to sign an assignment of benefits (AOB) agreement so the contractor can manage the claim with the insurance company. The homeowner may not realize that the AOB also gives the contractor the right to take legal action against the insurance company on behalf of the homeowner. If the insurer denies the claim, the contractor may bring legal action against the company. Up until December of 2022, Florida allowed "one-way" attorney fees, making the insurance company responsible for its own legal fees as well as the legal fees of the policyholder if any amount of recovery is awarded.[8] One way attorney fees may have encouraged insurers to settle, as settlement avoided the possibility the insurance company may be responsible for greater attorney fees if the claim goes to court and the ruling is in favor of the policyholder (Wolf, 2015; Insurance Information Institute, 2019).

Both of these situations are due to asymmetric information. The first is the standard moral hazard problem, where homeowners do not engage in preventative actions because they have insurance. In the second situation, where fraudulent claims are filed, various parties can engage in such a scheme because the insurance company does not have perfect information on the quality of every roof or exactly when any damage occurred. In both situations, because the insurance company does not know the exact condition of the roof before the severe weather event, it is difficult for the insurer to prove that the damage was not caused by the storm. If information on the exact condition of the roof was available, these issues could be addressed as there would be proof of which claims are valid and which are not.

To examine how information impacts the homeowners insurance market in Florida, we use two plausibly exogenous changes in the availability of information that created a discontinuity

[8]One-way attorney fees were removed in the December 2022 special session of the legislature. This change only applies to new claims filed, not those that were filed prior to the law change.

for individuals who have homeowners insurance through Citizens Insurance (Florida's state-run insurance company). First, in 2010 all homes insured by Citizens with asphalt shingles were required to have an inspection of the shingles only when the roof is 25 years old. Second, beginning in 2013, Citizens required all new applicants for home insurance whose home was 30 years or older to have a detailed four-point inspection. Homes that currently have coverage and were over 30 years could be subject to an inspection if requested by Citizens. The four-point inspection examines the roof, electrical, plumbing, and HVAC systems.[9] Therefore, all asphalt roofs are inspected at 25 years and some tile roofs are inspected when the house is 30 years old. Asphalt and tile roofs make up the majority of the market in Florida.

When these inspections take place, many of the informational asymmetries are removed. For homeowners that have delayed replacing a deteriorated roof, Citizens can require a roof to be replaced in order to receive insurance. To receive coverage through Citizens, a roof must have at least three years of estimated remaining roof life.[10] Since Citizens is the "insurer of last resort," it is unlikely that a homeowner who is denied coverage with Citizens will be able to find a private insurer willing to cover the home. Further, it is known that homes that reach these thresholds may be inspected and if so there will be documentation regarding the current quality and state of the various systems. Therefore, these homes are less likely to be targets of the schemes described above as the insurance company may have documentation on the quality of the roof before the storm and thus can better prove what actually caused the damage. We use data from Citizens Insurance to analyze the impact of the inspections on the claim filing behavior of policy holders after Hurricane Irma.

To determine the effect of information on claims, we use the two age cutoffs and differences in roof type as our identifying variation. First, we use the requirement that all asphalt roofs have to be inspected when the roof is 25 years old. The estimated roof life of an asphalt roof

[9]https://www.citizensfla.com/inspections

[10]Effective March 31, 2023, Citizens updated their policy to require five years of estimated remaining roof life to be eligible for insurance. See https://www.citizensfla.com/-/20230331-roof-rule-changes for more information.

in Florida is approximately 15-20 years.[11] This suggests that if an asphalt roof is 25 years old when the inspection occurs, the roof is likely to be sufficiently worn that Citizens will require a new roof in order to obtain coverage. We look at the pattern of roof replacements before and after the policy change. Prior to the policy change, we find that the likelihood of replacing the roof evolves relatively smoothly. However, after the 25 year inspection is instituted, the likelihood of replacing a roof declines notably before 25 years and spikes at 25 years. This could be driven by several factors one of which is that the insurance company has unintentionally set an anchor for homeowners. Specifically, by requiring an inspection at age 25, the insurer may have indicated to homeowners that this is the estimated roof life and may have driven the homeowner to postpone replacing a roof that may have been replaced earlier without the 25-year inspection requirement.

Then, we consider the likelihood of filing a hurricane related claim for the asphalt only roofs. We focus on the 2017 hurricane season when Hurricane Irma hit Florida, the first major storm to hit the state in over a decade. We find that those homes that had an asphalt roof that had not been inspected yet (i.e. those that were less than 25 years old) were significantly more likely to file a claim after the storm. Overall, our results suggest that the required inspection is identifying and correcting the problem. However, those homes that are over 20 years but less than 25 likely needed a new roof before the storm, but it appears homeowners delayed that maintenance. This provides evidence that the standard moral hazard problem regarding investing less in maintenance when insured may be present in this market. Alternatively, as mentioned above, Citizens may have unintentionally set an anchor when it instituted this policy. The 25 year inspection may have sent a signal to homeowners that roofs should not need to be replaced prior to this age and thus may have unintentionally caused homeowners to delay maintenance they would have performed in the absence of the inspection.

Second, we use the policy change that required all new policies where the house was over

[11] https://www.nationsroof.com/roof-lifespan-florida/

30 years to obtain a four-point inspection prior to receiving coverage through Citizens. In addition, for existing policy holders whose homes were over the age of 30, Citizens could request a four-point inspection which was paid for by the insurance company. Therefore, for homes that are over 30 years old, some homes have had a four-point inspection but for homes 29 years or younger it was unlikely there is an inspection on file. If the insurance schemes described previously are occurring, it seems likely that the roofers and lawyers would target those homes under 30 years old as the likelihood these homes have an inspection is low relative to those that are over 30 years old. We restrict our sample to homes with tile roofs due to requirement that asphalt roofs have an inspection at 25 years. Note that the estimated life of a tile roof in Florida is approximately 50 years.[12] Therefore, at the 30 year mark it is unlikely that a tile roof will need to be replaced but there may be documentation on the condition of the roof prior to the hurricane.

We estimate the probability of filing a claim based on the age of the house relative to a 40 year old home. We find that the likelihood of filing a claim for the homes with a tile roof that were over 30 years old at the time of the hurricane was not statistically significant. However, for those homes that had not yet obtained a four-point inspection (i.e. those that were 30 years old or less) and had a tile roof, we see a statistically significant higher likelihood of filing a claim. Furthermore, we find that these claims are significantly more likely to involve a lawyer. These results suggest that these tile roofs, which have not yet been inspected yet but will be soon, may be more likely to be subject to the insurance schemes by roofers and lawyers described above.

We consider alternative explanations that could be driving these results and rule them out as plausible explanations. We also consider the possibility that there was a change in the nature of how homes were built or building codes. If there was a change in building codes or how homes were built that occurred 30 years before Hurricane Katrina, this could explain our findings. Looking at various aspects of the roof and the nature of the building

[12]https://www.nationsroof.com/roof-lifespan-florida/

structure, we do not see evidence that there was a discrete change in how homes were built in 1987 or 1988 that may explain our results.[13]

We contribute to a growing literature on climate change and insurance markets. As the world experiences more and more extreme weather events, it is important that insurance markets are functioning efficiently to ensure against these shocks. The estimated roof life of an asphalt roof is approximately 15-20 years; we find that homes with asphalt roofs were likely to be replaced at the 25 year mark and that those that were over 20 years but had not been inspected yet are more likely to file a claim. This suggests that Citizens may not be properly timing their inspections to address these issues. Citizens has already recognized the importance of information in this market and how the timing of the inspection may be contributing as a recent change in regulations now requires home inspections at the 20 year mark instead of the 30 year mark.[14] This additional information is key to these markets working efficiently. While the inspections are costly they are the best tool utilized thus far.

We also contribute to a literature on moral hazard and fraudulent claim filing in the insurance market. Dionne and Gagne (2001) examined the role of deductibles on the amount of the claim filed in the car insurance industry. They found that the amount of the deductible is a significant determinant of the amount of loss experienced and the effect is stronger when it is a one car accident (i.e. there are no witnesses). Dionne and Gagne (2002) examined how full replacement cost insurance affected the automobile insurance market. The authors found that near the end of the coverage, policy holders were more likely to report the car stolen, suggesting that fraud is present in this market. This result is evidence of ex post moral hazard or opportunistic insurance fraud. Pao et al. (2014) found similar evidence in Taiwan, where after a typhoon individuals with theft insurance but not typhoon insurance were more likely to report a vehicle theft. Dionne and Wang (2013) found evidence that this type of fraud is counter-cyclical.

[13]There was a change in building codes in 1994 (CITE), which is observable in some of these figures, but given its timing does not impact our analysis.

[14]https://www.insurancejournal.com/news/southeast/2022/01/11/648877.htm

2. FLORIDA INSURANCE MARKETS

2.1. Citizens Insurance

Citizens Insurance was established in 2002 by the Florida legislature to provide affordable homeowners insurance to individuals who could not obtain coverage in the private market. A state-run homeowners insurance option such as this is not typical in the United States. Only one other state, Louisiana, currently offers homeowners insurance, which is also called Citizens Insurance. Citizens is intended to be the "insurer of last resort," and homeowners can be removed from coverage through the company if there is a private insurer who is willing to provide coverage. Given it is a state run insurer, Citizens also has the ability to institute a tax on policy holders, as well as all residents within the state, if it fails to cover certain expenses.

As the home insurance market has become additionally stressed in Florida, more and more homeowners have turned to Citizens for coverage. In 2017, approximately 500,000 homeowners were covered by Citizens Insurance. It is projected that by the end of 2023 approximately 2 million homeowners will have homeowners insurance through Citizens.[15] This dramatic increase in the number of homeowners turning to Citizens for insurance is creating stress on the financial stability of Citizens Insurance. There are many arguments as to why private insurers have been leaving the Florida homeowners insurance market. While most would immediately recognize that a key contributor is the extreme weather events in the state, there are concerns that the litigious nature of the state and its insurance market are further exacerbating the problems. Specifically, Governor DeSantis noted that Florida accounts for 9% of the country's home insurance claims but has 79% of all home insurance law suits in the United States.[16]

[15] https://www.abcactionnews.com/news/price-of-paradise/floridas-citizens-property-insurance-predicts-to-hit-record-with-nearly-2-million-policies-in-2023

[16] https://www.flgov.com/2022/04/26/calling-on-the-legislature-to-hold-a-special-session-regarding-property-insurance/

As claims have increased over the last several decades, Citizens and other insurers have taken steps to try to address the situation. In August of 2010, Citizens required that all asphalt roofs receive an inspection if the roof is 25 years old. The expected roof life of an asphalt roof in Florida is between 15 and 20 years, so any roof that makes it to 25 years has likely outlived its life and needs to be replaced. Also, beginning in 2013, Citizens required all new policy holders whose home was 30 years or older to have an extensive four-point inspection of the roof, HVAC, plumbing, and electrical systems. This inspection allows Citizens to gather information on the quality of these systems and mandate repairs as needed. Therefore, the result of the change in policy is that all asphalt roofs are inspected at 25 years and some tile roofs are inspected at 30 years.

These policy changes by Citizens attempt to gain information on the quality of the roof and the various systems. By gaining information on the current state of these components of the house, Citizens can mandate repairs and upgrades in order for coverage to be obtained. However, this system is still not perfect. Citizens adjusted its policy in 2022 to require all homes to have a four-point inspection at the 20 year mark. This will dramatically increase the number of homes inspected and the amount of information that Citizens has on the homes it insures. Given the sample period of our data, this policy change will not impact our analysis.

2.2. The Legal Environment in Florida

There are several laws and regulations specific to the Florida insurance market that are important to note, as they may be contributing to the current state of the insurance market. First, Florida has an assignment of benefits system (AOB), where a policy holder can sign over the right to manage an insurance claim to a third party. In some ways, an AOB system could increase efficiency as a specialized third party should be more accustomed to dealing with insurance companies and can manage claims more easily than an individual dealing with one claim periodically. However, while AOBs exist in other states, many argue that

this is contributing to the problem in Florida. Specifically, it is argued that roofers engage in schemes where they have homeowners sign an AOB and then perform repairs that are either unnecessary or incorrectly attribute existing wear to a storm.

Another feature of Florida's legal system that many argue is contributing to the problems with the homeowners insurance market is the one-way shifting of legal fees. Specifically, this one-way fee structure makes the insurer responsible for all legal fees if there is any award, even if the claim is settled out of court. The one-way fee structure will increase the likelihood an insurance company settles initially because a legal battle will often cost the company more money because the insurer will have to pay the homeowner's attorney fees. Furthermore, it is difficult for the insurer to win in a legal battle that the hurricane did not contribute to the damage unless the insurer has proof of the quality of the roof immediately prior to the storm. The one-way fee structure likely encourages lawyers to engage in the deceptive practices described earlier, as frequently they can earn a substantial amount of money by taking these cases due to the fee structure. In many situations, the legal fees paid are substantially higher than the actual cost of paying the claim, likely causing the insurers to choose to pay the claim versus engage in a legal battle.

Another likely contributor is the decision issued by the Florida Supreme Court in *American Home Assurance Co. v. Sebo*. In this case, Defendant Sebo purchased a home and after experiencing water damage and leaks when there were heavy rains, he realized that there were major structural defects with the home. After Hurricane Wilma in 2005, he experienced extreme damage that effectively made the home uninhabitable and he filed an insurance claim. His insurance provider denied most of the claim, justifying the decision by arguing that the majority of the damage was due to a pre-existing problem with the home. In 2016 the Florida Supreme Court ruled in favor of Sebo and stated that the insurance company was liable. Specifically, the court said there is no "reasonable way to distinguish the proximate cause of Sebo's property loss — the rain and construction defects acted in concert to create the destruction of Sebo's home." Thus, the decision has made it difficult

for insurers to deny claims due to the pre-existing condition of the home even if the lack of maintenance likely contributed to the damage experienced from a storm.

In December of 2022, a special session of the legislature convened to address the problems in the homeowners insurance market.[17] Two notable changes came out of this session, which was signed into law by Governor DeSantis. The first is that the AOB system was effectively eliminated in the home insurance market. The second major change removed the one-way attorney fees. Going forward, this means that if a judgement is made in favor of the plaintiff (i.e. the homeowner), the insurance company will no longer be responsible for all the legal fees incurred by both parties. The homeowner who brings suit will be required to cover his or her attorney fees. Many believe that this policy change will eventually have a significant impact on the homeowners insurance market in Florida and will reduce the number of claims that are believed to be fraudulent claims. However, according to the Insurance Information Institute, prior to the law taking effect approximately 300,000 lawsuits were filed that are still working their way through the system.[18] While this specific law change does not affect our analysis due to our sample period, it is expected to have significant impacts on the insurance market which future research should examine.

3. DATA

3.1. Claims

The primary data set used for our analysis was obtained from Citizens Insurance in Florida. The data includes information on claims and policies beginning January 1, 2002 and and ending June 30, 2022. There are 1,084,898 total claims, and 449,183 claims relating to wind damage, *wind claims*.[19] The claims data includes information on claim date, payout,

[17] The specifics of the law can be found at https://www.myfloridacfo.com/division/ica/2022propertyinsurancechanges.

[18] https://www.cbsnews.com/atlanta/news/farmers-insurance-pulls-out-of-florida-affecting-100000-policyholders/

[19] Wind damage is the modal cause of loss. Non-weather-related water damage is the next most frequent with 318,152 claims.

outcome, legal expenses paid by the insurer, and legal representation of the insured.

The *LossYear* is the year of the loss. In Florida, the statue of limitations for filing claims is 3 years. *Net Coverage-A* is the amount paid by the insurer for the claim net of the deductible. Coverage-A covers damage to the structure of the house. For wind claims, Net Coverage-A payments represent 90.1% of the total indemnity paid; other payments relate to personal property, short-term housing, and other items. *Defense and Cost Containment* is the amount of legal expenses paid by the insurer. *Assignment of Benefits* (AOB) claims are claims where policyholder has signed over her rights to claims on the policy. *Paid* claims are claims with Net Coverage-A>0.

Table 1 provides descriptive statistics for the wind claims. All dollar amounts are in 2004 dollars. Median per-claim Net Coverage-A expenses are $355 but are skewed right with a mean of $11,180 and a standard deviation of $28,970. Defense and Cost Containment are also right skewed with a mean of $530 but a maximum of $550,530. AOB claims are rare, appearing in fewer than 1% of claims. Finally, the insurer makes (net) payment on 68% of wind claims.

Figure 1 displays total Net Coverage-A payments and Defense and Cost Containment by year and catastrophe in 2004 dollars. Figure 1a shows 2005 and 2004 had the two largest Net Coverage-A payments, $1,528m and $1,913m, respectively. Defense and Cost Containment spending for these two years was $23m and $44m, respectively. 2017 has the third largest Net Coverage-A payments, $852m, but the largest Defense and Cost Containment spending of any year, $95m. The $95m alone would make it the sixth-most costly year.

Figure 1b displays result for catastrophes with 1,000 or more wind claims. By catastrophe, Hurricane Wilma was the most costly with Hurricane Irma the second-most costly. However, although Hurricane Wilma had almost twice as much Net Coverage-A payments than Hurricane Irma, Hurricane Irma had more than twice as much Defense and Cost Containment spending for wind claims.

Figure 2 displays wind claims, Net Coverage-A, and Defense and Cost Containment

spending by age of the property for Hurricane Wilma and Hurricane Irma. Figure 2a shows Hurricane Wilma had more claims than Hurricane Irma with older properties filing more claims. Figure 2b shows the age profile of New Coverage-A payments for Hurricane Wilma has a similar pattern to the claim profile in Figure 2a. In contrast, the Net Coverage-A payments for Hurricane Irma are largest for properties aged 25-years-old to 30-years-old. This pattern becomes more pronounced in Figure 3. These figures provide graphical support for an important change in claiming behavior for properties age 30-years-old.

3.2. Properties

The data also includes information on the properties underlying each policy. Based on Figures 1a and 1b, we limit our analysis to policies covering single-family homes active at the time of either Hurricane Wilma or Hurricane Irma, the two most costly hurricanes in our sample. Moreover, analyzing Hurricanes Charley, Frances, Ivan, and Jeanne in 2004 creates several challenges as the statute of limitations in Florida makes it difficult to identify the effects of one of these hurricanes from the effects of the remaining hurricanes.

Each policy includes policy effective date, property type, construction year for property, roof material (asphalt, clay, tile, etc.), and a roof replacement date, if any. Each policy can have multiple observations corresponding to the policy rolling over into another year of coverage. The *policy effective date* is the start date of the policy for that year. We also observe the policy cancellation date, if any. We calculate the age of the property using the construction year of the property. We assume all properties are constructed on January 1 of that year and calculate the age of the property as the year of the policy effective date minus the construction year.

We limit our sample to single-family homes. This excludes condominiums, mobile homes, and multifamily properties. We also limit our sample to properties with either asphalt, fiberglass, composition, tile, clay, slate, or concrete roofs. This excludes properties with wooden, tar/gravel, or metal roofing. We define *asphalt* roofs as roofs with either asphalt,

fiberglass, or composition shingled roofing. These roof types are affected by the 25-year replacement policy in 2010. We define *tile* roofs as roofs with either tile, clay, slate, or concrete roofing. These roof types are noted affect by the 25-year replacement policy in 2010. The data includes a year of roof replacement for each property at the policy effective date. We define *original roof* policies as policies where the year of roof replacement is missing. We can also identify new roofs based on future values of the roof replacement variable in the following year net of any wind-claim.

An additional consideration is the possibility the roof replacement data may have measurement errors. We control for this possibility in two ways. First, we flag and remove all policies for any property where the type of roof changes from one year to the next without an accompanying year of roof replacement update. This removes less than 0.1% of the sample. Second, our primary analysis focuses on roofs that are either 24-years-old or less (asphalt) or 29-years-old or less (tile); we later examine Hurricane Irma legal behavior using all properties 40-years-old or less active at the time of Hurricane Irma. We exclude any properties that are older than these ages as these properties are least likely to have their original roof. Any measurement error in the roof replacement field is likely to bias our results towards a null of no effect, as explained later. However, we find the field is almost always filled in for policies covering asphalt properties 26-years-old or older and there does not appear to be any back dating of roof updates.

Using this final sample, we define the Hurricane Wilma asphalt sample as the set of policies active during Hurricane Irma covering asphalt-roof properties with the original roof. We similarly define a Hurricane Irma asphalt sample. The Hurricane Irma tile sample. A Hurricane Wilma tile sample does not exist as Citizens did not start to cover tile roofs until 2009.

4. METHODOLOGY

4.0.1. Wilma and Irma Asphalt Roofs

We use a differences-in-differences approach to test for any changes in age-related claiming behavior before and after the 25-year roof replacement policy for the asphalt roofs. We separately estimate for property n for $t = 0, 1$ corresponding to Hurricane Wilma and Irma, respectively

$$NewRoof_{n,t} = \mu_{z(n),t} + \sum_{t=0,1} \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age,t} + u_{n,t} \tag{1}$$

In 2, $NewRoof = 1$ if property n replaces their roof in period t and $NewRoof = 0$ otherwise, $\mu_{z(n),t}$ is a zip code-type fixed effect, $I(Age(n) = Age) = 1$ if property n has age Age at the start of the policy and $I(Age(n) = Age) = 0$ otherwise, $\delta_{Age(n),t}$ is the age-specific effect on wind-claims at time t normalized $\delta_{A30,0} = 0$, and u_n collects all remaining unobservables.

The term $\mu_{z(n),t}$ controls for any hurricane-specific damage to zip code z. Finer geographic controls yield near-identical results as wind damage varies across zip codes but does not vary significantly within zip code. The $\delta_{Age,t}$ capture age-related claiming behavior. As the roof ages, and if policyholders do not engage in any strategic behavior, we expect $\delta_{Age,t} \leq \delta_{Age+1,t}, t = 0, 1$.

It is possible that policy holders may respond to the 25-year policy for asphalt roofs and delay roof replacements. This will occur if the 25-year policy causes policyholders to update their beliefs about the life expectancy of their roofs. It is not implausible that policyholders do not know the true quality of their roof, as few policy holders examine their roof in detail. This observation is a motivating factor for predatory roof-replacement behavior.

If policy holders do delay roof replacements as a result of the 25-year policy, the delay and the resulting increase in the average age of roofs may increase the probability of wind claims and the Net Coverage-A payments. We examine these possibilities by replacing $Claim$ as the

dependent variable of 2 with an indicator for wind claims and an indicator for paid claims.

4.0.2. Irma Tile Roofs

Tile roofs are expected to last 50 years or more. If the four-point inspection occurs at 30 years, there may be a gradual change in the quality of the roof, but there should be no discontinuous change in the quality of the roof. If there is no discontinuous change in the quality, any discontinuous changes at 30 years result from the information effects of the four-point inspection. Policyholders with roofs aged 29 years or less should be more willing to file wind claims before revealing information to the insurer. We test for information effects using a discontinuity estimator that occurs at $t = 30$ using a static version of 2

$$Claim_n = \mu_{z(n)} + \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age} + u_n \tag{2}$$

If we normalize $\delta_{30} = 0$ we can test there are no information effects using $H_0 : \delta_{Age-k} = 0, 0 < k \leq K$ for some K. Alternatively, the coefficient for ages slightly less than 30 should all be close to the normalized value $\delta_{30} = 0$.

4.1. Local Effects

Next, we test if local network effects related to the four-point inspection affect claiming behavior. For policies / properties i and j in zip code z, we estimate

$$Claim_{ij} = \mu_z + \beta_1 \times SameBlock_{ij} + \beta_2 \times AgeLess30_{ij} + \beta_3 \times SameBlock_{ij} \times AgeLess30_{ij} \tag{3}$$

In 3, $Claim = 1$ if both policies file a wind claim and $Claim = 0$ otherwise, $SameBlock = 1$ if both policies are on the same block and $SameBlock = 0$ otherwise, $AgeLess30 = 1$ if both policies care less than 30-years-old and $AgeLess30 = 0$ otherwise. The outcome variable in

3 indicates if both policyholders file a claim, and the explanatory variables in 3 affect the probability both policyholders will file a claim.

Hurricane damage is spatially correlated. However, within zip code, we assume wind damage from a hurricane is uniformly distributed across similar house types that vary across blocks; any geographic correlation within the zip code results from local effects unrelated to average wind damage within the zip code. This approach is similar to Bayer et al. (2008) where after controlling for labor market outcomes at the census-block level, employment outcomes within a block result from social networks. The fixed effect for zip code z captures wind damage from a hurricane within zip-code. The assumption of uniform damage within zip code may not be appropriate for property damage resulting from storm surge or other flooding events as this type of damage would have a greater effect on properties closer to bodies of water and not all properties in the zip code may be near the water. Limiting the analysis to wind claims precludes such within-zip code confounding.

The variable $SameBlock$ indicates if both properties are on the same block. We define a block as the hundred block of an address. For example, *7717 Flagler Dr* and *7726 Flagler Dr* and both on the *77XX Flagler Dr* block. If $\beta_1 > 0$, pairs of properties on the same on the same block in the same zip code are more likely to file a claim than other property pairs. Indirectly, $H_0 : \beta_1 = 0$ can be used to test if there is excessive claiming behavior within block regardless of property age.

The variable $AgeLess30$ indicates if both properties are 30-years-old or less. Interpretation of β_2 is challenging. If $\beta_2 > 0$, pairs of properties 30-years-old or less are more likely to file a claim than other property pairs. Alternatively, if hurricane damage is greater for properties 30-years-old or less within the zip code, $\beta_2 > 0$. Despite this, we do not require any particular interpretation when testing for local effects.

The interaction $SameBlock \times AgeLess30$ indicates if both properties are on the same block and 30-years-old or less. If $\beta_3 > 0$, pairs of properties on the same block 30-years-old or less are more likely to file a wind claim than both 1) pairs of properties on the same block

but where only one property in is 30-years-old or less and 2) pairs of properties not on the same block but both properties in the pair are 30-years-old or less.

The coefficient β_3 is our primary variable of interest. The hypothesis $H_0 : \beta_3 = 0$ is equivalent to there being no local (block-level) effects on claiming behavior. Rejecting this null hypothesis with $\hat{\beta}_3 > 0$ and not rejecting $H_0 : \beta_1 = 0$, provides evidence policyholders on the same block may exchange information about the costs and benefits of filing a claim regardless of the realized damage. One alternative, nefarious interpretation is the excessive expected claiming activity at the local level may result from fraudulent behavior from policyholders or roofers.

The results in 3 are primarily driven by the homeowner's decisions without any input from the insurance company. Local information may also affect other outcomes that result from actions taken by both the homeowner and insurance provider. We investigate the effect of local information on payment of the claim, non-AOB litigation, and AOB litigation. A majority (84%) of litigated Hurricane Irma policies resulted from differences in scope and pricing where coverage was not disputed but the amount of payment is disputed.[20] The provider will not make payment if the damage is determined to be below the deductible. If insurers do not have information on the condition of the roof resulting from a four-point inspection, they may update their beliefs about the expected utility of denying the claim with a possibility of future litigation. If so, the coefficient on β_3 using an indicator for claim payment, $Payment$, should be positive.

Information asymmetries may also affect the homeowner's decision to litigate a denied claim. The data includes information on non-AOB-litigated claims and AOB-litigated claims. Insurers have stated solicitation by roofers has increased insurance costs.[21] If true, expected utility-maximizing roofers should target neighborhoods where the information asymmetries, resulting probability of payment from the insurer, and payoffs are greatest; these three

[20] See Citizen's Claims Committee Meeting Thursday September 19, 2018.
[21] See Citizen's Consumer Services Committee Meeting on June 9, 2016.

variables increase sharply for properties 30 years or older. If $\beta_3 > 0$ when using AOB as the dependent variable in 3, the probability of AOB-related litigation increases for properties less than 30-years-old on the same block. Rejecting $H_0 : \beta_3 = 0$, not rejecting $H_0 : \beta_1 = 0$, and $\hat{\beta}_3 > 0$ are consistent with local effects driving AOB litigation after controlling for wind damage from Hurricane Irma.

5. RESULTS

5.0.1. Claiming Behavior

Figure 4 displays $\hat{\delta}_{Age,t}$ for Hurricane Wilma, Hurricane Irma, and their differences, $\hat{\Delta}_{Age} = \hat{\delta}_{Age,1} - \hat{\delta}_{Age,0}$, with 95% sup-t confidence intervals for the probability of replacing the roof. The results indicate the probability of replacing the roof net of wind claims is increasing for policies active at the time of Hurricane Wilma. Roof replacement probability appear to stabilize near 0.13 per year for properties 19 to 24-years-old. In contrast, the probability of replacing the roof net of wind claims is increasing for policies active at the time of Hurricane Irma up to 22-years-old. Policyholders with roofs 23 and 24-years-old have a decreased probability of replacing the roof. However, the larger contrast is the overall probability of replacing the roof. The differences-in-differences results in Figure 5 indicate the change in behavior is driven by the large decrease in the probability of replacing a roof after the policy is put in place for all roofs 16-years-old or more.

Similarly, Figure 6 displays results for the probability of filing a wind claim. The results indicate the probability of filing a claim is increasing for policies active at the time of both Hurricane Wilma and Hurricane Irma. However, the increase in the probability of filing a claim is steadily increasing for the Hurricane Irma policies. The differences-in-differences estimator indicates there is no statistical difference between the age-related wind claim probabilities until ages 23 and 24.

5.0.2. Irma Tile Roofs

Figure 8 displays results from the regression using policies for tile roofs active at the time of Hurricane Irma. Figure 8a shows there is no significant time trend in the probability of replacing tile roof before or after thirty years. This supports our identification scheme where any changes before age 30 do not result from changes in quality. Figures 8b and 8c indicate the probability of filing a wind claim and the probability of a paid wind claim are both increasing up to 30 years but fall off sharply after. In total, and assuming there is no change in unobserved quality of the roof, these figures indicate information revelation at age 30 from the four-point inspection is affecting claiming and payment behavior.

Figure 8d shows a similar pattern for the probability of litigation (Defense and Containment Costs ¿0). The probability of fighting the claim, a decision made by the insurer, is larger for policies covering tile roofs less than 30-years-old. Figure 8e shows the probability of an AOB claim is larger for properties aged 28 and 29.

5.0.3. AOB Local Effects

Results for 3 are displayed in Table 3. We use policies active during Hurricane Irma on 20-year-old to 40-years-old properties. Panel A shows results for asphalt roofs. Panel B shows results for tile roofs. Row 1 in columns 1-4 of Panel A provide evidence there is no excessive spatially correlated claiming behavior as we do not reject the null hypothesis that the coefficients are different from 0 at the 5% confidence level, although the coefficient on *SameBlock* is significant at the 10% level. Row 2 of Panel A indicates properties the age of an asphalt-roof property has no statistically significant effect on the four outcome variables. This is expected as at the time of Hurricane Irma, nearly all asphalt roofs were replaced at 25 years. The coefficients in row 3 columns 1-2 suggest local effects may drive claiming and payment activity. The coefficients in row 3 columns 3-4 suggest local effects not have a statistically significant effect on either non-AOB or AOB litigation.

Row 2 in columns 1-4 of Panel A provide evidence there is no excessive spatially correlated claiming behavior for tile roofs as we do not reject the null hypothesis that the coefficients are different from 0 at the 10% confidence level. Row 2 of Panel B indicate homeowners were more likely to file claims if there was no four-point inspection on file - the property was less than 30-years-old. Row 3 of Panel B also indicates these homeowners are also more likely to engage in both non-AOB and AOB litigation.

Row 4 of Panel B provides evidence of local effects for properties 30-years-old or less. Local effects drive claiming behavior, as homeowners on the same block with properties 30-years-old or less are more likely to file a claim than other pairs on the same block.

6. CONCLUSION

The homeowners insurance market in Florida is currently unraveling. While there is much debate over the various contributing factors and how to address this problem, our paper provides evidence that information, through the four-point inspection, reduces the number of claims filed after Hurricane Irma. This suggests that providing information on the quality of the roof shortly before or immediately after a storm will help to reduce the likelihood that a fraudulent claim is filed.

Our data is only from Citizens Insurance, but this is still an important first step to this analysis for several reasons. First, because Citizens is the state-owned insurance company, they must provide insurance to those that cannot obtain insurance in the private market. Understanding what is causing the increase in claims in recent years will help to adjust policy to ensure that the company will remain viable for the foreseeable future. Second, because it is a state-run insurer, Citizens has the ability to set reasonable regulations for homeowners to receive insurance through the company. This paper uses one of these reasonable polices - requiring a four-point inspection once the house is 30 years old and changing the four-point inspection form in order to be insured through Citizens. We find evidence that this

information is valuable and is possibly reducing the number of claims filed that are likely due to preexisting wear and tear or damage to the roof.

Based on recent evidence, Citizens has recognized the importance of information and is working to gather more information to address some of the problems in the insurance market. Specifically, Citizens has recently reduced the time frame for when a four-point inspection is required from 30 years to 20 years. This will result in approximately a 20% increase in the number of homes inspected annually.[22] With this additional information, Citizens will have more information on roof quality and will be able to possibly mitigate risk by requiring individuals to replace roofs that are close to the end of their life.

There are many questions related to how to design policy to address these issues (Grace and Klein, 2009; Born et al., 2021). Insurance companies have taken steps of their own to address this problem. As mentioned above, Citizens Insurance is now requiring an inspection every 20 years.[23] Some companies are requiring roof replacements after a certain number years regardless of the quality of the roof - sometimes after only 10 years. These steps that the insurance market is taking suggest strongly that government intervention may be needed to find a solution - as overly frequent inspections and replacing roofs after only a decade are likely to be inefficient and over correcting. In addition, the December 2022 special session of the Florida legislature took steps to address this problem by limiting the use of AOB and removing the one-way attorney fee structure. Future research should analyze the impacts of these recent policy changes, as well as estimate the impact of other options to find the best strategy to maximize efficiency in the system.

[22] https://www.insurancejournal.com/news/southeast/2022/01/11/648877.htm

[23] Bond and Crocker (1997) examines the impact of costly state verification where the insureds possess private information and the insurer has to incur costs to confirm the amount of the loss.

REFERENCES

Aarbu, Karl Ove. (2017) "Asymmetric Information in the Home Insurance Market," *Journal of Risk and Insurance*, 84(1), 35–72.

Arnott, Richard J. and Joseph E. Stiglitz. (1988) "Basic Analytics of Moral Hazard," *Scandinavian Journal of Economics*, 90, 383–413.

Arrow, Kenneth. (1963) "Uncertainty and the Welfare Economics of Medicare Care," *The American Economic Review*, 53(December), 941–973.

Bayer, Patrick, Stephen L Ross, and Giorgio Topa. (2008) "Place of work and place of residence: Informal hiring networks and labor market outcomes," *Journal of political Economy*, 116(6), 1150–1196.

Baylis, Patrick and Judson Boomhower. (2019) "Moral Hazard, Wildfires, and the Economic Incidence of Natural Disasters," *NBER Working Paper Number 26550*.

Bin, Okmyung and Stephan Polasky. (2004) "Effects of Flood Hazards on Property Values: Evidence Before and After Hurricane Floyd," *Land Economics*, 80, 490–500.

Bond, Eric W. and Keith J. Crocker. (1997) "Hardball and the Soft Touch: The Economics of Optimal Insurance Contracts with Costly State Verification and Endogenous Monitoring Costs," *Journal of Public Economics*, 63(2), 239–264.

Borch, Karl. (1962) "Equilibrium in a Reinsurance Market," *Econometrica*, 30(3), 230–231.

Born, Patricia, Cassandra Cole, and Charles Nyce. (2021) "Citizens and the Florida Residential Property Market: How to Return to the Insurer of Last Resort," *Journal of Insurance Regulation*, 40(6).

Cardon, James H. and Igal Hendel. (2001) "Asymmetric Information in Health Insurance: Evidence from the National Medical Expenditure Survey," *RAND Journal of Economics*, 32(3), 408–427.

Chiappori, Pierre-Andre and Bernard Salanie. (2000) "Testing for Asymmetric Information in Insurance Markets," *Journal of Political Economy*, 108(1), 783–798.

Cohen, Alma. (2005) "Asymmetric Information and Learning: Evidence from the Automobile Insurance Market," *Review of Economics and Statistics*, 87(2), 197–207.

Collier, Benjamin L, Daniel Schwartz, Howard C Kunreuther, and Erwann O Michel-Kerjan. (2021) "Insuring large stakes; A normative and descriptive analysis of households' flood insurance coverage," *Journal of Risk and Insurance*, 89(2), 273–310.

Crocker, Keith J. and Arthur Snow. (1985) "The Efficiency of Competitive Equilibria in Insurance Markets with Asymmetric Information," *Journal of Public Economics*, 26(2), 207–219.

Cummins, J. David and Sharon Tennyson. (1996) "Moral Hazard in Insurance Claiming: Evidence from Automobile Insurance," *Journal of Risk and Uncertainty*, 12(1), 29–50.

Dionne, Georges and Robert Gagne. (2001) "Deductible Contracts against Fraudulent Claims: Evidence from Automobile Insurance," *Review of Economics and Statistics*, 83(2), 290–301.

Dionne, Georges and Robert Gagne. (2002) "Replacement Cost Endorsement and Opportunistic Fraud in Automobile Insurance," *Journal of Risk and Insurance*, 24(3), 213–230.

Dionne, Georges and Kili C. Wang. (2013) "Does Insurance Fraud in Automobile Theft Insurance Fluctuate with the Business Cycle?," *Journal of Risk and Insurance*, 47(1), 67–92.

Dumm, Randy E., Charles Nyce, G. Stacy Sirmans, and Greg T. Smersh. (2020) "Pricing Moral Hazard in Residential Properties: The Impact of Sinkhole Claims on House Prices," *The Journal of Real Estate, Finance, and Economics*, 64, 30–70.

Einav, Liran and Amy Finkelstein. (2018) "Moral Hazard in Health Insurance: What we Know and How we Know it," *Journal of the European Economic Association*, 16(4), 957–982.

Fang, Hanming, Michael P. Keane, and Dan Silverman. (2008) "Sources of Advantageous Selection: Evidence from the Medigap Insurance Market," *Journal of Political Economy*, 116(2), 303—350.

Grace, Martin F. and Robert W. Klein. (2009) "The Perfect Storm: Hurricanes, Insurance, and Regulation," *Risk Management and Insurance Review*, 12(1), 81–124.

Hoyt, Robert E, David B Mustard, and Lawrence S Powell. (2006) "The effectiveness of state legislation in mitigating moral hazard: evidence from automobile insurance," *Journal of Law and Economics*, 49(2), 427–450.

Insurance Information Institute. (2019) "Florida's Assignment of Benefits Crisis: Runaway Litigation is Spreading, and Consumers are Paying the Price," .

Konetzka, R. Tamara, Daifeng He, Jing Dong, and John A. Nyman. (2019) "Moral Hazard and Long-Term Car Insurance," *The Geneva Papers on Risk and Insurance - Issues and Practice*, 44(2), 231–251.

Laffont, Jean-Jacques. (1995) "Regulation, Moral Hazard, and Insurance of Environmental Risks," *Journal of Public Economics*, 58(3), 319–336.

Mol, Jantsje M., WJ Wouter Botzen, and Julie E. Blasch. (2020) "Risk Reduction in Compulsory Disaster Insurance: Experimental Evidence on Moral Hazard and Financial Incentives," *Journal of Behavioral and Experimental Economics*, 84, 101500.

Nyce, Charles, Randy E. Dumm, Stacy G. Sirmans, and Greg Smersh. (2015) "The Capitalization of Insurance Premiums in House Prices," *Journal of Risk and Insurance*, 82(4), 891–919.

Pao, Tsung-I, Larry Y. Tzeng, and Kili C. Wang. (2014) "Typhoons and Opportunistic Fraud: Claim Patterns of Automobile Theft Insurance in Taiwan," 81(1), 91–112.

Pauly, Mark V. (1974) "Overinsurance and Public Provision of Insurance: The Roles of Moral Hazard and Adverse Selection," *Quarterly Journal of Economics*, 88(February), 44–62.

Powell, David and Dana Goldman. (2021) "Disentangling Moral Hazard and Adverse Selection in Private Health Insurance," *Journal of Econometrics*, 222(1), 141–160.

Rothschild, Michael and Joseph E. Stiglitz. (1976) "Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information," *Quarterly Journal of Economics*, 90(November), 629–649.

Saito, Kuniyoshi. (2006) "Testing for Asymmetric Information in the Automobile Insurance Market under Rate Regulation," *Journal of Risk and Insurance*, 73(2), 335–356.

Shavall, Steven. (1979) "On Moral Hazard and Insurance," *Quarterly Journal of Economics*, 93, 541–562.

Spindler, Martin, Joachim Winter, and Steffen Hagmayer. (2014) "Asymmetric Information in the Market for Automobile Insurance: Evidence from Germany," *Journal of Risk and Insurance*, 81(4), 781–801.

Wagner, Katherine RH. (2022) "Adaptation and Adverse Selection in Markets for Natural Disaster Insurance," *American Economic Journal: Economic Policy*, 14(3), 380–421.

Wilson, Charles. (1977) "A Model of Insurance Markets with Incomplete Information," *Journal of Economic Theory*, 16(December), 167–207.

Wolf, Jason B. (2015) "Florida Homeowner Insurers Deluged by Assignment of Benefits Lawsuit," *Claims Journal*.

7. TABLES AND FIGURES

Table 1: Claims Descriptive Statistics

	Min	Mean	Median	Max	Std Dev
Loss Year	2002.00	2008.19	2005.00	2022.00	5.70
Net Coverage-A ($000s)	0.00	11.18	3.55	4100.76	28.97
Defense & Cost Containment ($000s)	0.00	0.53	0.00	550.53	3.86
Assignment of Benefits	0.00	0.01	0.00	1.00	0.12
Paid	0.00	0.68	1.00	1.00	0.47

NOTE: Table 1 provides descriptive statistics for 449,183 wind claims in the Citizens' data. *Loss Year* is the year of loss, *Net Coverage-A* is the coverage-A payment net of the deductible, *Defense & Cost Containment* is defense and cost containment, *Assignment of Benefits* is an indicator for an assignment-of-benefits claim, and *Paid* is an indicator for claims with *Net Coverage-A*> 0. The *Net-Coverage-A* and *Defense & Cost Containment* are measured in 2004 thousands of dollars.

Table 2: Descriptive Statistics

Panel A: All Irma Policies, N=61,912				
	Min	Mean	Median	Max
Age	10.00	24.30	25.00	40.00
Original Roof	0.00	0.55	1.00	1.00
Wind Claim	0.00	0.23	0.00	1.00
Tile	0.00	0.42	0.00	1.00
Panel B: Asphalt with Original Roof, N=18,340				
Age	10.00	17.00	16.00	30.00
Original Roof	1.00	1.00	1.00	1.00
Wind Claim	0.00	0.19	0.00	1.00
Panel C: Tile with Original Roof, N=15,949				
Age	20.00	27.70	27.00	40.00
Original Roof	0.00	0.62	1.00	1.00
Wind Claim	0.00	0.32	0.00	1.00

NOTE: Table 2 displays descriptive statistics for the policies active at the time of Hurricane Irma, September 19, 2017, covering single-family properties with asphalt or tile roofs. *Age* is the age of the property, *Original Roof* is an indicator for properties with the original roof, *Wind Claim* is an indicator for policies that file a wind claim related to Irma, and *Tile* is an indicator for tile roofs.

Table 3: Local Effects

	Panel A: Asphalt Roofs			
	Claim	Payment	Non-AOB	AOB
SameBlock	0.002	0.002*	0.000	0.000
	(0.002)	(0.001)	(0.000)	(0.000)
AgeLess30	0.002	0.002	−0.001	0.000
	(0.003)	(0.002)	(0.001)	(0.000)
SameBlock× AgeLess30	0.010**	0.007***	0.000	−0.000
	(0.004)	(0.003)	(0.000)	(0.000)
Num. obs.	13,344,932	13,344,932	13,344,932	13,344,932
R^2 (full model)	0.261	0.010	0.252	0.002
Block FE	552	552	552	552
	Panel B: Tile Roofs			
	Claim	Payment	Non-AOB	AOB
SameBlock	−0.006	−0.001	0.000	−0.001
	(0.004)	(0.003)	(0.001)	(0.000)
AgeLess30	0.037***	0.016**	0.005***	0.003***
	(0.008)	(0.006)	(0.002)	(0.001)
SameBlock × AgeLess30	0.022***	0.010***	0.001	0.003***
	(0.005)	(0.004)	(0.001)	(0.001)
N	4,789,927	4,789,927	4,789,927	4,789,927
R^2	0.062	0.012	0.033	0.011
Block FE	256	256	256	256

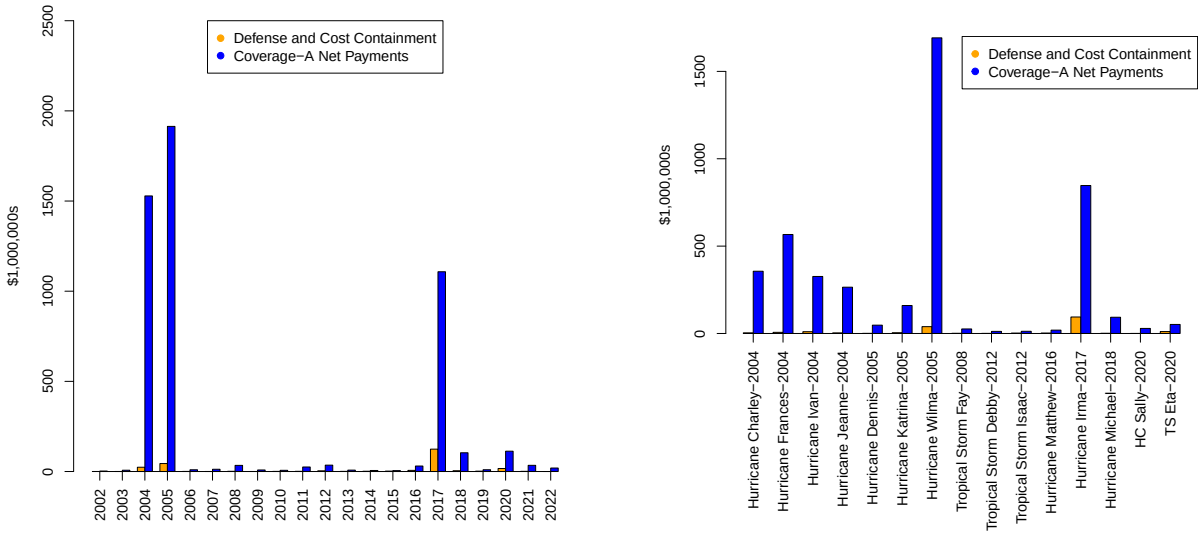
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$

NOTE: Table 3 displays regression results from the following regression for policy pair (i, j) in zip code z

$$Outcome_{ij} = \mu_z + \beta_1 \times SameBlock_{ij} + \beta_2 \times AgeLess30_{ij} + \beta_3 \times SameBlock_{ij} \times AgeLess30_{ij}$$

$SameBlock = 1$ if both policies are on the same block and $SameBlock = 0$ otherwise, $AgeLess30 = 1$ if both policies care less than 30-years-old and $AgeLess30 = 0$ otherwise. Panel A uses all pairs of active policies on properties with asphalt roofs. Panel B uses all pairs of active policies on properties with tile roofs. Both samples use 20-year-old to 40-year-old properties. Standard errors are two-way clustered at the zip code and age levels.

Figure 1: Wind Claims

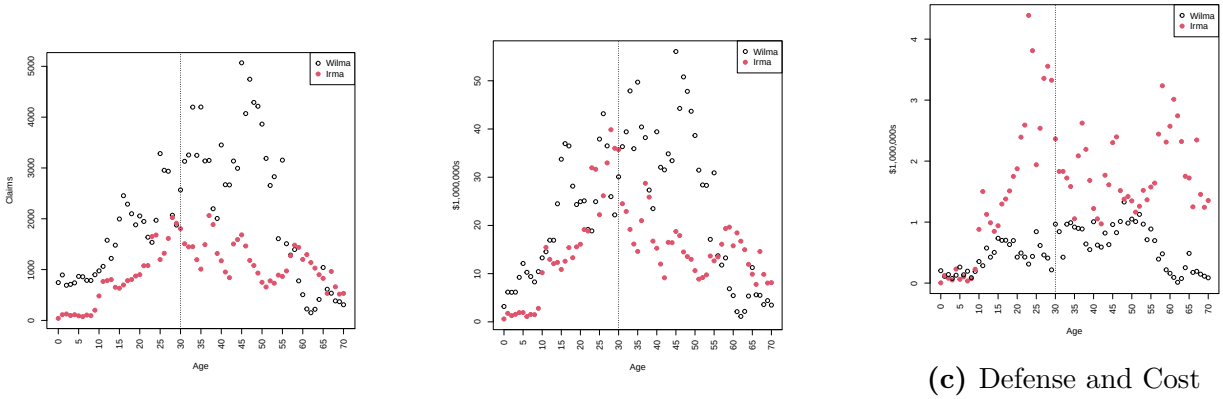


(a) Wind Claims by Year

(b) Wind Claims by Catastrophe

NOTE: Wilma 1 displays total Net Coverage-A and Defense and Cost Containment by year and catastrophe. Dollar amounts are in millions of 2004 dollars. All wind claims are used for calculations in Figure 1a. Only wind claims associated with catastrophes with more than 1,000 wind claims are used for calculation in Figure 1b.

Figure 2: Hurricane Wilma and Hurricane Irma Age Profiles

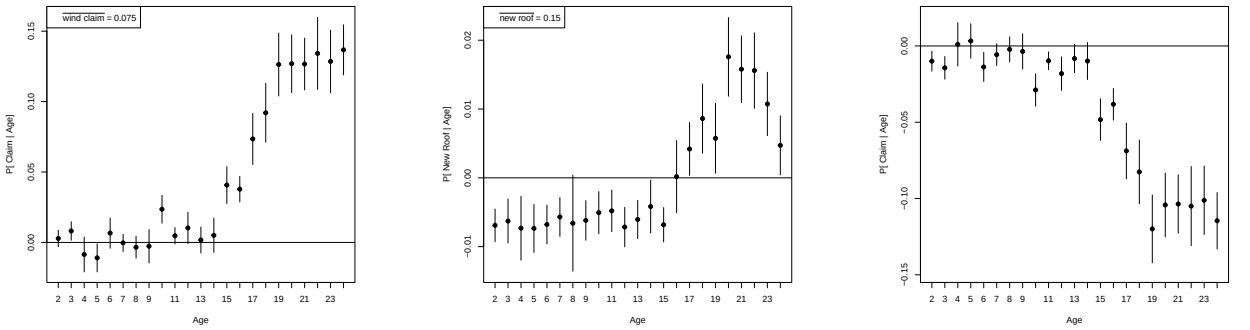


(a) Wind Claims **(b)** Net Coverage-A **(c)** Defense and Cost Containment

Figure 3: Defense and Cost Containment

NOTE: Figure 2 displays total claims, Net Coverage-A payments, and Defense and Cost Containment spending by age of the property for Hurricane Wilma and Hurricane Irma. Dollar amounts are in millions of 2004 dollars.

Figure 4: Hurricane Wilma and Hurricane Irma Asphalt Roofs, New Roofs



(a) Wilma **(b)** Irma **(c)** Differences-in-Differences

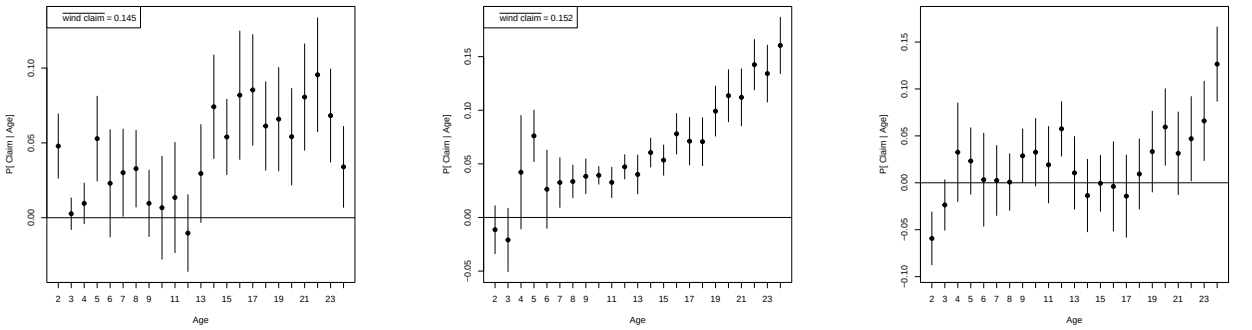
Figure 5: Defense and Cost Containment

NOTE: Figure 4 displays age coefficients form the following regression

$$NewRoof_{n,t} = \mu_{z(n),t} + \sum_{t=0,1} \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age,t} + u_{n,t}$$

Where $t = 0$ corresponds to Hurricane Irma policies and $t = 1$ corresponds to Hurricane Irma policies. Figure 5 is the difference $\hat{\Delta}_{Age} = \hat{\delta}_{Age,1} - \hat{\delta}_{Age,0}$. All standard errors are 95% sup-t standard errors.

Figure 6: Hurricane Wilma and Hurricane Irma Asphalt Roofs, Wind Claims



(a) Wilma **(b)** Irma **(c)** Differences-in-Differences

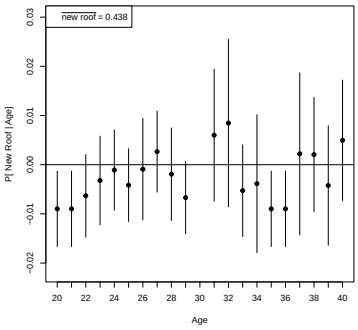
Figure 7: Defense and Cost Containment

NOTE: Figure 6 displays age coefficients form the following regression

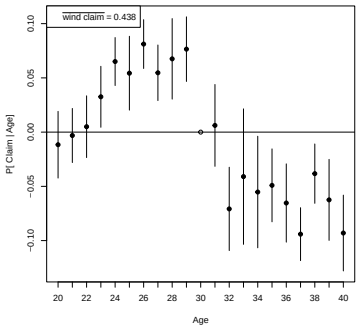
$$Claim_{n,t} = \mu_{z(n),t} + \sum_{t=0,1} \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age,t} + u_{n,t}$$

Where $t = 0$ corresponds to Hurricane Irma policies and $t = 1$ corresponds to Hurricane Irma policies. Figure 5 is the difference $\hat{\Delta}_{Age} = \hat{\delta}_{Age,1} - \hat{\delta}_{Age,0}$. All standard errors are 95% sup-t standard errors.

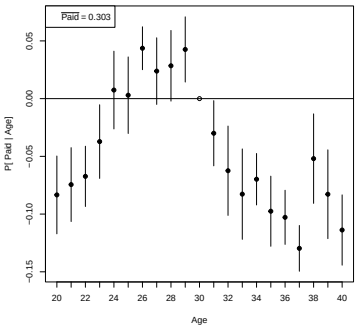
Figure 8: Hurricane Irma Tile Roofs



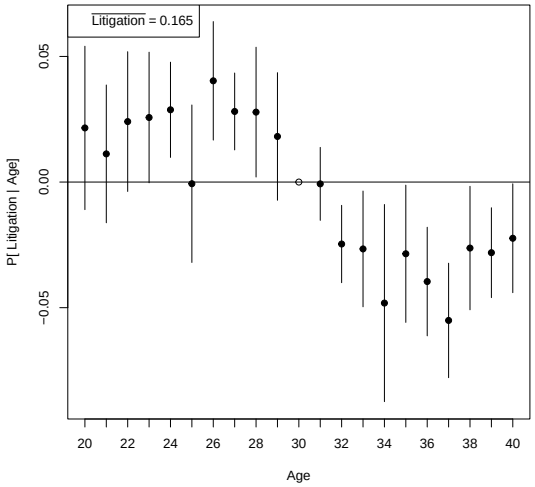
(a) New Roof



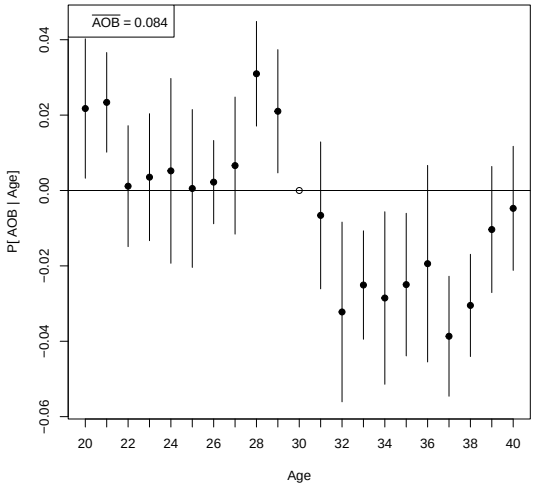
(b) Claim



(c) Paid



(d) Litigation



(e) Attorney

NOTE: Figure 8 displays age coefficients form the following regression

$$y_{n,t} = \mu_{z(n)} + \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age} + u_n$$

Where y_n is an indicator variable for new roofs, wind claims, paid claims, litigation from the insurer, and AOB. All standard errors are 95% sup-t standard errors.