Strategic Behavior in the Homeowners Insurance Market*

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Abstract: This paper investigates strategic behavior in filing home insurance claims following a severe weather event. Utilizing data from Citizens Insurance in Florida, we exploit variation in inspection probabilities by home age. We find that after Hurricane Irma, homes less likely to have an inspection were significantly more likely to file wind-related insurance claims. Evidence suggests the increase in claims is likely driven by third-party individuals, which indicates that fraud is driving our results. Our findings have implications for the financial stability of home insurance in regions vulnerable to extreme weather events.

Keywords: homeowners insurance; hurricanes; informational asymmetries; moral hazard; fraud; Florida; Citizens Insurance
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1. INTRODUCTION

The homeowners insurance market faces significant challenges stemming from asymmetric information, where policyholders often possess more detailed knowledge about the condition of their property than insurers. This imbalance creates market inefficiencies, driving up the cost of providing insurance and raising premiums for all policyholders, potentially limiting the availability and affordability of coverage (Borch, 1962; Arrow, 1963; Pauly, 1974; Rothschild and Stiglitz, 1976; Wilson, 1977; Shavall, 1979; Crocker and Snow, 1985; Arnott and Stiglitz, 1988; Chiappori and Salanie, 2000). These inefficiencies are compounded by moral hazard, as policyholders may exaggerate damages or strategically delay maintenance to coincide with events that increase the likelihood of filing a claim. For example, natural disasters, such as hurricanes, provide opportunities for policyholders to exploit insurers by claiming pre-existing damage or inflating the extent of losses. Insurers, in turn, face the difficult task of distinguishing legitimate claims from opportunistic behavior (Dionne and Gagne, 2001, 2002; Pao et al., 2014). The increasing frequency and severity of hurricanes, wildfires, and other natural disasters further complicates this distinction, amplifying both legitimate claims and opportunities for exploitation.[1] These dynamics pose significant challenges to the sustainability of homeowners insurance markets in regions increasingly vulnerable to climate risks.

These challenges are particularly evident in Florida, where the homeowners insurance market is under severe strain due to escalating costs. Since 2017, eleven insurance companies that previously offered property and casualty insurance in Florida have liquidated.[2] In July 2023, Farmer's Insurance and AAA Insurance announced they would no longer provide homeowners insurance in the state.[3] According to the Insurance Information Institute, insurance premiums in Florida increased by an average of 102% between 2021 and 2023.[4] While Florida's crisis has received considerable

[1]Homes in coastal regions typically have flood insurance, which is explored in a growing body of literature (Bin and Polasky, 2004; Bin and Landry, 2013; Blickle and Santos, 2022; Bradt et al., 2021; Collier et al., 2021; Gallagher, 2014; Kousky et al., 2018, 2020a; Wagner, 2022). Flood insurance constitutes a separate market with distinctive attributes that we do not consider in our analysis.

[2]https://www.wtsp.com/article/money/florida-home-insurance-cost-price-changes/67-3ddc6cee-e770-4049-8035-9e6c1529e8ad

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

[4]https://www.fox13news.com/news/florida-home-insurance-crisis-cost-price-premium-institute-

attention, similar challenges are emerging nationwide. In California, rising wildfire risks have driven insurers to reduce coverage and raise premiums. Louisiana and Colorado have seen increased reports of fraudulent claims following hurricanes and hailstorms, creating additional financial burdens for insurers and policyholders. Even states like Iowa and Minnesota, less traditionally associated with extreme weather, are grappling with rising costs due to frequent hailstorms, prompting insurers to adopt policies that shift more costs onto homeowners.

As premiums rise across the country, housing affordability is threatened, and the viability of the homeowners insurance market in some states is at risk. This paper examines the role of strategic behavior by homeowners and third in influencing claiming patterns, which escalate insurance costs. By exploring these dynamics, we shed light on a problem that, while currently most visible in Florida, has broader implications for insurance markets nationwide.

Two mechanisms illustrate how asymmetric information may contribute to the rising costs in homeowners insurance. First, ex ante moral hazard occurs when homeowners defer maintenance, particularly in regions prone to severe weather events. Homeowners may anticipate that a storm will damage their home, enabling them to file an insurance claim to cover repairs or upgrades (Laffont, 1995; Einav and Finkelstein, 2018; Konetzka et al., 2019). Prior research shows that the likelihood of deferring maintenance increases with the probability of a covered event (Mol et al., 2020). As extreme weather events become more frequent, this problem is likely to worsen.

Second, ex post moral hazard arises in excessive and potentially fraudulent claims. For example, some homeowners may use a storm as an opportunity to obtain a new roof at a reduced cost. Third parties, particularly roofing contractors, may exacerbate this issue by soliciting homeowners after a storm, claiming to see damage, and promising a "free roof" to the homeowner in exchange for signing an assignment of benefits (AOB) agreement. While the AOB allows the contractor to manage the claim, it also grants them the right to take legal action against the insurer without the homeowner's knowledge or approval. In Florida, "one-way" attorney fees - which required insurers to pay the policyholder's legal fees if any recovery was awarded - further amplified these incentive.[5] Consequently, both homeowners and third parties

rates

[5]One-way attorney fees were removed in the December 2022 special session of the legislature. This

benefit from filing excessive claims, driving up the cost of insurance.

To investigate the impact of asymmetric information on the homeowners insurance market, we exploit a plausibly exogenous change in information availability that created a discontinuity for homeowners insured through Citizens Insurance (the state-run insurer). Beginning in 2013, Citizens required all new applicants with homes over 30 years old to undergo a four-point inspection examining the roof, electrical, plumbing, and HVAC systems.[6] Existing policyholders with homes over 30 years old could be inspected at the insurers discretion, but no inspection was required for homes under 30 years old. This setup allows us to compare outcomes between homes just above and below the 30-year threshold, providing insights into how information affects claiming behavior.

Using data from Citizens Insurance, we analyze claim-filing behavior after Hurricane Irma in 2017, focusing on homes with original tile roofs due to their longer expected lifespan (30–50 years). We control for various home attributes — including roof shape, attachment type, wall material, and Florida Building Code compliance — and include zip code fixed effects to control for variation in storm intensity. Our findings reveal that homes aged 24–29 years are significantly more likely to file a claim compared to homes over 30 years old. Given that roof quality is expected to degrade smoothly over time, the sharp increase in the likelihood of filing a claim just before the 30-year mark strongly suggests that strategic behavior, likely driven by the anticipation of inspection requirements, is influencing these outcomes.

We estimate that this behavior imposes an additional cost of approximately $4,400 per policy on Citizens Insurance, resulting in an additional $50 million in Net Coverage A payouts for original tile roofs under 30 years old. To contextualize this, the total amount paid by Citizens Insurance for Net Coverage A claims for tile roofs in our sample is $270 million. Thus, Net Coverage A payments for these claims are approximately 18.5% higher than they would be in the absence of this strategic behavior. These findings underscore the substantial financial impact of opportunistic claiming on the homeowners insurance market, as this is just the cost borne by one insurer for one type of roof.

We also examine the mechanisms driving our results. First, we analyze the timing of claim filings. In the immediate aftermath of a storm, damage is typically obvious to

change only applies to new claims filed, not those filed prior to the law change.

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

homeowners, who are likely to file claims promptly to address issues. However, after the initial wave of repairs, roofing contractors may engage in the schemes described above to generate additional business. If third party involvement is a significant factor, we expect an increase in delayed claims. Indeed, we find that in 2017, immediately after Hurricane Irma, there was an increase in the likelihood of filing a claim for homes aged 28-31. Homes younger than 28 years were as likely or less likely to file a claim than homes aged 32 years. For claims filed in 2018 or later, however, homes under 30 years old were significantly more likely to file a claim. This delayed increase in claims strongly supports the argument that third party involvement drives to the observed patterns.

To further investigate the role of third parties, we stratify the sample based on whether the roof is Florida Building Code (FBC) compliant. Non-FBC-compliant roofs create incentives for homeowners to use storm damage claims to upgrade their roofs and qualify for insurance premium discounts. However, we find that non-FBC-compliant roofs exhibit the same claiming pattern across roof ages as the full sample, suggesting that compliance status alone does not explain our results. Instead, the findings point to external factors, such as third-party influence, as the primary driver. We also examine if the increase in claims is tied to the inspection itself or the anticipation of an inspection. Homeowners have perfect information about whether a four-point inspection is on file, whereas third parties do not. Third-parties, however, can infer the likelihood of an inspection based on home's age, which can be found through publicly available resources such as Zillow. We find that homes both with and without inspections follow the same trend: the likelihood of filing a claim increases up to age 30 and then declines. This pattern provides further evidence that third-party behavior is driving the observed patterns.

Finally, we address potential threats to the validity of our identification strategy. First, we consider whether homeowners systematically replace roofs at age 30, which might indicate that inspections address deferred maintenance rather than strategic behavior. We analyze roof replacement rates in two non-storm years, 2015 and 2016, and find that homes under 30 years old years are equally or less likely to undergo roof replacement compared to homes over 30 years old. Second, we examine whether changes in building codes could explain our results. While Florida implemented stricter building codes in 1994, corresponding to the 23-year mark in our sample, these changes would not account for the observed increase in claims at the 30-year threshold.

Moreover, we analyze structural characteristics - such as the wall material (masonry or frame), roof attachment type (clip, toe nail, or single wrap), and roof shape (gable or not) - and find no systematic changes in these attributes that could explain our results. Lastly, we assess the potential for sample selection bias, where lower-quality homes may be more likely to select Citizens Insurance. Since our identification strategy relies on age comparisons, sample selection would only bias our results if the quality of homes systematically varied with age. We find no such evidence of a correlation, indicating that sample selection is unlikely to bias our estimates.

We contribute to two key strands of the literature. First, we add to the literature on fraudulent claim filing and moral hazard in insurance markets. Prior research shows that higher deductibles increase reported losses, while full replacement cost insurance raises the incidence of reported thefts near the end of coverage (Dionne and Gagne, 2001, 2002; Dionne and Wang, 2013).[7] Strategic behavior has been identified in other contexts, such as vehicle theft reporting in Taiwan after typhoons (Pao et al., 2014). Our analysis identifies a novel form of strategic behavior in homeowners insurance: the exploitation of inspection timings, which increases inefficiencies and drives up costs.[8] We provide evidence that this behavior imposes substantial financial burdens on insurers, translating into higher premiums and reduced affordability for homeowners.

Second, we contribute to the growing body of literature on the impact of climate change and extreme weather events on real estate markets and homeowners insurance. Previous studies how perceptions of climate risks influence house prices and residential sorting (Bakkensen and Barrage, 2022; Baldauf et al., 2020; Bernstein et al., 2019, 2020; Gibson and Mullins, 2020; Giglio et al., 2021; Keys and Mulder, 2020; Murfin and Spiegel, 2020), as well as the effects of natural disasters on household debt and mortgage markets (An et al., 2023; Billings et al., 2019; Biswas et al., 2023; Gallagher and Hartley, 2017; Kousky et al., 2020b; LaCour-Little et al., 2024; Ouazad and Kahn, 2022; Sastry et al., 2024). While flood insurance has received significant attention (Blickle and Santos, 2022; Bradt et al., 2021; Collier et al., 2021; Gallagher, 2014; Kousky et al., 2018, 2020a; Wagner, 2022), less focus has been placed on homeown-

[7]Other work explores policy auditing, fraud detection methods, and the importance of trust (Artís et al., 2002; Debener et al., 2023; Dionne et al., 2009; Farbmacher et al., 2022; Gennaioli et al., 2022; Van Vlasselaer et al., 2017).

[8]Dunn et al. (2024) examined how insurance friction costs impact doctors, patients, and access to health care.

ers insurance specifically, despite its critical role in protecting property owners from financial losses (Boomhower et al., 2023; Ge et al., 2022). Our study fills this gap by demonstrating how extreme weather events exacerbate ex post moral hazard in the homeowners insurance market, creating inefficiencies that threaten the financial stability of both homeowners and homeowners insurance providers.

2. BACKGROUND INFORMATION

2.1. The Homeowners Insurance Market in Florida

Citizens Property Insurance Corporation, more commonly known as Citizens Insurance, was established in 2002 by the Florida legislature. Its primary purpose is to provide affordable homeowners insurance to homeowners in Florida who are unable to obtain reasonably priced coverage in the private market. The need for a state-run insurance company arose after several hurricanes in the 1990s, most notably Hurricane Andrew, which led many private insurers to either leave the state or to significantly increase their premiums. Citizens is intended to serve the residual insurance market and is often referred to as the "insurer of last resort."

As the private home insurance market has become additionally stressed in Florida, more homeowners have turned to Citizens for coverage. Since 2017, eleven insurers have liquidated, and many others have stopped offering coverage in the state.[9] In 2017, approximately 500,000 homes were covered by Citizens Insurance. By the end of 2023, this number had surged to 1.22 million homes.[10] This dramatic increase has placed a strain on the financial stability of Citizens Insurance.

Several arguments have been made regarding why private insurers have been exiting the Florida homeowners insurance market. One of the most commonly cited reasons is the rising frequency of extreme weather events. This relates to concerns regarding living in certain regions of the country that are most exposed to these events, as the costs to live in these areas continues to rise (Bernstein et al., 2019; Boomhower et al., 2023; Ge et al., 2022; Sastry, 2022). However, others argue that the litigious nature of the state is further exacerbating the problem. Governor DeSantis noted in

[9]Sastry et al. (2024) examine the impact of insurers exiting the market on homeowners and the mortgage market in Florida.

[10]https:https://www.theinsurer.com/news/citizens-ends-2023-with-pif-down-13-from-september-peak/

2022 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.[11] These challenges underscore the complex dynamics at play in Florida's insurance landscape.

As insurance claims have increased over the last several decades, Citizens Insurance and other insurers have taken steps to mitigate asymmetric information between insurer and insured. Starting in 2013, Citizens required an extensive four-point inspection for all new policy holders with homes over 30 years. This policy required a thorough examination of the roof, HVAC, plumbing, and electrical systems, allowing Citizens to assess their quality and require repairs before providing insurance. For existing policies, Citizens can request a four-point inspection if a home is over 30 years old. New policyholders are responsible for obtaining and paying for the inspection, whereas if Citizens requests an inspection for an existing policy, the homeowner is not responsible for the inspection cost. As a result of this policy change, some covered homes over 30 years old have a four-point inspection on file, but not every house. Citizens does not mandate inspections for homes under 30 years.[12]

2.2. The Legal Environment in Florida

Florida's insurance market has several features that may result in third-party involvement leading to excessive or fraudulent claims. First, Florida has an assignment-of-benefits system (AOB), which allows a policyholder to transfer claim management rights to a third party. While one might think that such a system can enhance efficiency, as specialists can manage many claims versus each individual handling one claim periodically, it may be contributing to the issues in Florida. Specifically, many believe that roofers exploit the AOB system by first obtaining rights and then performing repairs unrelated to the weather event or creating damage where none occurred. If the claim is denied, the roofer files a lawsuit against the insurer to recover costs - possibly without the homeowner's knowledge.

Another feature of Florida's legal system that may contribute to the situation is the one-way fee structure of legal fees. Under this system, insurers must pay the

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

[12] In 2022, Citizens adjusted their inspection policy, now requiring homes to have a four-point inspection at the 20-year mark. Given the sample period of our data, the 20-year inspection policy will not impact our analysis.

plaintiff's legal fees, even if a claim is settled out of court; however, plaintiffs are never required to pay the insurer's legal fees. Furthermore, insurers face a difficult task of proving in court that a hurricane did not contribute to the damage unless they possess documentation on the roof's quality prior to the storm. Without such evidence, insurers struggle with causation, especially when faced with claims related to storm damage. This documentation gap makes it challenging to dispute claims effectively, often leading to settlements even when claims might be inflated or fraudulent.

The AOB system and the one-way fee structure may inadvertently encourage lawyers and roofers to collaborate and file unnecessary or incorrectly attributed claims. Lawyers often stand to gain substantially from such cases as legal fees may surpass the claim amount. This creates a perverse incentive for legal professionals to take on dubious cases, knowing that the insurers are likely to settle to avoid the high costs of litigation. This dynamic may exacerbate the frequency of claims and increase the financial burden on insurance companies, further destabilizing the market.[13]

3. TRENDS IN CLAIMING BEHAVIOR

Figure 1 displays Net Coverage-A payments and Defense and Cost Containment (DCC) by catastrophe, adjusted to 2004 dollars. Net Coverage-A payments refer to the funds distributed by the insurer to repair damage to the physical structure of houses minus any deductible. DCC encompasses all expenditures by Citizens Insurance for litigation against disputed insurance claims. We restrict the sample to catastrophes with 1,000 or more wind claims to concentrate on the most destructive storms. Among these storms, Hurricane Wilma was the most costly storm for Citizens, followed by Hurricane Irma.[14] Despite Hurricane Wilma incurring nearly double

[13]In December of 2022, a special session of the Florida legislature convened to address the challenges in the homeowners insurance market. Two notable changes emerged from this new legislation, which was signed into law by Governor DeSantis. First, the AOB system was effectively eliminated in the home insurance market. Second, the law removed the one-way attorney fees. Going forward, the homeowner who brings suit will be responsible for covering his attorney fees. While many anticipate that this policy change will significantly impact on the number of lawsuits, according to the Insurance Information Institute, approximately 300,000 lawsuits were filed before the law took effect and are still progressing through the system. Although this specific law change does not directly affect our analysis due to our sample period, it is expected to have broad implications on the market - a topic for future research.

[14]It is important to note that our sample includes only claims through Citizens Insurance. Consequently, these cost measures are affected by the location of policyholders and where the storm was most destructive. For instance, Citizens Insurance has a limited number of policies in the

the Net Coverage-A payments compared to Hurricane Irma, the DCC expenditures for Hurricane Irma were more than twice those of Hurricane Wilma.

Figure 2 presents wind claims, Net Coverage-A payments, and DCC expenditures by property age for Hurricanes Wilma and Irma. These storms are highlighted because Hurricane Wilma was the most costly storm before the four-point inspection policy change and Hurricane Irma was the most costly storm after the change. As shown in Figure 2a, Hurricane Wilma generally had more claims than Hurricane Irma, with older homes filing more claims. For Hurricane Wilma, the number of claims by house age increases up to approximately 45 years, after which it declines. This pattern is consistent with our expectations, as older homes are more likely to file a claim due to normal structural wear. However, once homes reach a certain age, major renovations and repairs have likely taken place, reducing the likelihood of filing a claim. In contrast, for Hurricane Irma, there is an increase in the likelihood of filing a claim up to age 30, followed by a plateau and a slight decrease in the number of claims.

Figure 2b depicts the age profile of Net Coverage-A payments for Hurricane Wilma, which exhibits a pattern similar to the claim profile in Figure 2a. In contrast, the Net Coverage-A payments for Hurricane Irma are highest for properties aged 25 to 30 years, then drops off dramatically. These figures suggest that, prior to the policy change, claiming behavior and the amount of Net-Coverage A payouts generally increased with the property's age, as expected due to normal depreciation. For the storm occurring after the 2013 inspection policy change, there is a notable spike in claims filed and Net Coverage-A payouts prior to age 30. Given the improvements in building standards and methods that should render newer homes less susceptible to hurricane damage, this decline in the peak age for filing a claim, as well as the amount of Net Coverage-A payouts, seems unlikely to be caused solely by normal depreciation.

We next consider how DCC varies across these two storms, as illustrated in Figure 2c. For Hurricane Wilma, we observe a relatively consistent amount of spending across homes aged 15 to 55 years. In contrast, Hurricane Irma exhibits a notable spike in spending for homes under 30 years old, which drops off for homes over 30. This figure suggests that after the policy change, Citizens was more likely to litigate against claims filed for homes under 30 years old. This trend indicates that Citizens may

Florida Panhandle, where Hurricane Michael made landfall. Thus, while Hurricane Michael was not particularly costly for Citizens, it may have been for other insurers.

have suspected that the claims were not valid for these newer homes.

The patterns observed in Figure 2 are based on the total number of claims, payouts, and DCC spending. One explanation for these patterns is that Citizens Insurance covered more homes aged 25 to 30 when Hurricane Irma struck than for Hurricane Wilma, resulting in more claims for homes of that age range. To address this concern, we normalize these figures by the number of homes insured at each age in Figure 3. Now, Figure 3b presents the likelihood of filing a claim at each house age, Figure 3a shows the Net Coverage-A payouts per policy at each house age, and 3c illustrates the DCC spending per policy at each house age.

Overall, we observe a similar pattern in Figure 3 as we did in Figure 2. For Hurricane Wilma, there is an increase in each variable until around age 20, which then levels off for older homes. In contrast, for Hurricane Irma, each variable increases until reaching a peak around age 25, followed by a noticeable decrease in the likelihood of filing a claim, the Net Coverage-A payouts per policy, and DCC spending per policy. This suggests that the patterns observed in Figure 2 are not driven by Citizens insuring more homes aged 20-30 years, but are more likely driven by another factor.

4. DATA

4.1. Claims

The primary dataset used for our analysis was obtained from Citizens Insurance in Florida. The dataset includes information on all claims and policies through Citizens Insurance from January 1, 2002 to June 30, 2022. Over this 20-year period, there are 1,084,898 total claims, with 449,183 claims related to wind damage. Wind damage is the most frequent cause of loss in our sample, followed by non-weather-related water damage with 318,152 claims. The claims data includes detailed information including the date the claim was filed, the amount of the payout by the insurance company, legal expenses paid by the insurer, legal representation of the insured, and whether there was a specific cause of the damage (e.g., Hurricane Irma). Note that our data includes the amount paid by Citizens Insurance but not the amount of damages claimed by the homeowner. In other words, we know how much the insurer paid out, but we do not know how much the homeowner requested when the claim was originally filed.

The dataset also includes information on Net Coverage-A payments, which is the

amount paid by the insurer for the claim net of the deductible. Coverage-A insures damage to the structure of the house, which is the focus of our analysis.[15] For wind claims, Coverage-A payments represent 90.1% of the total indemnity paid. We classify a claim as being paid if Net Coverage-A>0, indicating that some portion of the claim above the deductible was paid. We also have information on the policy effective date, which is the start date of the policy for that year, as well as the policy cancellation or assumption date, if any.

The dataset includes information on Defense and Cost Containment (DCC). DCC refers to the legal expenses incurred by the insurer for litigation, defense, and cost containment that are internal to the insurer. In other words, this is the amount that Citizens Insurance pays its own lawyers to litigate. If Citizens Insurance is required to cover the legal expenses of the insured, due to the one-way fee structure of attorney fees in Florida during our sample period, that information is reported separately in our data.

Table 1 provides descriptive statistics for the wind claims that are the focus of our analysis. Specifically, our sample includes original tile roofs aged 20 to 40 years. All dollar amounts are in 2004 dollars. The median amount paid per claim for Net Coverage-A expenses is \$30,524, but the distribution is heavily skewed to the right, with a mean of \$33,541 and a maximum of \$531,615. DCC expenses are also right skewed, with a mean of \$4,653 and a maximum of \$95,062. Additionally, the insurer pays some portion of the claim on 67% of wind claims that are filed. It is important to note that since we do not know how much is claimed by the homeowner, we do not know what percentage of a claim was paid. The main reason a claim is filed but not paid is that the insurance company determines that the amount of damage is below the deductible. Often, the main issue to resolve between the insurer and the policyholder is the cost to repair the damage, not whether the damage occurred.

[15] Coverage-B protects other structures that are not attached to the house, such as a detached garage or a fence. Coverage-C insures damage to personal property within the house, and Coverage-D covers temporary living expenses, such as a hotel, that are necessary for the homeowner to maintain a normal living standard while the home is repaired. Coverage-E provides personal liability coverage and Coverage-F is for medical expenses.

4.2. Properties

We also obtain data on the properties underlying each policy. We limit our analysis to active policies at the time of Hurricane Irma, one of the most costly hurricanes in our sample, which also occurred after the 2013 policy change regarding four-point inspections. The dataset contains a variety of information on the property, including property type (e.g. single family detached or condo), construction year, roof material (e.g., clay, tile, asphalt), roof shape (gable or not), roof attachment type (single wrap, clip, toenail, or other), wall material (wood or concrete), whether the roof meets FBC standards, and roof replacement date, if any. We calculate the age of the property using the construction year of the property, assuming for simplicity that all properties are constructed on January 1 of the construction year.

We limit our sample to single-family homes, thus excluding condominiums, mobile homes, and multifamily properties. Additionally, we restrict our sample to properties with *tile roofs*: roofs made with tile, clay, slate, or concrete materials. We exclude roofs that are asphalt, fiberglass, or composition shingles because the expected lifespan of a roof made with one of these materials is 15-20 years. Moreover, Citizens requires the shingles of asphalt roofs to be inspected when they reach 25 years of age. Given that the expected roof life is 15-20 years and a shingle inspection occurs at age 25, we find in our data that nearly all asphalt roofs are replaced before the 30-year inspection. We also exclude properties with wooden, tar/gravel, or metal roofing.

Our empirical analysis focuses on tile roofs because their expected life is 30-50 years, suggesting that at 30 years, a roof may or may not have reached the end of its useful life. Our dataset contains 25,495 observations of policies that were active at the time of Hurricane Irma and had a tile roof. Note that we are unable to create an equivalent dataset for Hurricane Wilma, the most costly storm during our sample period, because Citizens Insurance did not insure any tile roofs until 2009. Hurricane Irma was the first major storm to hit Florida after the 2013 inspection requirement went into effect. Therefore, our analysis focuses solely on Hurricane Irma.

In our main analysis, we further restrict our sample to original tile roofs to remove any bias that could arise from roofs that had been replaced or instances where an owner replaced an asphalt roof with a tile roof. This further reduces our sample to 15,728 observations. We define a policy as having an original roof if the year of roof replacement is missing. There is a concern that the roof replacement data may have

measurement error, as this is self-reported by individuals who may or may not have been the occupants when the roof was replaced. We address 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, removing less than 0.1% of the sample. Second, our primary analysis focuses on roofs that are 20 years old to 40 years old and were active at the time of Hurricane Irma. We exclude any properties that are older than 40 years as these properties are less likely to have their original roof. Any remaining measurement error in the roof replacement field is likely random and would bias our results towards finding no effect.

Our data set has extensive information regarding the characteristics of the roof - specifically, whether the roof meets Florida Building Code (FBC) requirements, its attachment type (clip, single wrap, or toenail), the material of the walls (masonry or frame), and whether the roof is a gable-shaped roof. Unfortunately, one or more of these characteristics are listed as unknown in approximately 15% of our sample. We believe these characteristics are important to include as control variables for our analysis, and therefore we exclude any observations where one or more of these attributes is listed as unknown. This reduces our sample to 13,390 observations, which is the final sample size used in our analysis.[16]

Summary statistics on the properties in our final sample are presented in Table 2. We see that the average age of our sample is 25 years old, indicating the homes tend to be younger. Of all the homes in our sample, approximately 37% file a claim after Hurricane Irma. Only about one-third of homes meet FBC standards. The majority of roofs are attached via single wrap, then clip. Approximately 72% of roofs are gable shaped and the vast majority, 96%, have masonry or concrete walls.

5. METHODOLOGY

Our main analysis examines if there is a discontinuity in the likelihood of filing a wind related claim prior to age 30. We test for if a discontinuity occurs at $t = 32$ by estimating:

[16] We have run regressions including these observations where one of the control variables is unknown and the results are similar to those presented below. These results are available from the authors upon request

$$Claim_n = \mu_{z(n)} + \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age} + \gamma x_{n,t} + u_n \quad (1)$$

$I(Age(n) = Age)$ is an indicator variable equal to one if property n is age Age at the time of Hurricane Irma and equals zero otherwise.

where the dependent variable, $Claim_n$, is an indicator variable for if policy n files a wind-related claim. $\delta_{Age(n),t}$ is the age-specific effect on roof replacement at time t, normalized to $\delta_{A32,0} = 0$. This normalization means that our estimates are relative to age 32, allowing us to test if the observed probability of a roof replacement at each age is significantly different from the likelihood of replacing a roof at age 32. We use age 32 as our comparison year because the policy applies to all homes over 30 years old, which leaves some ambiguity regarding if 30 year old homes need to be inspected. In addition, while we know if there was an inspection we do not know the exact date, leaving some questions regarding if a 31 year old house has been inspected. For homes that are 32 years old, however, there is no uncertainty regarding whether or not the home is subject to the policy. Since our estimation strategy compares the likelihood of a roof replacement relative to age 32, selecting another house age will not impact the pattern of results. Our analysis tests for a systematic difference in the likelihood of filing a claim at different roof ages, which allows us to determine if information deferentially impacts claiming behavior before and after the four-point inspection may have occurred.

The vector $x_{n,t}$ includes controls for roof shape (gable or not), whether or not the roof meets Florida Building Code (FBC) standards, roof attachment method (clip, single wrap, or toenail), and wall type (masonry or frame). $\mu_{z(n),t}$ represent zip code fixed effects which control for any unobserved location-specific effects. The year-by-zip code fixed effects control for any hurricane-specific damage in zip code z. This allows us to address concerns that different zip codes may be more or less affected by the hurricane and that this may be correlated with the age of the home. Such a correlation would bias our estimates of the impact of a hurricane on claiming behavior. Finer geographic controls yield near-identical results as wind intensity varies across zip codes but does not vary significantly within zip codes. Furthermore, we assume that construction quality, beyond the control variables included, is controlled for using

the zip code fixed effects. u_n collects all remaining unobservables.

The age-of-home fixed effects, $\delta_{Age,t}$, capture age-of-home related claiming behavior. As the roof ages, and if policyholders do not engage in any strategic behavior, we expect $\delta_{Age} \leq \delta_{Age+1}$. In other words, if there is normal depreciation of the roof, the likelihood of filing a roof-related claim will increase with the age of the roof absent any external factors.

6. RESULTS

6.1. Impact of Hurricane Irma on Claim Filing

Next, we estimate the likelihood of filing a Hurricane Irma-related claim by estimating Equation 1. Figure 4 presents the likelihood of filing a Hurricane Irma-related claim based on the age of the house. Note that we use age 32 as the reference year, meaning that all reported coefficients are relative to the average 32 year old house. Our analysis reveals that homes under the age of 30, specifically those aged 24-29, exhibit a higher likelihood of filling a Hurricane Irma-related claim compared to homes that are 32 years old. Conversely, homes that are 32 years or older are equally likely to file a Hurricane Irma-related claim. These results include control variables for characteristics of the home, such as the shape of the roof and the attachment method, as well as location fixed effects. The location fixed effects control for the possibility that areas with homes under 30 years old coincidentally experienced stronger winds from Hurricane Irma.

Note that all roofs in our sample are original tile roofs. Assuming that deterioration progresses smoothly over time, one would expect the likelihood of experiencing damage - and thus the likelihood of filing a claim - to increase with the roof's age. It is plausible that a homeowner in Florida might delay replacing a worn roof because the chance of a hurricane is sufficiently high, and the subsequent insurance claim allows the homeowner to replace the roof at a reduced cost. If deferred maintenance occurs, it would likely affect all homes in our sample similarly or at an increasing rate as the likelihood of needing a new roof increases with the age of the home. Therefore, since our estimates are relative to roofs aged 32 years, we cannot rule out the possibly of deferred maintenance in our sample. However, deferred maintenance does not explain the spike in claiming at age 24-29 if depreciation evolves smoothly with the age of

the roof.

The observed pattern in Figure 4 suggests the presence of strategic behavior. Homes aged 32 and older may or may not have had a recent home inspection. Therefore, the increased likelihood of filing a claim for homes that are under age 30, and have not had an inspection recently but may soon, suggests there is strategic behavior present. This strategic behavior could be due to homeowners anticipating the upcoming inspection or third party individuals engaging in fraudulent schemes selecting homes that are less likely to have an inspection on file.

6.1.1. Estimated Cost of Strategic Behavior

We next estimate the financial impact of the strategic claiming behavior observed for homes under 30 years old on Citizens Insurance. Consider these summary statistics regarding the observed claiming behavior of homes 32 years old and older compared to those under 30. Table 3 shows that the probability of filing a claim after Hurricane Irma is approximately 20% for homes 32 and older, whereas it is around 38% for homes aged 29 and younger. Additionally, the average Net Coverage-A claim amount per policy is $5,740 for homes aged 32 and older while it is approximately $13,182 for homes aged 29 and younger. A similar difference is observed for the average amount of Net Coverage-A, conditional on filing a claim, with values of $28,733 and $34,621, respectively. The discrepancy in DCC expenses is also notable. The average DCC per policy is approximately $479 for homes 32 and older but rises to approximately $1,709 for homes 29 and younger. Conditional on filing a claim, these averages increase to $2,371 and $4,479, respectively. The total amount spent on Net Coverage-A and DCC for homes over 32 is $6,219 per policy and $31,105 per claim, increasing to $14,891 per policy and $39,100 per claim for homes 29 and younger.

We posit that the homes aged 32 and older represent a baseline for claiming behavior in the absence of strategic behavior. However, we acknowledge that homes have varying attributes that affect the likelihood and cost of damage. Such differences could explain the observed discrepancies in Table 3. To isolate the impact of strategic behavior, we use homes aged 32 and older to estimate the effect of home attributes on the likelihood of filing a claim, the amount paid, and the amount spent on DCC. We include zip code fixed effects and characteristics such as square footage, FBC compliance status, wall material, roof attachment type, and roof shape as controls.

Using these coefficients, we predict the likelihood of filing a claim, the Net Coverage-A amount paid, and DCC spending for homes aged 29 and younger.

As shown in Table 3, the predicted values for homes 29 and younger are significantly lower than the actual values. The predicted probability of filing a claim is reduced to 27%. The total amount spent on Net Coverage-A is predicted to be $9,908 per policy or $12,289 per claim. The predicted amount spent on DCC per policy is more than halved to $827 and is almost a quarter of the observed amount per claim filed at $922.77. The predicted total amount spent on Net Coverage-A and DCC per policy is $10,463 and is $13,211 per claim filed. Overall, we estimate that for each policy, the difference between the actual and predicted amounts of Net Coverage-A payouts and DCC spending - reflecting the inefficiencies from the strategic behavior - is approximately $4,400 per policy. This suggests the total cost of the strategic behavior, likely due to involvement by third parties, for original tile roofs is approximately $50 million for Citizens Insurance. Given that the amount spent on tile roof Coverage A claims was approximately $270 million, this suggests that Citizens paid 18.5% more than they likely would have in the absence of any strategic behavior. Additionally, note that conditional on filing a claim, the difference between the observed and predicted values is approximately $26,000. Overall, we estimate that there are substantial costs to Citizens Insurance due to the the additional claims and legal expenses incurred due to strategic behavior.

6.2. Likelihood of a New Roof in Non-Storm Years

An alternative explanation for our results is that the expected life of a roof is around 25-30 years. If this is true, then focusing on the 30-year inspection is problematic as we expect that the majority of roofs just under age 30 should have been replaced already. Therefore, we examine the likelihood of replacing an original tile roof based on its age in the absence of a severe weather event.

To determine if there is a discontinuity in the likelihood of replacing a roof near 30 years old in the absence of a severe weather event, we focus on the probability of replacing a roof in 2015 or 2016 – two years when there were no severe weather events in Florida. For these two years, we estimate the following using the original-and-replaced sample:

$$NewRoof_{n,t} = \sum_{t=0,1} \sum_{Age \in \mathcal{A}} I(Age(n) = Age) \times \delta_{Age,t} + \gamma x_{n,t} + \mu_{z(n),t} + u_{n,t} \quad (2)$$

In Equation 2, *NewRoof* is an indicator variable which equals one if property n has a roof replacement in either $t = 2015$ or 2016 and equals zero otherwise. All other variables are defined as they were previously. Note that in the absence of the storm, we expect $\delta_{Age,t}$, the age of home fixed effects, to increase with the age of the roof.

These results are presented in Figure 9 which displays results using all roofs that had not been replaced in 2015. This figure presents the likelihood of having a roof replacement at each age in the age profile, relative to age 32. Note that these new roofs are unlikely to have been replaced through an insurance claim, as there were not any severe storms during these years. Instead, this measure reflects individuals who replaced their roofs in that year, most likely at their own expense.

As depicted in Figure 9, there is no discernible pattern in the likelihood of replacing an original tile roof relative to age 32. While there are instances where the likelihood of replacing the roof is statistically lower than at 32 years, specifically for younger homes, the difference in the likelihood of a replacement is less than 2%, indicating a small and economically insignificant impact. Overall, Figure 9 supports our argument that tile roofs in our sample do not exhibit a systematic need for replacement at age 30. Additionally, there is no clear trend indicating that the likelihood of roof replacement increases with the age of the house, suggesting that roof replacements at 20 to 40 years old are likely to be random.

7. MECHANISMS

In the previous section, we identified a pattern of increased filing of Hurricane Irma-related claims for homes aged 24-29 years compared to those aged 32 years. These homes have not yet undergone, but may soon be subject to, a four-point inspection by Citizens. In this section, we explore the mechanisms that may be driving this pattern. Specifically, we examine if the observed patterns are due to a moral hazard problem with the homeowners, or if it is likely that third parties are involved which is likely to be fraud.

7.1. Timing of Claim Filing

To investigate whether the observed effects are driven by homeowners or third parties, we analyze the likelihood of filing a Hurricane Irma claim in 2017 compared to in 2018 or later. Florida's statute of limitations on insurance claims allows for the possibility that damage is not immediately obvious. If roof damage is recognized with a delay, we do not believe this is correlated with the age of the house. Specifically, we do not expect the likelihood of filing a delayed claim to change discontinuously at age 30. However, if roofers and lawyers are engaging in the schemes described earlier, such claims are likely to be filed with a delay. Immediately following a hurricane, contractors are occupied with repairs. As time progresses and the damages are repaired, contractors may seek additional work, potentially engaging in the schemes mentioned earlier. Therefore, we reestimate Equation 1, stratified by when the claim is filed - whether it was filed in 2017, immediately after Hurricane Irma, or with a delay in 2018 or later.

Figure 7 presents the results for the likelihood of filing a Hurricane Irma claim in 2017. Homes aged 28, 29, and 31 have a slightly higher likelihood of filing a claim than homes that are aged 32, while the likelihood for all other ages is approximately the same or lower. This suggests that immediately after the storm, homes near the 30-year cutoff are more likely to file a claim, possibly driven by homeowners aware of their roof's normal wear and seeking to file a claim before a potential 30-year inspection.

When examining the likelihood of filing a claim in 2018 or later, Figure 8 shows that homes under 30 years old are significantly more likely to file a Hurricane Irma related claim than 32-year-old homes. Homes older than 30 years are approximately as likely to file a claim as 32-year-old homes. Note that these dates are based on when the claim was filed, not when the repairs were completed. While it is plausible that younger homes were less damaged and thus were repaired later, there is no reason to expect homeowners to delay filing the insurance claims and starting that reimbursement process. Therefore, involvement by third parties, such as roofers and lawyers, are more likely driving these results.

7.2. Florida Building Code Compliant

To further justify our argument that third parties are driving the results, we stratify our sample based on whether or not the roof meets the Florida Building Code (FBC) requirements. Homeowners whose roofs do not meet FBC standards have an incentive to claim storm damage to upgrade their roof quality. This is particularly relevant as most insurance companies, including Citizens Insurance, offer premium discounts if the roof meets FBC standards. Therefore, following a storm, homeowners with a non-FBC compliant roof may be motivated to seek roof upgrades to qualify for these discounts.

Figure 5 presents the results for FBC compliant and non-FBC compliant properties. If non-FBC compliance contributes to storm damage, we would expect a similar likelihood of filing a claim regardless of the home's age. Furthermore, if homeowners are leveraging storms to upgrade to FBC compliant roofs, this behavior also should not vary with the home's age. However, if third parties are involved and targeting homes that are less likely to have a four-point inspection, we would observe a concentration of claim filings among homes aged 24-29, similar to our baseline results.

As we can see in Figure 5, the pattern for non-FBC compliant roofs is similar to our main results. Specifically, homes just under the 30-year mark are significantly more likely to file a claim compared to 32-year-old homes. Homes over 30 years old show a similar likelihood of filing claims as 32-year-old homes. While it is expected that non-FBC compliant roofs are more susceptible to hurricane damage, the spike in claim filings just before the 30-year mark is suspect. This pattern suggests strategic behavior near the 30-year inspection cutoff, possibly involving third parties. If homeowners were acting independently, we would expect a similar pattern across all non-FBC compliant homes. Note that no pattern is observed for FBC compliant homes.

7.3. Four-Point Inspection on File

To further support our argument that the observed spike in claiming for homes is due to the influence of third parties, we consider the differences in the information available to each group. Specifically, we examine data on whether a four-point inspection is on file with Citizens Insurance. Homeowners, who are responsible for submitting

the inspection, have perfect information on whether the insurer has a four-point inspection for the property. In contrast, third parties can determine the home's age through online resources such as Zillow but are typically unaware of the true inspection status. If homeowners are engaging in the strategic behavior, having a four-point inspection on file would deter them from filing an exaggerated or unnecessary claim, as they know the home's condition is documented. Conversely, the third parties, not knowing whether a home has been inspected, is likely to target homes under 30 years old, since they are less likely to have been inspected compared to those 30 years or older. Therefore, the age of the home might be a critical factor for third parties involved in fraudulent schemes. We examine whether the presence of an inspection or the age of the home is more influential in driving the increase in claims for homes under 30 years old.

Figure **??** separates the sample based on whether a four-point inspection is on file. For homes without a four-point inspection on file, homes under 30 years old are more likely to file claims than those 32 years or older, similar to our baseline results. The bottom portion of Figure **??** focuses on those homes with a four point inspection on file. In our sample of over 13,000 policies, only 428 had a four-point inspection. While some homes under the age of 30 had such inspections, the small sample size likely limits the statistical power of our analysis. Nonetheless, we observe a similar pattern: homes under 30 years old tend to file more claims than those over 30 years old, although these estimates are noisier. Both of these figures suggest that the inspection itself is not driving the main results, but that the change in the likelihood of an inspection is driving the increase in the probability of filing a clime.

8. POTENTIAL THREATS TO IDENTIFICATION

8.1. Changes in Building Codes

If there was a change in building codes or building preferences in 1987, the year homes that are 30 years old at the time of Hurricane Irma were built, the observed pattern in the previous subsection could be due to changes in how homes are built. However, a search of the Florida building codes finds no evidence of a change in the building codes around 1987. In fact, the first state-wide building codes in Florida occurred in 1994 in response to Hurricane Andrew. The homes impacted by these updates are

approximately 23 years old in our sample, and since most of the effect we observe is for homes aged 24-29 it is unlikely that this change is driving our results. Additionally, the post-Andrew building codes raised standards, which should reduce the likelihood of damage and claim filings. Therefore, given our result that homes under 30 years old are more likely to file a claim than homes 32 years or older, we argue that any impact from the 1994 changes would bias our estimates downward, suggesting that the reported coefficients are a lower bound. Furthermore, we include building characteristics as control variables to address differences in construction methods within the sample. Regardless, we examine various attributes of the homes to determine if there were any notable changes in construction practices at the 30-year mark that could explain our results.

We consider three different ways that homes can be built that impact the likelihood that a roof is damaged by a hurricane. First, we consider whether the home is constructed through masonry or frame methods. Homes that are built through frame have wood as the basis of their walls, while those built through masonry have brick or concrete as well. In general, masonry homes are less likely to experience damage from hurricanes. We examine if there are systematic differences across the age of the home relative to whether it is masonry or frame in Figure 11. While homes that are under 32 years old are less likely to have masonry frame at some ages, these magnitudes are not economically significant and tend to be noisy. The noise is not surprising as approximately 96% of our sample has masonry listed as the construction type.

Next, we consider how the roof is attached to the house - by clip, single wrap, or toenail. These different types of roof attachments have varying implications on the likelihood a roof is damaged by extreme winds, with single wrap being the most effective at minimizing storm damage and toenail being the weakest. In panel (a) of Figure 10, we present results for roofs attached by clip; in panel (b), for roofs attached by single wrap; and in panel (c) for roofs attached by toenail. The three categories are mutually exclusive, meaning each figure is relative to the two excluded attachment types. In Figure 10a, we observe that both newer and older homes are less likely to have a clip attachment. However, these patterns do not show a notable break for homes aged 26-32 where our main results are found. For roofs attached via single wrap in Figure 10b, there is in general a trend of younger homes being more likely to have a single wrap. Given that single wrap is the most hurricane resistant type of roof attachment, the fact that the younger homes are more likely to have this

type of attachment suggests that they should be less likely to file a claim. Homes with a toenail attachment, presented in Figure 10c, follow the opposite pattern as single wrap, with younger homes being less likely to have a toenail attachment. Again, toenail attachments are considered the weakest and thus should be more likely to experience hurricane damages. Overall, the estimates in Figure 10 suggest that the attachment type is unlikely to be driving our results.

Finally, we examine how the shape of the roof varies based on the age of the home in Figure 12. Gable roofs are typically cheaper to build, but they are also more susceptible to hurricane damage. Homes aged 27-32 years have a similar probability of having a gable roof. Homes that are younger than 26 years old are less likely to have a gable roof, making these homes more hurricane resistant. Since we find that younger homes are more likely to file an insurance claim after Hurricane Irma, it seems unlikely that roof shape is driving our main results.

In summary, our examination of building characteristics supports the argument that the observed increase in claims found for homes aged 24-29 years is unlikely to be driven by a change in building methods. Furthermore, all of the building characteristics discussed in this section are included as control variables in our main specification.

8.2. Sample Selection

Another potential concern for our identification is that individuals who select into Citizens Insurance may own lower-quality homes. While this is plausible, as Citizens was designed to insure the residual market, our results will only be biased if this selection is correlated with the age of the property. Therefore, as long as the quality of homes selecting into Citizens is not lower at certain ages and there is no discontinuity in the selection near age 30, sample selection will not be driving our results. We conduct a variety of tests to demonstrate that quality of the home is not correlated with the age of the house. These results are presented and discussed in more detail in the Appendix.

We first examine if sample selection selection may be present due to high-quality properties leaving the sample. If a private insurer is willing to provide insurance at a reasonable price, the homeowner must leave Citizens and move to the private

market, a process known as assumption.[17] Thus, during Citizens' depopulation efforts to reduce the number of policies it insures, one would expect private insurers would assume policies covering the highest quality homes. We do not find evidence that the likelihood of assumption is related to the age of the property.

Next, we examine sample selection resulting from low-quality properties entering the sample. We test whether there is a difference in sale price for homes eventually insured by Citizens and those homes not insured by Citizens. If lower-quality properties are at greater risk of hurricane damage, there should be a negative correlation between the sale price and the likelihood of being insured by Citizens in the future, after controlling for observable property attributes. To test this, we use single-family home transactions downloaded from the Miami-Dade County, Florida Assessor's Office and create an indicator variable for if the property is covered by Citizens at the time of Hurricane Irma.[18] We chose Miami-Dade County as it includes the plurality of policies and claims in the sample. Using a hedonic regression with a rich set of property attributes and year-quarter-zip fixed effects, the coefficient on the Citizens indicator is not statistically significant, suggesting there is not a relationship between sale price and eventually being insured by Citizens.

Finally, we examine sample selection occurring below the zip code level. To do so we employ the Duranton-Overman measure of geographic concentration to assess whether Citizens insured properties are more geographically concentrated (Duranton and Overman, 2005). For instance, it is plausible that areas near the coast may be considered higher risk for private insurers, leading Citizens to insure more properties in these areas. Using the Duranton-Overman measure for Citizens policies in Miami-Dade county, we do not find of geographic concentration of Citizens coverage. Overall, we these results support our argument that selection into Citizens insurance is not driving our results.

9. CONCLUSION

As extreme weather events become more frequent, the homeowners insurance market faces significant challenges. Our study provides compelling evidence of strategic

[17] Currently, a reasonable price is defined as if the private market premium is within 20% of the Citizens' premium.

[18] We match based on standardized address from the US Census geocoder.

behavior in insurance claiming following Hurricane Irma. Specifically, we find that after a policy change increased the likelihood of homes over 30 years undergoing a four-point inspection, there was a sharp rise in the likelihood of a claim for homes aged 24-29 years. This behavior is unlikely to result from the inspection requirements causing roof replacements at age 30, from changes in building codes or from sample selection. Instead, our findings suggest that third-parties, such as contractors and lawyers engaging in opportunistic or fraudulent schemes, are the primary driving our results - a concern increasingly highlighted in the public discourse.

We estimate that this strategic behavior imposed an additional cost of approximately $4,400 per policy for homes with original tile roofs, leading to $50 million in excess costs for Citizens Insurance, or 18.5% of total Net Coverage A payments for these claims. Notably, this estimate only accounts for original tile roofs and the costs borne by Citizens for claims and legal expenses after Hurricane Irma. The impact likely expands to other roof types and private insurers, suggesting a far greater financial burden across the broader market. Additionally, as insurers are likely to adjust premiums to account for these rising costs, homeowners will face increasing financial strain. Given Citizens' status as the state-run insurer, deficits incurred by the company could result in assessments or taxes levied on all Florida homeowners, further amplifying the economic impact. Overall, these estimated costs are just one piece of the broader economic impact of the opportunistic and fraudulent behavior on the homeowners insurance market.

While our analysis focuses on Florida, the findings have broader relevance for other regions. In Louisiana, for example, reports have surfaced of contractors engaging in fraudulent activities, such as intentionally creating damage during inspections to inflate claims.[19] In Colorado, where hail-related claims rank second in the nation, similar fraudulent behaviors have emerged, with contractors exploiting severe storms to fabricate or exaggerate damages.[20] Even in states like Iowa, which are less traditionally associated with extreme weather, rising costs from hailstorm-related claims have prompted insurers to shift financial burden to homeowners by reimbursing only depreciated roof values rather than full replacement costs.[21] These examples high-

[19] https://www.wafb.com/2024/10/16/roofing-contractor-arrested-allegedly-defrauding-homeowners-insurance-company/

[20] https://www.cbsnews.com/colorado/news/colorado-insurance-experts-warn-roofing-scammers-take-advantage-severe-storms/

[21] https://www.desmoinesregister.com/story/news/local/2024/05/31/iowa-insurers-cut-roof-

light how the issues examined in this paper extend well beyond Florida, underscoring the need for a broader understanding of the impacts of extreme weather events on insurance markets nationwide.

While our analysis does provide important insights into how third parties influence claims after a storm, there are limitations to our findings. First, our data is limited to Citizens Insurance, which serves as Florida's state-run insurer for the residual market. Patterns may manifest differently among private insurers. Second, while we identify a clear spike in claims, our causal effects are restricted to original tile roofs following Hurricane Irma. Future research should extend this analysis to other types of roofs, private insurers, and additional storms to develop more comprehensive understanding of these issues and a more complete estimate of the total cost.

A critical area for future work is the design of effective policies to address these challenges as extreme weather events become more prevalent (Grace and Klein, 2009; Born et al., 2021). Some insurers, including Citizens, have implemented measures such as requiring inspections every 20 years.[22] Private insurers have adopted more aggressive strategies, such as mandating roof replacements after a certain number of years, often as few as 15 years, irrespective of the roof's condition or material. While these steps aim to mitigate risk, they may introduce new inefficiencies and financial burdens for homeowners. In response to these challenges, the Florida legislature enacted reforms in December 2022, limiting the use of AOBs and eliminating the one-way attorney fee structure for new claims. Future research should evaluate the effectiveness of these policy changes and explore additional interventions to curve opportunistic behavior, enhance market efficiency, and ensure the long-term stability of homeowners insurance markets.

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[22]Bond and Crocker (1997) examine the impact of costly state verification where the insured possesses private information and the insurer has to incur costs to confirm the amount of the loss.

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Table 1: Claims Descriptive Statistics

	Min	Mean	Median	Max
Defense & Cost Containment	0.00	4,653.25	0.00	95,061.98
Net Coverage-A	0.00	33,541.63	30,524.74	531,615.00
Paid	0.00	0.67	1.00	1.00
Attorney	0.00	0.17	0.00	1.00
Public Adjuster	0.00	0.24	0.00	1.00

NOTE: Table 1 provides descriptive statistics for claim files in the Citizens' data where Hurricane Irma is labeled as the source of the damage for properties with original tile roofs 20- to 40-years-old. *Defense & Cost Containment* is defense and cost containment in dollars, *Net-Coverage-A* is the net coverage-A paid in dollars, *Paid* is an indicator for claims with *Net Coverage-A*$>$ 0, *Attorney* is an indicator for an attorney being the first notice of loss, and *Public Adjusted* is an indicator for a public attorney being the first notice of loss.

Table 2: Descriptive Statistics

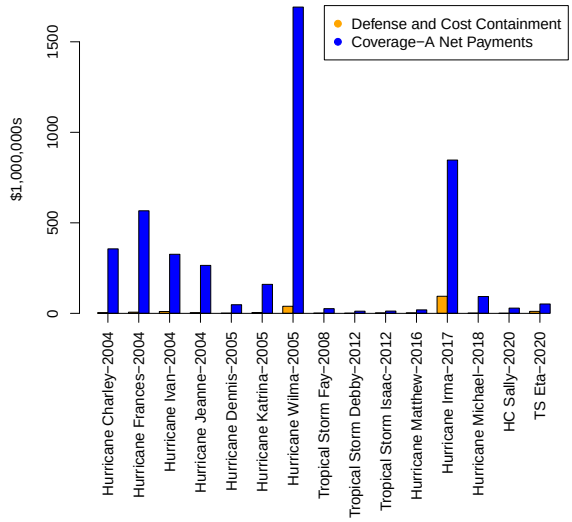
	Min	Mean	Median	Max
Age	20.00	25.25	24.00	40.00
Wind Claim	0.00	0.37	0.00	1.00
FBC	0.00	0.33	0.00	1.00
Non-FBC	0.00	0.67	1.00	1.00
Clips	0.00	0.18	0.00	1.00
Single Wrap	0.00	0.72	1.00	1.00
Toe Nail	0.00	0.10	0.00	1.00
Gable	0.00	0.72	1.00	1.00
Hip	0.00	0.28	0.00	1.00
Masonry	0.00	0.96	1.00	1.00
Frame	0.00	0.04	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 original tile roofs 20- to 40-years-old. *Age* is the age of the property, *Wind Claim* is an indicator for policies that file a wind claim related to Irma, *FBC* is an indicator for Florida Building Code equivalent roofs, *Non-FBC* is an indicator for Florida Building Code non-equivalent roofs, *Clips* is an indicator for roofs attached with clips, *Single Wrap* is an indicator for roofs attached with clips, *Toe Nail* is an indicator for roofs attached with toe nails, *Gable* is an indicator for gabled roofs, *Hip* is an indicator for hip roofs, *Masonry* is an indicator for masonry walls, and *Frame* is an indicator for wood-framed walls.

Table 3: Observed and Predicted Values of Claiming Behavior

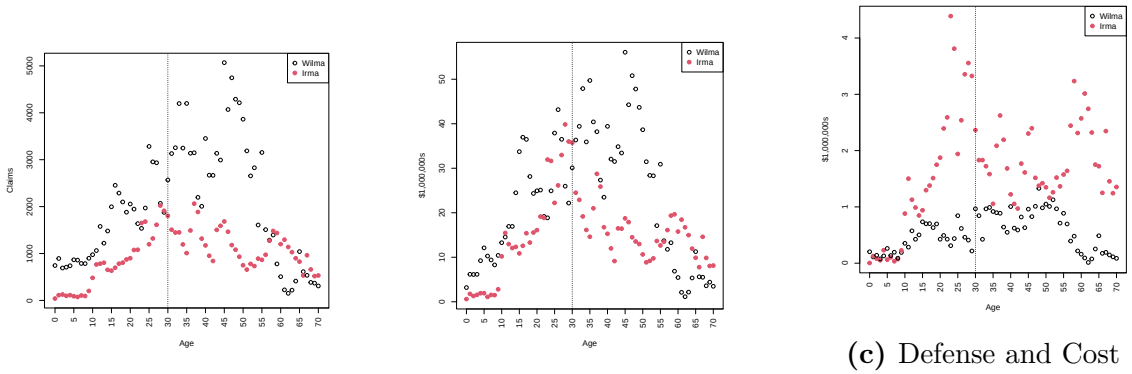
	Actual		Predicted
	Over 32	Below 29	below 29
Probability of a Claim	0.20	0.38	0.27
Net Coverage A	5,740.47	13,182.36	9,636.26
Net Coverage A, Policies with a Claim	28,733.35	34,621.29	12,288.61
DCC	478.91	1,709.05	826.93
DCC, Policies with a Claim	2,371.48	4,478.81	922.77
Net Coverage A + DCC	6,219.38	14,891.42	10,463.20
Net Coverage A + DCC, Policies with a Claim	31,104.83	39,100.10	13,211.38

Figure 1: Wind Claims by Catastrophe



NOTE: Dollar amounts are in millions of 2004 dollars. Only wind claims associated with catastrophes with more than 1,000 wind claims are used for calculation in Figure 1.

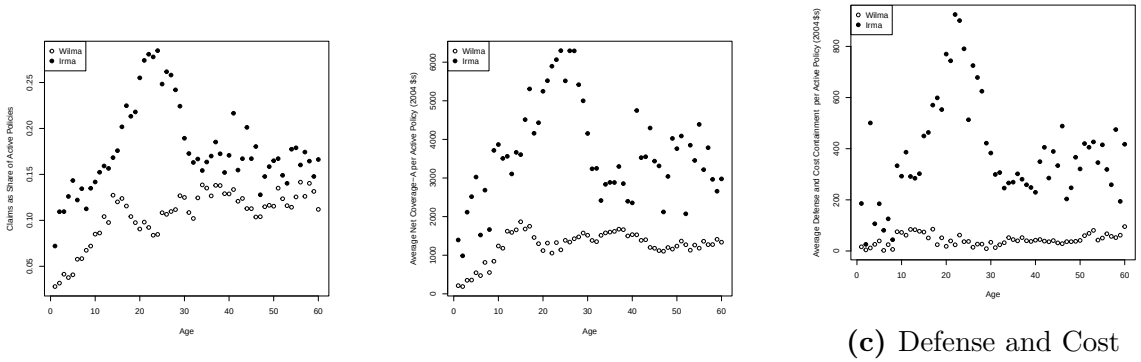
Figure 2: Claiming Behavior by Age of the Home for Hurricanes Wilma and Irma



(a) Wind Claims **(b)** Net Coverage-A **(c)** 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 3: Claiming Behavior and DCC by Age of the Home for Hurricanes Wilma and Irma



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

NOTE: Figure 2 displays per policy 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 2004 dollars.

Figure 4: Relative Probability of Filing a Claim for Hurricane Irma, Tile Roofs Only

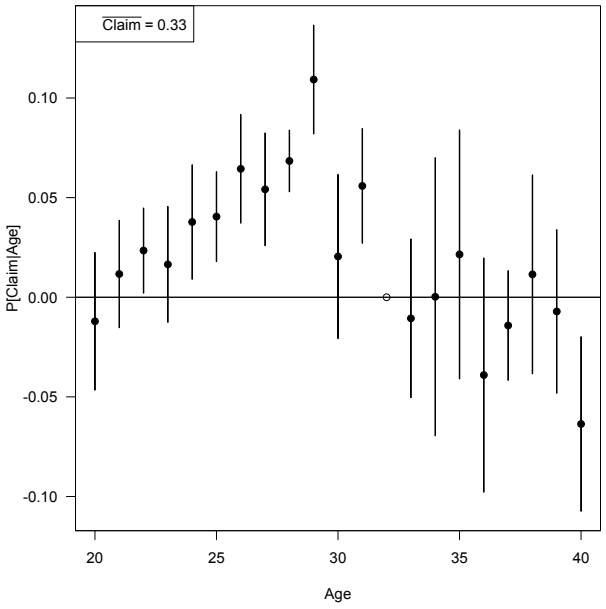


Figure 5: Probability of Filing a Claim, by FBC Equivalent Status

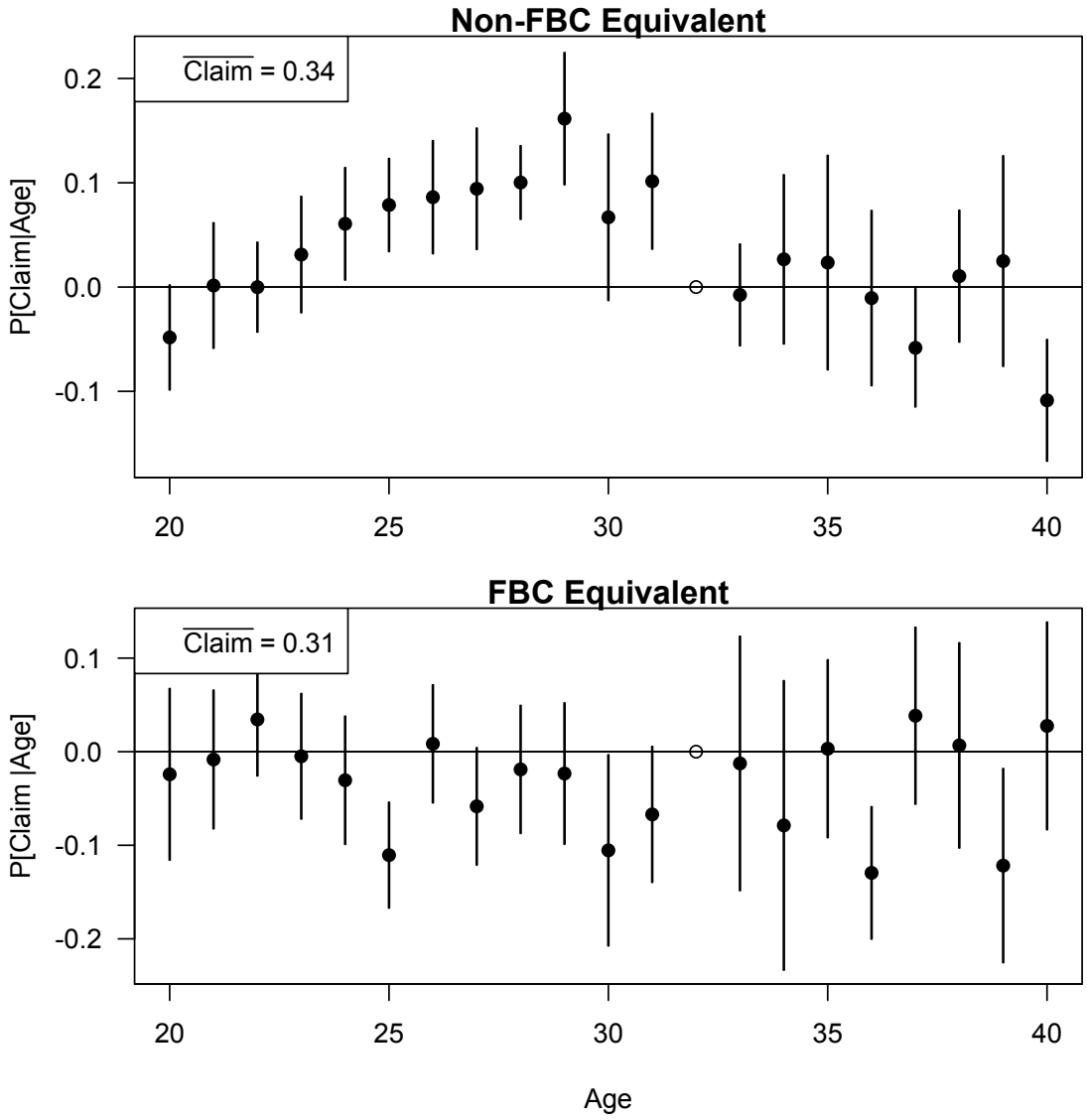


Figure 6: Claiming Behavior for Hurricane Irma by Four-Point Inspection Status, Tile Roofs Only

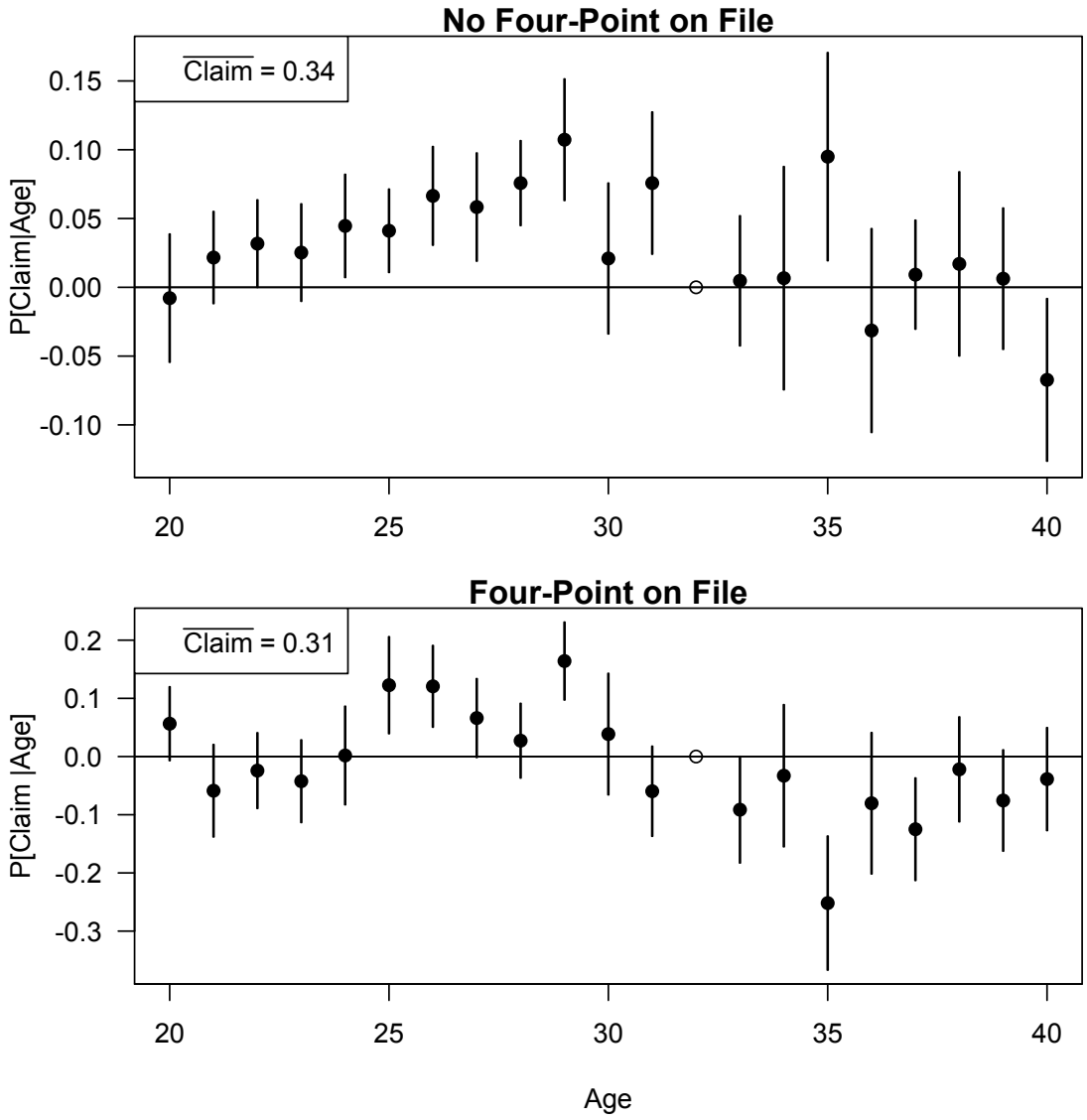


Figure 7: Claiming Behavior for Hurricane Irma in 2017, Tile Roofs Only

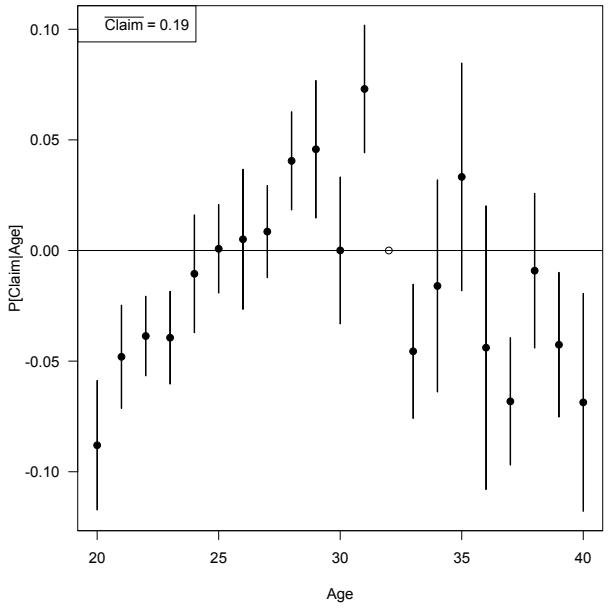


Figure 8: Claiming Behavior for Hurricane Irma in 2018 or Later, Tile Roofs Only

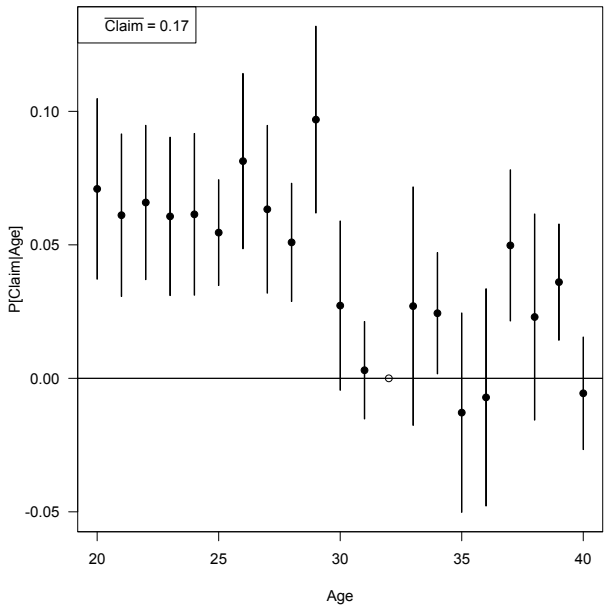


Figure 9: Probability of Replacing Roof in 2015 or 2016, Tile Roofs Only

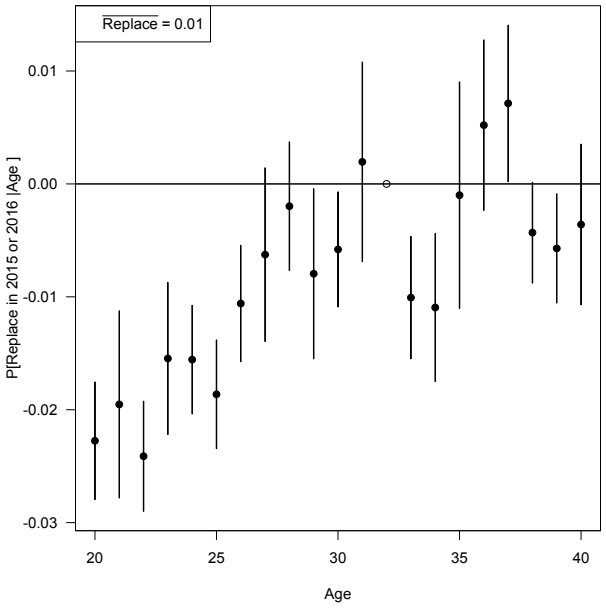
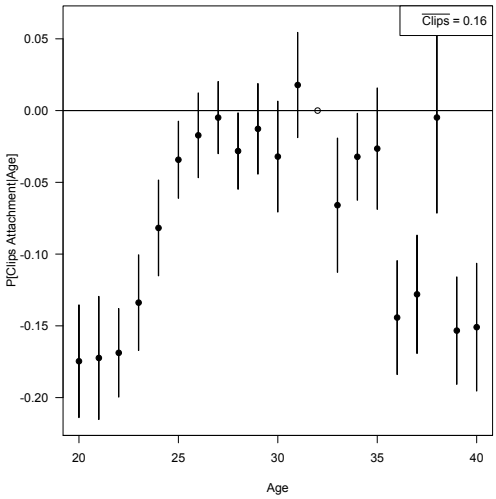
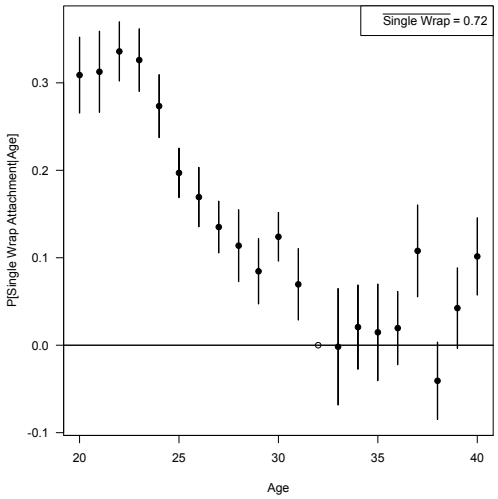


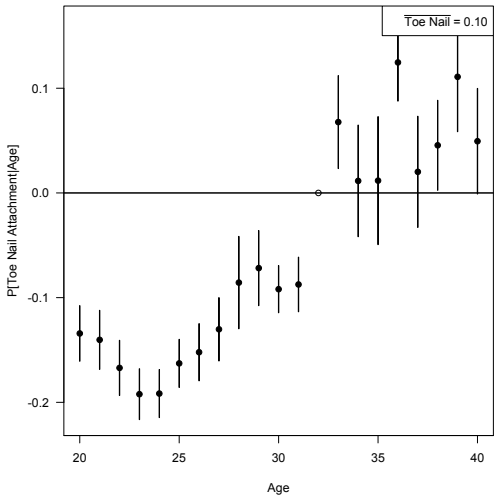
Figure 10: Attachment Type Relative to Age 32



(a) Clips



(b) Single Wraps



(c) Toenail

Figure 11: Construction Type Relative to Age 32

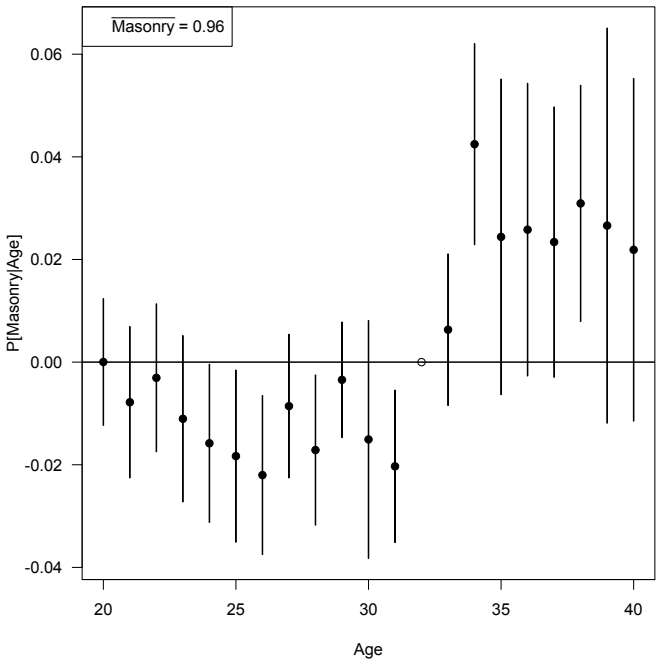


Figure 12: Shape Type Relative to Age 32

