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Property Values and the Risk from an Oil Spill: The Effects of the Deepwater Horizon Oil Spill in Hillsborough County

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Abstract

For months after the April 2010 Deepwater Horizon (DWH) oil rig explosion significant uncertainty existed regarding both the amount of oil remaining and the path of its dispersion in the Gulf of Mexico. The spill eventually affected hundreds of miles of beach along the Gulf Coast. While a few studies assess the impact of the spill on homeowners along these beaches, we leverage the uncertainty regarding oil dispersion to examine the impact on residential property values in areas that were not directly affected by the oil spill. We examine the costs of damage risk in such an area using a modern, regression-based difference-in-difference approach to analyze damages caused by the DWH oil spill through real estate prices. Using data on single-family residential properties in Hillsborough County, Florida, we compare the sales price paths of properties near the coast to those further inland over time in order to identify both the range of effected properties and the types of information which were salient for the internalization of risk into market prices. Our preliminary findings indicate that homes close to the coast during the nine months after the DWH oil spill sold for 3.5% less than homes located more inland in periods outside of the treatment period, suggesting there exists some positive cost attributable to the risk of oil wash-ups.

I. Introduction

On April 10, 2010, an oil rig belonging to BP called the Deepwater Horizon (DWH) exploded in the Gulf of Mexico. It is estimated that 4.9 million barrels of oil poured into the surrounding waters before the leak was successfully capped on July 15, 2010. Satellite images showed oil on the ocean's surface until August 20, 2010. During this period, there was a great deal of uncertainty regarding both the amount of oil that had leaked into the Gulf and the amount that remained on the surface after accounting for oil recovered and dispersed via natural processes. Ultimately, oil washed up on hundreds of miles of beach shores along the Gulf States of Louisiana, Mississippi, Alabama Florida, and Texas (Ramseur 2010). The goal of this project is to estimate the impact of the risk of damage from the oil spill on the sales of residential properties along the western coast of Florida.

The Economic and Property Damages Settlement Agreement established claim zones in the affected Gulf States to identify the class members whom the court deemed to have sufficient standing to sue for damages. As of May 2016, the DWH Economic and Property Damages Settlement Program reports 27% of claim forms submitted were from Florida (DWHECC 2016). According to BP, the company has made an estimated \$4.2 billion in various payments to Florida residents and businesses (BP 2016). Still, this figure may not capture the damages in their entirety, as it does not take into account real losses due to the risk of damage from the oil spill. For instance, while the northwestern coastal beaches of Florida saw oil and are part of both the court-certified economic loss and real property loss claim zones, the majority of the western coast of Florida did not ultimately see oil on their beaches, and only fall into economic loss claim zones (see Figures 1 and 2 in the appendix).

Individuals located outside the real property claim zones were not eligible to file claims for real property sales damage under the agreement. Additionally, while businesses located in

the economic claim zones could recover losses due to reduced tourism, real property owners were not. The US Census Bureau reports Florida as one of ten states with the highest percentages of homes deemed as seasonal, recreational or occasional use in 2010 (U.S. Census Bureau 2011). For these homes, it is possible that some of their value lies in income from vacation rentals during periods of vacancy. If so, the risk of the DWH spill may have also been capitalized into home value and sale prices due to reduced tourism. We investigate whether property sales suffered (through price or quantity channels) during periods of time following the spill due to the risk that oil might eventually wash up on shore.

Six years after the DWH oil spill we have full information on which coastal areas actually had oil wash up. Using sales data from Hillsborough County, a southwestern county in Florida that did not ultimately have any oil wash ups, we estimate the impact of the news regarding the DWH oil spill on single-family residential home sales prices and volumes during the period when the extent of direct coastal damage from released oil was still uncertain. Since Hillsborough County was only indirectly impacted by the DWH oil spill, our estimates capture the cost to residents of uncertainty surrounding the fate of the oil. In other words, any price effect would be attributable to the cost of risk rather than actual damage. The inability to establish an effect on the real estate market in these counties would lend support to the absence of these counties in the coastal real estate claim zone. However, a negative effect on the real estate market might suggest improper delineation of real estate claim zones in these counties as such a finding would indicate material harm to homeowners for which compensation is unavailable.

This paper proceeds as follows. The next section details a number of strands of relevant literature. Section III discusses how our analysis extends the current literature and the contributions of our research. Sections IV and V describe the data and our empirical approach, respectively. Finally, in Section VI we present and discuss our preliminary results and details our direction for additional analyses.

II. Literature Review

A number of studies have used hedonic models to estimate the impact of existing environmental disamenities, such as hazardous waste sites, landfills, and power plants, on property values. Farber (1998), Boyle and Kiel (2001), Jackson (2001), and Simons and Saginor (2006) summarize this literature, much of which finds that homes located closer to an existing environmental disamenity have lower sale prices than those located further away. Simons and Saginor (2006) also complete a meta-analysis based on data from 58 peer-reviewed journal articles on negative amenities and find the effect of contamination on property values is always negative or at least neutral. Additionally, hedonic models have been used to determine the effect of environmental accidents on property values, including nuclear power plant accidents (Nelson 1981, Gamble and Downing 1982, Clark et al. 1997), chemical plant explosions (Carroll et al. 1996), oil leaks from underground storage tanks (LUST) and pipeline ruptures (Simons, Bowen and Sementelli 1997, Simons 1999 and Simons, Winson-Geidema and Mikelbank 2001).

Other studies on the impact of existing environmental disamenities (hazardous waste and incinerator and lead smelter sites) and accidents (chemical plant explosions) on property values focus on how information provided to homeowners on the disamenity may play a role in price reductions (Michaels and Smith 1990, Kohlhase 1991, Kiel 1995, Kiel and McClain 1995, Carroll et al. 1996, Dale, Murdoch, Thayer, and Waddell 1999). These papers generally find

that once information on the accident's occurrence is announced, homes located closer to the accident site sell for less than those located further away. There are mixed results on whether prices rebound after the announcement of remediation plans.

Looking at the impact of environmental risk uncertainty on property values, various studies link this uncertainty with negative impacts on sale prices of residential properties (Simons, Bowen and Sementelli 1997, Simons 1999, McClelland, Schulze and Hurd 1990, Bin and Polasky 2004, and Kousky 2010). For instance, Simons (1999) examines the impact of a petroleum pipeline rupture on uncontaminated single-family and townhomes located along a pipeline corridor and find that these homes decreased in value after the rupture by between 0.3%-5.5% for home located within 10 miles of the pipeline. Simons (1999) suggests these losses occur even in the absence of contamination due to increased saliency of the potential for future pipeline incidents. Other studies examine the relationship among sale prices, risk uncertainty and media coverage on environmental hazards (McCluskey and Rausser 2001, Hansen, Benson and Hagen 2006, and Freybote and Fruits 2015). Freybote and Fruits (2015), for example, study changes in single-family home prices related to media coverage throughout various phases of development of a natural gas pipeline in Oregon. Their hedonic model indicates that during the construction phase only, media coverage on unrelated fatal gas pipeline explosions further reduces sales prices for already discounted homes located near the construction site.

Oil Spills (Exxon Valdez and Deepwater Horizon)

Prior to the DWH disaster, literature specifically addressing oil spills mostly focused on the Exxon Valdez oil spill that occurred in Prince William Sound, Alaska in March 1989. The Exxon Valdez oil spill was the largest oil spill in U.S. coastal waters before the DWH oil spill, which resulted in the release of nearly 19 times more oil than the Exxon Valdez oil spill (NOAA 2016). In a seminal paper, Carson et al. (2003) used contingent valuation to measure the damages from the Exxon Valdez oil spill, and estimated that the spill resulted \$2.8 billion in lost non-use values. This research sparked great debate over the validity of stated-preferences methods. Stated-preference methods were useful in the case of the Exxon Valdez oil spill as it occurred in a remote location and most of the damage was restricted to wildlife and natural resources for which no market prices existed. The DWH oil spill, alternatively, affected densely populated coastlines and heavily commercialized fisheries, allowing damages to be assessed through existing markets, such as the real estate markets examined here. Additionally, the Exxon Valdez spilled a finite amount of oil, whereas it was uncertain how much oil would be released from the DWH until it was actually capped. Together these facts allow us to look at the impact of uncertainty surrounding the risk of the DWH oil spill on prices in an active market.

In the context of property values, Epley (2012), Siegel, Caudill and Mixon (2013), and Winkler and Gordon (2013) look at the impact of the DWH oil spill on the sales volume and sales prices. Epley (2012) and Siegal, Caudill and Mixon (2013) indicate they use the before-and-after comparison to estimate the effect of the DWH oil spill on real estate prices. Both papers estimate effects using data on sales that occurred along the Alabama coast. For three land use types (condominiums, single family residences and vacant residential land) in Baldwin County, Alabama, Epley (2012) estimates the real estate loss as the difference between the median transaction price roughly 12 months prior to the oil spill and the median transaction price 16 weeks after the oil spill (August 15, 2010). The Epley results suggest that the oil spill impacted transaction prices only among undeveloped waterfront land zoned for residential construction for which the median transaction price was 16 percent lower 16 weeks post-spill. Siegal, Caudill and Mixon (2013) investigate real estate prices in the same area as Epley

(2012) but look at available transaction prices of condominiums from January 2009 to September 2011. Siegal, Caudill and Mixon (2013) find condominium sale prices fell between 10.1 and 13.5 percent in the first 100 days after the spill and that this effect dissipates thereafter.

Winkler and Gordon (2013) find that condominiums located in Baldwin County on the Alabama coast suffered both a statistically significant reduction in sales volume of 40% from July to December 2010 and statistically significant drops in sale prices of 5%-9% for sales occurring one to five months after the spill. Since their results show price impacts even after health advisories had been lifted, Winkler and Gordon conclude that uncertainty surrounding the effects of the spill may have played a role. They caution, however, that their results should not be extended to other areas or to single-family homes impacted by the spill.

III. Contribution

Our study extends the existing literature by using a natural experiment to estimate the impacts of uncertain damages on single-family residential property values in Hillsborough County, Florida. To our knowledge, our study is the first to look at real estate impacts in Florida. Additionally, our study provides damage estimates for an area that ultimately was not directly impacted by the oil spill (did not see any oil wash up) but is located in the CSSP claim zones. Therefore, we add to the literature by assessing the impacts of the risk of damages rather than realized damages. Since we also investigate impacts in the real estate market during different time periods after the oil spill occurred, we hope to shed light on which types of information may result in the internalization of risk into home prices. The types of information we explore include the accident itself, reports on oil wash-ups, reports of the failure of early attempts at capping the leak, and the announcement that the spill had been successfully capped.

Finally, we believe our paper is the first to use a modern, regression-based difference-in-difference approach to analyze damages caused by the DWH oil spill. In Epley's (2012) analysis, his simple comparison of changes in mean home prices may not adequately capture between-group differences and relies on ad-hoc rules to identify a control group, which includes properties that Epley considers to be "reasonably unaffected by the oil spill". Conversely, both Siegel, Caudill and Mixon (2013) and Winkler and Gordon (2013) estimate a hedonic model that includes various controls and dummies indicating time of sale to estimate the effect of the oil spill; however, these analyses include no comparable control location, making it difficult to draw a causal effect between the DWH oil spill and changes in real prices. Our study improves on the approaches above through the use of a well-controlled hedonic regression based on a natural experiment where we define the treatment and control groups with a quantitative analysis.

IV. Data

This investigation relies on publicly available data detailing structural, neighborhood and parcel characteristics for homes sold in Hillsborough County, Florida obtained from the Environmental Protection Agency. Hillsborough County is located on the Gulf Coast in southwestern Florida (see Figure 3 in the appendix). These data include sales (and repeat sales) occurring between the years 1901-2015; however, we focus our examination on single-family homes during the period from 2006-2015. The sample used in our main analysis includes 123,652 transactions of 100,628 unique properties in Hillsborough County. Table 1 (see appendix) provides summary statistics of the main sample in Hillsborough County.

V. Methodology

To estimate the impact of the DWH oil spill on properties located in Hillsborough County, Florida, we specify the following difference-in-differences model:

$$\ln p_{ijt} = \mathbf{x}_{ijt}\boldsymbol{\beta} + \varphi D_i + \gamma event_t + \theta\{event_t \times D_i\} + \mathbf{M}_t\boldsymbol{\alpha} + v_j + \varepsilon_{ijt} \quad (1)$$

Where $\ln p_{ijt}$ is the natural log of transaction price for home i located in neighborhood j at time t . \mathbf{x}_{ijt} is a vector of home, parcel and neighborhood characteristics, while \mathbf{M}_t includes year and month or week fixed effects and v_j is a neighborhood fixed effect (at the census tract group level). ε_{ijt} is a random disturbance term assumed to be distributed normally with a zero mean.

The variable D_i is a dummy that is equal to one if home i is included in the treatment group and equal to zero if home i is in the control group. To delineate the treatment and control groups, we compare the sales price paths of properties near the coast to those further inland over a variety of treatment periods in order to identify both the geographic and temporal ranges of the effects. The latter range will provide insight into the types of information which were salient for the internalization of risk into market prices.

$Event_t$ is a dummy variable equal to one if home i sold during the period when oil risk was salient. To identify this treatment period, we will investigate various time periods beginning from the initial announcement of the spill to identify whether the risk of oil wash-up had any impact on property values in the studied market at any point following the spill. The coefficient γ in Equation 1, identifies the difference in price effect for homes sold within the designated event time period and those sold outside the time period. Finally, the coefficient of interest, θ , for the interaction of the $event_t$ and D_i dummies represents the average treatment effect on the treated group. As the dependent variable in Equation (1) is logged, coefficient estimates are interpreted as the percent change in housing prices associated with a unit change in the associated independent variable.

In addition to the analysis of sales prices described above, we also look at the impact of the spill on monthly sales volumes, as homeowners may have waited to sell their property until the uncertainty in damages resolved. This represents another channel, alongside price impacts, where the spill had potential welfare impacts.

VI. Results and Discussion

Currently, we present preliminary results for one defined time period, between the date of the oil spill, April 20, 2010 to nine months later on December 20, 2010. Future analyses will define different event time periods to determine what types of information may lead to the internalization of risk into market prices. We begin with a broad time period to assess whether any impacts are present within the defined range.

After defining the time period for our treatment group, we further delineate the control and treatment groups by separating properties into coastal and non-coastal (as we suspect these properties are most likely to be affected by the oil wash-ups). To define a coastal cut off we plot the log of the detrended prices against the properties' distances from the coast. Since coastal properties typically sell at a price premium, we expect to see a distance decay of prices. Figure 4 shows this distance decay occurs up until nearly 2,500 meters from coast. Therefore, we define the treatment group as homes that sold between April 20, 2010 and December 20, 2010

and are located within 2,500 meters of the coast, and the control group includes homes that sold between January 1, 2006 and April 20, 2006, homes that sold between December 21, 2010 and December 31, 2015, and homes located beyond 2,500 meters from the coast.

Table 2 presents the regressions results using the defined treatment and control groups. The signs on the control variables are generally consistent with expectations. The value of a home decreases at a decreasing rate as age increases. As the number of bathrooms, interior living area, property acreage, and the sale price of homes increases, and these variables are all statistically significant at the 0.10 level. Additionally, the presence of air conditioning, a porch, or a pool increases the value of a home, though these variables are not statistically significant. The sign on the distance to the nearest urban center is positive; however, this magnitude of the coefficient is close to zero and statistically insignificant. The distance to the nearest main road variable is statistically significant at the 0.10 level, suggesting there is price premium for living away from a main road. Consistent with previous literature our results also indicate a price premium for homes located closer to the coast as the sign on this variable is positive and statistically significant at the 0.10 level. Finally, the coefficient of interest associated with the interaction between the time period and coast dummy is positive and statistically significant at the 0.10 level. These results suggest that homes close to the coast during the nine months after the DWH oil spill sold for 3.5% less than homes located more inland in periods outside of the treatment period. Therefore, preliminary results indicate there exists some positive cost attributable to the risk of oil wash-ups.

To further explore the value of information on sale prices, in future work we will explore different time periods for our treatment group and will also obtain results for different delineations of coastal vs. noncoastal properties. Additionally, similar transaction data sets for other Florida counties (Orange, Polk, Volusia, Manatee, Charlotte and Martin) are also available from the EPA. Volusia and Martin County are located on Florida's eastern coast, Charlotte and Manatee County are located on Florida's western coast (between Hillsborough and Lee County), and Polk and Orange County are located inland in central Florida. As the events at the DWH spill may have impacted coastal counties beyond the shoreline (through reduced tourism or the risk of reduced tourism), inland and coastal home sales in these counties may follow similar trends after the event. In this case, we could use the data from these other counties as controls and treat all sales in Hillsborough and Lee counties as part of the treated group (or potentially as having varied, but nonzero, intensities of treatment depending on their distance to the coast). While it is possible that sale prices on the east coast may increase as a result of the spill if property along the east coast beaches is in greater demand due to decreased demand on the west coast, sales in inland counties may not have been impacted the oil spill; therefore could try to estimate a triple differences model similar to Muehlenbachs et al. (2015) by exploiting differences in sale prices of homes located inland vs. on the coast in both eastern and western Florida counties before and after the oil spill. Finally, we will also look at the impact of the spill on monthly sales volumes, to capture any delay or diminution of sales imposed by the uncertainty potential damages from oil wash up. This represents another channel, alongside price impacts, where the spill had potential welfare impacts. Preliminary results indicate that while sales prices remain unaffected by the risk of damage, sales volumes decreased in the months following the spill, suggesting that homeowners in this county suffered losses as a result of the uncertainty.

VII. Appendix



Fig. 1. Economic claim zones established by the Economic and Property Damages Settlement. All claim zones required that businesses must prove actual financial losses in 2010 in their claim; however, the proof of causation requirement varied by claim zone. All business types in Zone A were not required to prove causation. In Zone B, only businesses that met the tourism or seafood industry definition were exempt from the causation requirement. In Zone C, only businesses that met the seafood industry definition were exempt from the causation requirement. Finally, Zone D required all business types to prove causation (DWHECC 2016).

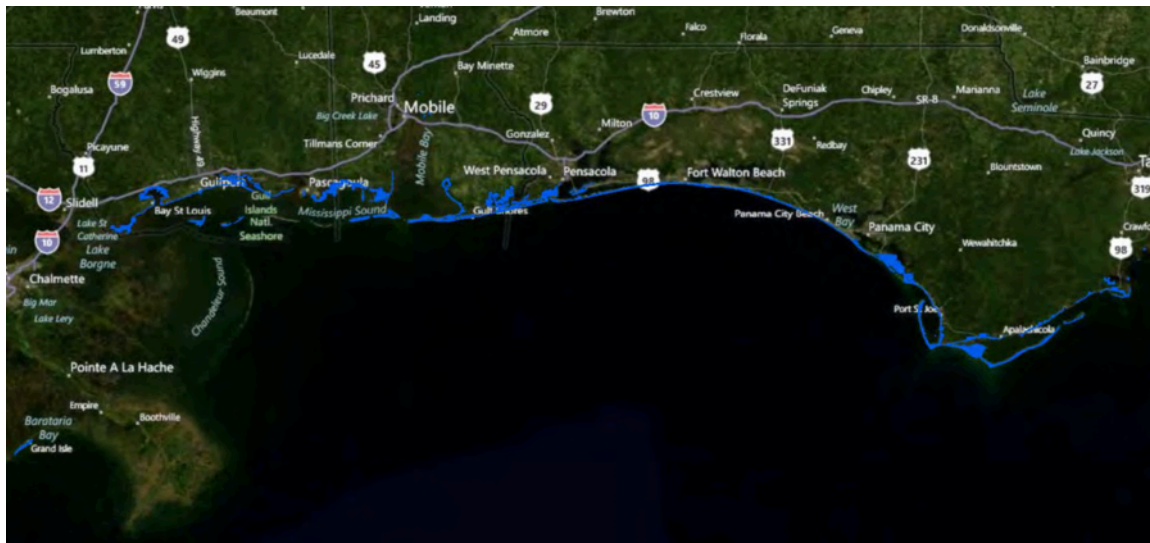


Fig. 2. Coastal Real Property claim zones established by the Economic and Property Damages Settlement. Individuals or businesses located in this claim zone could submit claims of property damages with proof they either owned or leased residential parcels, commercial parcels, deeded boat slips or other types of parcels between April 20, 2010 and December 31, 2010 (DWHECC 2016).



Figure 3. Location of Hillsborough County in the state of Florida
(https://commons.wikimedia.org/wiki/File:USA_Florida_location_map.svg).

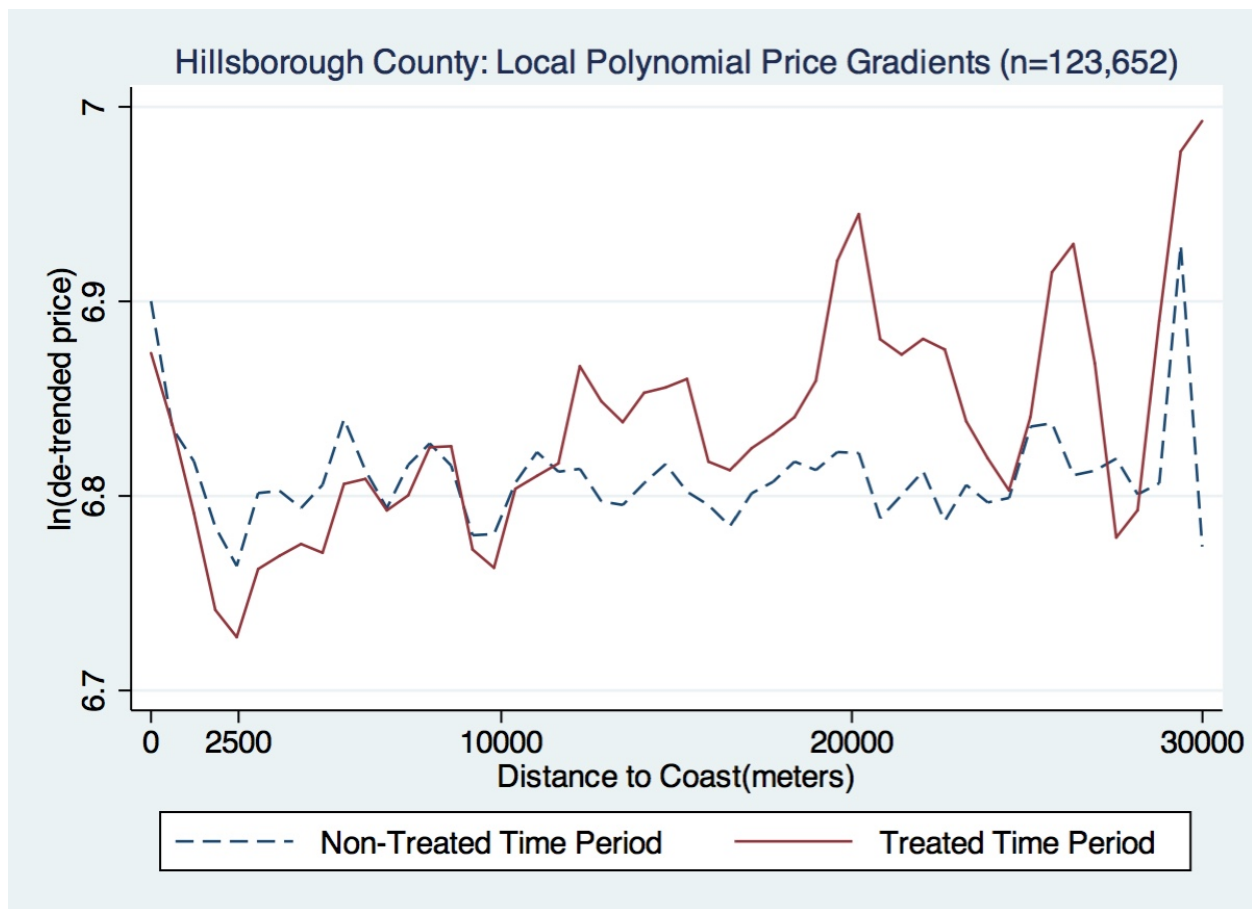


Figure 4. Local Polynomial Price Gradients for Treated and Untreated Time periods for Hillsborough County, Florida.

Table 1. Descriptive Statistics for Single-Family Home Sales in Hillsborough County (n=123,652).

<i>Variable</i>	<i>Description</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
REALPRICE	Transaction price in 2014\$	204,410	127,251	29,802	837,826
TRANYR	Transaction year	2010	2.81	2006	2014
TRANMO	Transaction month	7	3	1	12
AGE	Age at time of sale	21.83	22.40	0	123
BATHTOT	Number of bathrooms	2.27	0.72	0	10.50
SQFTSTRC	Interior living area (sq ft)	1901.05	757.48	140	12387
ACRES	Parcel acreage	0.28	0.71	0.00	79.71
AIR_COND	=1 if air conditioning present, 0 otherwise	1.00	0.05	0	1
PORCH	=1 if porch present, 0 otherwise	0.99	0.12	0	1
POOL	=1 if pool present, 0 otherwise	0.22	0.42	0	1
UC_DIST	Distance to nearest urban center (km)	18.22	9.59	0.03	44.54
ROAD_P_DIST	Distance to primary road (m)	4863.53	3804.92	0.90	26875.68
DISTTCOAST	Distance to the coast	9994.03	7342.38	0.00	39434.29
COAST	=1 if located within 2,500m from coast, 0 otherwise	.1485944	.3556897	0	1
Event2010_4_12	=1 if sale occurred between April 20, 2010 and Dec 20, 2010, 0 otherwise	.0601365	.2377406	0	1

Table 2. Regression results for main specification.

Variables	Coeff. (SE ¹)
Age	-0.00748*** (0.00076)
Agesq	0.00005*** (0.00001)
Bathtot	0.02616*** (0.00651)
Sqftstrc	0.68823*** (0.01612)
Acres	0.12294*** (0.00816)
Air_cond	0.03468 (0.0309)
Porch	0.12676*** (0.02306)
Pool	0.14132*** (0.00602)
UC_dist	-0.00151 (0.00676)
Road_p_dist	0.0000008 (0.00001)
Coast	0.10077*** (0.03356)
Event2010_4_12	0.02308*** (0.00741)
Coastevent2010_4_12	-0.03530** (0.01382)
Tract Fixed-Effects	Y
Year Fixed-Effects	Y
Month Fixed- Effects	Y

¹Standard errors are clustered at the census tract group level.

* Significant at 0.10

**Significant at 0.05

*** Significant at 0.01

VIII. References

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