Forgetting the Flood: Changes in Flood Risk Perceptions over Time

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Abstract

This paper examines whether homeowners update their flood risk assessment following a large flood event, and whether changes in risk perceptions induced by large flood events are temporary or permanent. We use all single family residential property sales in Albany, Georgia, between 1985 and 2010 in a difference-in-difference hedonic model framework. After a very large flood in 1994, prices of properties in the 100-year floodplain did not change significantly, but prices of properties within the 500-year floodplain fell by almost 32 percent. This effect was, however, short lived. It decreased at a rate of approx. 5 percent per year. The discount for properties in the area inundated by the 1994 flood was as high as 46 percent immediately after the flood, decreasing at a rate of about 6 percent per year.

1 Introduction

Floods are the most common natural disaster. Between 1985 and 2009, floods and storms represented 71 percent of the natural disasters worldwide. They accounted for 44 percent of the deaths, 67 percent of the number of people affected, and the bulk of economic damages caused by natural disasters (EM-DAT 2010). In the United States, each year, on average, floods kill about 140 people and cause $6 billion in property damage (USGS, 2006). Between 1955 and 2008 the flood loss totals for United States have amounted to 252,574 million dollars. For the state of Georgia, where the study area for this paper is located, it was equal to 1,234 million dollars loss (Pielke, et al., 2002; NWS, 2011).

Flood damage has increased in the United States, despite local efforts and federal encouragement to mitigate flood hazards and regulate development in flood-prone areas (Pielke, et al., 2002). IPCC (2001) and Swiss Re (2006) report dramatic increases in related damages over time. These trends are believed to have two causes. The first is an increase in the frequency and intensity of extreme weather events associated with climate change. A warmer climate, with its increased climate variability, is expected to increase the risk of both floods and droughts (Wetherald and Manabe, 2002). The second, and of particular interest to this paper is the increased value in hazardous areas (Kunreuther and Michel-Kerjan, 2007). The movement of both capital and people into flood plains and other high-risk areas (Freeman et al. 2003; IPCC 2007a, Chapter 3) drives up the costs, economic and otherwise, when a flood occurs. There are over six million buildings located within the boundary of 100-year floodplains (i.e. areas with a 1% chance of flooding in any given year) in the United States (Burby, 2001). This raises important questions: Do homeowners have accurate information about flood risks? Do they understand this information? Do homeowners update their flood risk perception following a large flood event? Is the perceived risk persistent over time?

Several previous studies have shown that a house located within a floodplain has a lower market value than an equivalent house located outside the floodplain (Bin and Kruse, 2006, Bin, et al., 2008, Bin and Polasky, 2004, Harrison, et al., 2001, Kousky, 2010, Speyrer and Ragas, 1991). However, they also found that if property owners underestimate the cost of flooding, or homeowners are relatively unaware of flood hazards, there may be little reduction in the value of properties within a floodplain.

Fewer studies have investigated how actual flood events alter homeowners' risk perceptions (Bin and Polasky, 2004, Carbone, et al., 2006, Kousky, 2010, Skantz and Strickland, 1996). These studies typically find that, after a significant flood event, properties within a floodplain have a lower market value than equivalent houses located outside the floodplain. For example, Kousky (2010) found that after the 1993 flood on the Missouri and Mississippi rivers, property prices in the 100-year floodplain did not change significantly but prices in the 500-year floodplain (those with a 0.2% chance of flooding in any given year) declined by 2%. Bin and Landry (2011), however, find that it is properties within the 100-year flood plain that are discounted after a large flood event. Only two studies to the best of our knowledge, (Bin and Landry, 2011) and Kousky, (2010) have looked at the persistence of perceived flood risk following a large flood event over time. Bin and Landry, (2011) use post flood data to examine how the risk premium changes through time but it is not clear why the years 2002-2008 was chosen for analysis when the latest flood occurred in 1999 in their study. Kousky, 2010 however uses all the dataset after major flood event but the analysis is very limited. Both the authors however, find that the discount was higher if the flooding was recent which means that consumer’s willingness to pay for a decrease in flood risk decay with time.

Our contribution to this scare literature is twofold. First, we analyze whether changes in risk perceptions induced by a large flood event are temporary or permanent by accounting explicitly for the number of years after the flood has taken place. Second, we use actual inundation maps as a proxy for flood risk in addition to the Federal Emergency Management Agency (FEMA)’s designated flood hazard maps. We hypothesize that the discount in these properties is larger as they are more likely to have experienced physical damages after the flood but also because homeowners respond better to what they have visualized (“seeing is believing”).

In 1994, the city of Albany, Georgia, was affected by a devastating flood from the effects of tropical storm Alberto. The extent of flooding caused mass evacuation of over 78,000 people (22,000 in Albany), it affected more than 104 thousand miles and 400,000 acres of farmland were flooded during 15 days causing billions of dollars in damage (DFO, 2011) .

In order to explore variability in risk perception after a significant flood event we used a difference-in-difference (DD) model (as in e.g. Kousky, 2010, and Bin and Polasky, 2004). The 1994 flood in Georgia which is regarded as the “flood of the century” is used as an information source that might influence the property prices. We find that after the 1994 flood there was no significant discount for properties in the 100-year floodplain but there was a significant discount of almost 32% for property in 500-year floodplain. This result is consistent with that of Kousky (2010), although larger in magnitude. Homeowner’s in 100-year floodplains are mandated to buy flood insurance so they are more likely to discount the property price to accommodate their insurance cost (we actually find that they did before the flood), but properties in 500-year floodplains are not required to buy flood insurance so homeowner's have less information, if any, on the flood risks they face. A large flood updates that information, and that is the effect we capture. The large discount is, however, short lived. We find it decays rapidly, at a rate of 5% annually. Overall our results suggest the existence of availability heuristic (Tversky and Kahneman, 1973). A major event causes homeowners to adapt their perceptions, but the focusing effect of the event declines over time as it loses relevance.

Using the actual inundation map as a proxy to flood hazard zone provided more pronounced results. After the 1994 flood when the homeowners experienced the actual flood we find that the property in inundated area was significantly discounted by almost 46%. This discount is much higher as compared to discount for properties in 100-year and 500-year floodplain which could be partly due to the direct reconstruction cost that is required for resettling. The flood risk perception also decays rapidly at a rate of almost 6% annually.

2 Study Area

Albany was founded in the early 1800s along the Flint River in southwest Georgia. The east and south side of Flint River have been home to predominantly poor minority residents while there are mostly white and more effluent residents to the north and west of the river. The city of Albany has a total area of 55.9 square miles, of which 55.5 square miles is land and 0.3 square miles is water (US Census Bureau, 2010). In 1994, severe flood caused by tropical storm Alberto hit Albany, and destroyed parts of downtown and south Albany, causing 15 deaths and displacing almost 22,000 people. Peak discharges greater than the 100-year flood discharge were recorded at all USGS Flint River gauging station (Stamey, 1996). According to a report by USGS, at Albany, the Flint River peaked at a stage about 5 ft higher than the 1925 flood, which was the previous maximum flood at that gauging station.

Many properties in flood hazard zones as designated by FEMA map have not experienced a flood in decades. On the contrary, there could be cases of properties designated as "outside the floodplain" that have unexpectedly experienced floods. In other cases, individuals in the 100-year flood plain may erroneously think that since they have experienced a flood, there will not be more flooding in 100 years. In these cases the cost associated with living in a flood prone area may not be adequately internalized by homeowners. Individual often neglect low-probability events (Tversky and Kahneman, 1973). Homeowner's perception of risk is a function of personal experience with floods, the history of past flooding in the community, the level of risk that exists and how each individual responds to risk (Holway and Burby, 1990). Consistent with Tversky and Kahneman's "availability heuristic" (1973), which postulates judgment of probability or frequency to be reflective of the availability of information or recall of specific events related to evaluation of hazard under consideration, we hypothesize that the occurrence of an event leads to revision of subjective likelihood as past scenarios can be envisioned.

According to FEMA, nearly 20,000 communities across the United States and its territories participate in the National Flood Insurance Program (NFIP) enacted in 1968, by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities. Community participation in the NFIP is voluntary. In order to actuarially rate new construction for flood insurance and create broad-based awareness of the flood hazards, FEMA maps 100-year and 500 year flood-plains in participating communities.

Albany, Georgia is one of the participating communities in NFIP since 1974. Homes and buildings in high risk flood areas, those with 1% or greater chance of flooding in any given year and with mortgages from federally regulated or insured lenders are required to have flood insurance.[1] There were 1,668 houses in the100-year floodplain that were sold between the 1985 and 2010 and there are only 1486 policies in force from 1978 to 2011 (FEMA, 2011), which suggests that the uptake of flood insurance is less than complete, but more houses in the 100-year flood plain did have insurance compared to houses in 500-year floodplain because of the mandatory law. Figure 1 maps the Flint River, housing units and the associated floodplains (100-year; 500-year and outside floodplain) for Albany region. Almost 8% of the properties sold between 1985 to 2010 fall in 100-year floodplain and almost 1.2% of the properties fall within 500-year floodplain.

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[1] The 1% probability is equivalent to 26% of flooding during a 30 year mortgage.

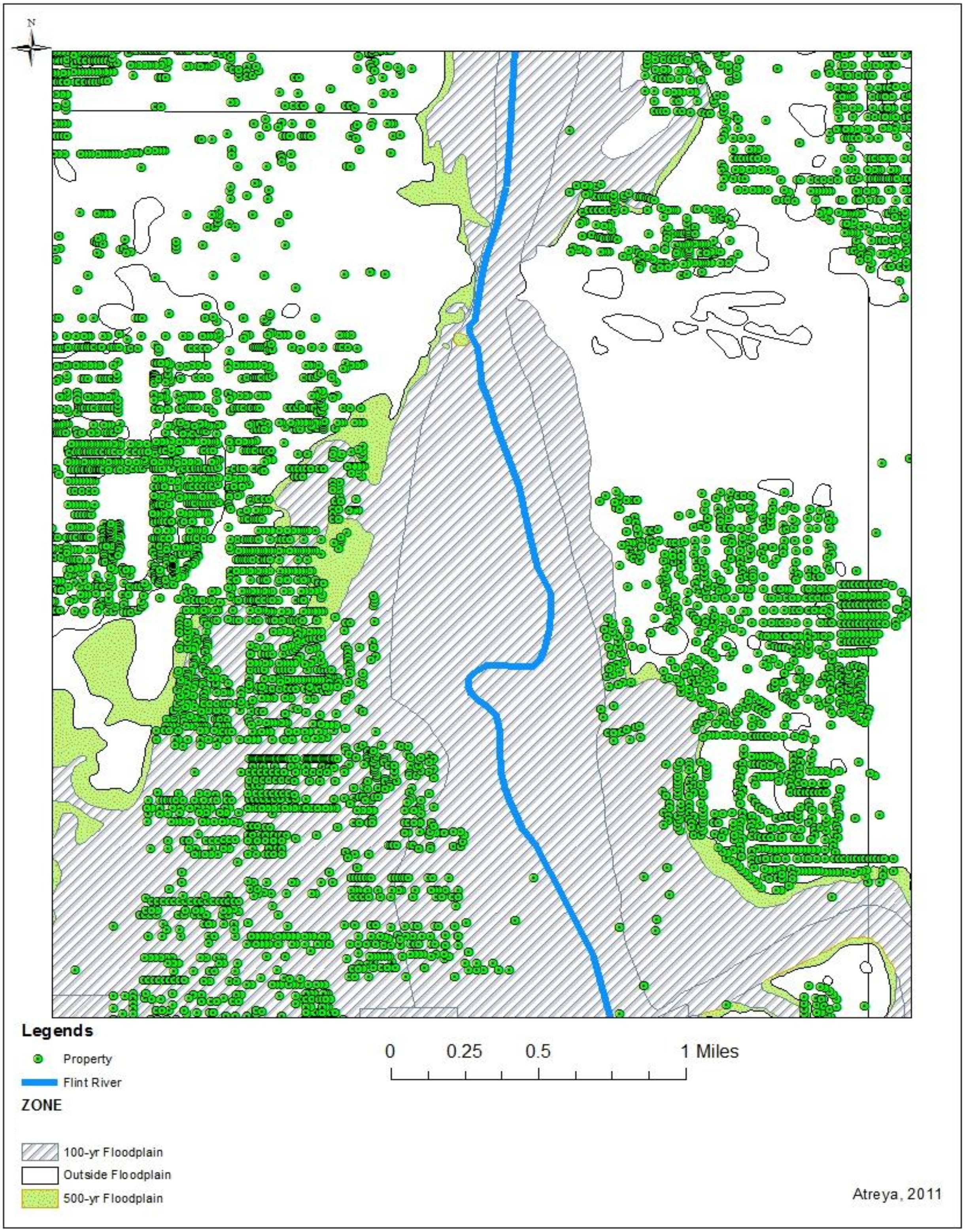
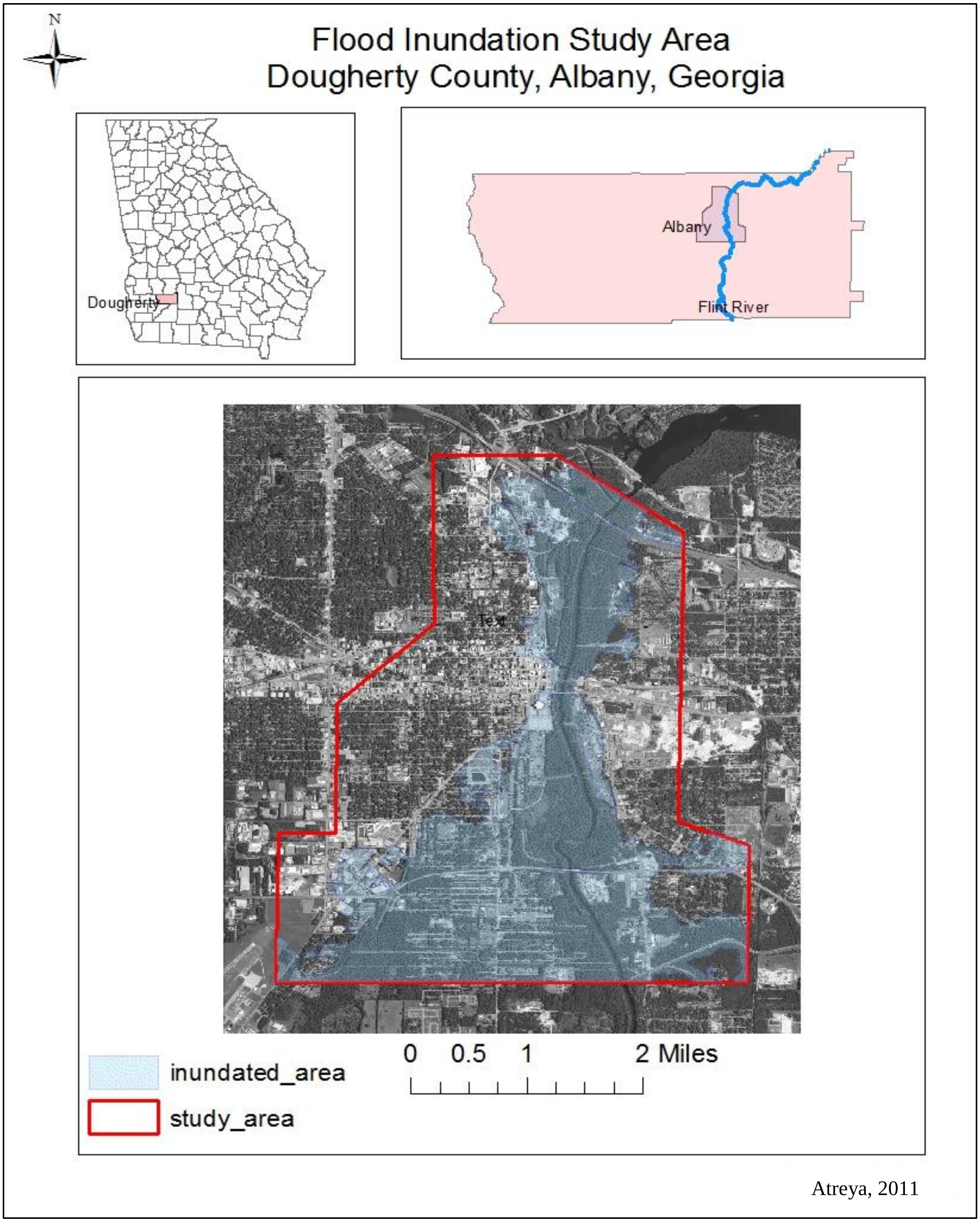


Figure 1: Flint River and FEMA designated Flood Plains in Albany, Georgia

In addition to the FEMA hazard maps, we also use maps of the area that was actually inundated by the 1994 flood in Albany. With a major goal of reducing vulnerability of people and areas most at risk from natural hazard; United States Geological survey (USGS) along with partners the National Weather Service (NWS), U.S. Army Corps of Engineers (USACE), the Federal Emergency Management Agency (FEMA), state agencies, local agencies, and universities have developed a web-based tool, for flood response and mitigation. It provides digital geospatial flood-inundation maps that show flood water extent and depth on the land surface. USGS have modeled potential flow characteristics of future flooding along a 4.8-mile reach of the Flint River in Albany, Georgia, that was simulated using recent digital-elevation-model data and the U.S. Geological Survey finite-element surface-water modeling system for two-dimensional flow in the horizontal plane. Simulated inundated areas, in 1-foot (ft) increments, were created for water-surface altitudes at the Flint River at Albany stream gage from 179.5-ft altitude to 192.5-ft altitude. 192.5-ft altitude corresponds to 1994 flood stage at Flint River caused by tropical storm Alberto. In our study we have used simulated flood inundation for a water surface altitude of 192.5 feet at Albany stream gauge as an actual inundation map, which is eventually used to locate actual flood hazard zone. Figure 2 shows the study area and the inundated area when the water surface altitude is 192.5 feet at Flint River, which corresponds to the 1994 flood caused by tropical storm Alberto.



Atreya, 2011

Figure 2: Flood Inundation Study Area, Albany, Georgia

3 Methods

Hedonic models (Freeman, 2003, Rosen, 1974) have been extensively used to estimate the contribution to the total value of a property attributable to each characteristic possessed by the property. In general, structural characteristics of the houses have been shown to have significant impact on the price of house. Hedonic model has also been proven to be an effective tool for estimating the effects of changes in environmental quality on housing price since its earliest uses in property value studies in the late 1960's (Halstead, et al., 1997). Previous studies have used hedonic pricing models to examine the effect of flood risk on property values (Beatley, et al., 2002, Bin and Kruse, 2006, Bin, et al., 2008, Harrison, et al., 2001, MacDonald, et al., 1987, Shilling, et al., 1985, Speyrer and Ragas, 1991). Consistent with earlier studies we use hedonic model to determine the shadow value of non market environmental commodities such as the flood risk. In hedonic property models (Freeman, 2003, Rosen, 1974), the price of a property, P, is modeled as a function of structural characteristics, S, (e.g. number of rooms, size of the house), neighborhood and location characteristics, L, (e.g. distance to river, distance to parks), and an environmental variable of interest, in this case flood risk, R.

$$P_{it} = \beta_0 + \beta_1 L_i + \beta_2 S_{it} + \beta_3 R_i + \varepsilon_{it} \qquad (1)$$

In equation (1) subscripts i and t represent property and time respectively. β_3, the coefficient on the risk variable, captures homeowners' perception to flood risk. For choosing functional form in hedonic model, the only guidance provided is that the first derivative with respect to environmental characteristics be negative if the characteristic is a "bad" and vice versa (Halstead, et al., 1997). Most of the studies have used natural log of price as the dependent variable in their hedonic regression as it is usually normally distributed (Bin and Polasky, 2004, Kousky, 2010). We performed Box-Cox transformation of the dependent variable and after comparing the residual sum of squares it was concluded that the natural log of price as the dependent variable was the best specification for our model as well. After testing several transformations of the independent variables the location variables were best fitted in their log form while the other attributes were fitted best in their quadratic specification which is consistent with the functional form used by Bin and Polasky (2004).

To capture flood risk, two dummy variables for 100-year floodplain and 500-year floodplain were used. There were more than 800 properties that were in zone D which FEMA defined as "An area of undetermined but possible flood hazard". Including these properties in 100-year floodplain, 500-year floodplain, or in outside floodplain did not change the results. Thus, properties in zone D were dropped from the analysis because of its anonymous nature. Thus, the hedonic model used is,

$$ln\,(P_{it}) = \beta_0 + \beta_1 lnL_i + \beta_2 S_{it} + \beta_3 100yrFP_i + \beta_4 500yrFP_i + \gamma_i + \delta_t + \varepsilon_{it} \qquad (2)$$

The variable 100yrFP (100-year floodplain) in this model is a dummy equal to 1 if the property falls within the 100-year floodplain and 0 otherwise. Similarly, the variable 500yrFP (500-year floodplain) is a dummy equal to 1 if the property falls within 500 year floodplain and 0 otherwise. Census tract fixed effect (γ_i) was included to control for possible omitted variables such as crime rate or any other significant variables at the census tract level. Year fixed effect (δ_t) were also included to capture yearly shocks if any. White's method was used to get estimates of standard error that are corrected for potential heteroskedasticity.

In order to determine the effect of 1994 flood on the property prices the Difference-in-Difference (DD) model below was used,

$$ln\,(P_{it)} = \beta_0 + \beta_1 lnL_i + \beta_2 S_{it} + \beta_3 100yrFP_i + \beta_4 500yrFP_i + \beta_5 PostFlood_{it} +$$

$$+ \beta_6 100yrFP_i * \mathit{PostFlood}_{it} + \beta_7 500yrFP_i * \mathit{PostFlood}_{it} + \beta_8 \mathit{years} +$$

$$+\beta_9 \mathit{years} * 100yrFP_i + \beta_{10} \mathit{years} * 500yrFP_i + \varepsilon_{it} \qquad (3)$$

The DD model has been used by previous researchers (Bin and Polasky, 2004, Kousky, 2010) to examine the information effects provided by large floods. In this model we assumed properties that fall in within a floodplain to be the treatment group and properties that do not fall in a floodplain to be the control group. The variable *PostFlood* in DD model is a dummy variable equal to one if the sale happened after the 1994 flood. The interaction of the 100 year floodplain variable (100yrFP) and *PostFlood* tells us how the 1994 flood might have affected the prices of properties that are in the 100-year floodplain and that are sold after the 1994 flood. A similar interpretation applies for the 500-year floodplain and flood dummy interaction.

To examine the persistence of the risk premium over the years after the flood event we used an interaction term between a variable capturing the number of years after the 1994 flood (*years*) and the location in the flood plain variables. The interaction term estimates how the risk premium changed over time after 1994 flood. It is hypothesized that if homeowners are aware of flood hazards, property prices for houses lying within the floodplain will be lower than those of comparable properties lying outside the floodplain. We also hypothesize that the perceived risk will be heightened after a major flood event and the risk premium will lessen as years after flood increases. Rejecting these hypotheses could indicate a need to improve the system of communication of flood risk to homeowners, for example, through effective education, outreach and extension systems.

4 Data

A unique dataset was constructed by merging individual property sales data for residential homes in Albany, Dougherty County from the Dougherty County's Tax Assessor's office for years 1985 to 2010, with a parcel-level Geographic Information System (GIS) database from Georgia's GIS clearinghouse. The property records contain information on housing characteristics (number of bedrooms, number of bathrooms, total square footage, total acres, size of the house, etc.), S in equation (1), as well as sale date and price. All the property sales prices were adjusted to 2010 constant dollars, using the housing price index for Albany metropolitan area from the Office of Federal Housing Enterprise Oversight.

GIS was utilized to measure the distance from each property to important features that could influence property values such as proximity to major roads and highways; distance of properties to nearest railroads, and also to other amenities such as parks and rivers. These variables are denoted by L in equation (1). To measure flood risk, R in equation (1), a GIS layer of Federal Emergency Management Agency's (FEMA) data to identify parcels in 100-year and 500-year floodplains was used. For this analysis, FEMA Q3 flood data published in 1996 which depict 100-year and 500-year floodplains as represented on Flood Insurance Rate maps (FIRMs) are used.

Simulated flood inundation for a water surface altitude of 192.5 feet at Albany stream gauge produced by USGS was used to determine the extent of 1994 flood. The parcel map was overlaid onto the inundated area to determine the properties that were inundated by 1994 flood. After dropping properties for which data were missing, properties that sold for less than $2,000or more than $10 million,[3] more than 21,000 sales were included in the data.

Table 1 provides definition and summary statistics for each variable. The mean property value in 2010 constant dollar was found to be $111,553. The mean age of the property was almost 30 years with the oldest home built in 1841 and the newest built in 2010. The mean acre of the property was 0.35.The maximum number of bedrooms was 30 with 7 maximum full baths and 2 maximum half baths. The mean distance to river Flint was 274 feet. Twenty seven census tracts were included as fixed effect. Of all sales between 1985 and 2010 almost 8% of the houses were in high risk zones such as 100 year floodplain and almost 2% of the houses were in 500 year floodplain.

5 Results

5.1 Flood Risk Discount: Flood Plains as Proxy to Flood Risk

The estimates of the pooled regression are presented in Table 2. Column 1 shows the pre flood discount estimates and column 2 is the estimation result for DD model. All coefficients for structural housing characteristics have the expected sign and most of the parameters are statistically significant. The quadratic specification seems to capture diminishing marginal effect for acres, age, bedrooms, and full baths half baths. The results indicate that proximity to Flint River, ponds, roads, utility lines, and parks increased the property prices significantly except for proximity to parks which was insignificant. Proximity to school and railroad was found to have insignificant negative effect on property prices.

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[3] Sales less than $2000 were probably transfers and not true sales. There were just two properties that were over $10, 000000.

Using the pre-flood data it was found that there was a significant 8.5 percent discount associated with property in 100 year floodplain but no significant discount was associated with property in 500 year floodplain. For the average priced home the discount is equivalent to almost $9,822. This discount is more than the present value of insurance premium under discount rates of 5% i.e. $ 6750 for an average valued home ($125K) and less than discount rate of 3% i.e. $11,233. Flood insurance premium for single-family houses in 100-year floodplain without a basement and with estimated base flood elevation of 3 feet or more is equal to $337 for an average valued house[4]. The marginal effect of flood risk is calculated by multiplying the risk coefficient with the mean property price. The elevation variable seems to have significant effect on the sales price of the property. There is some premium associated with elevated homes, though in a very small amount.

Table 2, column 2 shows the effect of 1994 flood on the estimated discount for property prices within the floodplain. Assuming that properties outside the floodplain represent a valid control group, the causal effect of the change in information, attributable to major flood event on flood prone property values are reflected in the coefficient for interaction term between flood and floodplain variables. The result indicated that the average property value for 100 year floodplain did not drop significantly probably because there was a significant discount of almost 19% for properties in 100 year floodplain even before 1994 flood. However, properties in 500-year floodplain decreased by 32% after 1994 flood. We also examined the information decay effect in column 2. It was found that the decay effect was prominent and was statistically significant for both 100-year and 500-year flood zones indicating that the information effect associated with 1994 flood receded over time which is consistent with the theory of availability bias. For 100-

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[4] Using 0.27 as annual post firm construction rate per $100 of coverage as designated in NFIP flood insurance manual, effective January 1, 2011.

year floodplain the information effect decreased by almost 2% and for 500-year floodplain it decreased by almost 5%. The coefficient of the year and floodplain interaction term suggested that the decay effect vanished after 1999 i.e. five years after the flood event.

We believe that this finding of higher discount for property in 500-year floodplain is plausible. Homeowners in the 100-year floodplain are mandated to buy flood insurance so they are likely to discount the property price to accommodate their insurance cost, but property in 500-year floodplain are not required to buy flood insurance, so homeowner's have less information regarding flood risks. After the 1994 the information updating effect of the flood is thus, more likely to be important for the 500-year floodplain properties.

5. 2 Flood Risk Discount: Actual Inundation Map as Proxy to Flood Risk

Table 3 shows the result of using the actual inundation map as a proxy for flood risk. Assuming the properties outside the inundated area represent a valid control group, the results indicated that after 1994 flood, homeowner's discounted the property that was inundated by almost 46%, consistent with the notion that people respond better to what they have visualized. However, it is also possible that some of the houses have been badly affected by the food and require costly clean-up and reconstruction investments. The 46% discount is equivalent to $53,154 for an averaged valued home in Albany. However, with the inundated areas also, it appears that the information effect decay with time as suggested by positive and significant interaction term between inundated area and years after 1994 flood. The information effect seems to decay at the rate of 6.2% per year.

6 Conclusion

This study offers evidence of the effect of 1994 flood on flood prone properties in Albany, Georgia. The estimates of the effect of property location within a floodplain in property prices is found to be consistent with the results from previous researchers (Bin and Polasky, 2004, Kousky, 2010) that the price of property located within floodplain is lower than property located outside a floodplain. But, interestingly the Albany residents discounted the property in 100-year floodplain well before 1994 flood indicating availability of some prior information. There was no significant discount for the property in 100-year floodplain after the massive flooding caused by tropical storm Alberto in 1994. Perhaps, because of prior recognition of the risk of being in 100-year floodplain the flood damage was no surprise to homeowner's in 100-year floodplain. The discount for property in 100-year floodplain being higher than the present value of insurance premium under discount rate of 5% indicate the substantial uninsurable cost such as emotional attachment with the property is perceived by homeowners.

We find the flood to have a marked impact on prices of properties in the 500-year flood plain, those for which flood risk awareness was probably more limited as they were not required to acquire flood insurance. However, sale price differential was not significant for properties in 500-year floodplain before the flood indicating the homeowner's were in fact unaware of the risk of being located in 500-year floodplain. Consistent with the theory of availability bias risk perception receded over time and was found to be nonexistent after five years of the flood event.

In addition, this study is the first one in using actual inundation maps to measure flood risks. Using the actual inundation map, the results are not surprisingly more marked. The discount for property that was actually inundated was as high as 46%, well above the discount for properties in 100-year and 500-year floodplain suggesting that actual flood reinforces the perceived risk. However, the impact of actual flood in property prices is also short-lived. The overall result suggests that the risk perception is pronounced in the years immediately after significant flood event but diminishes over time.

Table 1: Variable and Descriptive Statistics

Variables	Description	Mean	Std. Dev.	Min	Max
Price	Sale Price of property adjusted to 2010 constant dollars	115553.5	134797.1	2154	6524000
Structural Variables					
Year	Sale Year of the house	1999	6	1985	2010
Yearbuilt	Year the property was built	1969	20	1841	2010
acres	Total acreage of the Property	0.4	1	0	32
bedrooms	Number of bedrooms in the house	3	1	0	30
fullbths	Number of full bath in the house	2	1	0	7
halfbths	Number of Half Bath in the house	0	0	0	2
fireplace	Total number of fireplaces	1	1	0	8
Location Variables					
River	Distance to Nearest River in feet	2176.97	1548.17	10.67	7695.50
Flint	Distance to Flint River in feet	16637.67	10033.41	274.36	38899.20
Lake	Distance to Nearest lake in feet	1716.26	1214.70	0	6410.27
Park	Distance to Nearest Park in feet	8425.79	5485.22	148.41	24556.20
Railroad	Distance to Nearest Railroad in Feet	6216.87	5029.40	51.87	21872.50
Road	Distance to Nearest Road or Highway in feet	131.51	119.76	0.02	1383.66
Utility	Distance to nearest utility lines in feet	9253.60	4868.07	125.75	21944.60
School	Distance to Nearest school in feet	3838.69	2550.00	83.51	13591.50
Flood Variables					
100 yr Floodplain	An area inundated by 100 year flooding	0.08	0.31	0	1
500 yr Floodplain	An area inundated by 500-year flooding	0.01	0.11	0	1
Outside Floodplain	An area that is determined to be outside the 100- and 500-year floodplains	0.91	0.29	0	1
Dummy variables					
Inundation	1 if property is within inundated area				
PostFlood	1 if property is sold after 1994 Flood				
Fixed Effects	Census Tract, Year				

Table 2: Hedonic Regression: Floodplain as Proxy to Flood risk

VARIABLES	(Before 1994) lnprice	(1985-2010) lnprice
100yr FP	-0.0855*	-0.191***
	(0.0444)	(0.0363)
500yr FP	0.0416	-0.0463
	(0.0933)	(0.0876)
PostFlood		0.143
		(0.608)
PostFlood*100yr		0.0429
		(0.0537)
PostFlood*500yr		-0.329**
		(0.138)
Years		-0.0177
		(0.0389)
100yr FP*years		0.0177***
		(0.00458)
500yrFP*years		0.0487***
		(0.0111)
elevation	0.00298***	0.000760
	(0.000892)	(0.000477)
Ln (River)	-0.0491***	-0.0198**
	(0.0152)	(0.00781)
Ln (Flint)	-0.192***	-0.0121
	(0.0422)	(0.0232)
Ln (Lake)	-0.0886***	-0.0279***
	(0.0171)	(0.00857)
Ln (Railroad)	0.0179	-0.00596
	(0.0195)	(0.00980)
Ln (Road)	-0.0216**	0.000504
	(0.00873)	(0.00454)
Ln (Utilities)	-0.0966***	0.0212
	(0.0305)	(0.0159)
Ln (Park)	-0.00662	-0.0271*
	(0.0292)	(0.0147)
Ln (School)	0.0119	0.00143
	(0.0198)	(0.0103)
acres	0.169***	0.107***
	(0.0525)	(0.0167)
acresq	-0.0763***	-0.00554***
	(0.0166)	(0.000864)
age	0.0249***	0.0107***
	(0.00152)	(0.000764)
agesq	-0.000310***	-0.000201***
	(2.14e-05)	(1.02e-05)
bedrooms	0.310***	0.0769***
	(0.0929)	(0.0137)
bedsq	-0.0320**	-0.00215***
	(0.0139)	(0.000591)

Table 2: Continued

fullbths	0.251***	0.346***
	(0.0619)	(0.0311)
fullbathsq	-0.0204	-0.0295***
	(0.0135)	(0.00676)
halfbths	0.207	0.0828
	(0.234)	(0.0961)
halfbathsq	-0.0589	0.0500
	(0.230)	(0.0933)
sqfeet	2.84e-06***	8.72e-07***
	(9.28e-07)	(1.43e-07)
sqft_sq	0***	-0***
	(0)	(0)
Garage	-0.0140	0.0776***
	(0.0272)	(0.0143)
Fireplace	0.116***	0.0959***
	(0.0241)	(0.0119)
AC	0.213***	0.152***
	(0.0362)	(0.0181)
brick	0.0332	0.0402
	(0.0558)	(0.0375)
Constant	12.71***	10.78***
	(0.642)	(0.336)
Census Tract Fixed Effect	Y	Y
Year Fixed Effect	Y	Y
Observations	4,889	21,030
R-squared	0.422	0.365

Table 3: Hedonic Regression: Actual Inundation Map as Proxy to flood Risk

VARIABLES	(1985-2010) Lnprice
inundation	-0.170*
	(0.0905)
PostFlood	0.304*
	(0.179)
PostFlood*inundation	-0.459***
	(0.115)
Years	-0.0325***
	(0.00908)
Inundation*years	0.0626***
	(0.00921)
elevation	-0.00296
	(0.00306)
Ln (River)	-0.0406
	(0.0328)
Ln (Flint)	0.0484
	(0.0780)
Ln (Lake)	-0.0318
	(0.0490)
Ln (Railroad)	-0.0881**
	(0.0418)
Ln (Road)	-0.0235
	(0.0145)
Ln (Utilities)	0.0412
	(0.133)
Ln (Park)	-0.116
	(0.0751)
Ln (school)	-0.0737*
	(0.0406)
Constant	13.94***
	(1.725)
Structural Attributes	
Census Tract Fixed Effect	Y
Year Fixed Effect	Y
Observations	3,007
R-squared	0.195

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