Hurricanes, Catastrophic Risk and Real Estate Market Recovery

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Executive Summary. *We gather data from the Cape Fear region of North Carolina, an area at elevated exposure to hurricanes and catastrophic risk, in support of three main objectives: First, we affirm an earlier documented pattern of price declinations with successive landfalls; second, we discover a tempering of this trend in the years after the last major strike in 1999; third, we construct a test statistic for the timing and intensity of the real estate market reaction to perceptions of catastrophic risk. A Chow test is used to frame market responses to repeated hurricane landfalls in the study area. The test reveals a structural shift in the housing market in the periods following the last two in a series of four hurricanes. We find that home prices recover and market stability returns in the years following the last storm. Our findings are important to varied stakeholders in the coastal real estate market.*

Key Words: Hurricanes, catastrophic risk, real estate markets, housing prices

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1. Introduction

The Cape Fear region of North Carolina, near the South Carolina border along the Atlantic coast, experienced four hurricane landfalls between 1996 and 1999; Hurricane Bertha and Fran struck within two months of one-another late in the summer of 1996, with Bonnie coming ashore in August of 1998 and Floyd in September of 1999. The real estate market seemed to exhibit no grave consequence following the storms of 1996, an outcome we affirm with this study, but responses following Bonnie and Floyd were successively more extreme and more immediate. The years following Floyd have framed a recovery in the housing market. This is the first study to document these patterns, to describe a market's possible confusion over its exposure to catastrophic risk, and to affirm that market's "recovery" as the time since the last major hurricane passes and memories fade.

A substantial literature considers the impacts of catastrophic events such as floods, earthquakes, and hurricanes on real estate values. The academic and practitioner press remark on the personal and financial costs of these events; suggestions vary from encouraging greater government involvement in the prediction of natural disasters to more focused lender, builder, and insurance measures to minimize losses when these catastrophes occur.

Among these studies, Graham and Hall (2001, 2002) highlight the impact on the housing market of increasing expectations of one particular catastrophic risk – hurricanes. The authors find that with increased expectations of catastrophic risk following a period of unprecedented hurricane activity, both home values and real estate market sentiment suffer. They examine transactions in the area around Wilmington, North Carolina, – the Cape Fear region – a coastal community portrayed in Figure 1. Graham and Hall report a declination in home values following the last in a series of hurricane strikes, the market effectively "giving up" and throwing in the towel after four hurricane landfalls in as many years. Likewise, they report that market sentiment - as evidenced by declining monthly home sales and widening relative spreads between asking and selling prices - deteriorates following the last of these hurricanes.

A premise is forwarded in those studies that the market is able to "shrug off" the first one or two hurricanes as "bad luck," but with Hurricane Bonnie in 1998 and Hurricane Floyd in 1999, perceptions of the likelihood of hurricane strikes in the study region may have changed, and with increased expectations of hurricane activity and hurricane damage, home prices and the housing market suffer. No circulating study, though, examines the duration of the change in the housing market or the recovery of home values following periods of perceived increased catastrophic risk; nor does any study consider the depth of the structural shifts in the market that may take place around the time of hurricane landfalls.

Bin and Kruse (2006) and Bin and Polasky (2004) echo Graham and Hall (2001), finding property values negatively associated with both hurricane flooding and exposure to storm surge wave action; their studies employed data from an area just north of the Cape Fear region. Curiously, this pattern of property value declinations concomitant with hurricane strikes is not reflected with recent anecdotal evidence along the Gulf coast. There, broadcast and daily media report that with the sudden availabilities of broad tracts of land near Biloxi and Gulfport, effectively cleared by Katrina, prices have risen significantly in the months following that hurricane's devastating landfall.

We consider the recovery of home values and the restoration of a less volatile housing market in the Cape Fear region, following the hurricanes of the late '90's. While the area's reputation of greater exposure to hurricane risk has passed, over the past few years, to points further south and along the Gulf Coast, in the period examined this is not yet the case. While no evidence is cited here affirming changing probabilities of hurricane strikes in a given area, homeowner perceptions of probabilities nonetheless influence real estate market behavior, as frightened prospects cancel plans to move to an at-risk area and as existing residents move. The timeliness of this examination, thus, is underscored by the South Florida hurricane landfalls of 2004, and the devastation of Hurricanes Katrina, Rita and Wilma in 2005, though these storms were far removed from the Wilmington area.

We review other examinations of real estate values and catastrophic risk in the next section. We describe our data and methodology in the third section, where we employ a Chow test to capture patterns of home value changes over time; we then discuss a structural change in the determination of these values in the periods soon after successive hurricane strikes. This change becomes more evident with recurring strikes, and tempers in the years following the most recent hurricane landfall. We conclude with a summary and a consideration of the implications of our findings for varied stakeholders in the coastal real estate markets.

2. Background

Natural disasters and catastrophic risk are shown, by several authors, to influence property values. Pedrozo (1998) finds a "small significant [residential price] change for one month only" following the 1994 Northridge earthquake in Los Angeles. He suggests the market suffers no long run measurable and significant impacts from the Northridge 'quake. Brunette (1995) considers the impacts of the 1989 Loma Prieta earthquake in San Francisco, Hurricane Andrew in 1992 in South Florida, and the Northridge earthquake. He finds no significant reduction in commercial property returns in either San Francisco or Miami that are attributable to the catastrophic events in those regions. He finds no clear link between the 1994 Los Angeles earthquake and property values. Murdoch, Singh, and Thayer (1993) also examine the impact of the Loma Prieta earthquake. After providing a set of control variables, Murdoch et al. find the earthquake had an impact of only around two percent on housing prices. MacDonald, Murdoch, and White (1987) study the impact of flooding expectations on property values in Monroe, Louisiana. These expectations are precursors to reductions in home values of less than three percent; these home value impacts are found to be equivalent to the present value of increased insurance costs borne by homeowners at flood risk. Anecdotally, insurance premiums do not dramatically increase in our study area during the study period (1995-2002); noteworthy increases occur in the years following the unprecedented seasons of 2004 and 2005, suggesting any observed changes in home values in the Cape Fear area near the end of the last century cannot defensibly be tied to insurance costs.

Recent work by Simmons, Kruse and Smith (2002) considers the relationship between housing prices and hurricane risks. These authors consider the impact on housing values of a homeowner's investment in hurricane mitigation, including such improvements as storm blinds and structural enhancements to the home, and find that homebuyers value these self-insurance expenditures by home sellers. In their study area, one at perceived elevated hurricane risk similar to the Cape Fear region, home values were enhanced with the improvements, highlighting the awareness by the market of the increased risk exposure of the sample homes.

Many factors other than catastrophic risk influence home values. Among these, factors having a positive impact on housing prices include the property's proximity to a golf course (Do and Grudnitski, 1995) or the ocean (Rush and Bruggink, 2000) or a nearby resort (Spahr and Sunderman, 1999). New residential construction nearby has a positive effect on property values (Simons, Quercia, and Maric, 1998), as do "mature" trees on the property (Dombrow, Rodriguez, and Sirmans, 2000). Condominium age restrictions (Allen, 1997), and expectations of local urban development (Isakson, 1997 and Guntermann, 1997) seem also to have a positive impact. A developer's "good will" (Chau, Ng, and Hung, 2001) is shown as well to favorably influence home prices. Nuclear power plants nearby (Gamble and Downing, 1982) and airport noise (Nelson, 1980), as well as proximate underground storage tanks (Simons, Bowen, and Sementelli, 1997) are shown to adversely affect home prices. Prices suffer also in high crime areas (Buck, Deutsch, and Hakim, 1991), in neighborhoods with "undesirable" traffic (Nelson, 1980), in areas with significant air pollution (Nelson, 1978), and for property near a landfill (Mohanty, Reichert and Small, 1992).

None of the studies above, however, seek to describe real estate market behavior and home prices in the fashions contemplated by this study. Real estate pricing changes and the actions of real estate market participants do not lend themselves easily to traditional financial or economic theory. The real estate market, noted for its high transaction costs and abbreviated flows of information, is not as efficient as capital markets, as real estate products are relatively illiquid, and the ability of real estate prices to reflect quickly or fully relevant information is far less than in the securities markets. However, we are able to develop a set of functions that can be used to gauge the impact of catastrophic perceptions that may exist in this real estate market.

3. Research Methods

To begin our study, home selling data are gathered for the Cape Fear region around Wilmington, NC, an area at elevated hurricane risk. (See, again, Figure 1.) Monthly housing sales data between December of 1995 and March of 2002 for the contiguous New Hanover, Brunswick, and Pender Counties in southeastern North Carolina are collected. This information on single-family housing prices is obtained from the Multiple Listing Service

(MLS) and the Greater Wilmington Association of Realtors. Additional data on regional economic activity and average mortgage rates, provided by the federal government, are gathered, as well.

Descriptive data are provided in Table 1. Such unavailable factors as home age and size are not provided in the data set – sales of several hundred homes per month precluded the realistic gathering by hand of such data – but sufficient information is given to construct a set of meaningful models. There, a general pattern of increasing home values is observed. Prices at Wrightsville Beach and other areas closer to the coast are higher, with values most removed from the beach the lowest in the study region. Unit sales are significantly higher in selected eastern and southwestern areas of New Hanover County, with unit sales in Wrightsville Beach and counties adjacent to New Hanover typically much lower.

[TABLE 1 ABOUT HERE]

Inasmuch as we wish to ascertain the degree to which the market's perception of catastrophic risk in the late 1990's and very early 2000's increases and then diminishes, we examine data gathered between late 1995 and mid-2002. Data containing escalating valuations, independent of catastrophic risk expectations, may complicate any attribution of the escalations to any single or set of factors, so we employ a "time" factor below to capture these increasing valuations, that are independent of our selected explanatory factors; if price increases are merely the result of second-home-purchase escalations early this century, for example, we provide controls for that outcome. We direct our examinations towards anticipating market behavior in recent hurricane-exposed and hurricane-damaged markets, using data from this earlier-exposed and affected region.

3.1 Housing Values

We first seek to affirm earlier discoveries of the relationship between successive hurricane strikes and housing values in the Cape Fear Region. Following Graham and Hall (2001), we estimate home prices as a function of time, macroeconomic variables, location within the study region and the series of hurricane strikes ending in the fall of 1999. We use the following model (between December of 1995 and March of 2000; months zero to 54) to discover the strength of Graham and Hall's findings: that housing prices are negatively associated with the last in a series of four hurricanes. Here, we estimate Model (1):

$\text{Ln (Real Price)} = \beta_0 + \beta_1 \text{ Time} + \beta_2 \text{ LnRRS} + \beta_3 \text{ Turn} + \beta_4 \text{ New Listings} + \beta_5 \text{ RIR}_{t-2} + \beta_6 \text{ Fran} + \beta_7 \text{ Bonnie} + \beta_8 \text{ Floyd} + \beta_9 \text{ Coast} + \beta_{10} \text{ SWNHC} + \beta_{11} \text{ NWNHC} + \beta_{12} \text{ Pender} + \varepsilon$, where:

Ln (Real Price) is the natural logarithm of the inflation adjusted home selling price.

Time is a counter variable (0,…,54) for the initial 55 months in the data set (month 0 is December, 1995 and month 54 is June 2000).

LnRRS is the natural log of the area's real retail sales, and serves as a proxy for the area's economic activity.

Turn is a measure of the health of the local real estate market, and is the last month's unit home sales divided by the available units in the listed housing inventory.

New Listings is the number of listings added during the month.

RIR_{t-2} is the real interest rate, provided by the FED, lagged two periods.

Fran, Bonnie and Floyd are the products of the dummy variables for the periods after each storm and the monthly time variable, squared, respectively.

Coast is an indicator variable for home sales in coastal areas including Northeast New Hanover County, Southeast New Hanover County, Wrightsville Beach, Pleasure Island, Brunswick County and Coastal Pender County. Coastal areas are typically within two-three miles of the Atlantic coast, with many properties on the waterfront.

SWNHC is a dummy variable for a home in Southwest New Hanover County.

NWNHC is a dummy variable for a home in Northwest New Hanover County.

Pender is a dummy variable for a home in the non-coastal region of Pender County.

The error term completes the model.

We also estimate the model using an updated and complete data set through month 76 (March 2002). We expect, with both data sets, that selling prices will increase over time, with economic and real estate activity positively associated with home values. The time variable also captures any escalation of real estate values attributable merely to an overall increasing market, allowing the more meaningful hurricane factors below to partition that element of price changes associated with the hurricane landfalls.

We believe a greater turnover of the available housing inventory will be associated with higher prices. We posit a greater number of new listings will be associated with an over-supplied market and declining prices, though we acknowledge that more new listings could be associated as well with a vibrant market marked with accelerating sales activity and many new listings. A negative relationship is expected with interest rates, which are lagged two months; this is an intuitive estimate of the typical delay between homebuyers making a purchase and borrowing decision and the sale being reported by the local Realtors. We expect market indifference to Fran and Bertha in 1996, as little more than bad luck, with successively greater averse responses to Bonnie in 1998 and Floyd in 1999; however, with the full 76-month data set, we expect the explanatory power of all the hurricanes to diminish, as the market's memory of those destructive events fades. The hurricane factors are also expected to capture non-linear components of the changes in home values over time, with the relative significance of those factors a function of the importance of the landfalls themselves in describing changing house prices. The greatest real estate values will be reported for the coastal regions, with the lowest values west and north of Wilmington.

[TABLE 2 ABOUT HERE]

Results portrayed in Table 2 are generally in line with our expectations, though some of the findings are surprising. Home values are increasing over time, and are greater with an increasing inventory turnover. Rising rates do not favor home values. Hurricane Floyd, in the initial examination of the data prior to March of 2000, is associated with a negative and significant change in home prices; given the manner with which the dummy variables for the hurricanes are assembled, this suggests that selling prices, in the months following Hurricane Floyd, are at first lower than would be the case in the absence of a hurricane landfall in the study region. Moreover, in this application of Model 1, prices are still increasing at an increasing rate following Fran and are neutral following Bonnie.

Geographic indicator factors and the new listing variable coefficients are generally in line with expectations. Results in Table 2 also support our expectations for the months and years following the last major hurricane strike in the study area. As time passes, we expect the market to become forgetful, and for the effects of the hurricane strikes to be tempered. This expectation is borne out in the last two columns of Table 2. There, we see that while the majority of the signs and significance levels of the independent variables are unchanged, the negative effect with Floyd becomes insignificant. Results in Table 2 suggest that a marked relationship exists between hurricane landfalls and selling prices in the late 1990's and early in 2000. Examination of the extended data set for the months through early 2002 indicates that a structural shift has taken place in more recent years.

It is tempting to attribute the price declinations following the most recent storm to the time required to clean up and repair homes, but this attribution is erroneous; Fran is far and away the most damaging of the storms, relative to the memorable but far more modest Hurricanes Bonnie and Floyd. (Hurricane Bertha, a Category 1 hurricane, struck in July of 1996 followed by Hurricane Fran less than two months later.) Hurricane Fran's strongest gusts exceeded 120 mph, with Bonnie and Floyd between 95 and 105 mph. Fran's storm surge (over eight feet), as well, far exceeded either Bonnie (five feet) or Floyd (six feet). Yet the market "recovers" very quickly following Fran (and Bertha, her predecessor), with far greater disruptions observed following Bonnie and Floyd. Something other than home repair, or price concessions for damaged homes, is at play in the housing market following this series of storm strikes; the home repair following Fran was far greater, with hardly a ripple observed following Fran in the housing market at large.

Towards further describing these results, and explaining the anomaly noted above, we model home prices independent of hurricane strikes and formally test for structural change.

We consider prices over time, such that any underlying pattern might be revealed absent an explicit focus on successive hurricane strikes. Potential structural changes in these models can then be examined at break points that coincide with the months surrounding hurricane strikes. Among several specifications considered, the two models presented below provide the best approximation for housing prices in terms of overall fit and signs and significance of individual coefficients. We first estimate Model (2) for the entire 76 months:

$\text{Ln (Real Price)} = \beta_0 + \beta_1 \text{ Time} + \beta_2 \text{ Time-squared} + \beta_3 \text{ Turn} + \beta_4 \text{ New Listings} + \beta_5 \text{ DOM} + \beta_6 \text{ Coast} + \beta_7\text{SWNHC} + \beta_8 \text{ NWNHC} + \beta_9 \text{ Pender} + \varepsilon,$

Time-squared captures the non-linearity of the relationships over the study period, and is equal to the coded numerical value (0,1,…,75) of the month in the series, squared. The non-linearity is captured in the first model by the hurricane dummy variables. DOM is the average number of days that homes listed for sale have been on the market; all other variables are as described with Model (1).

Our concern here is with modeling housing prices as accurately as possible, absent any concern about that impact of hurricanes. Discovering a more satisfactory function to model prices, we can then test for structural changes in the model that might be related to tropical storms. Hence it is the overall fit of the modeling effort that is our primary concern. In Model (2), prices are a quadratic function of time and other variables hypothesized to influence prices. Relative to Model (1), a better fit is provided with two new factors, the time-squared and DOM variables. We expect the sign of the time variable to be positive and that on time-squared to be negative, as we believe prices are increasing in the Cape Fear Region at a decreasing rate. We expect again that the turnover of the available single-family housing supply will be positively associated with home values. An increase in the number of homes added to the existing market inventory suggests increasing supply conditions, which should decrease selling prices. The sign for DOM may be positive or negative; more days on the market suggest favorable conditions for buyers, yet homes with higher values could take longer to sell. As homes on the coast generally command higher prices, we expect a positive coefficient for the Coast variable, with lower values, generally, elsewhere. The results of Model (2), estimated using data through March of 2002, are shown in Table 3.

[TABLE 3 ABOUT HERE]

The signs of the coefficients are as expected. The concave-down nature of the series is reflected in the positive sign on time and negative sign on time-squared; prices are generally increasing at the start of the series and increasing at a decreasing rate or falling at the end of the series. Other findings are as with Model (1). As the number of houses added to the market inventory increases, signaling more favorable conditions for buyers, home prices, on average, decline. Finally, we note the insignificance of the DOM variable, suggesting any explanatory power it possesses is displaced by other included variables. Homes on the coast clearly command a premium.

3.2 Housing Market Instability

Contrasting results in Table 2 imply that some sort of shift takes place between the end of the original data series in 2000, and the extended data set ending in 2002. Indeed, it is reasonable to assume that the relationships between housing prices and their determinants, particularly the susceptibility of housing prices to hurricanes and perceptions of catastrophic risk, have changed over time. Housing prices are nonstationary, and a break has occurred somewhere during the series. Breaks in any series of data can occur for a variety of reasons (e.g. changes in economic policy, periods of war, or structural changes in industry) and may manifest themselves as discrete changes in regression coefficients at a distinct date, or as a gradual evolution of the coefficients over a longer period of time (see Stock and Watson, 2003, p. 467). To explore this issue further, we perform a Chow test for structural change in the model over time.

Employing the Chow test, we consider two time periods contained in our series: December 1995 – March 2000 and April 2000 – March 2002, recalling that the first series ends six months after the last hurricane strike. If there is no structural change in the model over time and the parameters are stable, the Chow test will reveal that regressions estimated for these two periods are essentially the same, hence the residual sum of squares should not be statistically different between the two periods (Gujarati, p. 223).

If there is a structural change in the model over time, pooling data from the two periods will result in coefficient estimates which only hold on average over the entire time period, and which may not produce accurate fitted values for a particular period within the series. Whether the residual sums of squares are statistically equivalent between the periods can be tested using the following F ratio, which has K+1 degrees of freedom in the numerator and (N_1+ N_2 – 2K – 2) degrees of freedom in the denominator:

$$F = \frac{(RSS_T - RSS_1 - RSS_2)/(K+1)}{(RSS_1 + RSS_2)/(N_1 + N2 - 2K - 2)} \qquad (1)$$

Where: RSS_T is the residual sum of squares from the full data set,
RSS_1 is the residual sum of squares from the first sub-sample,
RSS_2 is the residual sum of squares from the second sub-sample,
K is the number of estimated slope parameters in the equation,
N_1 is the number of observations in the first sub-sample, and
N_2 is the number of observations in the second sub-sample.

For each regression, the residual sum of squares (RSS) is given by:

$$RSS = \sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2 \qquad (2)$$

Where, Y_i is the i^{th} observation on the dependent variable, and $\hat{Y}_i$ is the corresponding fitted value. If the value of the F statistic in (1) is greater than the critical value of F, we reject the null hypothesis that the two sets of regression coefficients are equivalent (Studenmund, 2006). In order to ascertain whether there is a structural change in the formation of housing prices over our data period, we perform this test using alternative values of the break time spanning the period from October of 1996 to October of 2001. We limit our testable break points to those within the middle 70 percent of the series, as periods encompassing less than 15 percent of the available time series are not large enough to estimate one of the regressions to test for structural change (Greene, 1993).

The resulting F values from these tests are presented in Figure 2, along with the 5 percent and 10 percent critical values of the F distribution (1.83 and 1.60, respectively).

[FIGURE 2 ABOUT HERE]

The figure has several empirical implications. First, the model remains stable during the time between hurricanes Fran (September of 1996) and Bonnie (August of 1998), but is clearly unstable in the periods immediately following Bonnie (August of 1998) and Floyd (September of 1999). Second, the number of periods for which the model is unstable is greater following Floyd than following Bonnie; following Bonnie we reject the null hypothesis of stability in three of the subsequent 12 months, and following Floyd we reject the null hypothesis in six or the subsequent 12 months.

Following Floyd, the model parameters become more quickly unstable, taking only two months to reach the rejection region compared to a four-month lag following Bonnie. Additionally, the model is returning to normal at around the time of Floyd’s landfall, but the occurrence of an additional hurricane strike, the fourth in just over three years, pushes the model back into the unstable range. While there is a slight spike in the spring of 2001, the model parameters become far more stable in the years since Floyd than in those periods just after the last two storms. If housing market stability is proxied by the consistency of the coefficients of the factors describing real estate prices, then the market in less than two years appears to recover from the last hurricane strike.

A limitation to the above analysis is that when the break date is unknown a priori, the chi-square critical values may be inappropriate (Hansen, 2001). Treating the break date as an unknown does however allow us a view of the data that might not otherwise be possible, and reveals Quandt’s statistic – the breakdate where the Chow test statistic is largest (Quandt, 1960). For the above analysis, the largest Chow statistics occur in February of 1999 (six months after hurricane Bonnie) and May of 2000 (seven months after hurricane Floyd). This suggests that for the second and third hurricane strikes, structural breaks occur approximately six months after landfall. With this expectation in mind, we estimate the following second-order autoregressive model of price formation (Model 3):

$$\text{Ln (Real Price)} = \beta_0 + \beta_1 \text{ Ln (Real Price}_{t-1}) + \beta_2 \text{ Ln (Real Price}_{t-2})$$

As with model (2), our concern is with modeling housing prices as accurately as possible. The results of this estimation are shown in Table 4. We note that this model fits the data considerably better than the two models presented above, but provides little utility beyond prediction. We can, however, employ the Chow test as above, using dates six months after each hurricane strike as a potential breakdate: April of 1997, February of 1999, and April of 2000 for Fran, Bonnie, and Floyd respectively. The Chow test statistics for these dates are 0.76, 2.21, and 2.45, with corresponding p-values of 0.52, 0.08 and 0.06. Once again, these results indicate a significant structural shift in the determination of housing prices following Bonnie and Floyd, but not following Fran. In other words, we see that the significant structural shift is robust to the specification of prices.

[TABLE 4 ABOUT HERE]

4. Concluding Remarks

We examine housing sales data for the Cape Fear region of North Carolina, an area that experienced four significant hurricane landfalls in a 40-mile section of coastline in less than four years. Extending earlier examinations, we find that Hurricanes Bertha and Fran in 1996 are not associated with the sort of housing market turbulence that characterized the periods following Bonnie in 1998 and Floyd in 1999. The closely-spaced hurricanes of 1996 are viewed as a random event, but Bonnie and Floyd seem to be perceived as harbingers of increased catastrophic risk in the study region. This perception is priced into housing values soon after Bonnie, and almost immediately after Floyd.

Our tests affirm the findings of Graham and Hall (2001), where housing prices suffer in association with the last in this series of hurricanes. Expanding on their findings, we find also that prices begin to recover less than a year after Hurricane Floyd. Observing this recovery, and considering also the pricing patterns around the hurricanes of the late 1990's, we sense a shift in the underlying descriptive structure of any model purporting to portray real estate values in the study region. As such, we use a Chow test to reveal the significance of any structural shift that may have occurred in our pricing model over the study period, independent of the hurricane landfalls.

We estimate Chow test F-statistics for break points spanning the series of hurricane landfalls and find a striking correlation with the last two hurricanes. This suggests that the observed instability in the local real estate market may be largely related to recurring hurricane landfalls and increased perceptions of catastrophic risk. The market volatility subsides by mid- to late-2000, suggesting that with the passage of time, catastrophic concerns abate, or that the market recognizes its earlier overreactions, and market forces return to more stable patterns.

At a minimum, it seems that a new set of factors are influencing real estate values in new and previously undocumented fashions. Framing our findings, anecdotal evidence suggests a curious response by the real estate markets to hurricane landfalls during the unprecedented seasons of 2004 and 2005; prices in selected markets have responded positively in the periods immediately following the landfalls of Denis in the Florida panhandle and to the landfall of Katrina in Gulfport and Biloxi, MS. Developers have been given access by the storms to broader tracts of previously unavailable real estate; small neighborhoods not earlier for sale have come onto the market, underscoring the presence of new market forces at play following hurricanes.

These findings are of value to at least five audiences: first, the homeowner and prospective buyer will be able to use the study's findings to motivate market behavior as a function of the market participant's views on the susceptibility of the market to catastrophic risk; second, these results may assist institutional lenders/insurers as they consider lending/insuring policies for a given area; third, the findings are valuable to local and regional governing bodies as they consider area land uses, perhaps tailoring planning activities according to the degree to which an area is at risk; fourth, these results may anticipate the manner with which similarly afflicted markets may behave in the time following one or multiple hurricane landfalls; finally, the results are important as a complement to existing academic research, and as an encouragement for later studies.

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Table 1. Housing Sales in the Study Region for 1996-2001.

	Southwest New Hanover County	**Northwest New Hanover County**	**Non-Coastal Pender County**	**Coastal Areas**[*]
1996				
Units Sold	605	294	61	1,592
Average Price	$120,622	$100,424	$87,858	$156,318
1997				
Units Sold	792	331	89	1,837
Average Price	$123,539	$108,068	$95,129	$174,676
1998				
Units Sold	936	355	79	2,216
Average Price	$128,053	$108,324	$96,126	$187,127
1999				
Units Sold	854	336	88	2,262
Average Price	$133,416	$105,548	$97,129	$191.341
2000				
Units Sold	271	90	36	753
Average Price	$132,863	$105,513	$84,968	$203,184
2001				
Units Sold	331	97	35	909
Average Price	$134,492	$120,464	$102,808	$197,188
1Q2002				
Units Sold	96	26	11	233
Average Price	$157,582	$117,425	$103,027	$208,244

*Includes Northeast New Hanover County, Southeast New Hanover County, Wrightsville Beach, Pleasure Island, Coastal Pender County, and Coastal Brunswick County

Table 2. Model 1 Results.

		T = 0-54		**T=0-75**	
Variable	Predicted Sign	Coefficients	T-values	Coefficients	T-values
Intercept	+	18.30***	4.14	13.46***	3.61
Time	+	0.5E-02***	2.76	0.13E-02	1.33
LnRRS	+	-0.26	-1.34	-0.069	-0.42
Turn	+	0.95*	1.84	1.17**	2.30
New Listing	-/+	-0.33E-02***	-5.35	-0.32E-02***	-5.28
RIRL2	-	-28.53	-1.18	-15.60	-0.80
Fran	+/-	0.11E-03*	1.67	0.16E-03**	2.56
Bonnie	-	0.14E-04	0.36	0.67E-04**	2.12
Floyd	-	-0.70E-04**	-2.15	-0.12E-04	-0.51
Coast	++	1.07***	13.71	1.015***	14.65
SWNHC	-	0.84***	8.07	0.74***	8.21
NWNHC	-	0.45***	5.00	0.39***	4.83
Pender	-	0.29***	3.32	0.25***	3.11
R-Squared		0.4293		0.3935	

Notes: ***, **, and * represent significance at the 0.01, 0.05, and 0.10 levels, respectively

Table 3. Model 2 Results.

Variables	**Coefficients**	**T-values**
Intercept	10.49***	112.88
Time	0.95E-02***	3.37
Time-Squared	-0.12E-03***	-3.16
Turn	1.51***	3.20
New Listing	-0.31E-02***	-5.36
DOM	0.28E-03	1.27
Coast	1.01***	14.91
SWNHC	0.73***	8.29
NWNHC	0.38***	4.87
Pender	0.25***	3.22
R-Squared	0.40	

Note: *** represents significance at the 0.01 level.

Table 4. Model 3 Results.

Variables	**Coefficients**	**T-values**
Intercept	1.64***	5.79
Ln (Real Price $_{t-1}$)	0.41***	11.73
Ln (Real Price $_{t-2}$)	0.44***	12.69
R-Squared	0.67	

Note: *** represents significance at the 0.01 level.

Figure 1: Map of the Coastal Carolinas: *The Appraisal Journal*, page 381, October 2001.

Figure 2. Chow Test F statistics and critical values of 1.83 (five percent) and 1.60 (ten percent).