On the Determinants of House Value Volatility

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Abstract Few studies have analyzed the determinants of house value volatility at the level of individual houses. This paper uses two panels of the American Housing Survey covering 1974 to 2003 to test four hypotheses related to the determinants of house value volatility. The findings are that (1) house values at both ends of the quality distribution have greater variance than those with average quality levels, (2) the more atypical a house is, the greater the variance of house value, (3) the more highly ''land leveraged'' a house is, the greater the variance of its value, and (4) house values of minority households have greater variance than those of whites.

Housing is both a consumption good and an investment good (Henderson and Ioannides, 1987). Thus, households' investment decisions regarding tenure choice and housing quantity depend, in part, on the volatility of house prices.[1] Knowledge about house price volatility also should be an important input to housing policy. For example, if low-valued houses' values are relatively volatile, then policies that encourage low-income renter households to become homeowners should be evaluated in light of the house price risk that they would bear. Other housing market participants, such as mortgage lenders, also should be interested in the correlates of house price volatility. For example, both default risk and the rate of recovery of collateral values are related to house price volatility and thus mortgage lenders should price this risk into the cost of a mortgage. Thus, full risk-based pricing of mortgages would account for not only the characteristics of the borrower, but also those of the dwelling. While there are a number of studies of house price volatility at the aggregate level, there are few studies of the determinants of the volatility of individual houses' values. This gap in the literature may be due to the difficulty of finding the needed data, which is a panel of individual dwellings' values.

Literature

It is surprising that few studies of the determinants of the volatility of owner-occupied house prices have been published, especially considering the high level of volatility of real house prices after 1995. Case and Shiller (1987) found that the standard deviation of house price estimation errors increased with the length between transactions of the property. An explanation is that the buyers and sellers have better information the closer to the transaction date, thus their offers and reservation prices better reflect market value. Case, Pollakowski, and Wachter (1997) used housing data from four counties to study how the transaction frequency is related to a house's price volatility, as well as its appreciation rate. They found that the values of more frequently transacting homes tend to be less volatile than those infrequently transacted. Their explanation is similar to that of Case and Shiller. Both studies relate house value volatility to the accuracy of owners' reported house values, not to house characteristics.

Glaeser, Gyourko, and Saks (2005) examined decennial census data from 1950 to 2000 in the United States. They found both the mean and variance of house price appreciation increased across the U.S. in that 50-year period. They argued this occurred because regulatory approval for building new homes in expensive regions became more difficult to obtain. That is, the inelastic supply of homes in expensive metropolitan areas contributed to the increase in housing price variance.

A number of papers study the difference in relative risk characteristics of homes by value stratification. Belsky and Duda (2002) used 1982–1999 repeat sale housing transaction data from Boston, Chicago, Denver, and Philadelphia to study house price dynamics. Low-cost, medium-cost, and high-cost homes are defined for each city. Their data show a consistent trend in the four cities: low-cost homes have the highest real annual price appreciation rates and the highest price volatility. High-cost homes' values were the least volatile and their real annual appreciation rate is the lowest. Poterba (1991) and Mayer (1993) used 1970–1986 data from Atlanta, Chicago, Dallas, and Oakland, and found the opposite from Belsky and Duda (2002): prices of high-value homes were more volatile than the prices of lower-value homes. Smith and Tesarek (1991) studied the Houston MSA housing market in 1970–1985 and found high-quality (typically high valued) homes appreciated more than low-quality homes during a boom, but depreciated more during a recession, implying their prices are more volatile. Seward, Delaney, and Smith (1992) classified 18,722 repeat sales of single-family owner-occupied homes from Florida in 1970–1985 into three value categories and found high-valued homes appreciated more rapidly in boom periods, but there was no significant difference among three value categories during recessions. Li and Rosenblatt (1997) used 1990 Census and Fannie Mae/Freddie Mac data to study the relationship between nine neighborhood indicators and three variables related to house prices including the standard deviation of annual census tract level home price appreciation during 1986–1994. They found that within each PMSA studied (Oakland, Southern California, and Los Angeles-Long Beach), the relationships were mixed both across census tracts and over time periods.

Bourassa, Haurin, Haurin, Hoesli, and Sun (2009) argued that not all types of houses appreciate or depreciate at the same rate. They hypothesized that the variation depends on the interaction between a house's level of "atypicality" and changes in the strength of the housing market.[2] This conclusion was based on the argument that sellers of atypical houses face a larger variance of offer prices and wait a relatively longer time for a high sale price. In strong markets, the ratio of the expected sales price to the mean of offer prices will be relatively high for atypical houses, leading to a larger increase in house price. The opposite holds in weak markets. Their conclusion was that atypical houses' prices vary more over a housing cycle than the prices of typical houses. They tested the hypotheses using three MSAs in New Zealand and data from 1989–1996, and found support for this hypothesis.

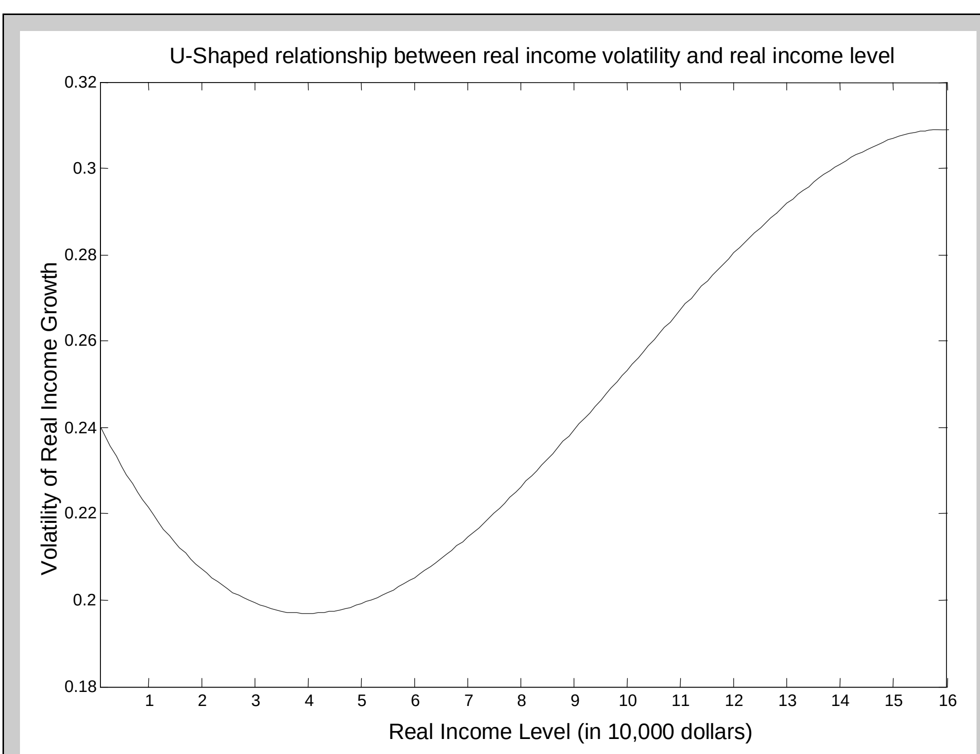
Bostic, Longhofer, and Redfearn (2007) proposed that houses with a greater amount of ''land leverage'' will have relatively more volatile prices. Land leverage is defined as the ratio of a property's land value to total property value. They note that housing is a bundled good, and the different parts forming the bundle might have different trends of price changes.[3] The overall change in house price is a weighted average of price changes of the various components. They partitioned house value into two parts: land value and structural value. Their argument is that the supply of construction materials and labor is relatively elastic but land is ''non-transportable and its benefit can only be enjoyed at a fixed location.'' To the extent that location is the ultimate source of house price appreciation and volatility, the larger is land leverage, the potentially larger the volatility of house value appreciation. Their research explains, to some extent, why homes in some big cities and high amenity coastal areas are more volatile than their counterparts. Their empirical work used data from Wichita, Kansas, and they found that house price volatility is positively related to the degree of land leverage. Additional evidence for the land leverage hypothesis is shown in Bourassa, Haurin, Haurin, Hoesli, and Sun (2009), who adopted the Bostic, Longhofer, and Redfearn (2007) argument and found support using New Zealand data. Specifically, when the housing market is strong, appreciation rates are larger for houses with greater land leverage. However, in housing market downturns, houses with larger land leverage depreciate more.

Miller and Peng (2006) used a panel of quarterly data between 1990 and 2002 from 277 MSAs to estimate a VAR model that analyzed both the determinants and consequences of housing price volatility at the MSA level. Their volatility measure is the variance of the unpredictable part of the housing price appreciation rate, which was estimated using an ARMA method. Then, based on the series of the unexplainable residual from all quarters for each MSA, they applied a GARCH model to estimate house price volatility. They found that house price volatility is Granger-caused by the housing appreciation rate and the per capita metropolitan gross product growth rate.[4]

Four Hypotheses about House Value Volatility

Our review of the empirical literature on the volatility of house prices revealed mixed results about the relative risk characteristics of houses in different value and quality stratifications. We note that these mixed results could be reconciled if houses prices at both ends of the quality distribution are relatively volatile; that is, the most stable prices are for mid-quality homes.[5] There is indirect evidence that the supply of low-quality homes is relatively inelastic. New construction of unsubsidized low-quality homes is low and increases in supply are primarily due to the filtering down of mid-quality homes. On the demand side, the evidence suggests that the demand for homes in the tails of the quality distribution will be relatively volatile. Additional support for this hypothesis comes from the observation that the highest variance of household incomes occurs in the tails of the income distribution. We documented this claim using household income data from the American Housing Survey (AHS), finding a cubic relationship between the standard deviation of the growth rates of households' real income and households' real income levels (the base year is 1984). In Exhibit 1 the standard deviation first falls with income (measured in $10,000 units), hitting a trough at $44,000, and then rising through $160,000. Combining the volatility of income at the tails of the income distribution with an inelastic supply of low-quality houses and relatively elastic supply of mid-quality units would result in relatively greater volatility of house prices among low-quality and high-quality houses.

Exhibit 1 | Real Income Volatility and Real Income Levels: 1985–2003



Our second test is of the hypothesis proposed by Bourassa, Haurin, Haurin, Hoesli, and Sun (2009); specifically, that houses with higher atypicality will exhibit more volatile prices. The third hypothesis is that houses with a higher degree of land leverage will be more volatile. The fourth hypothesis is that house prices in predominantly minority areas will be relatively more volatile. Underlying this hypothesis is the assumption that the housing market contains submarkets, this conclusion supported by a series of studies (Smith and Ho, 1996; Li and Rosenblatt, 1997; Bourassa, Hamelink, Hoesli, and MacGregor, 1999; Bourassa, Hoesli, and Peng, 2003). The implied lack of arbitrage could be due to household preferences, discrimination, or financial constraints. A possible result of housing market segmentation is the evolution of house prices along different paths in different submarkets, the implication being different rates of appreciation and variance.

Evidence shows that minority households encounter more discrimination in the housing market than other racial and ethnic groups, including steering households toward racially homogeneous areas (Yinger, 1998). The implication is that the effective supply elasticity of housing for minority households is likely less than for whites. On the demand side, there is evidence that the incomes of minority households are more volatile than that of white households. Robst, Deitz, and McGoldrick (1999) used 1983–1987 data from the Panel Study of Income Dynamics to estimate an earning function, finding that the volatility of income is higher for blacks. These results for supply and demand combined with evidence that housing submarkets are correlated with race lead to the hypothesis that house prices will be more volatile in predominately minority areas.

Data

Our study requires a time series of house prices at the level of individual houses. We use the national component of the American Housing Survey (AHS), 1974–2003.[6] The first panel of the AHS reports dwelling level data from 1973 through 1981 and in 1983. The second panel began in 1985 and continues biannually. The shortcomings of the AHS include data suppression issues such as top coding and bracketing, reporting little information about neighborhood locations, and reporting owner-estimated house values rather than transacted house prices. The advantages include reporting substantial information about the characteristics of the dwelling and its occupants for a series of years.

To calculate real house price appreciation rates, we first deflate owner-reported house value by the CPI. We then calculate the standard deviation of this series as a measure of the volatility of a dwelling's house value. The AHS 1974–1983 has two problems regarding the owner-reported home values: bracketing and top/bottom coding. Kiel and Zabel (1997) used AHS proprietary data (an internal version of the AHS, not top-coded and not bracketed), and found that house price appreciation rates derived from using the midpoint of each bracket are very similar to those derived from the proprietary data. Further, they found that using the full sample and the sample excluding top-coded observations produced very similar results when estimating appreciation rates.

To address the bracketing of house values in the 1974–1983 sample, we assign to each house a randomly-generated value from within the reported price bracket. This method is superior for estimating the standard deviation of the time series of house prices compared with using the mean of the brackets.[7] In the 1974–1983 sample, we delete both top-coded and bottom-coded observations.[8] Other requirements include the dwelling unit must be owner-occupied, sit on a lot of less than 10 acres, have survey data for at all nine surveys, and have unchanged basic structural characteristics. Observations in rural areas are dropped. These restrictions yield a panel of 2,800 observations.[9]

A description of the explanatory variables is contained in Exhibit 2. The mean house value (in 1984 dollars) was $62,160 during 1974–1983. The average home age was 18.5 years and 30% were located in a central city. The owners were 48.4 years old on average, had remained in the dwelling for 11.9 years, were 91% white,[10] and had 13.0 years of education.

The variables indicating the characteristics of the owner serve the role of controlling for owner-specific variability of house value estimates. For example,

Exhibit 2 | Variable Statistics: 1974–1983

Variable	Description	Mean	Std. Dev.	Min.	Max.
Dependent Variable					
Std. dev. of the annual real housing price appreciation rate		0.27	0.23	0.03	3.14
House Characteristics					
Value74	Home value in 1974 (in $10,000)	6.22	2.25	0.64	12.16
HOMEAGE74	Home age in 1974	18.52	8.03	1.00	30.50
Atypicality74-1	Home atypicality measure in 1974 (in $10,000)	1.98	0.66	0.59	5.75
Atypicality74-2	*Atypicality74-1* divided by home value	0.39	0.29	0.06	4.28
Central74	1 for Central city location, 0 for suburb	0.30	0.46	0.00	1.00
Resident Characteristics					
White74	1 for whites, 0 otherwise	0.91	0.29	0.00	1.00
Age74	Age of household head in 1974	48.42	12.51	18.44	85.00
Grade74	Highest school grade by household head	13.02	2.99	0.00	19.00
Male74	1 for male, 0 or female	0.89	0.31	0.00	1.00
Occupancy74	Years of residence in current homes in 1974	11.91	7.30	1.00	26.00

Note: The number of observations is 2,800.

Kish and Lansing (1954) used the 1950 Survey of Consumer Finances and found that female homeowners tended to have greater errors when estimating their homes' values. Kain and Quigley (1972) used a random sample of 421 owner-occupied units within the city of St. Louis in 1967 and found that better educated homeowners in St. Louis were less likely to overstate their homes' values. Ihlanfeldt and Martinez-Vazquez (1986) used 1978 AHS-Atlanta MSA data and found that homeowners' measurement errors of home values are related to homeowner characteristics. Goodman and Ittner (1992) used the AHS 1985 and 1987 national sample to study the accuracy of owner-reported home values. Although they found homeowners tend to overestimate their home values by 6%, their OLS regression did not find a highly correlated relationship between owners' estimation errors and house characteristics, owners' characteristics, or local market condition variables. A similar finding was provided by Kiel and Zabel (1999), but they used the 1978–1991 AHS metropolitan sample for only three cities: Chicago, Denver, and Philadelphia. None of these studies addressed the issue of whether the variance of homeowners' estimates is biased, but it is sensible to include owners' characteristics as control variables. In our study we also include the length of tenancy as a control based on the studies by Case and Shiller (1987) and Case, Pollakowski, and Wachter (1997).

The atypicality measure for a house must be measured relative to a reference area because a house that is typical in one area might not be in another. The reference areas are established by separating the sample into four census regions (Northeast, South, West or Midwest) and two urban locations (Central city, Suburb) and allocating observations to these categories.[11] To calculate the atypicality variable, we first estimate a hedonic house price equation for each of the eight areas and retain the estimated implicit prices of house attributes β.[12] The atypicality of the ith house is $A_i = \beta|m_i - \overline{m}|$. Here, m_i is the column vector of the ith house's characteristics and $\overline{m}$ is the column vector of the mean characteristics of all houses in that group.[13] We also created a second measure of atypicality equaling the above value (*Atypicality-1*) divided by house value (*Atypicality-2*). This measure has a mean of 0.39 and ranges from 0.06 to 4.28, indicating there is a wide range of atypicality in the sample of houses.

For the 1985–2003 biennial sample, we again require that nine observations of house value be present in the data.[14] The sample is much larger, 9,655 dwellings and two additional variables are present, lot size and the square footage of the dwelling. We use the square footage of the house as an alternative measure of housing quality, rather than house price.[15] In general, the variables' means are similar comparing the two panels (Exhibit 3). Mean real house value is 10% greater in 1985 compared with 1974.[16]

One interesting observation is the change in house value volatility between the two samples, falling from 0.27 to 0.15. This result differs from Glaeser, Gyourko, and Saks (2004), who found that the variance of house prices increased from 1950 to 2000. Our measure of house price volatility differs from theirs. In their paper, for each of the 316 metropolitan areas, they first calculated the mean house price

Exhibit 3 | Variable Statistics: 1985–2003

Variable	Description	Mean	Std. Dev.	Min.	Max.
Dependent Variable					
Std. dev. of the annual real housing value appreciation rate		0.15	0.13	0.02	0.82
House Characteristics					
Value85	Home value in 1985 (in $10,000)	6.87	3.22	0.37	23.23
Unit-sqft85	Home square footage in 1985 (in 1,000)	1.88	0.73	0.12	4.48
Homeage85	Home age in 1985	27.93	14.97	1.00	61.50
Atypicality85-1	Home atypicality measure in 1985 (in $10,000)	3.14	1.32	0.91	9.50
Atypicality85-2	*Atypicality85-1* divided by home value	0.61	0.72	0.07	14.54
Landleverage85	Land leverage (land value / home value) in 1985	0.10	0.07	0.00	0.96
Central85	1 for Central city location, 0 for suburb	0.35	0.48	0.00	1.00
Resident Characteristics					
White85	1 for whites, 0 otherwise	0.88	0.33	0.00	1.00
Age85	Age of household head in 1985	54.76	13.64	22.50	88.50
Grage85	Highest school grade by household head	13.89	3.10	0.00	19.00
Male85	1 for male, 0 for female	0.83	0.38	0.00	1.00
Occupancy85	Years of residence in current homes till 1985	14.11	10.14	1.00	61.50

Note: The number of observations is 9,625.

in each decade, 1950–2000, and then computed the variance of house prices across all 316 metropolitan areas. They then compared these cross-sectional variances across decades. In our study, we compute the variance of the real house value appreciation rates over time at the level of individual houses, and then compare the variance over two broad periods.

An explanation for the intertemporal decrease in variance is that in the first time period two severe recessions occurred. In the 1974–1983 period, there was a recession in 1973–1975, followed by one in 1980–1982. The savings and loan crisis severely impacted the housing market in the latter recession. In the second panel, which covered more years, recessions occurred in 1990–1991 and 2001.

We must have a measure of the value of land to estimate land leverage. Lot size is reported only in the 1985–2003 sample. To determine land values, we estimate a hedonic house price regression that includes lot size, its square and cube. Using these regression coefficients, we first calculated the implicit value of land for each house and then calculated the land leverage ratio (land value divided by house value). The mean value of land leverage is 0.10 with a wide range from 0.002 to 0.958. The hedonic estimation model is presented in Exhibit A1 in the Appendix.

Descriptive Findings

Exhibit 4 reports the standard deviations of house prices for the two periods. Houses are categorized based on their values in the first year of the period. We define a high-valued home when its value is higher than the mean of all homes plus one standard deviation; a low-value home when its value is lower than the mean minus one standard deviation; and middle-valued homes are in-between.[17] In both panels, low-valued houses are the most volatile, with the difference in means being statistically significant. The means for the three categories when defined by square footage also indicate smaller houses have the most volatile prices.

The volatility of house prices is significantly greater for minority respondents than whites in both panels. The AHS lacks information on the racial composition of the neighborhood. Malpezzi, Ozanne, and Thibodeau (1987) noted that the householder's race variable in the AHS can be interpreted as a measure of the neighborhood racial composition based on the consideration that most minority households live in minority neighborhoods. We follow this interpretation in our study.[18]

The Panels A and B of Exhibit 5 report house value volatility classified by the level of atypicality and Panel C reports it by land leverage. The standard deviation of the house price appreciation rate is greater for highly atypical houses than for other houses for both measures of atypicality in both periods. We also find in

Exhibit 4 | Volatility by House Value and Square Footage

	1974–1983		1985–2003	
	# Obs	Mean	# Obs	Mean
High-valued	458	0.24	1,428	0.15
Middle-valued	1,900	0.25	7,022	0.13
Low-valued	442	0.40	1,205	0.25
Large square feet			1,438	0.14
Medium square feet			6,776	0.14
Small square feet			1,441	0.18

Exhibit 5 | Means of Volatility by Atypicality and by Land Leverage

	1974–1983		1985–2003	
	# Obs	Mean	# Obs	Mean
Panel A: Atypicality-1:				
High atypicality houses	397	0.30	1,464	0.18
Medium atypicality houses	1,981	0.26	6,721	0.15
Low atypicality houses	397	0.24	1,470	0.12
Panel B: Atypicality-2				
High atypicality houses	700	0.35	2,415	0.20
Medium atypicality houses	1,400	0.24	4,825	0.13
Low atypicality houses	700	0.23	2,415	0.12
Panel C: Land Leverage				
High land leverage			931	0.23
Medium land leverage			8,187	0.14
Low land leverage			537	0.16

Notes: To be consistent with Panel B where the standard deviation of the atypicality variable is larger than its mean, we used an alternative classification for Panel A: the top 25% are defined as high atypicality houses and the lowest 25% are defined as low atypicality houses.

Panel C that the mean volatility of house prices is greater for properties with a high level of land leverage.

Regression Findings: 1974–1983

In all regression models, location variables and householder age, gender, education, house age, and occupancy length act as controls.[19] In the results shown in Exhibit 6, we find no effect of house age or location in a central city. Volatility is greater if the household head is a female, older, less educated, and has had a longer occupancy.

We test both quadratic and cubic specifications for house value. Both models confirm a nonlinear relationship between house value volatility and house quality levels. Given that all three terms in the cubic are significant, we focus on those results. The three coefficients of the house value terms are −0.164, 0.022, and −0.001, respectively. They imply a local minimum and maximum at house values

Exhibit 6 | Regression Results: Housing Value Volatility—1974–1983

	Model 1		
Variable	Estimate	S.E.	*t*-Value
Intercept	0.661***	0.095	6.98
Central City	0.004	0.009	0.39
Male74	−0.036***	0.013	2.71
Zage74	0.002***	0.000	5.89
Grade74	−0.007***	0.001	4.53
Occupancy74	0.002**	0.001	2.16
Value74	−0.164***	0.036	4.56
Value74SQ	0.022***	0.005	4.21
Value74CU	−0.001***	0.000	3.67
White74	−0.056***	0.015	3.70
Homeage74	0.0001	0.001	0.16
Atypicality74-2	0.083***	0.027	3.09

Notes: The dependent variable is the standard deviation of the real annual house price appreciation rate. The coefficients of the locational indicators are not reported. The number of observations is 2,800. The adjusted R^2 is 0.1640.

*Significant at the 10% level.

**Significant at the 5% level.

***Significant at the 1% level.

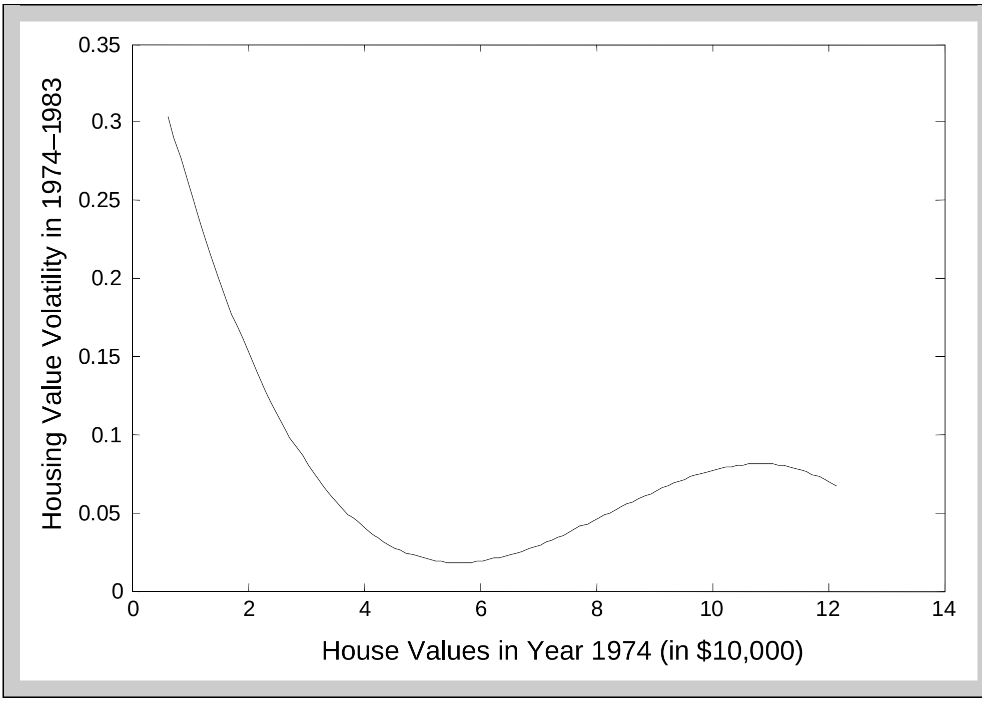
of $56,235 and $108,208, as shown in Exhibit 7. The sample mean house value is $62,160.[20] Thus, we find evidence that the greatest house price volatility occurs in the upper and lower tails of the value distribution.[21]

We find that the second atypicality measure performs best, and it has the expected positive effect on house value volatility. The estimation also confirms the hypothesis that house value volatility will be greater in neighborhoods that are predominately occupied by minorities, as proxied for by the race of the occupant of the dwelling.

Regression Findings: 1985–2003

The regression approach for the second period is similar, but now the land leverage hypothesis can be tested.[22] We again use a cubic term in house value (model 1) but for comparison we also use a house's square footage (cubic) term to proxy for house quality (model 2). Exhibit 8 contains the results. Again, central city

Exhibit 7 | House Price Volatility and House Values: 1974–1983



location has no effect on house value volatility; however, we find that the greater the house age, the greater is house value volatility. Price volatility is greater if the household head is a female, older, less educated, and has had a longer occupancy.

Regarding the relationship of house price volatility and house quality, we again find a cubic relationship with house value. The three coefficients of house value imply a local minimum and maximum at house values of $68,346 and $281,208. The upper turning point is greater than the sample's maximum house value (recall these are 1984 values), thus we essentially find a U-shaped relationship, as shown in Exhibit 9. Note that the minimum occurs at a value similar to that for the first sample of dwellings in the earlier period, suggesting a consistent relationship between volatility and value for a thirty-year period.[23] In model 2 we replace house value terms with measures of square footage. A quadratic relationship again is found with *UnitSF85* and *UnitSF85SQ* significant, with a local minimum at 1,700 square feet, which is below the sample's mean value.[24]

Some authors have found that lower-valued housing was the most volatile, others have found the opposite. Our findings reconcile the mixed findings in literature

Exhibit 8 | Regression Results: 1985–2003: Housing Value Volatility

	Model 1		Model 2	
	Estimate	S.E.	Estimate	S.E.
Male85	−0.008***	0.003	−0.010***	0.003
Zage85	0.001***	0.000	0.001***	0.000
Grade85	−0.005***	0.000	−0.005***	0.000
Occupancy85	0.001***	0.000	0.001***	0.000
Value85	−0.023***	0.004		
Value85SQ	0.002***	0.000		
Value85CU	−0.000***	1.214E-05		
UNITSF85			−0.041*	0.024
UNITSF85SQ			0.018*	0.011
UNITSF85CU			−0.002	0.002
White85	−0.044***	0.004	−0.045***	0.004
Homeage85	0.000**	8.587E-05	0.000**	8.555E-05
Atypicality85-2	0.032***	0.002	0.038***	0.002
Ewater85	0.005	0.009	0.007	0.00
LandLev85	0.204***	0.024	0.201***	0.022

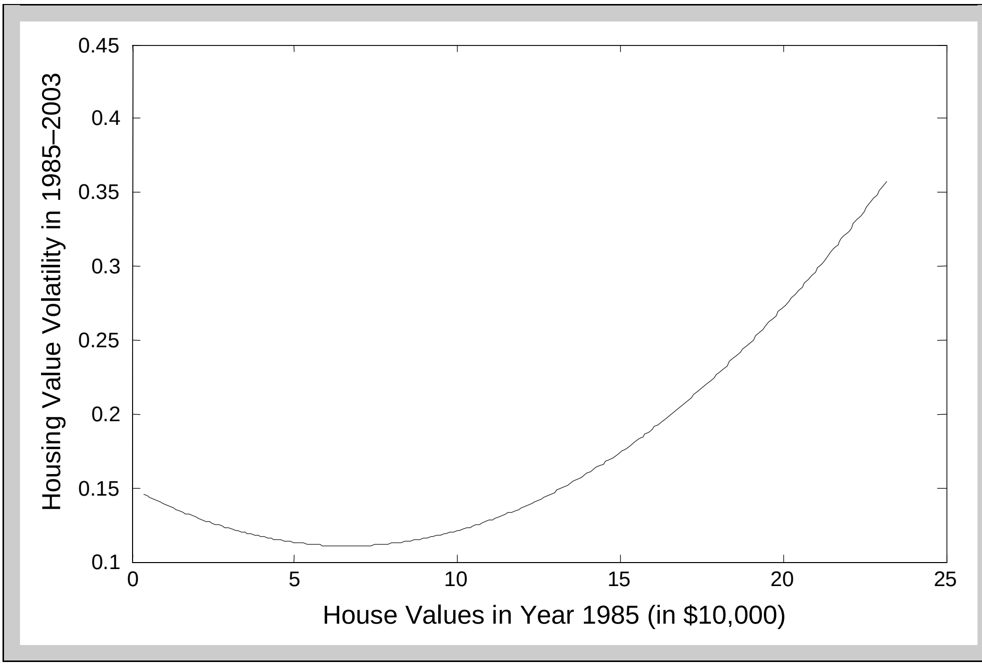
Notes: The dependent variable is the standard deviation of the real annual appreciation rate. The number of observations is 9,655. The adjusted R^2 is 0.216.
*Significant at the 10% level.
**Significant at the 5% level.
***Significant at the 1% level.

because we find a nonlinear relationship where the most volatile house values are at the extremes of the distribution of quality.

In the 1985–2003 sample, we find that minority house prices are more volatile than those of whites. We again find that atypical houses have more volatile house values. We also tested an alternative measure of atypicality, specifically, whether there is body of water within 300 feet of a house. However, this variable has no effect.[25]

Both regression models strongly support the land leverage hypothesis proposed by Bostic, Longhofer, and Redfearn (2007). Houses with high land leverage have more volatile prices, the elasticity being 0.13. Given that land leverage's values vary greatly among houses, even a small elasticity implies a relatively large effect on house price volatility.[26]

Exhibit 9 | House Price Volatility and House Values: 1985–2003



Conclusion

We use the American Housing Survey to test four hypotheses about the determinants of house value volatility. Using two panels of data (1974–1983 and 1985–2003) we find that (1) house values at the extremes of the quality distribution of houses are more volatile than those with median quality levels; (2) the more atypical a house is, the more volatile its house value; (3) the more highly land leveraged a house is, the more volatile is its value; and (4) houses owned by black household heads have a more volatile price than those owned by whites. Additional findings are that the house value estimates of female, elderly, low education, and long-residence householders are more volatile.

We expect that the results will be of interest to investors in housing, which includes households and other investors in residential housing. One consequence is that we expect house prices to be influenced by the level of house price volatility, which is consistent with prior findings in the housing market (Crone and Voith, 1999). Knowledge about house price volatility also should be an important input to housing policy. Whether low-income households should be encouraged to become homeowners depends on many factors, one of which is the house price risk that they would bear. Our finding that low-quality houses (and low-valued homes) have relatively high price volatility is directly relevant.

Other housing market participants, such as mortgage lenders, also should be interested in the correlates of house price volatility. For example, both default risk and the rate of recovery of collateral values are related to house price volatility. One would expect lenders to price this risk in the cost of a mortgage. Thus, risk-based pricing of mortgages would account for the characteristics of both the borrower and the dwelling.

Appendix

Exhibit A1: Hedonic Estimation of Land Leverage

Variables	Estimate	S.E.	*t*-value
Intercept	1.108	0.204	5.42
LotSize1985	0.087 E-3	0.019 E-3	4.61
LotSizeSqu1985	−2.771 E-9	1.274 E-9	2.17
LotSizeCubic1985	2.630 E-14	2.423 E-14	1.09
Northeast1985	−1.023	0.070	14.61
South1985	−2.760	0.050	54.84
Midwest1985	−3.362	0.059	57.09
Central1985	−0.384	0.039	9.77
Bathroom1985	2.202	0.039	56.81
Bedroom1985	0.028	0.032	0.88
TotalRoom1985	0.252	0.018	14.29
SinFamilyAtt1985	−0.316	0.094	3.36
HomeAge1985	−0.008	0.001	6.18
Basement1985	−0.369	0.048	7.67
Garage1985	1.010	0.047	21.30
SteamHeat1985	1.498	0.066	22.66
AirCondition1985	−0.2101	0.040	5.23
Plugs1985	0.408	0.156	2.62
Rats1985	−0.354	0.102	3.46
Hispanic1985	−0.678	0.077	8.75
Black1985	−0.461	0.060	7.73
UnitSF1985	0.001	0.000	26.66

Note: The Adj. R^2 is 0.4091.

Endnotes

[1] We use the terms ''house price,'' ''house cost,'' and ''house value'' interchangeably.

[2] Their primary measure of house atypicality was the ''aggregate value of deviation of a house's characteristics from the sample mean.'' This measure was also used by Haurin (1988) and Capozza, Israelsen, and Thomson (2005).

[3] This argument is similar to that in Gill and Haurin (1991), who focus on differences in the land and structure appreciation rates of coastal California houses.

[4] Other papers on house price volatility find that it affects mortgage terminations (Harrison, Noordewier, and Ramagopal, 2002), whether house price volatility clusters at the state level (Miles, 2008), and the relationship of house price volatility and housing returns (Gu, 2002).

[5] A high-quality home is typically highly valued and vice versa. However, we use ''quality'' instead of ''value'' in our discussion because of the possibility that price volatility affects house value, while home quality is not directly affected.

[6] Many key variables were missing in the 1973 survey and thus we omit it.

[7] As a test of this method, we transformed the non-bracketed 1985–2003 house values into bracketed data similar to that for the first time period. House price appreciation rates were derived using three methods: (1) the true value, based on the AHS reported house prices, (2) based on the assumption that house values equal the appropriate bracket's mid-point, and (3) based on the assumption that house value was a random draw from the appropriate bracket. The derived means of the standard deviations of the appreciation rates are 0.154 (true), 0.184 (midpoint), and 0.165 (random draw). Thus, the random generation method yields a better representation of the actual values of house price volatility.

[8] The bottom categories of house price indicate only very low levels of value (below $2,500 in 1974 and below $5,000 thereafter) and the top categories contain only a very small percentage of observations (approximately 3% in every year.) Davis and Palumbo (2008) follow an alternative method when using the AHS, assigning to top-coded houses a value of 1.5 times the maximal bracket value.

[9] We consider the number of bedrooms and bathrooms to be the critical structural characteristics that must remain constant over time. If we relax the requirement that a dwelling must appear in all nine surveys, the increase in sample size would be 557 for omitting one survey, and another 336 for omitting two.

[10] In our data, the designation of white households includes white Hispanic respondents. We refer to the other group as minority households, which include blacks, American Indians, Asians, and Pacific Islanders.

[11] The AHS does not report state indicators in the national sample, thus we were forced to use regional indicators. The alternative was to use MSA information but the MSA's sample sizes are sufficiently small in the national sample that MSA-level estimation of hedonic price models would be very imprecise, inducing substantial measurement error in the atypicality measure.

[12] Our estimates of the hedonic house price regression follows Pollakowski, Stegman, and Rohe (1991) regarding the set of explanatory variables selected from the AHS 1974–1983. These variables include the number of bathrooms, bedrooms, and total rooms, age of the dwelling, dummies for single-family attached house, basement, steam heat, air

conditioning, presence of rats, and black or Hispanic householder. Results for the eight hedonic regressions for both surveys are available from the authors.

13 See Haurin (1988) for details.

14 The AHS 1985–2003 has 10 surveys in total. If we relax the restriction that a house must appear in at least nine surveys, the gain in sample size is 1,214 for eight, and an additional 663 observations for seven appearances.

15 When testing the first hypothesis, we separate the sample into high–value, medium–value, and low-value houses. One method is to use 1985 home values; however, the starting-year values might contain random errors resulting in mismeasurement of the value of the house and affecting the eventual measure of house price volatility. For example, if a home is overvalued in the starting year, there would be a tendency to fall in value, thus creating a relatively large home value variance, and vice versa. The use of square footage as a measure of quality addresses this problem.

16 The rate of appreciation of real house prices in the Freddie Mac CMHPI between 1974 and 1985 was −2.0%. However, the means of real house prices in the two AHS samples are not directly comparable because housing quality is not held constant.

17 Seward, Delaney, and Smith (1992) used the same classification method to study house value appreciation in a market stratified by house sizes and house values. This mean-standard-deviation method applies to other classifications, unless otherwise noted.

18 The means of house price volatility are greater for respondents that are female, older, low levels of education, and have a longer occupancy. The means also are greater for older homes [see Zhou (2009) for details].

19 The location of a house is reported at the MSA level for some AHS dwellings in the national sample. We include a series of locational dummy variables in the regressions explaining price volatility. Our measures are state-level aggregations of MSAs, with unidentified locations aggregated to a single "unknown state" category.

20 There are only 91 observations with house value above $108,208 in the sample.

21 If we include only a linear price term, its coefficient is negative and significant. Thus, it is possible that prior studies that found low–valued house prices were the most volatile did so because they failed to test for non-linearities in price. The same result holds for the 1985–2003 sample.

22 We tested whether the two samples could be pooled, but pooling was strongly rejected.

23 We artificially bracketed the 1985–2003 sample and re-estimated the model, assuming observations took the value of the midpoint of the bracket and, alternatively, assigning values based on the midpoint of the bracket and a random component (as we did for the 1974–1983 sample). The results for the second method better matched the actual 1985–2003 results and were clearly superior to simply using the brackets' midpoints. The result is greater confidence in the 1974–1983 results [see Zhou (2009) for details].

24 The local maximum is at 3,380 square feet, which relatively few houses in the sample exceed.

25 Less than 2% of the houses in the sample are within 300 yards of a body of water.

26 The 1985–2003 sample identifies when a dwelling is a manufactured home. We included a manufactured home dummy in the price volatility regressions and found a significantly positive coefficient, implying manufactured homes are more volatile in value than traditional homes. All of the other key variables retained their significance and signs. Explaining the causes and consequences of the high volatility of the price of manufactured houses is a topic for future research.

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