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House Price Volatility and the Housing Ladder

James Banks, Richard Blundell, Zoë Oldfield, and James P. Smith

One of the most critical consumption and investment decisions that individuals and families make over their life cycle involves the amount of housing services to consume and whether or not to combine consumption with ownership. Housing is an important component of consumption, but not simply because it absorbs a large fraction of the household budget—which it does. Where we live and how much we decide to spend on housing is a key ingredient to the amenities and lifestyle we have chosen for our families and ourselves. But housing, or more particularly housing wealth, can be even more critical as an investment as it is typically by far the biggest marketable asset in the household portfolio for most people.

The contribution of this chapter is to bring together two key elements of housing consumption and home ownership decisions into an empirical model of housing outcomes. The first of these is the housing ladder. Rather

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than modeling home ownership as a one-time durable purchase, we model it as a series of purchase decisions, or a housing ladder, where the desired flow of housing services rises with family formation and growing family size over the life cycle. The second is the acknowledgement of the role of future house price risk. In some geographic markets housing can be a risky asset with high levels of unpredictable price volatility, while in other places the prospect of capital gains or losses in housing are understandably not the subject of much social conversation.

Our contribution is to focus on the importance of ownership as a hedge against future house price risk as individuals move up the ladder. We use a stylized model to show that increasing house price risk acts as an incentive to become a homeowner earlier in the life cycle and, once an owner, to move more rapidly up the housing ladder. Increases in volatility are shown to increase ownership and to increase the quantity of housing wealth conditional on ownership in earlier periods of the life cycle. We then establish that these relationships hold empirically using panel data on families in different geographic markets in Britain and in the United States.

Housing needs change over the life cycle and the decision of when to buy the first property and at what point to move up the ladder is a key life-cycle decision. For example, Ortalo-Magne and Rady (2004, 2006) note the importance of new entrants at the bottom of the ladder for the determination of housing transactions along the whole ladder. Ermisch and Pevalin (2004) document the importance of childbearing and family formation decisions on housing choices. We follow this lead by allowing the demand for housing consumption and movements up the ladder to depend directly on the demographic profile of the family. We then add to this the enhanced incentive to own and to move up the ladder created by more volatile house prices.

The idea that home ownership can be seen as a hedge against uncertainty in the price of housing services has many precedents. For example, Sinai and Souleles (2005) use this observation to carefully show the increased demand for ownership when rental price uncertainty is higher. Our contribution instead is to focus on the importance of ownership and the quantity of housing owned as a hedge against future house price risk as individuals move up the ladder. We examine the impact of volatility on both ownership and on measures of the quantity of housing wealth conditional on ownership. Both are shown to rise with increased house price volatility.

In contrast to other risky assets in which risk-averse individuals can simply choose to avoid them, everyone must consume housing, and the vast majority of people desire to and eventually do end up owning their own home. In addition, for most individuals the demand for housing will rise over the life cycle as family size increases. The combination of these factors results in an insurance role for housing wealth in early adult life that drives the predictions we investigate in our empirical analysis.

Using panel data from the United Kingdom and the United States, we test the implications of the ladder and price volatility on the decision on when to become a homeowner, how much housing to consume, and whether to refinance out of housing equity. In the presence of volatility in house prices, housing has three roles—investment, consumption, and insurance—against price fluctuations for future movements up the housing ladder. A simple theoretical discussion illustrates these effects, and the predictions for home ownership and housing wealth accumulation are drawn out.

Because housing price volatility is spatially variable, we test the importance of the role of volatility in housing decisions empirically using comparable panel data from the United States and the United Kingdom. There are significant differences in housing price variability between and within these two countries. But in addition there are also differences in the tax treatment of mortgage debt, the nature of mortgage arrangements, and even the level of geographic mobility of younger households. Consequently a test relying on between-country differences is unlikely to isolate the effects of interest. In our analysis we show that while the international differences are indeed in accordance with the predictions of our model, the model also performs well when estimated from within-country variation in each of the countries we consider, despite their rather wide institutional differences.

The analysis in this chapter is in five sections. Section 3.1 documents a critical and salient fact—a steep housing ladder with age that is coincident with changing demographics over the life cycle that are common across the two countries. Section 3.2 shows the large spatial dispersion in house price volatility within and between the United Kingdom and the United States. Section 3.3 then discusses the implications of housing price variability for housing choices in a simple life-cycle framework. In section 3.4 the model predictions concerning the age of initial home ownership, the decision to refinance, the shape of housing wealth and the number of rooms, and the decision in the United Kingdom to obtain an endowment mortgage are put to the test. In the final section we summarize our conclusions.

3.1 The Housing Ladder

Even without credit constraints or income uncertainty, individuals would not choose to consume the same flow of housing services at all times in their lives. People may start by moving out of the parental home into a small rented or purchased apartment or flat of their own. When they marry they may know that two may well live more cheaply than one, but they generally do not want to live in smaller places and often may want to own a bigger but still modest first home. Children then appear on the scene and eventually will age into rooms of their own—all of which requires a bigger, if not better, home.

A simple way of illustrating this point is to examine how the size of homes

Table 3.1 Number of rooms by age of head of household

	Age of head of household						
	< 25 years	25–34	35–44	45–54	55–64	65+	All
United States							
Owners and renters	3.89	4.97	5.99	6.40	6.16	5.34	5.61
Owners only	5.22	6.16	6.82	6.89	6.56	5.99	6.48
United Kingdom							
Owners and renters	3.04	3.69	4.45	4.98	4.89	4.07	4.40
Owners only	4.36	3.92	4.69	5.24	5.17	4.54	4.78

Note: Pooled data from the PSID and BHPS. The US data excludes bathrooms, and the UK data excludes kitchens and bathrooms.

people live in changes with age. Table 3.1 shows the age profile of mean number of rooms of household heads for owners and renters alike in the United States and the United Kingdom using the Panel Study of Income Dynamics (PSID) in the United States and the British Household Panel Study (BHPS).[1] Note that the number of rooms in the British data excludes kitchens and bathrooms, while in the American data they exclude only bathrooms, and so the number of rooms is not strictly comparable across the two countries.

In both countries there is a strong increase in size of house as the head of household grows older, flattening out around the age of fifty, but rising steeply from the twenties to the forties. The general shape of the ladder is similar in the two countries.[2] It is important to note that the steep part of the ladder is not simply the consequence of changing tenure status from renter to owner, although that transition certainly plays an important role. While owned homes are always larger than rented ones on average, the steep early ladder characterizes both rented and owned properties.[3]

Another way of seeing this transition is to examine the increase in home size at the time of purchase among new and repeat buyers as shown in table 3.2. New buyers are defined as those who were previously renters in the prior wave of PSID or BHPS so that, especially at young ages, this often will be their first owned home. Repeat buyers were previously also homeowners so

1. A detailed data description is provided in appendix A.

2. In the United Kingdom there is little evidence of cohort effects during the early part of the adult life cycle for the period 1968–1998 (Banks, Blundell, and Smith 2003). This suggests the rise would be the same whether we look at individual date-of-birth cohorts or pool across cohorts as in the tables here. In the United States there is some evidence of the number of rooms plateauing out at higher values among more recent cohorts.

3. The profiles in table 3.1 show some evidence of "downsizing" at older ages as children move out and the parents transit into retirement. While this downsizing may be important, especially for retired American households (see Venti and Wise 2001; Banks et al. 2012), it is not the focus of this chapter, which concentrates instead on the implications of the steps up the ladder earlier in life. A full analysis would need to take into account the possible effects of cohort differences among those at older ages on these profiles.

Table 3.2 Changes in rooms for movers, by type of buyer

	Age of head of benefit unit						
	< 25	25–34	35–44	45–54	55–64	65+	All
		United States					
First-time buyers—before	3.86	4.66	4.95	4.87	4.99	4.01	4.70
First-time buyers—after	5.51	6.61	6.24	5.91	5.72	4.63	5.98
First time—difference	1.62	1.45	1.28	1.05	0.71	0.61	1.27
Repeat buyers—before	4.84	5.91	6.56	6.87	6.56	5.92	6.32
Repeat buyers—after	5.49	6.72	7.27	6.94	5.99	5.48	6.66
Repeat—difference	0.65	0.81	0.71	0.07	–0.57	–0.43	0.30
		United Kingdom					
First-time buyers—before	—	3.31	3.83	4.25	4.13	3.98	3.79
First-time buyers—after	—	3.83	4.43	4.95	4.49	3.97	4.29
First time—difference	—	0.52	0.60	0.70	0.36	–0.01	0.50
Repeat buyers—before	—	3.63	4.38	4.98	5.23	4.98	4.59
Repeat buyers—after	—	4.54	5.26	5.45	4.99	4.05	4.99
Repeat—difference	—	0.91	0.88	0.47	–0.24	–0.93	0.40

Note: Pooled PSID and BHPS data from 1990 to 1999 and 1991 to 2003, respectively. First-time buyers restricted to those previously living in rented accommodation. Cell sizes too small in the United Kingdom for age < 25.

that this change now reflects changes in the size of owner-occupied housing. In the United States, while the transition from renter to owner involves a larger increment in house size, people are also clearly trading up in the early part of the life cycle when they purchase their second and subsequent homes. This effect is even stronger in the United Kingdom—on average, first-time buyers purchase houses that are bigger comparable to their rented house, but bigger movements up the ladder, defined in terms of increments to number of rooms, tend to take place for repeat buyers.

We view the shape of the ladder as demographically determined as individuals marry, form families with children growing, and eventually complete their family building with the by now older children leaving home to go off on their own. Figures 3.1A and 3.1B plot the cumulative distribution of individuals who have completed their fertility by age.[4] The steepness of this cumulative distribution mimics closely the overall shape of the housing ladder—a steep incline during the twenties and thirties with a flattening out during the forties. In fact, between ages twenty-five and the late thirties, this cumulative distribution of completed fertility is almost linear, with each year of age increasing the fraction that has finished childbearing by 5 percentage

4. Completed family size is computed by taking individuals age fifty or older and assuming they will not have any more children. We then look back through their fertility history and find the age at which their final child was born, and call this age the age of completed family size.

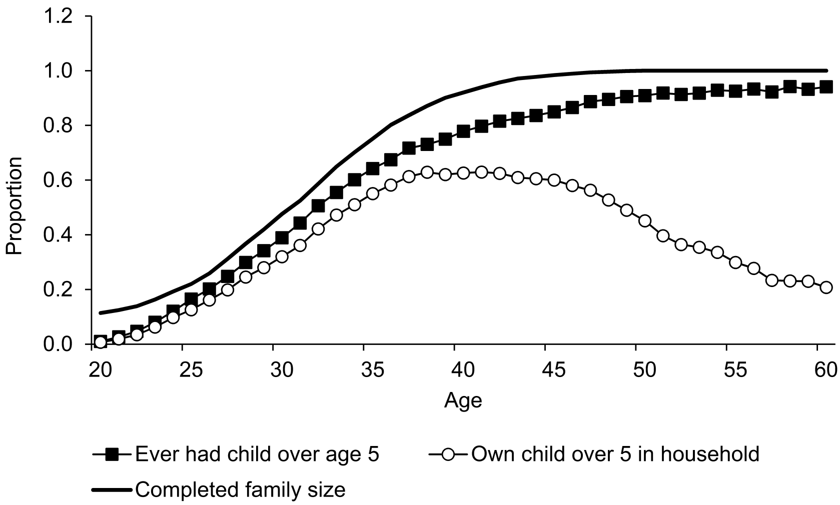

Fig. 3.1A The demographic ladder, United States

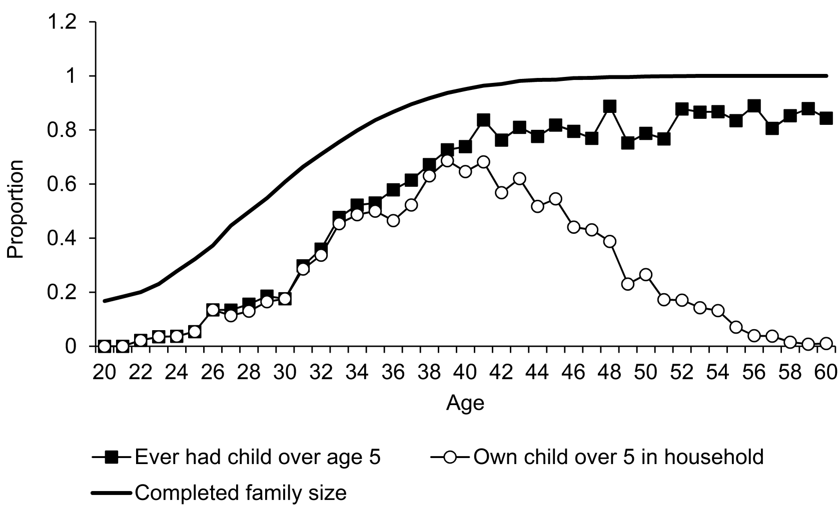

Fig. 3.1B The demographic ladder, United Kingdom

points. For example, around age thirty-one, half of all American individuals have completed their fertility with three out of every four doing so by age thirty-six. The shape and level of the profile corresponds extremely closely to that observed in the United Kingdom over the same ages.

Children turning five years old may be at a critical stage for housing decisions since parents may choose places to live with the quality of schools in mind and may want to stay longer in the same place. This could be another indicator of reaching the top of the housing ladder and arrival in the "family home." With this in mind, figures 3.1A and 3.1B also plot the cumulative fraction of individuals who ever had a child at least five years old. Not surprisingly, compared to the cumulative completed fertility, this figure is shifted out to the right so that, if age five is taken as the marker, reaching the top of the ladder takes place for the median family in the mid- to late thirties. Nevertheless, as with the completed family-size profile, the proportion rises steeply over the life cycle up to age forty in parallel to the sharp rise in the number of rooms demonstrated over the same ages. Finally, figures 3.1A and 3.1B also plot the proportion with their own children ages five or over currently in the household, as a measure of contemporaneous housing needs. Again the similarities between the United States and the United Kingdom are striking—in both countries after age forty there is a sharp decline in young children at home, an indication of an eventual demographic rationale for downsizing in later life.

3.2 House Price Volatility

Figure 3.2 shows real indices of country-wide average house prices for the United States and United Kingdom over the period 1974 to 1998 with both series normalized to take a value of 1 in 1980. Immediately apparent is the much larger volatility of housing prices in the United Kingdom, with real prices rising by 50 percent over the period 1980 to 1989 and then falling back to their previous value by 1992. Over the period as a whole, however, real returns were similar across the two countries.

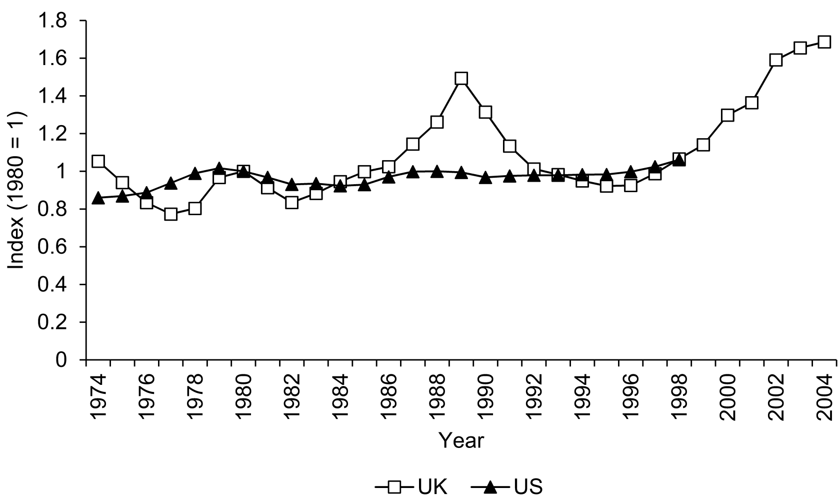

Fig. 3.2 Comparison of UK and US house prices

Although such difference will be instructive when looking at differences in housing choices across the two countries, the majority of our testing will rely instead on within-country differences in house price volatility over time in each of the two countries. The United Kingdom and the United States indexes both hide considerable differences across regions with some places and times being much more volatile in housing prices than others. In figures 3.3A and 3.3B, we present house prices from regional subindices, grouped to show house price trends in the more and less volatile areas.

The variation across American states in housing price volatility is large. Using the standard deviation in real prices (relative to a 1980 base) as the index, Massachusetts ranks at the top with price swings between peak and trough over this period of more than 2 to 1. At the other extreme lies South Carolina, where the peak price exceeds the trough by only 15 percent. The most volatile states are concentrated in New England and along the Northeastern seaboard (Massachusetts, New York, New Jersey, Rhode Island, Connecticut, New Hampshire, and Maine) and in California and Hawaii. While we will use a continuous measure of volatility in our analyses below, for descriptive purposes now we label these the volatile states.

To exploit regional and time-series differences in volatility in house prices, we construct indices of volatility by computing the standard deviation of the change in the log real house price index over the previous five years for each of the fifty US states and twelve UK regions for which we have house price indices. These indices, which measure percent volatility over the sample, are plotted in figures 3.4A and 3.4B, grouped by the same two "volatile" and

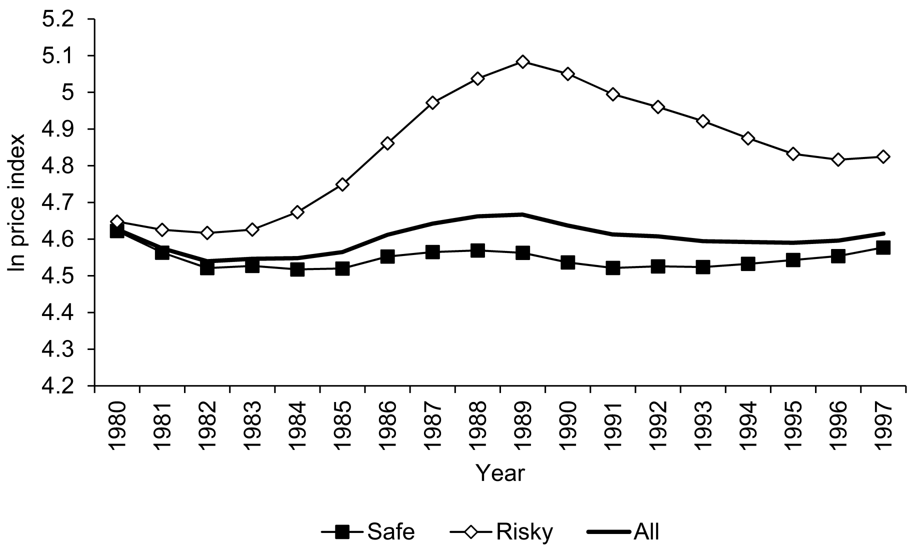

Fig. 3.3A US mean house price index by area, 1980–1997

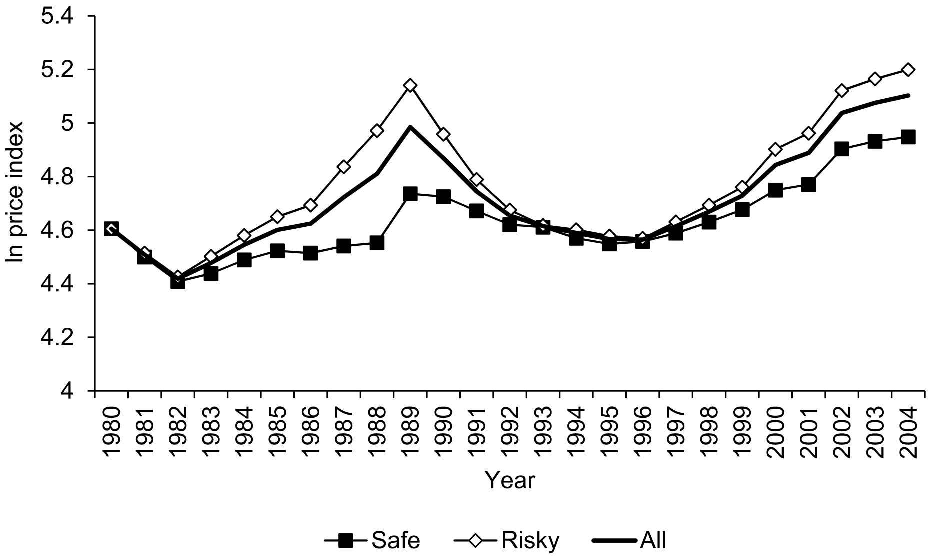

Fig. 3.3B UK mean house price index by area, 1980–2000

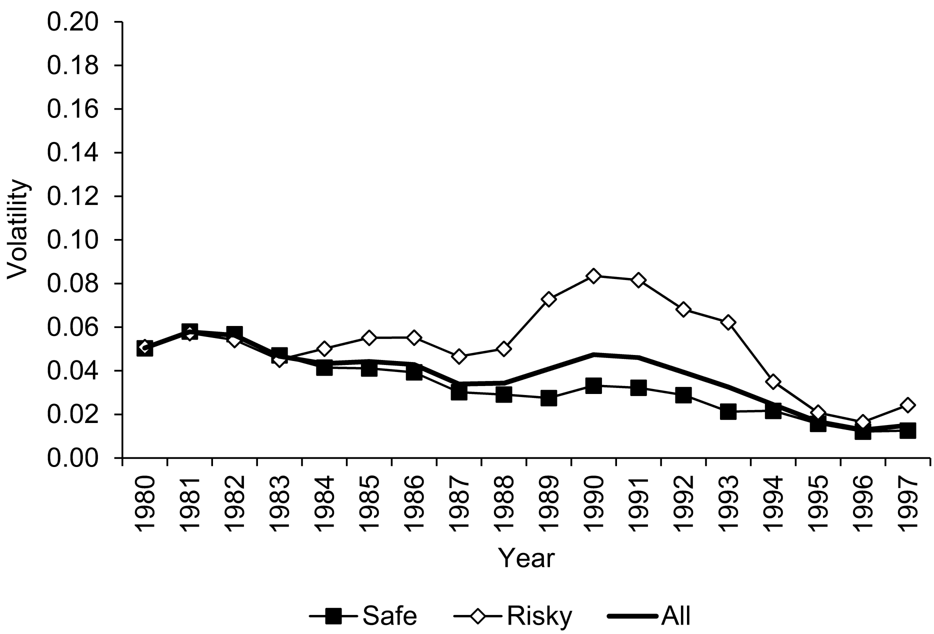

Fig. 3.4A Regional volatility indices by area (US, 1980–1997)

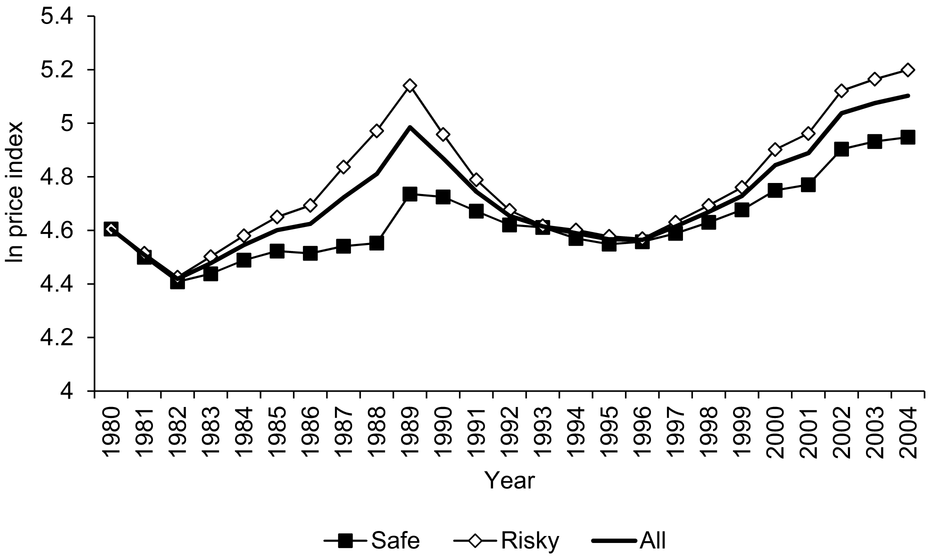

Fig. 3.4B Regional volatility indices by area (UK, 1980–2000)

"nonvolatile" areas as before. Two things are important to note. First, the higher levels of volatility in the United Kingdom (even in the nonvolatile regions) are apparent. Second, in both countries it will be the state/regional level volatility index, not an average across groups of regions, that enters our empirical specifications.

3.3 Housing Choices in the Presence of House Price Risk and the Housing Ladder

In order to think about how the housing ladder might affect housing demand in the presence of house price risk, we use the concept of a minimum housing "need" that changes with family size. This need can then be thought of as increasing over the life cycle as individuals form into couples, have children, and reach their maximum family size. Central to our empirical modeling is the idea that these increasing housing needs over the life cycle interact with future house price risks to generate an insurance role for housing consumption early in life.[5] In this section, we discuss the intuition behind this idea before moving on to testing the predictions of such a framework empirically.

In a standard model without house price risk, housing demand would

5. In a related framework, Ortalo-Magne and Rady (2006) have looked at the theoretical predictions of an equilibrium model of home ownership when house prices are volatile.

increase with wealth but would also adjust to reflect the minimum necessary level of consumption. In such a framework one could write housing demands in each period as a function of adjusted lifetime wealth (i.e., the present discounted value of lifetime wealth ***net*** of the discounted sum of minimum necessary levels of housing over the lifetime[6]), the real user cost of housing services, and the minimum level of housing needs in that period. Any future change in household demographic composition would simply act through its effect on adjusted wealth. While the consumption of housing services may involve the purchase of a house and an asset accumulation decision, the assumption of perfect credit markets and certainty would yield this aspect of housing consumption unimportant in such a setting. We need to generalize this model in order to incorporate house price risk and consider the additional role of housing as a durable asset.

For ease of exposition we will assume the life-cycle profile can be represented by the following sequence of three discrete life stages: at (Demographic) stage $D = 1$ the individual is living with his or her parents, at stage $D = 2$ he or she partners to form an independent family unit, and at stage $D = 3$ the couple has had children and completed its family size. This is a simplified demographic profile but effectively represents the upside of the housing "ladder" that we wish to capture in our model.[7] For further simplicity we will assume that the leaving home decision $D = 1 \rightarrow D = 2$ simply concerns a decision over whether to rent or own in light of the possible increase in family size associated with the arrival of children between $D = 2$ and $D = 3$.

Without price uncertainty the rent/own decision will be driven by transaction costs of ownership as well as the desire for mobility, the potential tax advantage of a mortgage, and any down payment rules or constraints on the multiples of income that may be borrowed. For a household that expects to remain in their house for a reasonable length of time, for example, at $D = 3$ (the top stage of the demographic ladder), owning is the most efficient way of achieving a desired level (and type) of housing service—with idiosyncratic tastes a renter can never commit to stay long enough to make it in the landlord's interest to invest in the renter's idiosyncratic tastes. Hence we will assume for simplicity that all households will be owner-occupiers at $D = 3$ and that this is known to them at $D = 2$.[8]

Before turning to the introduction of house price risk, there are two

6. This wealth variable contains the current value of assets and the future stream of discounted income flows. Housing equity and other assets will be added in our discussion of uncertainty below.

7. We ignore here older stages of the life cycle where the possibility of downsizing comes into play (e.g., see Venti and Wise 2001; Banks et al. 2012).

8. To the extent that this probability is less than 1 then any insurance motive will be dampened, but as long as the positive probability of home ownership at $D = 3$ is not zero, the insurance motive will still exist. Since our empirical tests are simply for the presence of an insurance effect of house price risk on housing choices at $D = 2$, all they formally require is that this probability is not zero.

aspects of the supply of housing services that are relevant to our discussion. First, a more inelastic supply will induce a larger sensitivity of house prices to changes in demand and, in particular, to fluctuations in incomes of young first-time buyers. The second aspect relates to the rental market—imperfections and/or regulation of the private rental market may make it difficult for the young to use rental housing as the step between leaving the parental home and acquiring a house.

The introduction of house price uncertainty into the model adds an important distinction between ownership and renting that will enhance the desire to accumulate housing wealth and thus the need to become an owner earlier in the life cycle—house price risk generates an incentive to accumulate housing equity at $D = 2$ before the family is complete. At first sight this may seem a puzzle since accumulation of a risky asset might normally be expected to decrease with the level of price volatility for a household with risk-averse preferences. That usual result does not hold because of the vital insurance role played by housing in early life in our framework. We argue this intuitively below, but to back up this intuition in appendix B we simulate the predictions of a simple three-period model with constant relative risk-aversion preferences that allows us to demonstrate more formally the effects on housing consumption profiles of changing volatility, the changing steepness of the housing ladder, and changing degrees of risk aversion.

At $D = 2$ there are two choices: how much housing to consume, and whether to own or to rent. If house prices are variable and uncertain then, given the expected increase demand as the household moves up the demographic ladder from $D = 2$ to $D = 3$, housing equity will be an important source of insurance against future house price risk. Indeed, in the absence of a financial instrument that could insure this house price risk (which may well be defined at a very local level), holding housing early in life may be the only insurance mechanism. The larger the uncertainty in house prices and the steeper the increase in minimum housing needs over the life cycle, the more important is the insurance aspect of housing equity.

Thus the key mechanism for these effects is the insurance role of housing in period 2. If prices turn out to fall or stay the same then ownership will not, ex post, dominate renting. Indeed, if house prices fall there will be some loss to ownership. However, because of the strongly declining marginal utility of consumption associated with housing consumption in period 3 approaching the minimum necessary requirement, insuring the risk of house price rises is more important than avoiding the risk of a house price fall. To achieve this, the consumer needs to hold an asset whose return is correlated with (local) housing prices. If such an asset is not available on the financial market, the insurance can only be achieved by purchasing the asset itself. Consequently, other things equal, the higher the level of house price uncertainty the higher the incentive to become an owner-occupier. In this context increasing minimum housing requirements or increases in risk aversion are acting in a similar way to an increase in volatility. By a straightforward extension of these arguments, individuals will also stay away from endowment mortgages and refinancing of housing equity for nonhousing consumption or investment purposes.[9]

In summary, the decision to accumulate housing equity early in the life cycle will be an increasing function of house price volatility for risk-averse households who expect an increase in family size. In the absence of an equity market in local housing assets, this demand for housing equity also enhances the decision to own.[10]

Some housing price insurance against mid-life house price risk could be provided by inheritances from parents of which housing wealth is frequently the most important part. But this insurance is limited by a number of factors. First, not all parents are homeowners themselves, especially since their homeowner decisions were made in a distant past when home ownership was much less common. Second, inheritances are typically split among all the siblings, making this type of insurance partial at best. Parents may also not live in the same type of housing price volatility area as their children, which would also diminish the insurance value of this mechanism. Finally, the timing of the inheritance is relevant. Inheritances received when adult children are in the early stages of the adult-housing ladder have lost their insurance value, while those received after the peak of the ladder may have liquidity problems in creating an insurance value.

One further extension that needs to be discussed, since we endeavor to control for it in the empirical analysis that follows, is geographic mobility. If individuals anticipate residing in less volatile areas in period 3, then their demand for insurance is reduced (and the insurance value of their housing equity in period 2 will be reduced also to the extent that house prices are not perfectly correlated across regions). It is expected volatility at $D = 3$ (from the point of view of $D = 2$) that drives the insurance motive. In the case of

9. Borrowing constraints add further refinements to the model. They typically take two forms: a down payment constraint and a multiple-income (or debt-to-income) constraint. The down payment is proportional to the house price. The multiple-income constraint restricts the mortgage to be a multiple of current income. With such constraints in place, the potential downside of a house price rise between $D = 2$ and $D = 3$ for a nonowner enhances the insurance value of ownership at $D = 2$. If house prices rise relative to incomes then the capital gain reduces the mortgage requirement and makes it more likely that the earnings-to-mortgage debt can be met. Such borrowing constraints add to the insurance value of ownership since an unexpected price increase at $D = 3$ considerably relieves the down payment constraint.

10. An additional reason for ownership is given by rental price risk. As Sinai and Souleles (2005) point out, house ownership insures housing consumption from rental price risk (although it may not alleviate cyclical fluctuations in housing costs when variable-rate mortgages are the predominant form of finance for housing purchases). Our focus here is specifically on the housing ladder where we show house price risk enhances the probability of ownership and the speed with which an individual moves up the ladder. At this stage of the life cycle where expected duration of stay in rental housing is relatively short, rental price risk may be less relevant than for lifetime renters. In addition, young agents can avoid rental price risk by living with their parents until they are ready to buy a home. This is relatively common pathway in Britain.

individuals in $D = 2$ anticipating moving to a safe area at $D = 3$, both these factors are likely to play a reduced role, although they could still be important to some extent.

3.4 The Empirical Relationship between Housing Choices and Risk

On the basis of our discussions in the previous section, and the numerical model solutions presented in appendix B, there are three principal predictions that we will test empirically in this chapter: (a) other things being equal, individuals should buy homes earlier in more volatile areas; (b) young homeowners are less likely to consume capital gains on housing through refinancing in more volatile areas; and (c) young homeowners will consume "more" housing in more volatile areas than their counterparts in less volatile areas. In the following subsections we deal with each of the above predictions in turn.

3.4.1 Age of Home Ownership

In the presence of a housing ladder, individuals living in places with more volatile housing prices need to self-insure by buying their first home at a younger age. In the final column of table 3.3, we list for both the United Kingdom and the United States the proportion of individuals who are homeowners, by age, for a typical year—1994. These patterns do not depend critically on the year chosen. The data are also presented separately for the volatile and nonvolatile areas in both countries. While average rates of home ownership are similar, there are striking differences by age between the two

Table 3.3 Proportion of individuals who are homeowners in 1994

Age	Volatile regions	Nonvolatile regions	All
United Kingdom			
20–29	0.336	0.397	0.357
30–39	0.717	0.755	0.731
40–49	0.799	0.784	0.794
50–59	0.801	0.723	0.775
60–69	0.754	0.667	0.723
70+	0.602	0.547	0.583
All	0.652	0.641	0.648
United States			
20–29	0.187	0.273	0.253
30–39	0.528	0.612	0.590
40–49	0.691	0.748	0.736
50–59	0.825	0.830	0.828
60–69	0.784	0.875	0.850
70+	0.683	0.723	0.714
All	*0.583*	*0.649*	*0.633*

Source: Data are from the 1994 BHPS and PSID.

countries. Home ownership rates among young households are far higher in the United Kingdom than in the United States, with differences of 10 percentage points for householders between ages twenty and twenty-nine and 13 percentage points those between ages thirty and thirty-nine. However, through middle age, home-ownership rates converge so quickly that US rates actually exceed those in the United Kingdom among older households.

Since prices are far more variable in the United Kingdom, these cross-country differences in home-ownership rates are consistent with our theoretical implication that ownership should occur at a younger age in more price-volatile housing markets. However, when we compare home-ownership rates between the volatile and nonvolatile areas within each country, the challenge to our theory becomes more apparent. In both countries, owning a home is somewhat less common among younger households in the volatile market.

However, there are other significant differences between these two markets in each country that will presumably strongly affect the decision to own. Tables 3.4A and 3.4B list some of the more salient ones. Perhaps,

Table 3.4A **Differences across broad regions, United States (twenty-one to thirty-five-year-olds)**

	Nonvolatile	Volatile
Fraction of population (1999)	0.78	0.22
Owns home	0.43	0.33
Rents	0.37	0.44
Ever had a child	0.58	0.47
Years of education	13.04	13.58
Log income in 1995$	9.90	10.07
Mean PSID house value	83,777	155,989
Mean PSID annual rent	4,116	6,025

Source: PSID and BHPS.

Table 3.4B **Differences across broad regions, United Kingdom (twenty-one to thirty-five-year-olds)**

	Nonvolatile	Volatile
Fraction of population (2000)	0.34	0.66
Owns home	0.53	0.50
Rents	0.24	0.27
Has a child	0.45	0.50
Education—low	0.48	0.48
Education—medium	0.24	0.25
Education—high	0.28	0.28
Ln income (in £2000)	9.50	9.55
Mean BHPS house value (£)	80,455	103,405
Mean BHPS weekly rent (£)	64.00	85.70

Source: PSID and BHPS.

most important, housing prices are much higher in the volatile markets. For example, the average price of a home in the more volatile states is almost twice that in the less volatile ones, which should certainly discourage home ownership among the young. While rental prices are also higher in the more volatile states, the percentage difference is 46 percent compared to 68 percent for housing prices. Young individuals living in the volatile states also have more education, more household income, and are less likely to be married and to have children. All of these factors are obviously relevant to the housing tenure decision, so the final verdict on the theory requires multivariate modeling.

In our multivariate analysis, we estimate a probit model of whether or not one is a homeowner using a sample of individuals who are between the ages of twenty-one and thirty-five. Results are similar if one uses a somewhat younger or somewhat older age band that corresponds to the rising part of the housing ladder. In addition to our measure of housing price volatility described above, this model includes several relevant demographic attributes—a quadratic in age, indicator variables for whether one is married and whether one has children, the log income of the tax unit in which the individual participates, and measures capturing years of schooling. We measure area and age-specific housing prices by using the PSID and BHPS to compute mean housing prices and mean rents in each state/region for owners and renters respectively, within broad age groups. These prices as well as benefit unit income are entered in logs.

The critical variable for testing our theory concerns housing price variability, which varies across space and time. We construct a five-year moving window of the standard deviation of the year-to-year differences in the log real housing prices in a region[11] as described in the previous section. Since our US housing price series starts in 1974, this means that our PSID analysis starts with the 1980 PSID and extends to the 1997 PSID. Since fewer historical years are available in the BHPS, the analysis there covers the years 1991–2003.

We stop our analysis at these times for several reasons. First, after the 1997 wave the PSID switched its periodicity from one year to two years, making it not strictly comparable to the BHPS, especially for the type of time-series price volatility analysis we are conducting in this chapter. Second, the signature event after this period would be the housing price collapse in both countries associated with the Great Recession. But the magnitude of this event is an order of magnitude more unique and larger than the house price volatility risk we are trying to model in this chapter.

As noted earlier, expected capital gains are likely to be an important component of the demand for a risky asset like housing. Expected capital gains reduce the user cost, reflecting the risk-return trade-off. To construct an

11. For each of the fifty US states and the twelve UK regions.

expected gains variable, we use the change in the regionally varying log real house price index over the previous five years—precisely the same five-year moving window for house prices we use in constructing the house price risk variable.

There may well be other attributes of states or regions that create an incentive to own homes and that may be correlated with housing price volatility. To control for the possibility that the variability in housing prices across regions and states may simply be capturing unmeasured differences across states and regions, we estimated all models with and without state and region effects. Putting in these geographic-level fixed effects means that only attributes of geographic areas that are changing over time can affect our results. We see this as much less likely. A linear time trend is added to our models so our time-series variation is relative to a common linear trend.

The results are displayed in tables 3.5A and 3.5B, which list marginal effects and standard errors of all variables obtained from probit models. In both countries we find positive income effects (slightly higher in the UK) and education effects (a possible proxy for permanent income) on home ownership. Not surprisingly, marriage in both countries encourages home ownership and children do likewise. In the United States and the United Kingdom, we also have statistically significant negative price-level effects on the probability of owning a home. We also find a positive impact of expected capital gains, although this is not uniformly significant across all model specifications.

In both countries high area-specific rents also discourage home owner-

Table 3.5A **Probability of home ownership, United States**

	(1)		(2)	
	dF/dx	Std. err.	dF/dx	Std. err.
Price volatility index	0.1873	0.0945	0.4061	0.1084
Age	0.0448	0.0061	0.0478	0.0061
Age squared	–0.0004	0.0001	–0.0005	0.0001
Married	0.2727	0.0045	0.2698	0.0045
Ever have a child	0.0628	0.0039	0.0671	0.0039
Education	0.0105	0.0009	0.0104	0.0009
Ln income	0.2057	0.0026	0.2070	0.0026
Ln housing prices	–0.0561	0.0051	–0.0365	0.0069
Exp. capital gains	0.0360	0.0538	0.1069	0.0554
Ln rental prices	–0.0476	0.0057	0.0151	0.0069
Move A-B	–0.1513	0.0155	–0.1139	0.0157
Move B-A	–0.1114	0.0173	–0.1341	0.0174
Trend	0.0022	0.0004	0.0009	0.0004
State dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models also control for city size, missing values, trend, number of waves in panel, and a constant term.

Table 3.5B Probability of home ownership, United Kingdom

	(1)		(2)	
	dF/dx	Std. err.	dF/dx	Std. err.
Price volatility	0.3361	0.1212	0.3629	0.1226
Age	0.1107	0.0127	0.1093	0.0127
Age squared	–0.0014	0.0002	–0.0014	0.0002
Married	0.4623	0.0065	0.4623	0.0065
Has children	0.0349	0.0089	0.0352	0.0089
Educ.—low	–0.0874	0.0086	–0.0866	0.0087
Educ.—medium	0.0066	0.0097	0.0070	0.0097
Ln income	0.2992	0.0061	0.2989	0.0061
Ln house prices	–0.1084	0.0203	–0.1080	0.0222
Exp. capital gains	0.1648	0.0928	0.1595	0.0968
Ln rental prices	–0.1025	0.0174	–0.0963	0.0186
Move A–B	–0.0808	0.0302	–0.0802	0.0302
Move B–A	–0.1558	0.0279	–0.1559	0.0280
Regional dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models include controls for living in a big city, number of waves observed in panel, trend, and a constant term.

ship. While this may at first blush seem counterintuitive, it is important to remember that there are three options open to young persons in terms of their housing choices—owner, renter, or living with others—especially parents. When we estimated models for whether one was a renter, higher rental prices discouraged both renting and home owning.

The coefficients on the price-volatility variables form the basis of the fundamental test of our central prediction. In both the United States and the United Kingdom, we estimate statistically significant positive effects of price volatility indicating that as predicted individuals choose to own homes at a younger age in the more housing price volatile areas. When state/region dummy variables are included, these estimated effects are remarkably similar in the two countries so that on the margin Britons appear to react more in moving into home ownership at a younger age only because volatility on average is so much higher there.

3.4.2 The Decision to Refinance

As discussed above, our key hypothesis is that households in areas where housing prices are volatile should self-insure at young ages by holding more housing. However, if they were to buy a house and then refinance and use the proceeds to finance consumption or to purchase risky assets, this would simply undo the safety housing provides. As such, we would expect less of such behavior in volatile areas and we test this prediction in this section. Although imperfect, our two data sets provide some measure of the extent to which individuals engage in such activities. With regard to the United

Table 3.6A Probability of refinancing a US home

	(1)		(2)	
	dF/dx	Std. err.	dF/dx	Std. err.
Price volatility index	–0.5654	0.1268	–0.3715	0.1485
Age	–0.0081	0.0094	–0.0072	0.0093
Age squared	0.0001	0.0002	0.0001	0.0002
Married	–0.0042	0.0065	–0.0025	0.0065
Ever have a child	0.0181	0.0054	0.0170	0.0054
Education	–0.0081	0.0011	–0.0079	0.0012
Ln income	–0.0183	0.0035	–0.0153	0.0036
Ln house equity $t - 1$	0.0367	0.0022	0.0384	0.0022
Exp. capital gains	0.1626	0.0696	0.2228	0.0740
Move A–B	0.0012	0.0344	0.0177	0.0337
Move B–A	0.0239	0.0330	0.0182	0.0328
State dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models also include controls for city size and missing value dummies.

States, PSID data contain no direct questions in each year on refinancing, so we define an indicator of refinancing to take the value 1 if an individual's mortgage is observed to have risen by a specified amount between waves.[12] The problem with this measure is that individuals could well be using the extra finance to improve their home, which would not unravel the housing as price insurance mechanism, thus making it an imperfect measure for our purposes.

This prediction can, however, be directly addressed in the United Kingdom using BHPS data, where individuals are asked specific questions about whether they refinanced their housing equity between waves, and if so the purposes for which the resulting money was used. With such detailed questions we are able to construct a more precise indicator in the United Kingdom that takes the value 1 only if individuals refinance between waves and do not increase the quantity or quality of housing as a result.

Our results are summarized in tables 3.6A and 3.6B. In addition to the nonprice variables that were part of the home-ownership model, we included a measure of home equity in the previous year to capture the amount available for refinancing. In both countries, using both measures of refinancing, the predictions of the theory are borne out—individuals in more risky areas are less likely to refinance, conditional on other characteristics and their initial level of net housing equity.

12. In practice, small rises could simply be a result of measurement error, so we choose a variety of thresholds above which we assert a change in mortgage can be interpreted as a refinance. The specification in table 3.6A uses a definition of mortgage rising by at least 30 percent or $5,000, whichever is the greater.

Table 3.6B Probability of refinancing a UK home

	(1)		(2)	
	dF/dx	Std. err.	dF/dx	Std. err.
Price volatility	–0.1726	0.0885	–0.2093	0.0876
Age	0.0071	0.0071	0.0071	0.0071
Age squared	–0.0001	0.0001	–0.0001	0.0001
Married	–0.0115	0.0069	–0.0116	0.0069
Has children	0.0124	0.0036	0.0128	0.0036
Educ.—low	0.0148	0.0043	0.0145	0.0043
Educ.—medium	0.0112	0.0049	0.0110	0.0049
Ln income	0.0083	0.0031	0.0074	0.0031
Ln equity $t-1$	0.0056	0.0017	0.0050	0.0017
Exp. capital gains	0.2262	0.0661	0.1434	0.0759
Regional dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models include controls for living in a big city, number of waves observed in panel, trend, tax unit composition change between waves $t-1$ and t.

3.4.3 Increased Consumption of Housing

As pointed out in section 3.2, one can insure against future housing price volatility in period $D = 3$ not only by purchasing a house in period $D = 2$, but also by consuming more owned housing than one might otherwise want given the objective demographic circumstances. Moreover, in the presence of borrowing constraints there is a possibility that, if prices rise more quickly than income, debt-to-income restrictions may prevent individuals being able to purchase a larger home at $D = 3$. With this possibility on the horizon, individuals already more likely to be an owner-occupier as a result of the increased volatility would also choose to increase their consumption of housing. In the case of prices rising, the capital gain will be higher and can be used as down payment on the final home in order to offset the debt-to-income restriction. Indeed, in the United Kingdom the two conditions are often linked (since on a secured loan the consequences of default to the lender are reduced with a higher down payment) such that individuals with higher down payments can borrow a higher multiple of income.

In order to measure the consumption of housing for the purposes of testing this prediction, we use two variables—the number of rooms in the house and the gross value of the house.[13] Neither is perfect since the former omits

13. With increasing availability of appropriate panel data on wealth, there has been renewed interest in the study of housing wealth dynamics and its implications for other economic factors. Flavin and Yamashita (2002) look at the effect on households' optimal financial-asset holding of integrating housing (i.e., both housing wealth and the associated consumption demand for housing services) into the portfolio model. In a more empirical study, Banks, Blundell, and

Table 3.7A Number of rooms in the United States

	(1)		(2)	
	Coeff.	Std. err.	Coeff.	Std. err.
Price volatility index	0.0593	0.6931	0.5800	0.7514
Age	0.3916	0.0495	0.3585	0.0468
Age squared	–0 0041	0.0008	–0.0036	0.0008
Married	1.6815	0.0765	1.5641	0.0699
Ever have a child	0.7385	0.0317	0.7569	0.0302
Education	0.1309	0.0064	0.1235	0.0061
Ln income	1.5806	0.0519	1.4971	0.0488
Ln housing prices	–0.5104	0.0368	–0.3232	0.0490
Exp. capital gains	0.9832	0.3889	1.2084	0.3766
Move A–B	–1.0676	0.1376	–0.6873	0.1295
Move B–A	–0.3129	0.1482	–0.4833	0.1419
Mills ratio	2.7749	0.1186	2.6086	0.1087
State dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models also include controls for city, trend, missing value dummies, number of waves observed in panel, and a constant term. Selection equation is reported in table 3.5A. Rental price omitted from rooms equation.

possible quality effects (such as variation in the size and quality of a room, which varies much more in the United States than in the United Kingdom), and the latter may be contaminated by unmeasured price variation leading to uncontrolled-for demand effects. Nevertheless, each provides a useful complementary test for the predictions of the model. For each of these measures of housing consumption, we use a standard Heckman-type selectivity model to evaluate the predictions for homeowners only, using the probits reported in tables 3.5A and 3.5B as the selection equations and omitting the rental price from the continuous part of the model.

Tables 3.7A and 3.7B report the results of estimating selection models for the number of rooms occupied by young homeowners. These estimates show significant positive effects of volatility on house size, but only in the United Kingdom—other things equal, young British homeowners in risky areas tend to consume more rooms than their counterparts in safer areas in order to partially insure themselves against housing price risk. The effects are positive in the United States as well, but not statistically significant at conventional test levels. It is possible that the much larger variation in size and quality of rooms in the United States make it a weaker test there.

Smith (2003) show that housing wealth differentials between the United States and the United Kingdom offset to some extent the differences in financial wealth observed between the two countries. But in spite of recognition of the dual importance of housing as both consumption and investment, the implications of the often-considerable housing price uncertainty for the life-cycle path of housing wealth are not well understood.

Table 3.7B **Number of rooms in the United Kingdom**

	(1)		(2)	
	Coeff.	Std. err.	Coeff.	Std. err.
Price volatility	4.2949	0.6503	4.1218	0.6474
Age	0.2886	0.0766	0.2874	0.0760
Age squared	–0.0023	0.0013	–0.0023	0.0013
Married	2.2813	0.1268	2.2594	0.1258
Has children	0.9393	0.0470	0.9377	0.0465
Educ.—low	–0.5862	0.0471	–0.5909	0.0467
Educ.—medium	–0.1119	0.0501	–0.1172	0.0496
Ln income	1.3262	0.0721	1.3193	0.0716
Ln house price	–1.2942	0.0817	–1.3970	0.1084
Exp. capital gains	2.0882	0.4611	2.3989	0.5026
Move A–B	–0.2887	0.1768	–0.2973	0.1749
Move B–A	–0.8030	0.1788	–0.7649	0.1773
Mills ratio	2.6704	0.1556	2.6425	0.1544
Regional dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Model also includes controls for city size, trend, number of waves observed in panel, and a constant term. Selection equation is reported in table 3.5B. Rental price omitted from rooms equation.

Other estimated parameters accord with a priori intuition. The number of rooms increases with income, education, whether an individual is married, and with the presence of children, and decreases with the average price of housing per room in the area. The magnitude of the demographic effects (marriage and children) and the income effects are similar in the two countries. Finally, those individuals moving from risky to safe areas have a reduced number of rooms, as would be predicted by their insurance motive being reduced, although not by enough to offset the volatility effect altogether.

In tables 3.8A and 3.8B we repeat this analysis using gross house value as our measure of housing consumption. Again in both countries, as predicted by our theory, individuals in risky areas choose to have higher housing wealth than those living in safe areas. This effect is reduced for those observed to move from risky to safe areas during the period of our data. Thus, those individuals who end up moving out of the risky housing-price areas appear to insure less in the sense that they do not overconsume housing when they are young. Once again, the principal demographic variables enter with the expected signs and in about the same magnitude in both countries—home values increase with marriage, children, and age (at least until middle age). Similarly, income and education effects are positive in both countries, although our estimated current income elasticity is much higher in the United States than in the United Kingdom.

Table 3.8A **Gross housing wealth in the United States**

	(1)		(2)	
	Coeff.	Std. err.	Coeff.	Std. err.
Price volatility index	2.5190	0.3510	1.7861	0.3787
Age	0.3266	0.0253	0.3045	0.0241
Age squared	–0.0044	0.0004	–0.0041	0.0004
Married	0.8253	0.0393	0.6766	0.0375
Ever have a child	0.1031	0.0161	0.0888	0.0154
Education	0.1002	0.0032	0.0956	0.0031
Ln income	1.0191	0.0266	0.9176	0.0257
Ln housing prices	0.3990	0.0187	0.3220	0.0248
Exp. capital gains	0.1532	0.1971	0.2007	0.1901
Move A–B	–0.4946	0.0703	–0.4152	0.0678
Move B–A	–0.1506	0.0754	–0.1286	0.0736
Mills ratio	1.3505	0.0613	1.1134	0.0590
State dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models also include controls for city size, missing value dummies, number of waves observed in panel, and a constant term. Selection equation is reported in table 3.5A. Rental price omitted from rooms equation.

Table 3.8B **Gross housing wealth in the United Kingdom**

	(1)		(2)	
	Coeff.	Std. err.	Coeff.	Std. err.
Price volatility	1.3034	0.2337	1.1828	0.2298
Age	0.1891	0.0276	0.1860	0.0270
Age squared	–0.0023	0.0005	–0.0023	0.0005
Married	0.8706	0.0467	0.8530	0.0458
Has children	0.2426	0.0169	0.2419	0.0165
Educ.—low	–0.2377	0.017	–0.2409	0.0166
Educ.—medium	–0.0448	0.0181	–0.0484	0.0177
Ln income	0.5862	0.0258	0.5794	0.0253
Ln house prices	0.5118	0.0295	0.4291	0.0385
Exp. capital gains	0.7693	0.1659	1.0163	0.1785
Move A–B	–0.087	0.0637	–0.0911	0.0623
Move B–A	–0.2896	0.0646	–0.2653	0.0633
Mills ratio	0.9565	0.0556	0.9347	0.0545
Regional dummies	No		Yes	

Note: Ages twenty-one to thirty-five. Models also include controls for city size, trend, number of waves observed in panel, and a constant term. Selection equation is reported in table 3.5B. Rental price omitted from rooms equation.

The models estimated in tables 3.7A and B and 3.8A and B are based on two alternative and imperfect measures of housing consumption. However, the general similarity of the estimated models across both specifications, and in particular the similar estimated effects of our measure of housing price variability on housing consumption in both countries, lends support to the predictions of our model.

3.4.4 Endowment Mortgages

Over the period covered by our data, one relatively common financial instrument used to finance house purchases in Britain was an endowment mortgage. During the life of the mortgage, the borrower makes only interest payments on the loan, leaving the principal to be repaid at the end of the term of the mortgage. In addition to the interest, the borrower pays into a saving scheme, which is designed to mature and repay at least the value of the capital sum borrowed at the end of the period of the loan. Throughout the 1980s and 1990s these schemes were common, with the most common type of saving scheme being an endowment policy—essentially term life insurance with the accumulating fund invested in the stock market.

While the relative attractiveness of such a mortgage product is not so clearly different across volatile and less volatile areas from the perspective of our main story (after all, the homeowner retains the housing wealth and hence gets the insurance against the future house price risk regardless of how that housing purchase is financed), one might still expect some differences simply due to background risk effects. These endowment funds were typically quite large and unavoidable for anyone who was unable to use a repayment mortgage (typically those without the liquidity to finance a substantial down payment). One might argue that the future house price risk that is the main object of interest in this chapter acts like a large background risk that would discourage individuals from taking on a substantial further risk elsewhere in their portfolio. As such, households who live in volatile areas should be less likely to choose this type of mortgage.[14] These predictions are borne out using the same empirical framework as the tests presented above. In table 3.9, we report results obtained from probit models with the dependent variable being whether individuals finance their house purchase with an endowment mortgage as opposed to some other method. Since mortgage arrangements typically do not change over the term of the mortgage (and in the case of endowment policies the penalties for early termination are high), we are able to use homeowners of all ages for this test, thus also implicitly

14. One complication in testing this prediction is that, particularly in the 1980s (and early 1990s), there is some evidence that misselling of this type of mortgage took place by mortgage providers. In particular, there is the possibility that consumers were not fully informed of the nature of other choices of mortgage arrangements available or about the risky nature of the endowment policy. Assuming such effects were constant across regions, however, we might still expect those living in more volatile regions to be less likely to take out such mortgages.

Table 3.9 Probability of holding endowment mortgage, homeowners in the United Kingdom only

	(1)		(2)	
	dF/dx	Std. err.	dF/dx	Std. err.
Price volatility	–5.0454	0.1097	–5.0143	0.1120
Age	0.0202	0.0018	0.0203	0.0018
Age squared	–0.0003	2.07E–05	–0.0003	2.08E–05
Married	0.0395	0.0089	0.0392	0.0089
Has children	0.0438	0.0066	0.0442	0.0066
Education—low	0.0430	0.0070	0.0440	0.0070
Education—medium	0.0200	0.0081	0.0201	0.0081
Ln income	0.0072	0.0052	0.0072	0.0053
Exp. capital gains	0.7835	0.0924	0.8017	0.0927
Move A–B	0.1121	0.0452	0.1143	0.0450
Move B–A	–0.0531	0.0479	–0.0590	0.0479
Regional dummies	No		Yes	

Note: All ages. Models also include number of waves observed in panel, city trend.

increasing the period over which effects are apparent. Whether or not we include region dummies, British families who live in more volatile housing price areas are less likely to take out an endowment mortgage. This estimated effect is statistically significant.

3.5 Conclusions

Typically, risk-averse individuals will avoid risky assets as volatility increases. In this chapter we show that owner-occupied housing is an exception to this rule. The consumption role of housing wealth, coupled with increasing necessary levels of housing over the life cycle due to demographic changes, and the fact that individuals will typically prefer to own rather than rent, mean that individuals will expect to be consuming a risky commodity—owner-occupied housing—in middle age. Since housing is a necessity, the utility consequences of this risk might be expected to be relatively large. In the absence of suitable financial products to insure this risk, this will lead individuals to invest in housing early in the life cycle as a way of insuring future price fluctuations. Not only does this lead to higher owner-occupation rates, it also leads to more housing wealth and less propensity to realize capital gains on housing through refinancing to fund nonhousing consumption.

Using microdata from two countries we have constructed tests of these predictions and all are borne out empirically. Cross-country differences between the United States and the United Kingdom correspond to the cross-country differences in volatility—the United Kingdom is more volatile and

UK households own earlier, and have more of their portfolio in housing. Because this may be driven by other differences between countries, we use within-country tests that rely on time-series and cross-sectional variation in volatility within and across states (in the United States) or regions (in the United Kingdom), and we continue to find empirical support for the predictions of the theory.

Appendix A
Data Sources

In 1968 the PSID started collecting information on a sample of roughly 5,000 (original) families. Of these, about 3,000 were representative of the US population as a whole (the core sample), and about 2,000 were low-income families (the Census Bureau's Survey of Economic Opportunities [SEO] sample). Thereafter, both the original families and their split-offs (children of the original family forming a family of their own) have been followed, giving a total of around 35,000 individuals. Panel members were interviewed each year until 1997, when a two-year periodicity rule was established. All original members of the 1968 households and their progeny are considered sample members and thus are part of the panel even if they move out of the original household. The US models presented in this chapter include the SEO over-sample, although they were also estimated using only the core sample and our results regarding the effects of housing price volatility were not affected.

In each wave of the panel, the PSID asks detailed questions on individual and household income, family size and composition, schooling, education, age, and marital status. State of residence is available yearly and individuals are followed to new locations if they move. Unlike many other prominent American wealth surveys, the PSID is representative of the complete age distribution. Yearly housing tenure questions determine whether individuals currently own, rent, or live with others. Questions on housing ownership, value, and mortgage were asked in each calendar year wave of the PSID.[15] Renters are asked the amount of rent they pay and both owners and renters are asked the total number of rooms in the residence.

In addition to the PSID, housing-price data were obtained from the Office of Federal Housing Enterprise Oversight (OFHEO) House Price Index. These data contain quarterly and yearly price indexes for the value of single-family homes in the United States in the individual states and the District

15. Mortgages are not available in the PSID for years 1973, 1974, 1975, and 1982.

of Columbia.[16] These data use repeat transactions for the same houses to obtain a quality constant index and is available for all years starting in 1974. All yearly housing prices by state are reported relative to those that prevailed in 1980. By 1995 there were almost seven million repeat transactions in the data so that the number of observations for each state is reasonably large. No demographic data are available with this index.

For the United Kingdom, we use the British Household Panel Survey (BHPS). The BHPS has been running annually since 1991 and, like the PSID, is also representative of the complete age distribution. The wave 1 sample consisted of some 5,500 households and 10,300 individuals, and continuing representativeness of the survey is maintained by following panel members wherever they move in the United Kingdom and also by including in the panel the new members of households formed by original panel members. The BHPS contains annual information on individual and household income and employment as well as a complete set of demographic variables. Like the PSID, data are collected annually on primary housing wealth and on secondary housing wealth.[17]

In addition to the BHPS, regional house price data were obtained from the Nationwide Building Society House Price series, which is a quarterly regional house price series going back to 1974. Rather than use a repeat sales index, the prices are adjusted for changes in the mix of sales to approximate a composition constant index, and are also seasonally adjusted.

Throughout the chapter we take care to define the unit of analysis as the benefit unit (i.e., singles or couples with dependent children) such that young individuals at the beginning of the life cycle living in shared accommodation or with other family members are not lost from the analysis as subsidiary adults in households headed by other individuals. This is particularly important for older independent children who are still residing with parents and who would show up in middle-aged households in a conventional head of household-based analysis. In both countries, housing wealth is allocated to the home-owning benefit unit only. Hence a twenty-five-year-old living with his or her parents in an owned property is not defined as an owner (unless the property is owned jointly with the parents) and is assigned zero housing wealth.

We use several housing wealth concepts in this chapter. The current value of the house is derived in both the PSID and BHPS by asking respondents to report the current market value of their home, while housing equity is constructed by subtracting from the current house value the outstanding mortgage.

16. For details on this data see Calhoun (1996). The paper is available on the OFHEO website.
17. Housing wealth and mortgages are not available in 1992.

Appendix B

Numerical Simulation of a Simple Model of Ownership and Housing Equity in the Presence of House Price Risk and a Housing Ladder

The integration of housing price risk into a single theoretical framework is complex and even algebraic closed-form solutions will only be possible under certain (restrictive) forms of preferences. Ideally, however, we want to use relatively flexible preferences for consumption and housing to generate predictions relating to the effects of houseprice risk. In this appendix we use numerical methods in order to offer insight into the predictions of the model using a very simple set of specifications for preferences, the steepness of the housing ladder, and the time-series process for the underlying uncertainty.[18]

For the purpose of our simulations, we assume that individuals maximize expected discounted lifetime utility, with the utility functions for an individual in each of the decision periods being given by:

$$(1) \qquad u_t = \frac{1}{1-\gamma}\left[(q_t - \overline{q}_t)^{\alpha} c_t^{1-\alpha}\right]^{1/(1-\gamma)},$$

where q_t is the consumption of housing services in period t and all other consumption is summarized by c_t. To accord with our discussions of section 3.3, these preferences are characterized by having a necessary level of housing consumption, $\overline{q}_t$, in each period to capture the housing ladder, but they also take the CRRA form to allow us to look at the impact of varying risk aversion on the predictions of the model.

We solve the numerical model with three periods, aimed at capturing the phases of the life cycle discussed in section 3.3, rather than calendar years, quarters, or even months. When building a numerical solution algorithm, the choice of units and parameter values forces one to think carefully about the relative length of periods. In taking numerical methods to our model we essentially need to think of periods of unequal length in order to capture the sense in which period 2 (the middle rung on the housing ladder) is a transition to a more permanent state of completed family size and a "permanent" family home. A convenient way in which to do this is to introduce factors δ_2 and δ_3, with $0 < \delta_t \leq 1$, $t = 2,3$ and $\delta_2 \leq \delta_3$, which describe the flow of consumption services q_t from housing stock H_t, so that $q_t = \delta_t H_t$.

18. Ultimately, many other extensions could be looked at with this approach, such as the sensitivity of predictions to rental premia, the cost of mortgage borrowing, the extension of the model to a greater number of time periods, or the differences in predictions that emerge as we allow income uncertainty (with differing degrees of correlation between income and house price shocks). But we leave these extensions for further work since, at this stage, we want to make the model as simple as possible while still remaining sufficiently general to examine the specific predictions on which the empirical analyses in this chapter are based.

We choose a stylized model in which the only uncertainty is in house prices. In accordance with our earlier discussions, we assume that in period 1 everyone is a renter and in period 3 everyone is an owner. The key decision is whether to own in period 2 or wait until period 3. We show that increasing house price uncertainty increases the payoff to ownership in the second period. This payoff is larger the larger the degree of risk aversion and the stronger the gradient in the housing ladder. As we are only interested in the relative payoff of ownership we normalize on first-period utility and examine relative payoff in periods 2 and 3. The budget constraint for periods 2 and 3 under each option is given by:

(2a) [Owner at $t = 2$]: $y_2 + y_3 + (p_3 - p_2)H_2 = c_2 + c_3 + p_2\delta_2 H_2 + p_2\delta_2 H_2$

(2b) [Renter at $t = 2$]: $y_2 + y_3 = c_2 + c_3 + \tau p_2\delta_2 H_2 + p_3\delta_3 H_3$

depending on which tenure is chosen, where y_t are discounted incomes, p_t are discounted prices, c_t are discounted consumptions, and τ is the rental premium.

Implicit in this set up is that an individual can borrow or save at the same (safe) rate of interest equal to the discount rate. Finally, we introduce house price uncertainty in period 3 by allowing p_3 to take the value $p_2(1 + \pi)$ with probability .5 and $p_2(1 - \pi)$ with probability .5. We can then vary the variance of housing price uncertainty by solving the model for different values of π.[19]

We solve the model by backward induction with a relatively straightforward numerical method that involves a discrete grid search across all possible paths for housing consumption in each period, q, consumption in each period, c, and the owner/renter decision in period 2. For the purposes of the solution, baseline values are set at: $\tau = 1$, $\alpha = 0.3$, $\delta_2 = 0.5$, $\delta_3 = 1$, $\overline{q}_2 = 0$, $y_3 = 200$, and $y_2 = 0.5y_3$. The later equality equates the flow of income across the two periods given the choice of δ_2 and δ_3. The model is then solved under varying degrees of uncertainty for various values of the necessary level of housing in period 3 (which we shall refer to as D) ranging from $D = 10$ to $D = 40$, and for various values of the risk-aversion parameter, γ.

Figure 3A.1A shows the difference between the expected utility of renting and owning in period 2, expressed as a fraction of the utility of renting, as the variance of housing prices increases and as the minimum level of housing required in period 3, that is, the steepness of the housing ladder, increases. The figure shows that increases in the minimum level of housing demand in period 3 result in an increase in the relative utility of owning in period 2 for all positive levels of volatility. Similarly, for all levels of the minimum housing requirement in period 3, increasing price volatility results in a stronger

19. In this discussion we abstract from expected capital gains. However, our empirical model will allow for a capital gains term that will reflect the risk-return trade-off. Holding the riskless return constant, an expected capital gain will reduce the user cost of housing and make ownership more attractive.

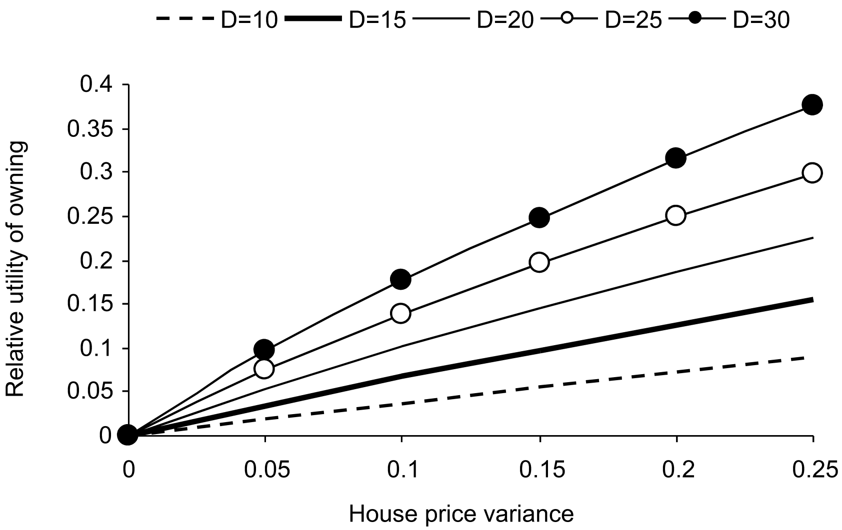

Fig. 3A.1A Relative utility of owner occupation when young by variance of house prices and steepness of housing ladder

preference for owning: increasing house price risk reduces expected utility for both renters or owners in period 2, but the impact is stronger on the rental option. Consequently there is a gain in expected utility terms from ownership in period 2 and this gain increases with risk. Figure 3A.1B presents a complementary analysis, but where we hold the housing ladder constant and vary the degree of risk aversion in preferences. As risk aversion increases, the slopes of the profiles with respect to volatility steepen.

In addition to the home-ownership predictions, the model should also have predictions for the quantity of housing consumed as discussed in section 3.3. Figures 3A.2A and 3A.2B show the predictions for housing consumption in period 2 as the housing ladder steepens and as risk aversion increases. Figure 3A.2A shows that, for any level of the minimum housing requirement in period 3, as volatility increases the quantity of housing demanded in period 2 increases—individuals buy more insurance as risk accumulates.[20] If volatility is significant, a steeper housing ladder results in more housing consumption in period 2. This implies that not only will individuals be more likely to purchase a house in period 2, they will also be more

20. Varying the minimum housing requirement and keeping lifetime resources constant also generates a wealth effect. This is not important for our empirical tests since we will be examining demand for housing as volatility varies for a given steepness of the housing ladder. As a result we abstract from this wealth effect in this figure by normalizing the housing demand to its zero-volatility value in the two figures.

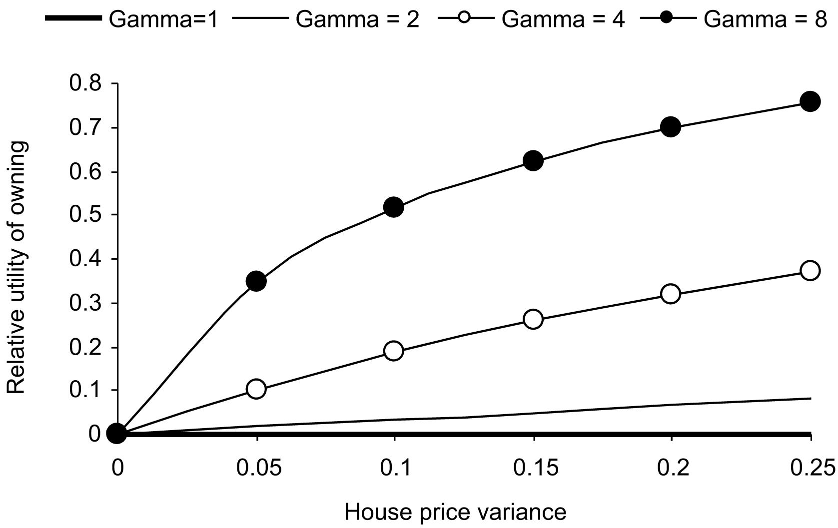

Fig. 3A.1B Relative utility of owner occupation when young by variance of house prices and degree of risk aversion

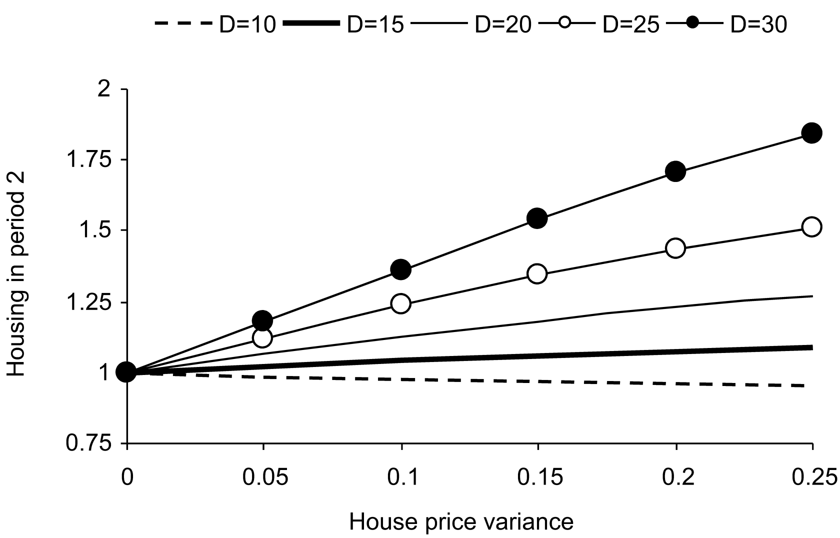

Fig. 3A.2A Consumption of housing when young by variance of house prices and steepness of housing ladder

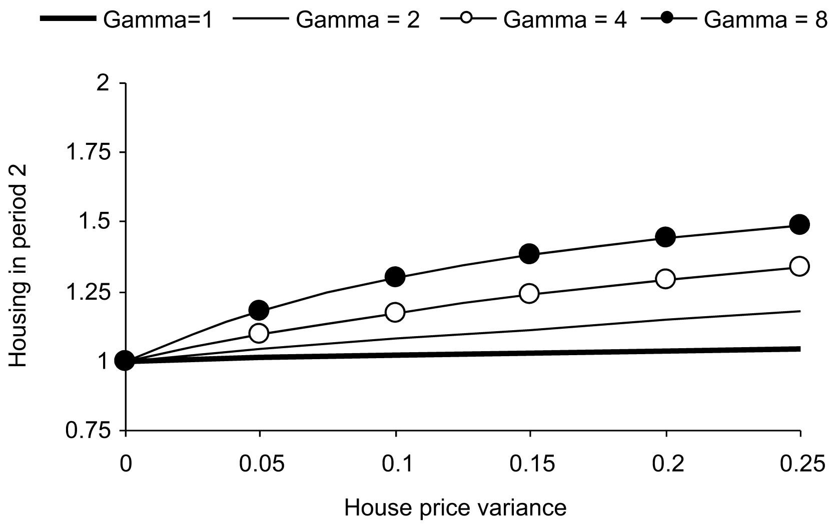

Fig. 3A.2B Consumption of housing when young by variance of house prices and degree of risk aversion

likely to purchase a "bigger" house. Note that for the very lowest value of the minimum housing requirement ($D = 10$) the quantity of housing actually declines with volatility. At such a low value of the minimum (and given the relative preference for housing implied by our choice of a of 0.3) the housing ladder constraint is not effectively binding and therefore the predictions of the model are in accordance with the standard case: individuals choose less of a risky activity.

Figure 3A.2B presents similar results by risk-aversion coefficient. Once again, as risk aversion increases, the quantity demanded of housing in the second period increases. While not shown in these graphs, our model also has implications for nonhousing consumption in period 2, which is generally declining in housing price volatility.

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Comment Steven F. Venti

Housing is the dominant component of wealth and housing services are the dominant component of consumption for most young households. These facts alone suggest that volatile house prices can have enormous consequences for household behavior and welfare. Unlike most other risky assets, housing investments are also indivisible, illiquid, and difficult to diversify. Given these differences, it is not surprising that many of the standard predictions of financial models may not apply to housing. One such prediction is that house price risk should make ownership less attractive. This prediction is challenged by the central finding of this chapter, which concludes: "Typically, risk-adverse individuals will avoid risky assets as volatility increases. In this chapter we show that owner-occupied housing is an exception to this rule." This chapter provides compelling evidence that young households correctly perceive the price risk associated with home ownership and are able to hedge this risk by "buying-in" to the housing market earlier in the life cycle. Results supporting the dominance of the hedging motive are found for five indicators of housing demand and these results are strikingly similar across countries. The authors have done an excellent job establishing the "fact" that housing demand responds positively to price volatility, so in my comments I will try to offer some additional insights into the origins, identification, and limitations of hedging behavior from a finance perspective.

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