HOUSE PRICE VOLATILITY AND THE HOUSING LADDER

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ABSTRACT

This paper investigates the effects of spatial housing price risk on housing choices over the life-cycle. Housing price risk can be substantial but, unlike other risky assets which people can avoid, most people want to eventually own their home thereby creating an insurance demand for housing ownership early in life. Our contribution instead is to focus on the importance of ownership as a hedge against future house price risk as individuals move up the ladder. We show that people living in places with higher housing price risk should own their first home at a younger age, should live in larger homes, and should be less likely to refinance. These predictions are shown to hold using comparable panel data from the United States and United Kingdom. This paper will be presented at the biannual NBER economics of aging Carefree Arizona in May 2015.

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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 life-style 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 paper is to bring together two key determinants of housing consumption and home ownership decisions into an empirical model of housing outcomes. The first of these is the housing ladder. Rather 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 US.

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 life that drives the predictions we investigate in our empirical analysis.

Using panel data from the UK and the US, 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 US and the UK. 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 paper is in five sections. Section 1 documents a critical and salient fact—a steep housing ladder with age which is coincident with changing demographics over the life-cycle that are common across the two countries. Section 2 shows the large special dispersion in house price volatility within and between the UK and US. Section 3 then discusses the implications of housing price variability for housing choices in a simple life-cycle framework. In Section 4 the model predictions concerning the age of initial home ownership, the decision to refinance, and the shape of housing wealth and the number of rooms are put to the test. In the final section we summarize our conclusions.

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 people live in changes with age. Table 1 shows the age profile of mean number of rooms of household heads for owners and renters alike in the US and UK using the Panel Study of Income Dynamics (PSID) in the US 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 50 but rising steeply from the 20s to the 40s. The general shape of the ladder is similar in the two countries.[2] It is important to note that the steep

[1] A detailed data description is provided in Appendix 1.

[2] In the UK 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 US, there is some evidence of the number of rooms plateauing out at higher values among more recent cohorts.

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 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 that this change now reflects changes in the size of owner-occupied housing. In the US, 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 UK—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, eventually complete their family building with the by now older children leaving home to go off on their own. Figures 1a and 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 20s and 30s with a flattening out during the 40s. In fact, between ages 25 and the late

[3] The profiles in Table 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) or Banks et al. (2012)), it is not the focus of this paper, which concentrates instead on the implications of the steps up the ladder earlier in life and a full analysis would need to take into account the possible effects of cohort differences amongst older those at older ages on these profiles.

[4] Completed family size is computed by taking individuals aged 50 or over 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.

30s, this cumulative distribution of competed fertility is almost linear, with each year of age increasing the fraction that has finished childbearing by five percentage points. For example, around age 31, half of all American individuals have completed their fertility with three out of every four doing so by age 36. The shape, and level, of the profile corresponds extremely closely to that observed in the UK over the same ages.

Children turning 5 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 1a and 1b also plot the cumulative fraction of individuals who ever had child at least 5 years old. Not surprisingly, compared to the cumulative completed fertility, this figure is shifted out to the right so that if age 5 is a useful 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 40 in parallel to the sharp rise in the number of rooms demonstrated over the same ages. Finally, Figures 1a and 1b also plot the proportion with their own children aged 5 or over currently in the household, as a measure of contemporaneous housing needs. Again the similarities between US and UK are striking—in both countries after age 40 there is a sharp decline in young children at home, an indication of an eventual demographic rationale for downsizing in later life.

2. House Price Volatility

Figure 2 shows real indices of country-wide average house prices for the US and UK over the period 1974 to 1998 with both series normalized to take a value of one in 1980. Immediately apparent is the much larger volatility of housing prices in the UK, with real prices rising by 50% over the period 1980 to 1989 and then falling back to its previous value by 1992. Over the period as a whole, however, real returns were similar across the two countries.

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 in each of the two countries. The UK and the US indexes both hide considerable differences across regions with some places being much more volatile in housing prices than others. In Figures 3a and 3b we present house prices from regional sub-indices, 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 two to one. At the other extreme lies South Carolina where the peak price exceeds the trough by only 15%. The most volatile states are concentrated in New England and along the North Eastern 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 50 US states and 12 UK regions for which we have house price indices. These indices, which measure percent volatility over the sample are plotted in Figures 4a and 4b, grouped by the same two ‘volatile’ and ‘non-volatile’ areas as before. Two things are important to note. First, the higher levels of volatility in the UK (even in the ‘non-volatile’ 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. 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 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

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[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.

[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.

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 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 represents effectively 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 → D=2 simply concerns a decision over whether to rent or own in the 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 aspects of the supply of housing services, which are relevant to our discussion. First, a more inelastic supply will

[7] We ignore here older stages of the life cycle where the possibility of downsizing comes into play (see Venti and Wise (2001) and Banks et al. (2012) for example.

[8] To the extent that this probability is less than one then any insurance motive will be dampened but as long as the positive probability of homeownership 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.

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 which 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 2 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 non-housing 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

[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 non-owner 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 relieve the down payment constraint.

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]

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 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.

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 2, there are three principal predictions that we will test empirically in this paper: (1) other things being equal, individuals should buy homes earlier in more volatile areas; (2) young homeowners are less likely to consume capital gains on housing through refinancing in more volatile areas; and (3) 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.

[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.

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, we list for both the UK and US 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 non-volatile areas in both countries. While average rates of home ownership are similar, there are striking differences by age between the two countries. Home ownership rates amongst young households are far higher in the UK than in the US, with differences of 10 percentage points for householders between ages 20-29 and 13 percentage points those between ages 30-39. However, through middle age, home ownership rates converge so quickly that US rates actually exceed those in the UK among older households.

Since prices are far more variable in the UK, 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 non-volatile 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 4a and 4b lists some of the more salient ones. Perhaps, 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%

compared to 68% for housing prices. Young individuals living in the volatile states also have more education, 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 21 and 35. 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.

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 expected gains variable we use the change in the regionally

[11] For each of the 50 US states and the 12 UK regions.

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.

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. 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 5a and 5b, which lists 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 at least in the US children do likewise. In the US and the UK, 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 ownership. While this may at first blush seem counter-intuitive, 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 test of our central prediction. In both the US and UK, 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 only because volatility on average is so much higher there.

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 datasets provide some measure of the extent to which individuals engage in such activities. With regard to the US, 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 UK using BHPS data, where individuals are asked specific questions about whether they refinanced their housing equity between waves, and if so whether the purposes for which the resulting money was used. With such detailed questions we are able to construct a more precise indicator in the UK that takes the value 1 only if individuals refinance between waves and do not increase the quantity or quality of housing as a result.

[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 6a uses a definition of mortgage rising by at least 30% or $5000, whichever is the greater.

Our results are summarized in Tables 6a and 6b. In addition to the non-price 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.

4.3 Increased Consumption of Housing

As pointed out in Section 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, since 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 UK, 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 possible quality effects 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 home-owners only, using the probits reported in Tables 5a and 5b as the selection equations and omitting the rental price from the continuous part of the model.

Tables 7a and 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 UK—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 US as well but not statistically significant at conventional test levels.

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.

[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 Yamshita (2002) look at the effect on household's 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 Smith (2003) show that housing wealth differentials between the US and the UK 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.

In Tables 8a and 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 over consume 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 elastic city is much higher in the US than in the UK.

The models estimated in Tables 7 and 8 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.

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 that is an investment product—essentially term life insurance with the fund invested in the stock market.

Because of the risky nature of this product, our framework would predict that 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 framework as the tests presented above. In Table 9, we report results obtained from probit models with the dependent variable being whether individuals finance their house purchase with an endowment mortgage. 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 increasing the period over which are 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.

5. Conclusions

Typically, risk-averse individuals will avoid risky assets as volatility increases. In this paper 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,

[14] One complication in testing this prediction is that particularly in the 1980's (and early 1990's), there is some evidence that mis-selling 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.

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 non-housing consumption.

Using micro data from two countries we have constructed tests of these predictions and all are borne out empirically. Cross-country differences between the US and UK corresponds to the cross-country differences in volatility—the UK 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 US) or regions (in the UK), we continue to find empirical support for the predictions of the theory.

Appendix I: Data Sources

The PSID started in 1968 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 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 paper 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

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

yearly price indexes for the value of single-family homes in the US in the individual states and the District 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 7 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 UK, 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 UK 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 paper 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

[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.

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 25-year-old living with their parents in an owned property is not defined as an owner (unless they own the property jointly with their parents) and is assigned zero housing wealth.

We use several housing wealth concepts in this paper. 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.

Appendix 2: 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 house price 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 life-time utility, with the utility functions for an individual in each of the decision periods being given by:

(1) $$u_t = \frac{1}{1-\gamma}[(q_t - \bar{q}_t)^{\alpha} c_t^{1-\alpha}]^{1/(1-\gamma)}$$

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 III, these preferences are characterized by having a necessary level of housing consumption, $\bar{q}_t$, 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, rather than calendar years, quarters or even months. When

[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 whilst still remaining sufficiently general to examine the specific predictions on which the empirical analyses in this paper are based.

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 $q_t = \delta_t H_t$.

We choose a stylised 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 pay-off to ownership in the second period. This pay-off 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 pay-off of ownership we normalise on first period utility and examine relative pay-off in periods 2 and 3. The budget constraint for periods 2 and 3 under each option is given by:

(2a) [Owner at t=2]: $y_2 + y_3 + (p_3 - p_2)H_2 = c_2 + c_3 + p_2\delta_2 H_2 + p_3\delta_3 H_3$

(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 ½ and $p_2(1-\pi)$ with probability ½. 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:, $\tau = 1$, $\alpha = 0.3$, $\delta_2 = .5$, $\delta_3 = 1$, $\bar{q}_2 = 0$ $y_3 = 200$ and $y_2 = .5y_3$. 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 A1.a 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, i.e., 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 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 A1.b presents a complementary analysis but where we hold the housing ladder constant and vary the degree of risk aversion in

[19] In this discussion we abstract from expected capital gains. However, our empirical model will allow for a capital gains term which 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.

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. Figures A2.a and A2.b show the predictions for housing consumption in period 2 as the housing ladder steepens and as risk aversion increases. Figure A2.a 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 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 α 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 A2.b 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 non-housing consumption in period 2, which is generally declining in housing price volatility.

[20] Varying the minimum housing requirement and keeping life-time 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.

Table 1. Number of Rooms by Age of Head of Household

	Age of head of household						
	< 25	25-34	35-44	45-54	55-64	65+	All
US							
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
UK							
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. US data excludes bathrooms, UK data excludes kitchens and bathrooms.

Table 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
US							
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
UK							
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 1990-1999 and 1991-2003 respectively. First time buyers restricted to those previously living in rented accommodation. Cell sizes too small in UK for age < 25.

Table 3. Proportion of Individuals Who are Homeowners in 1994

	Age	'Volatile'	Non-volatile	All
UK				
	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
US				
	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*

Note: Data are from the 1994 BHPS and PSID.

Table 4a. Differences across Broad Regions, 21-35 year olds, US

	Non-volatile	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

Table 4b. Differences across Broad Regions, 21-35 year olds, UK

	Non-volatile	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.

Table 5 a. Probability of Home-Ownership, US

	(1)		(2)	
	dF/ dx	Std. Err	dF/ dx	Std. Err
Price Volatility Index	0.1874	0.0944	0.4061	0.1084
Age	0.0448	0.0061	0.0478	0.0061
Age Squared	-0.0004	0.0001	-0.0047	0.0001
Married	0.2727	0.0047	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	-0.0559	0.0051	-0.0366	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	0.0153	-0.1341	0.0174
Trend	0.0022	0.0004	0.0009	0.0004
State Dummies	No		Yes	

Note: Ages 21-35. Models also control for city size, missing values, trend and number of waves.

Table 5b. Probability of Home-ownership, UK

	(1)		(2)		(3)	
	dF/ dx	Std. Err	dF/ dx	Std. Err	dF/ dx	Std. Err
Price Volatility	0.4483	0.1196	0.3361	0.1212	0.3629	0.1226
Age	0.0939	0.0123	0.1107	0.0127	0.1093	0.0127
Age Squared	-0.0011	0.0002	-0.0014	0.0002	-0.0014	0.0002
Married	0.4634	0.0065	0.4623	0.0065	0.4623	0.0065
Has children	0.0347	0.0089	0.0349	0.0089	0.0352	0.0089
Educ - low	-0.0880	0.0086	-0.0874	0.0086	-0.0866	0.0087
Educ - medium	0.0062	0.0097	0.0066	0.0097	0.0070	0.0097
Ln Income	0.2978	0.0061	0.2992	0.0061	0.2989	0.0061
Ln House Prices	-0.2019	0.0128	-0.1084	0.0203	-0.1080	0.0222
Exp. Capital Gains	0.4022	0.0835	0.1648	0.0928	0.1595	0.0968
Ln Rental Prices			-0.1025	0.0174	-0.0963	0.0186
Move A-B	-0.0866	0.0301	-0.0808	0.0302	-0.0802	0.0302
Move B-A	-0.1479	0.0281	-0.1558	0.0279	-0.1559	0.0280
Regional dummies	No		No		Yes	

Note: Ages 21-35. Models include controls for living in a big city, number of waves observed in panel, and trend.

Table 6a. Probability of Refinancing a US Home

	(1)		(2)	
	dF/ dx	Std. Err	dF/ dx	Std. Err
Price Volatility Index	-0. 5043	0. 1224	-0. 3206	0. 1472
Age	-0. 0078	0. 0094	-0. 0072	0. 0093
Age Squared	0. 0001	0. 0001	0. 0001	0. 0002
Married	0. 0045	0, 0065	0. 0030	0. 0065
Ever have a child	0.0180	0. 0054	0.0017	0. 0054
Education	-0. 0081	0. 0011	-0. 0079	0. 0011
Ln Income	-0. 0179	0. 0035	-0. 0149	0. 0035
Ln House Equityt-1	0. 3086	0. 0242	0.0038	0. 0022
Move A-B	0. 0059	0. 0346	0.0021	0.0034
Move B-A	-0. 0231	0. 0331.	-0. 0179	0. 0323
State dummies	No		Yes	

Note: Ages 21-35. Models also city size controls, missing value dummies.

Table 6b. Probability of Refinancing a UK home

	(1)		(2)	
	dF/ dx	Std. Err	dF/ dx	Std. Err
Price Volatility	-0.1385	0.0873	-0.2120	0.0875
Age	0.0069	0.0073	0.0072	0.0071
Age Squared	-0.0001	0.0001	-0.0001	0.0001
Married	0.0073	0.0071	0.0071	0.0070
Has children	0.0122	0.0036	0.0128	0.0036
Educ - low	0.0155	0.0044	0.0146	0.0043
Educ - medium	0.0113	0.0050	0.0111	0.0049
Ln Income	0.0089	0.0032	0.0076	0.0032
Ln equity t-1	0.0073	0.0016	0.0055	0.0017
Regional dummies	No		Yes	

Note: Ages 21-35. 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.

Table 7a. Number of Rooms in US

	(1)		(2)	
	coeff	Std. Err	coeff	Std. Err
Intercept	-23.8112	1.16311	-22.6809	1.2213
Price Volatility Index	0. 2411	0.6962	0.7810	0.7572
Age	0. 3963	0. 0500	0.3630	0.0473
Age Squared	-0, 0041	0. 0008	-0.0037	0. 0008
Married	1. 6957	0. 0772	1.5770	0.0707
Ever have a child	0. 7413	0.0320	0.7600	0.0305
Education	0. 1312	0.0064	0.1237	0.0061
Ln Income	1. 5934	0. 0523	1.5098	0.0493
Ln Housing Prices	-01636	00146.	-0.3099	0.1307
Move A-B	-0. 4416.	0. 0452	-0.6720	0.0493
Move B-A	-0. 3288	0. 0506	-0.4967	0. 1434
Mills ratio	2. 8039	0. 1198.	2.6379	0.1100
State dummies	No		Yes	

Note: Ages 21-35. Models also city size controls, trend, missing value dummies, number of waves observed in panel. Selection equation is reported in Table 4.1a. Rental price omitted from rooms equation.

Table 7b. Number of Rooms in the UK

	(1)		(2)	
	coeff	Std. Err	coeff	Std. Err
Intercept	-7.6760	1.4902	-8.2616	1.6620
Price Volatility	5.5235	0.5611	5.4155	0.5696
Age	0.2742	0.0728	0.2862	0.0735
Age Squared	-0.0021	0.0012	-0.0023	0.0012
Married	2.1851	0.1193	2.1993	0.1212
Has children	0.9388	0.0446	0.9377	0.0450
Educ - low	-0.5797	0.0448	-0.5835	0.0451
Educ - medium	-0.1168	0.0476	-0.1185	0.0480
Ln Income	1.2717	0.0677	1.2862	0.0690
Ln House Price	-1.1801	0.0740	-1.1473	0.0917
Move A-B	-0.3124	0.1679	-0.3228	0.1692
Move B-A	-0.7284	0.1692	-0.7193	0.1713
Mills ratio	2.5369	0.1461	2.5570	0.1486
Regional dummies	No		Yes	

Note: Ages 21-35. Model also includes controls for city, trend, number of waves observed in panel. Selection equation is reported in Table 4.1a. Rental price omitted from rooms equation.

Table 8a. Gross Housing Wealth in the US

	(1)		(2)	
	Coeff	Std. Err	Coeff	Std. Err
Intercept	-9.7116	1.0887	-10.5366	0.3186
Price Volatility Index	2.5495	0.3493	1.8225	0.3781
Age	0.3273	0.0253	0.3053	0.0241
Age Squared	-0.0044	0.0004	-0.0041	0.0004
Married	0.8275	0.0393	0.6791	0.0376
Ever have a child	0.1035	0.0161	0.0894	0.0154
Education	0.1002	0.0032	0.0956	0.0030
Ln Income	1.0211	0.0266	0.9199	0.0257
Ln Housing Prices	0.4011	0.0184	0.3238	0.0247
Move A-B	-0.4927	0.0702	-0.4133	0.0678
Move B-A	-0.1526	0.0754	-0.1308	0.0736
Trend Mills ratio	1.3550	0.0612	1.1187	0.0591
State dummies	No		Yes	

Note: Ages 21-35. Models also city size controls, missing value dummies, number of waves observed in panel. Selection equation is reported in Table 4.1a. Rental price omitted from rooms equation.

Table 8b. Gross Housing Wealth in the UK

	(1)		(2)	
	Coeff	Std. Err	Coeff	Std. Err
Intercept	-5.3252	0.5358	-5.1074	0.5886
Price Volatility	1.7576	0.2018	1.7320	0.2011
Age	0.1843	0.0262	0.1860	0.0260
Age Squared	-0.0023	0.0004	-0.0023	0.0004
Married	0.8354	0.0439	0.8279	0.0439
Has children	0.2427	0.0160	0.2422	0.0159
Educ - low	-0.2354	0.0162	-0.2379	0.0160
Educ – medium	-0.0465	0.0172	-0.0488	0.0170
Ln Income	0.5670	0.0243	0.5661	0.0243
Ln House Prices	0.5534	0.0267	0.5347	0.0324
Move A-B	-0.0962	0.0605	-0.1023	0.0599
Move B-A	-0.2620	0.0612	-0.2456	0.0609
Mills ratio	0.9095	0.0523	0.9000	0.0523
Regional dummies	No		Yes	

Note: Ages 21-35 only. Models also includes controls for city, trend, number of waves observed in panel. Selection equation is reported in Table 4.1a. Rental price omitted from rooms equation.

Table 9. Probability of Holding Endowment Mortgage, Home Owners in UK Only

	(1)		(2)	
	dF/ dx	Std. Err	dF/ dx	Std. Err
Price Volatility	-4.6663	0.0995	-4.6318	0.1020
Age	0.0199	0.0018	0.0201	0.0018
Age Squared	-0.0003	2.10E-05	-0.0003	2.10E-05
Married	0.0383	0.0089	0.0380	0.0089
Has children	0.0432	0.0066	0.0436	0.0066
Education - low	0.0429	0.0070	0.0438	0.0070
Education - medium	0.0197	0.0081	0.0197	0.0081
Ln Income	0.0081	0.0052	0.0083	0.0053
Move A-B	0.1114	0.0453	0.1134	0.0452
Move B-A	-0.0403	0.0480	-0.0452	0.0479
Regional dummies	No		Yes	

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

Figure 1a: The Demographic Ladder, US

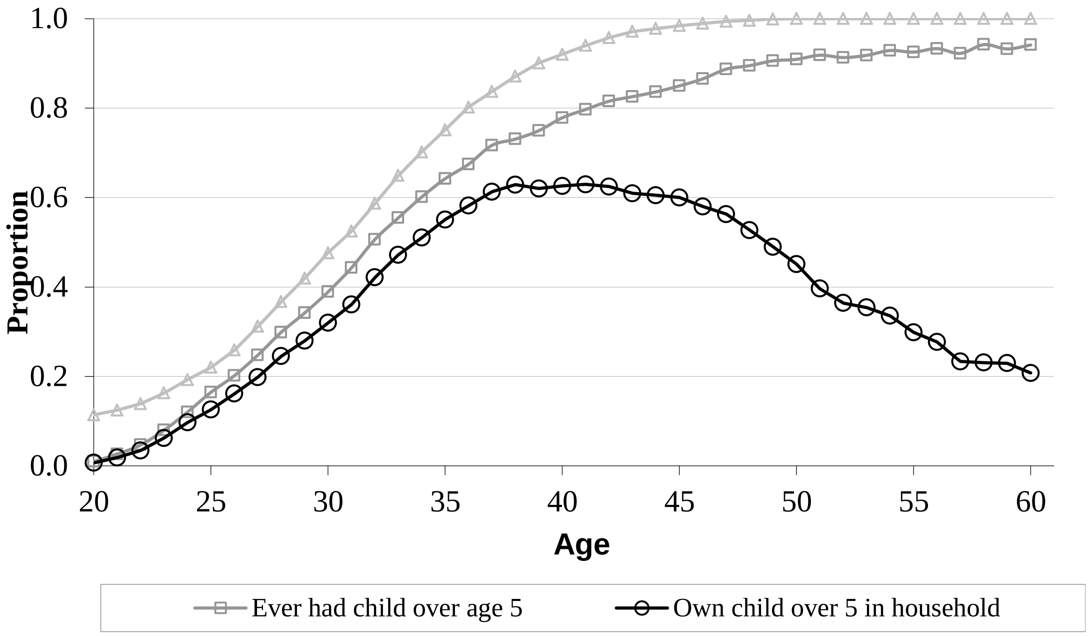


Figure 1b: The Demographic Ladder, UK

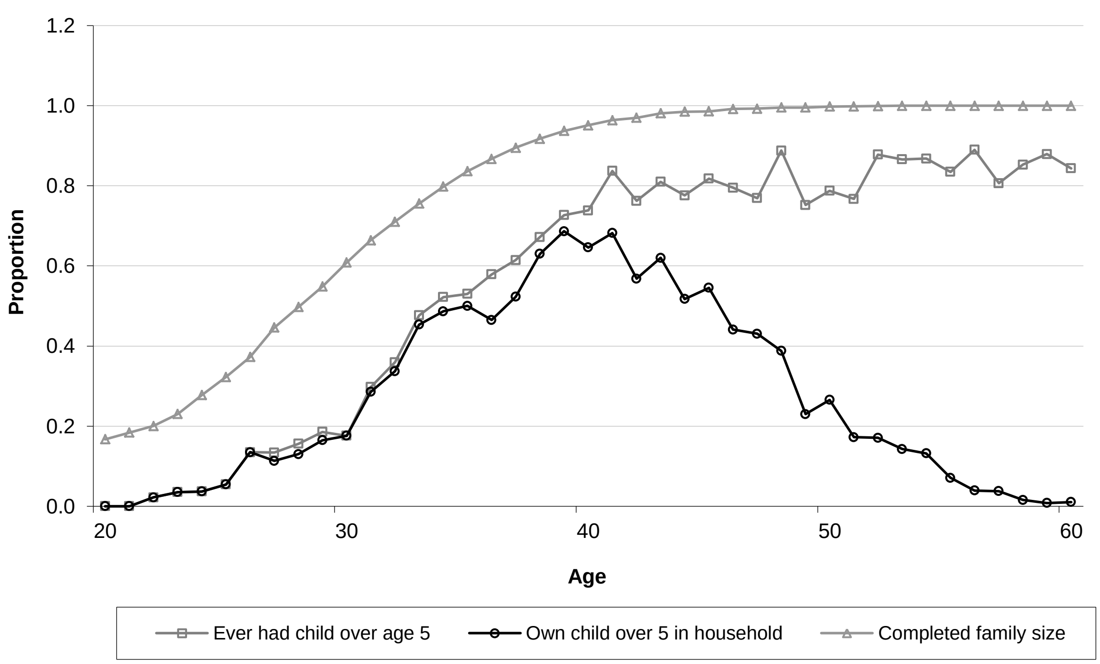


Figure 2. Comparison of UK and US House Prices

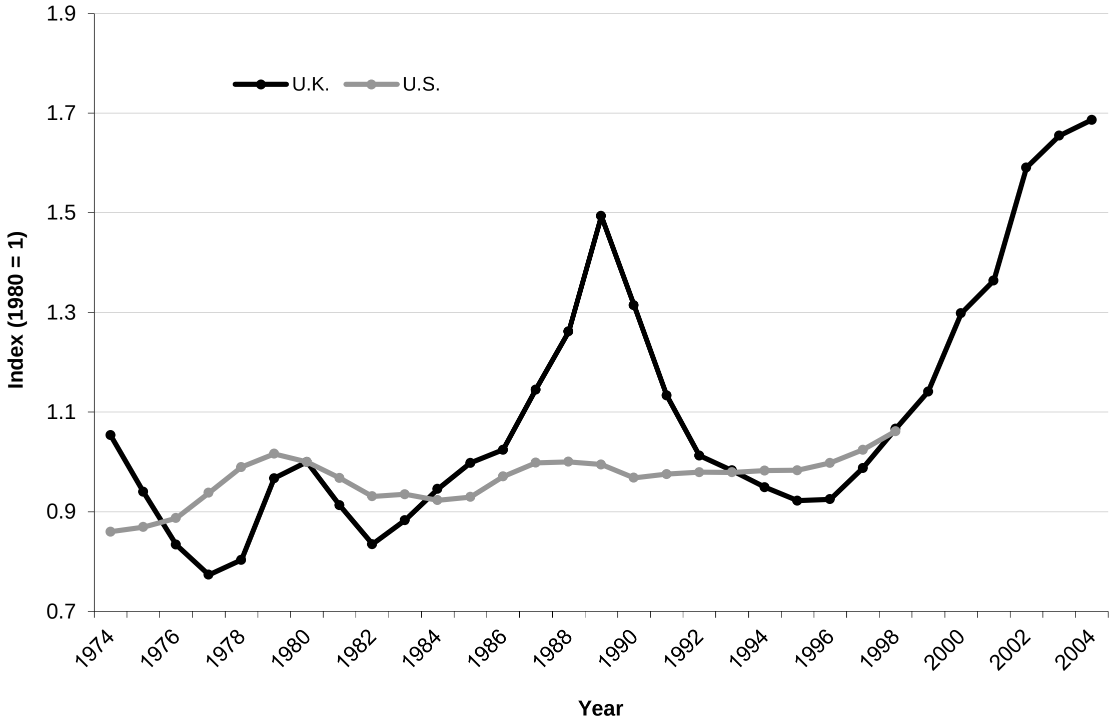


Figure 3a: US Mean House Price Index by Area, 1980-1997

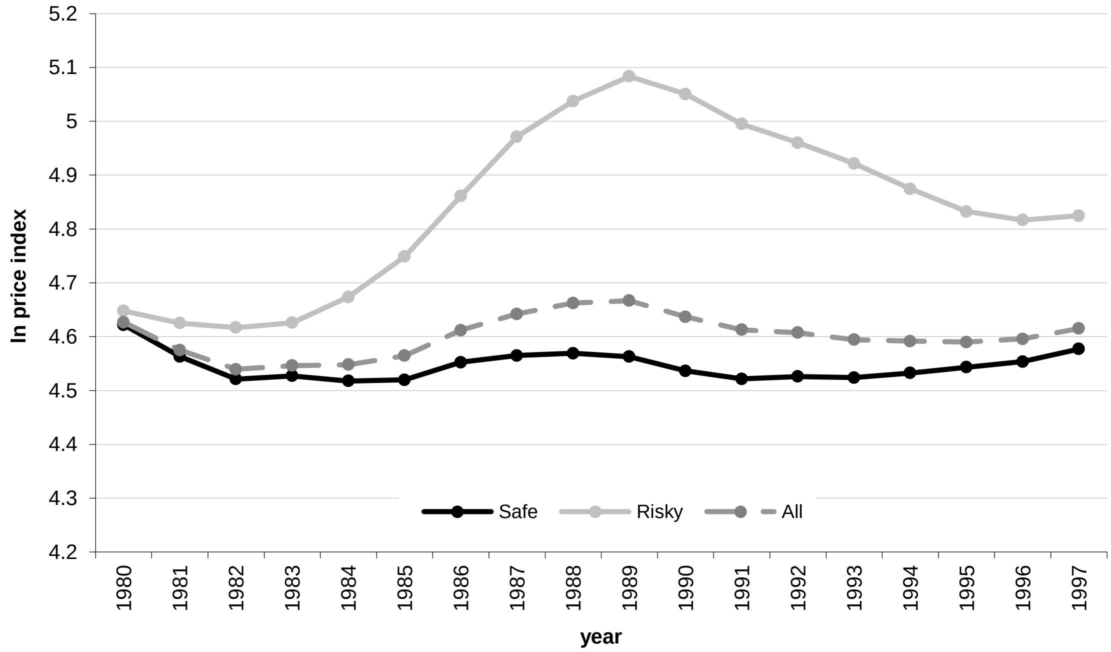


Figure 3b: UK Mean House Price Index by Area, 1980-2000

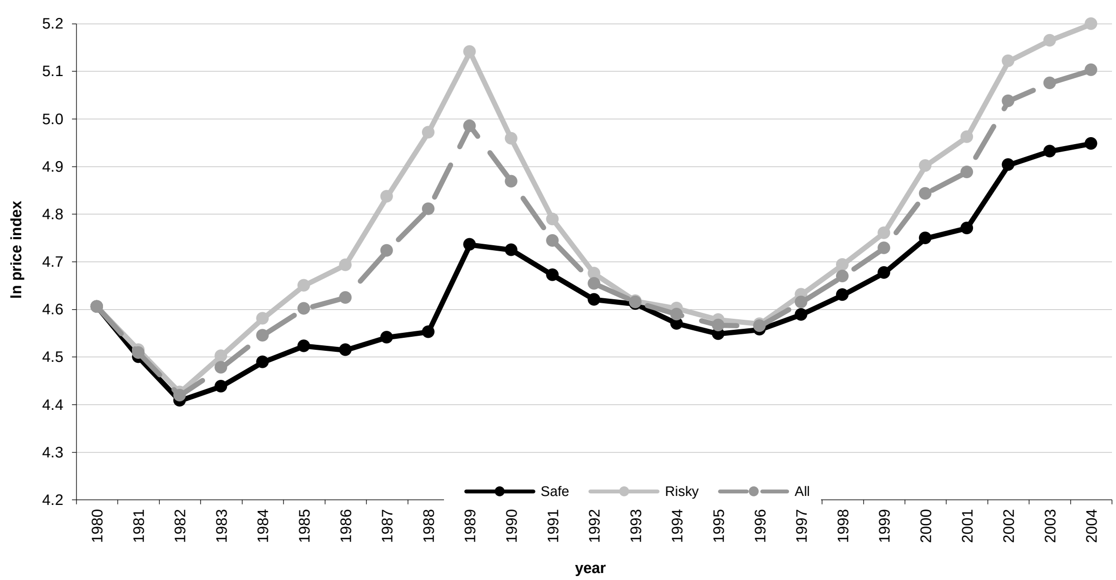


Figure 4a. Regional Volatility Indices, US, 1980-1997, by Area

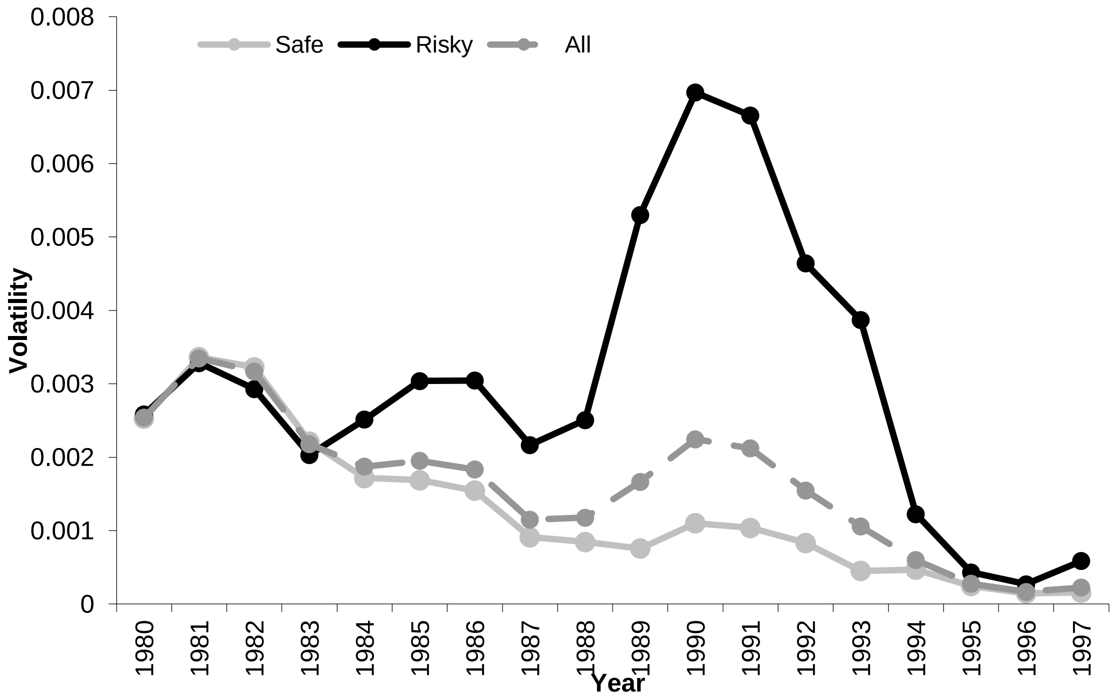


Figure 4b. Regional Volatility Indices, UK, 1980-2000, by Area

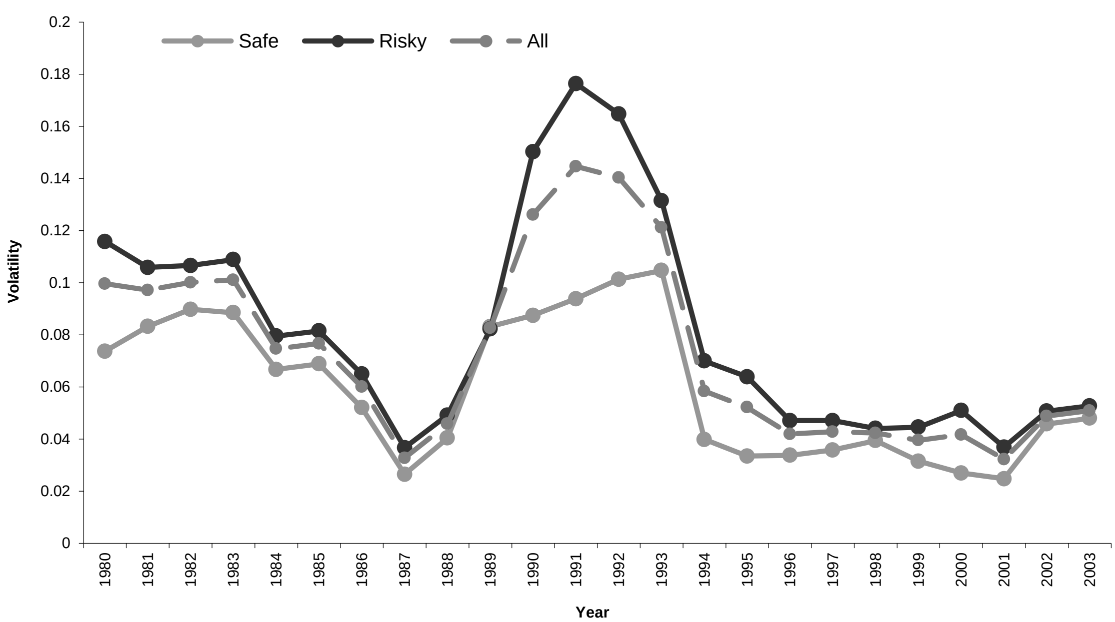


Figure A1a: Relative Utility of Owner Occupation when Young by Variance of House Prices and Steepness of Housing Ladder

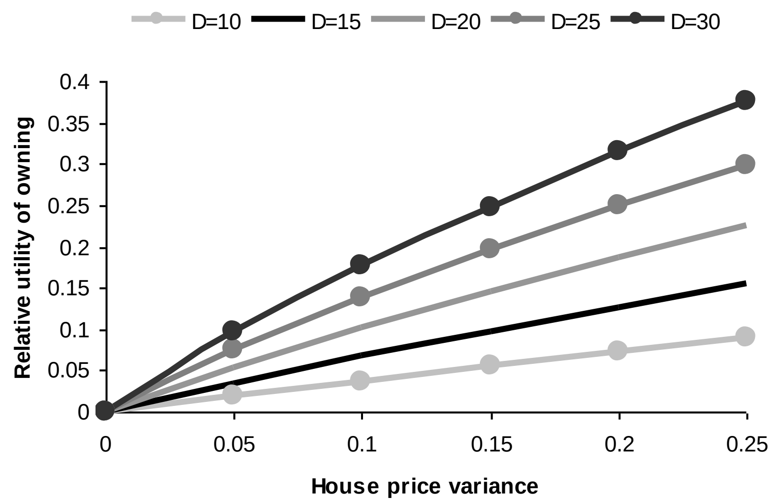


Figure A1b: Relative Utility of Owner Occupation when Young by Variance of House Prices and Degree of Risk Aversion

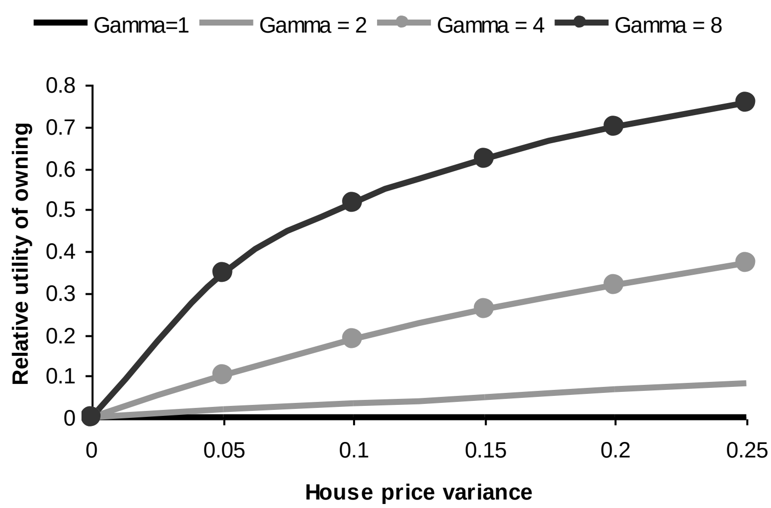


Figure A2a: Consumption of Housing when Young by Variance of House Prices and Steepness of Housing Ladder

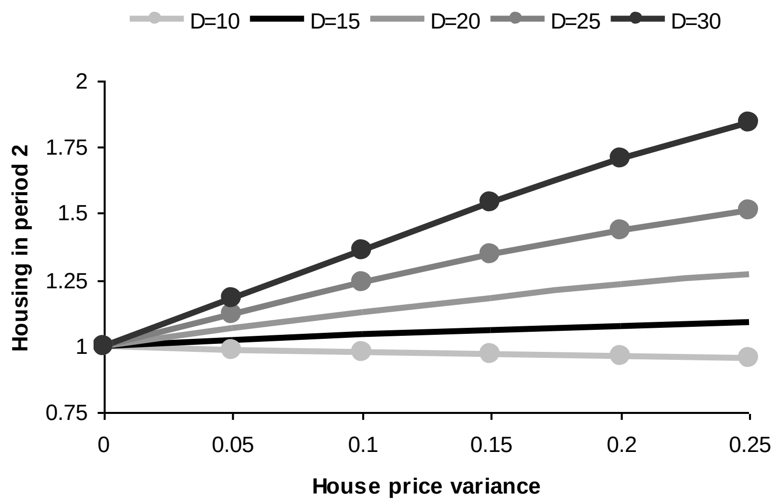
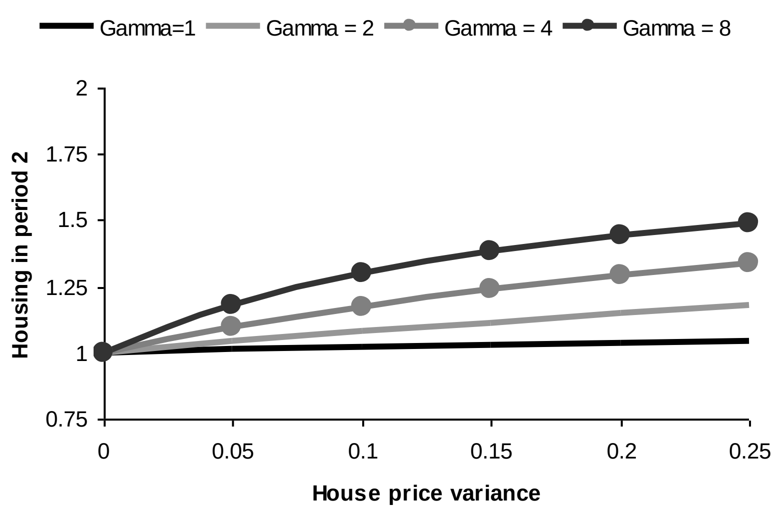


Figure A2b: Consumption of Housing when Young by Variance of House Prices and Degree of Risk Aversion



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