Working Paper no. 294

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March 2006

Bank of England

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The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England. I thank seminar participants at the Bank of England for comments and am especially grateful to Francois Ortalo-Magne, Simon Price, Chris Shadforth, Rob Wood and an anonymous referee for comments. The microdata employed were originally collected by the ESRC Research Centre on Micro-Social Change at the University of Essex. This paper also appears in the *Journal of Housing Economics* (March 2006). Neither the original collectors of the data nor the Data Archive bear any responsibility for the analyses presented here. This paper was finalised on 9 January 2006.

The Bank of England's working paper series is externally refereed.

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ISSN 1749-9135 (on-line)

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Abstract

A house purchase typically requires a deposit (or down-payment) and so a significant amount of cash. This paper considers the empirical implications of this borrowing constraint for the housing market. It shows that, at the aggregate level, models of the housing market that incorporate the constraint are consistent with the following stylised facts: i) a positive correlation between house price inflation and transactions; ii) greater volatility of former owner-occupiers' house price inflation than for first-time buyers; iii) the presence of first-time buyers in the market falls with the rate of change of house prices; and iv) house prices are more sensitive to the incomes of the young.

The paper then exploits variation across local housing markets in the rate of change in house prices and considers how leverage affects the response of the rate of change of house prices to shocks. The evidence, based on data for 147 district-level housing markets for the period 1993-2002, suggests that a large incidence of households with high levels of leverage (loan to value ratios) raises the sensitivity of house prices to a shock. This is also consistent with the down-payment constraint model of the housing market.

Key words: House prices, down-payment, leverage.

JEL classification: R2.

Summary

Buying a home usually requires a significant amount of cash. Lenders typically require that a home-buyer has some equity in the home. There are good reasons for why this should be the case. This paper considers the implications of this borrowing constraint for the UK housing market.

For the aggregate housing market, the paper shows that several features can be explained by the model which attaches an important role to the down-payment constraint: first, a positive correlation between the rate of change of house prices and transactions; second, the greater volatility in the rate of change of house prices among former owner-occupiers' properties than for first-time buyers; third, the presence of more former owner-occupiers relative to first-time buyers in the market when the rate of change of house prices is high; and fourth, house prices are more sensitive to the incomes of the young than to aggregate income.

An important feature of the model highlighted in this paper is that it is based on the economic fundamentals of the housing market. This contrasts with some discussions of the housing market which draw on the idea of housing market 'bubbles' to attempt to rationalise outcomes, in particular significant swings in activity and prices. Any model based on bubbles is difficult to test. Moreover, used in this paper also suggests that there can be episodes of price 'overshooting' in the housing market, as prices increase beyond their new equilibrium in response to an increase in income and then decline. Traditional models find this difficult to explain. This may be why, by default, some commentators have attempted to explain house price fluctuations by appealing to notions of bubbles instead.

Much commentary on the housing market appeals to ratios such as the ratio of house prices to incomes or earnings as being a key attractor to which house prices should return in the long run. Yet basic economic theory suggests that prices are not determined by averages, but instead, are set at the margin. If the marginal buyer is a young first-time buyer then this suggests that the prices should be more sensitive to the incomes of the young than to average income. This paper demonstrates that in the early 1990s, when house prices declined significantly, there was a notable decline in incomes among young, potential first-time buyers relative to the wider population, suggesting a greater sensitivity to their income than to the wider population. More generally, higher volatility in the incomes of the young than for the population as a whole suggests that

house prices will be more volatile than if they were related to average incomes.

The paper also explores variation across districts. Despite some remarkable movements witnessed in house prices in recent years, there is much more variation across districts than over time in the rate of change of house prices. Examining these differences across districts can also shed light on the behaviour of the housing market. Market professionals themselves argue that different districts should be thought of as quite distinct housing markets: so using aggregate data to examine changes in house prices could be misleading. But there are few, if any, studies of local housing markets in the United Kingdom that can be said to cover a large part of the country.

By focusing on variation in house price inflation across districts, the paper examines another key implication of these down-payment models, namely the role for leverage (loan to value ratios) in influencing the response of local house prices to incomes. The paper finds that a large incidence of households with relatively high loan to value ratios in an area increases the response of prices in that area to local incomes and financial shocks. This justifies many commentators' focus on loan to value ratios in their discussion of the housing market. In recent years loan to value ratios have been declining in the United Kingdom among first-time buyers, suggesting a lower sensitivity of house prices to shocks in future.

1 Introduction

Typically, a house purchase requires a deposit or down-payment. There are good reasons for this, associated with adverse selection and moral hazard issues facing lenders. Recent models of the housing market suggest that this necessary down-payment, as a credit constraint, can have important implications for our understanding of the housing market. This paper considers whether this holds empirically. First, it considers whether predictions made by these models for the behaviour of the aggregate housing market are consistent with the data. Second, local housing markets in the United Kingdom are examined. This analysis exploits variation across UK districts in the rate of change of house prices.

The paper draws on models of the housing market developed by Stein (1995) and Ortalo-Magné and Rady (2005). These models highlight the down-payment requirement for house purchase. Some households' choice of existing home is likely to have been a constrained choice, restricted by available liquid assets required to make the down-payment. This is particularly likely to be true for relatively young households. For these households house price shocks can give rise to capital gains which they can then leverage to make a preferred house choice. This can give rise to interesting properties for the housing market, including price 'overshooting' (prices rise but then fall back to equilibrium) excess sensitivity to movements in income and multiple equilibria which may also be consistent with episodes boom and bust in the housing market. These episodes might otherwise be difficult to explain by more traditional models of the housing market.

Any promising model of the housing market should be able to account for the basic empirical regularities of that market. One robust feature of the aggregate housing market is the positive association between the rate of change of house prices and transactions. Typical asset pricing models are silent with regards to transactions and so cannot account for this. The models considered in this paper make the rationale for this defining feature of the housing market explicit. In these models, higher levels of trading activity occur in a rising market owing to a greater number of households enjoying capital gains on their current properties and being able to make down-payments on their desired home. In contrast, when the market turns down, properties take longer to sell and the number of transactions declines because people choose not to move, being unable to make a down-payment on any desired move. But these correlations do not arise due to irrationality or extrapolating past price movements by those buying and selling homes.

There are two more traditional ways of looking at the housing market. The first, is to view the market and house prices in particular as being driven, like any asset price, by fundamentals including the user cost of capital, rents and construction costs (eg Poterba (1991)). Such an approach generally fails to account for the volatility observed in house prices and episodes in the housing market of dramatic swings from boom to bust. A second approach is instead to emphasise possible irrational behaviour by households with the housing market being prone to 'bubbles'. The type of model highlighted in this paper offers an alternative to these approaches. It identifies the possibility of excess sensitivity of prices to incomes, and of 'overshooting' in prices. Moreover it does so while considering households as behaving in a rational manner.

Another failure of the traditional approach is to try to explain average price behaviour by changes in average fundamentals such as average income. A basic lesson in economics is that it is the marginal agent that matters rather than the average. The models employed in this paper also highlight this basic point.

To the policymaker, the two approaches to the housing market cited above, namely that based on fundamentals which highlights variables such as demographics, constructions costs and the like and that on an inherent tendency for bubbles, are unsatisfactory. It is difficult to reconcile the first approach with the observed volatility in house prices. On such a view it is difficult to understand why prices in one area can boom over a long period of time, while in another where market participants experience the same user costs, construction costs and other fundamentals, there is no such boom. At the same time, an approach which simply concedes that the housing market is prone to 'boom and bust' perhaps due to the inherent tendency for bubbles offers little guidance of when, where and by how much, prices tend to experience large corrections. The class of models considered in this paper are more satisfactory in the sense that they provide a framework for understanding the functioning of the housing market. They provide a foundation for why prices tend to overshoot in response to shocks or changes in fundamentals and highlight what factors play the key role in determining when such tendencies arise.

The models with down-payment effects of Stein (1995) and Ortalo-Magné and Rady (2005) also make a number of more specific predictions for how the impact of local shocks on house prices varies according to the level of housing equity (or loan to value ratio). Indeed levels of leverage in local housing markets play a crucial role in determining the propagation of local shocks. To

confront such implications by constructing and using a data set of local housing market data is the second aim of this paper. Most–if not all–previous studies of the rate of change of house prices for the United Kingdom have been conducted using aggregate data, eg Muellbauer and Murphy (1997). Despite the remarkable movements witnessed in house prices in recent years, there is much more variation across districts than over time in the rate of change of house prices. Exploiting such heterogeneity in order to understand the functioning of the housing market is likely to be fruitful. Market professionals argue that these should be thought of as quite distinct housing markets, raising the prospect of aggregation biases being introduced when examining house price dynamics using aggregate data. This paper examines house price dynamics across local authority districts of the United Kingdom over the period 1993 to 2002 using data drawn from the British Household Panel Survey (BHPS).

The remainder of the paper is organised as follows. Section 2 provides further economic background, reviewing the theories of the housing market of Ortalo-Magné and Rady (2005) and Stein (1995). Section 3 considers hypotheses for the aggregate housing market based on these models and confronts them with data. Section 4 turns to local housing market data for UK districts and presents the estimation results. Section 5 concludes.

2 Economic background

2.1 The down-payment constraint

In reviewing US mortgage contracts, Caplin *et al* (1997) state that 'it is almost impossible to buy a home without available liquid assets of at least 10% of the home's value'. How pervasive is the down-payment constraint likely to be in the United Kingdom? Chart 1 shows the distribution of first-time buyer loan to value ratios over time. It shows that in recent years only a small minority have a loan to value ratio approaching one. The typical or median loan to value ratio in recent years has been around 80%. These figures may also be indicative of preferences on the part of households over their mix of debt and equity but it should also be noted that the relevant denominator is not simply the value of the home but the value including all transactions costs which are likely to represent around 5% of the value of the home, typically (Muellbauer and Murphy (1997)).[(1)]

(1) Note that this figure applied to the UK and is lower than for many other countries. Subsequent increases in stamp duty will mean the figure is now higher. The Caplin *et al* (1997) quote in the text refers to the US case.

If the down-payment constraint is important we would also expect that saving for a down-payment constitutes an important motive for household saving. In the British Household Panel Survey (BHPS), individuals that report that they regularly save from their current income are asked what their saving motive is. They provide up to two reasons. Table A indicates that saving for a house purchase ranks among the most important saving motives. Some of these motives are rather short term such as 'holidays', and 'paying household bills' so that presumably if considering annual saving they would not feature. 'Old age' indicates that the retirement saving motive is then the most important saving motive.(2) Saving for house purchase is the next most important motive reported by over 10% of the sample (including those with short-term motives) and compares to 15% citing a retirement saving motive. There is also evidence of saving in order to make intergenerational transfers to children and grandchildren. Such transfers may also occur so that those relatives can overcome the down-payment constraint (see below).(3)

The down-payment constraint is more likely to bind for first-time buyers who are typically younger people. Table A shows that of those aged 35 or less, a significantly higher proportion cite the down-payment motive for their saving, rising to 21.9% among this sample. A tiny fraction of those aged 35 or under state that they save for retirement (less than 3%). The down-payment constraint may also help explain the hump-shaped profile for consumption over the life cycle that the traditional life-cycle model finds difficult to account for. Households early in their life cycle are trying to build up the requisite funds to purchase a home and this depresses their current consumption. These data suggest that saving for a down-payment is an important motive for saving. Indeed, a case can be made to argue that it is a saving motive that has been neglected compared with the extensive literature that exists on the retirement and precautionary saving motives.

The above data do not indicate how quantitatively important the down-payment saving motive is likely to be in aggregate. An important finding of Jappelli and Pagano (1994) is to show that saving rates across OECD countries are quite strongly correlated with the maximum loan to value ratio offered by their lending institutions. An increase in the maximum loan to value ratio of 10 percentage points is associated with an increase in the household sector saving ratio of around 5

(2) It is not clear what 'special events' denotes exactly. It may be indicative of saving for birthday presents or for a wedding, for instance. Alternatively, it may reflect saving for emergencies in which case it would reflect a precautionary saving motive.

(3) Of course, these saving motives tell us little about aggregate saving since they do not consider amounts saved (saving for a holiday will involve smaller amounts than for a down-payment, for instance).

percentage points–a large effect.[4]

What sources of funds do people use for their deposits? Table B presents data from the Survey of English Housing. The most important sources for the deposit are savings and proceeds from the sale of the previous home. These are by far the most important sources of funds but the relative importance of each differs markedly between first-time buyers and owner-occupiers.[5] Savings are particularly important among first-time buyers, 56% of whom cite it as a source of funds for the deposit. A lower fraction of UK owner-occupiers cite this source of funds, at 25%. In contrast 83% of former owner-occupiers use proceeds from their previous home to make a deposit on their next home. These observations are crucial for the models below. These models assert that the house purchase of some first-time buyers is constrained by the down-payment constraint while former owner-occupiers are able to leverage capital gains in their existing home to place a down-payment on a subsequent house purchase.[6] The data in Table B are consistent with these ideas. Nevertheless, 23% of first-time buyers state that they have a 100% mortgage. Table B also compares responses for a year following a period of high house price inflation (2003/04) with responses following a period of low and negative house price inflation (1993/94). An interesting feature of this comparison is that the proportion of former owner-occupiers that cite the sale of the previous home as a source of funds for the down-payment is lower in a period of low house price inflation.

2.2 Theoretical background

This section reviews the theoretical model of Ortalo-Magné and Rady (2005) and relates this to the model of Stein (1995). In order to distil the main properties of the model, a graphical treatment is presented.

As a life-cycle model of four overlapping generations, households differ across the four ages in the following way. Households face a credit constraint at ages 1 and 2. Whether the household is credit constrained at age 2 depends on its income, but all households at age 1 are credit constrained: if they buy a property it must be a starter-home flat (F) rather than a larger house

(4) See Engelhardt (1996) for some evidence of the role of the down-payment constraint in influencing US households' saving behaviour. Jappelli and Pagano (1989) find that the loan to value ratio constraint can account for cross-country differences in sensitivity of consumption to current income.
(5) Transfers from relatives also feature as a significant source of funds, particularly for first-time buyers.
(6) Former (or existing) owner-occupiers are those who at the time of making a purchase already own a property.

(H), regardless of their preference for housing (m).[7] At age 3 households are no longer constrained. At this age households also differ in terms of the premium they attach to living in a house versus a flat (m) and that, along with their earlier housing choice, determines whether they trade up, do not move home or trade down.[8] Income increases over the life cycle and preferences are such that all consumption takes place in the final period. This makes the model more tractable.

Chart 2 illustrates the main aspects of the Ortalo-Magné and Rady (2005) model and how transactions respond to a *small* change in income. Households are described or indexed by their combination of income, i and preference for housing, m. The down-payment constraint is such that to purchase a particular property the household requires (liquid) wealth equal to some fraction of the purchase price.

Prior to the income shock, a certain threshold level of income, i_F defines whether a household at age 2 owns a flat or no property; another income level for age 3 households, i^*_{FH} defines whether they own a flat or a house, whereas at age 4 their housing choice depends on their preference relative to the threshold preference for housing m^*_H. In the model it is the fact that $i^*_F < i^*_{FH} < 1$ combined with the down-payment constraint that gives rise to the role for capital gains on a starter-home ('flat') purchase in influencing subsequent house price dynamics.[9]

The increase in income lowers the age 2 income threshold at which a household will own a house, from i^*_{FH} to i^+_{FH}. So a greater proportion of households at that age own houses rather than flats. This is because the demand for houses from first-time buyers aged 1 and aged 2 increases with their increased income. The age 2 first-time buyers enjoy a capital gain on their flat while the demand for houses from age 3 households will rise because it is shown that the price differential between houses and flats will be expected to rise in the future. The dual role for the incomes of the young (age 1) is worth highlighting. Their incomes affect house prices through their demand as credit-constrained buyers and also through generating a capital gain for flat-owners, which has a further effect on the demand for, and price of, houses.

The increase in the ownership of houses by age 2 households is offset by a reduction in

(7) The figure assumes there are no age 2 households owning a house. This is not necessary but eases exposition.
(8) See Ermisch (1995) on how the demand for housing varies with age.
(9) The condition for the two income thresholds implies some houses are purchased by those who previously owned a flat.

house-ownership by those aged 4. This consists of two parts: the reduction in house purchases by age 3 households (the light-shaded area in the chart) and the increase in flat purchases by those aged 3. That increase comes about because more older households (age 3) decide to trade down given the house price increase and because some age 3 households that would have traded up at the old house and flat prices now instead choose not to do so. It should be clear that the volume of transactions also increases, particularly for repeat-purchase houses.

In this model, the price of a flat rises proportionately to the increase in income. But the price of houses will under certain conditions rise more than proportionately to the increase in income–before it then falls. The more-than-proportionate increase in house prices is required for market-clearing and in particular because the capital gain improves the marginal housebuyer's ability to pay. This also gives rise to an overshooting property for house prices, a temporary effect, since the capital gain for those aged 2 when the price of flats rise is a once-for-all gain and those who reach that age one period later do not enjoy the same capital gain.

This description of Ortalo-Magné and Rady (2005) is shown by the authors to apply to a small income shock although the results should also hold for large income shocks. But with a large negative income shock, the marginal buyer will change and with it the allocation of properties across cohorts. In this situation the conditions of Stein's model (1995) are obtained. In Stein's model, transactions decline with a large negative shock as a larger number of households find themselves with negative equity as prices decline. These households are heavily credit constrained. Again the transmission mechanism is through a spillover of house price inflation on the ability to make a down-payment on a subsequent home move for someone whose first home purchase was a constrained one.

In Stein's model three classes of households are distinguished, according to their level of leverage. Unconstrained movers have a sufficiently low level of leverage (loan to value ratio) that their house purchase decision is not constrained by the down-payment requirement. At the other end of the spectrum are non-movers, the most highly leveraged. They cannot meet the down-payment constraint and choose not to move home foregoing those benefits. A key role however is assigned to the remaining group, labelled 'constrained movers'. These households can still enjoy the benefits from moving house but the down-payment constraint is binding and their choice of home is constrained accordingly. These households play a crucial role because their demand is a

positive function of price. As house prices rise their down-payment constraint is relaxed–they can realise a larger capital gain on their existing home to help finance a new house purchase. Indeed it is the presence of these households that generates the scope for excess sensitivity to fundamentals and for multiple equilibria in Stein's model. The latter may be especially important in accounting for volatility in the housing market and the move from housing 'boom to bust' in response to quite small changes in fundamentals.

2.2.1 Other theories

Other theories of the housing market may also be relevant. Most relevant are likely to be those based on nominal loss aversion (see Genesove and Mayer (2001); Engelhardt (2003)) where sellers are particularly averse to accepting a price below their own purchase price for a property and matching and search models (eg Wheaton (1990); Krainer (2001)). These theories can be viewed as quite complementary to the down-payment constraint model. For instance, nominal loss aversion would accentuate a downswing in transactions when prices decline. It does not explain price-overshooting as such but could amplify a downswing that was already underway owing to price-overshooting due to down-payment effects.

An important difference between the down-payment constraint model of Ortalo-Magné and Rady (2005) and the search or matching models is the type of transactions they are attempting to model. Search models are concerned with 'horizontal' moves in the housing market as people experience some shock to their valuation of housing services (eg due to a job move) meaning their current property is no longer a match. The down-payment model of Ortalo-Magné and Rady (2005) is concerned with vertical moves up (and down) the housing ladder. Evidence from Holmans (1995) for the UK housing market suggests that vertical moves by repeat buyers dominate variation in the number of transactions.

3 Stylised facts on the UK housing market

To gauge the likely usefulness of models with down-payment constraints, a number of empirical implications for the aggregate housing market are considered. These are first discussed and then considered empirically.

- A positive correlation between house price fluctuations and transactions. This should hold in both aggregate and local housing markets, although Stein (1995) suggests that the latter would constitute a stronger test of the model's predictions.
- The volatility of house price inflation of former owner-occupier properties should be greater than that of first-time buyer properties. The result is derived in the model of Ortalo-Magné and Rady (2005) but is absent in Stein (1995) where relative prices are constant by assumption. (Stein's model only consists of former owner-occupiers.) Ortalo-Magné and Rady (2005) show that the overshooting result–whereby prices increase above their new steady-state level in response to a permanent income shock–only applies to former owner-occupiers' properties ('houses') and not the purchases made by first-time buyers (of 'flats'). This is because the demand for housing of those whose first purchase was a constrained one amplifies the impact of any income shock.
- The composition of buyers varies with house price inflation and in particular the relative presence of first-time buyers declines with house price inflation. Former owner-occupiers are insulated from the effects of house price inflation by the capital gains they can realise on their current property. Indeed, for constrained movers since their demand is a positive function of the price, at higher rates of house price inflation the relative presence of former owner-occupiers should be greater. First-time buyers, in contrast, must wait for longer before they can accumulate the necessary down-payment following a period of high house price inflation.
- The demand, and hence income, of first-time buyers is especially important in the model of Ortalo-Magné and Rady (2005). They show in particular that in the United States house prices follow the incomes of the young (a proxy for first-time buyers) more strongly than with those of the wider population.

These hypotheses are considered in turn. It is shown that each can be considered an empirical regularity of the UK housing market.

House prices and transactions

Chart 3 shows clear evidence of a positive association between these two series. From the peak in 1988, house price inflation fell from 32.9% in 1988 Q4 to -7.3% by 1992 Q4. Over a similar period transactions per quarter more than halved, falling from 583,000 to 258,000. Stein (1995) suggests that a similar correlation in local housing markets would offer a finer test of whether the

sort of predictions made by that model are borne out by the data. Does the correlation between purchases and house price inflation also exist at a disaggregated level?

Using Land Registry data for the United Kingdom, available for the period 1996 Q1 to 2003 Q4 for 110 areas, the positive correlation also exists at the regional level, although the relationship is by no means constant across areas.[10] A fixed effects panel regression of (log) transactions against house price inflation produces a coefficient (standard error) of 0.925 (0.048). This indicates that controlling for levels differences across cities/regions (through the fixed effects), a 10 percentage point increase in house price inflation in a particular city or county is associated with an increase in transactions of almost 10%, and is statistically significant. This points to a statistically significant and quantitatively important relation between transactions and house price inflation. The pattern is consistent with capital gains enhancing households' ability to make down-payments, thereby increasing transactions, with further effects on demand and house prices.[11]

Below, analysis is conducted at the level of local authority districts, with the data constructed from the British Household Panel Survey (BHPS) for the period 1993 to 2002. In addition to self-reported house prices, each household in the BHPS also states when they moved to their current address. Chart 4 considers this as a measure of transactions. The proportion of households that moved to their current address in the past year is shown against average house price inflation per district. The relationship is far from precise–there are of course many other factors influencing whether or when a household moves home–but there remains evidence, even at the district level, of a positive association between turnover and house price inflation. The 't-ratio' on the least squares slope coefficient shown in the figure is 3.10.

The volatility of house price inflation: first-time buyers and former owner-occupiers

Chart 5 shows house price inflation rates (measured by the Halifax index) separately for first-time buyers and former owner-occupiers. In the model of Ortalo-Magné and Rady (2005), the ability to pay of former owner-occupiers (or at least constrained movers) is higher when prices rise, and house price inflation for these properties should be greater than for those purchased by first-time

(10) For brevity and in view of the large number of regions these data are not shown graphically.
(11) Most previous discussion has focused on the relationship between house price inflation and transactions. But the theory can equally be interpreted as implying a relationship between the level of house prices and transactions. A relationship between detrended (by a quadratic time trend) house prices and transactions is almost as strong as it is for house price inflation.

buyers. As noted by Stein (1995), the reason why this kind of result is not overturned by a standard no-arbitrage type condition is because diminishing returns in housing are much more pronounced than for other asset types such as equities.[12]

Since the two series are both house price inflation rates, albeit for different types of property, they are inevitably going to be close to one another. That said, the series for former owner-occupiers does peak at a higher level in the two housing booms that occurred during the sample period. In the late 1980s, the difference in annual house price inflation rates, at its peak, reaches 7.0 percentage points; and the volatility in this series is greater (ie its standard deviation is larger in value). The standard deviation of annual house price inflation of former owner-occupiers is 9.2%, greater than for first-time buyer properties of 8.5%. This is consistent with Ortalo-Magné and Rady's (2005) result that there is a stronger overshooting tendency for the prices of properties bought by former owner-occupiers than for first-time buyers. Of course, it does not prove that result.

The composition of buyers and first-time buyers being priced out

As the ability to pay of former owner-occupiers is insulated from price rises, and for some is a positive function of price, the composition of buyers should vary with the level of house price inflation and the relative presence of first-time buyers (FTBs) should decline at higher house price inflation rates. Repeat buyers are able to leverage their increased current home value to meet the (albeit increased) required deposit such that they account for an increasing fraction of all home-buyers at high and increasing levels of house price inflation. Evidence of this relation is shown in Chart 6. As house price inflation increased in the mid/late 1980s, the percentage of FTBs declined from 54.4% to 43.7% between 1985 and 1988. In the period of house price inflation from 1995, the percentage of FTBs fell from 53.6% to under 30% by end-2003.

House prices and income: do first-time buyers' incomes matter more?

The discussion above noted the key role assigned to first-time buyers, and in particular their incomes, in the model of Ortalo-Magné and Rady (1999, 2005). Indeed, Ortalo-Magné and Rady (2005) suggest that because such incomes are more volatile than for the wider population this goes

(12) This amounts to stating that it is more efficient to own than to rent a home and there are possible sources of this (see Stein (1995)). Housing may also be a hedge against rental price risk (Sinai and Souleles (2003)).

some way to explaining why fluctuations in house prices are greater than one would expect on the basis of movements in aggregate incomes.

Chart 7 shows the ratio of young persons' average (gross) earnings in the United Kingdom to that for all employees for the period 1985 to 2002 using data from the New Earnings Survey.[13] Of special note is the decline in house prices witnessed in the early 1990s. Ortalo-Magné and Rady (2005) showed that the reduction in US house prices during this period tracked a reduction in incomes among younger US households while households in general witnessed stable or rising incomes. For the United Kingdom, Chart 7 shows that the early 1990s was the only period during which young persons' earnings fell relative to the average. It is consistent with prices responding more strongly to young persons' earned incomes than with incomes overall. Common discussions of house price/income ratios use some measure of average household income or earnings. Since it is at the margin where prices are set and if the marginal buyer in the housing market is a (young) first-time buyer, then some approximation of that household's income should serve as a better guide.[14]

This section has reviewed a number of hypotheses which emerge from the down-payment constraint models and confronted them with aggregate data for the UK housing market. The data support these hypotheses which have been described as regularities in the UK housing market.

4 Shocks, leverage and local house price inflation

4.1 Data and estimation results

This section considers the specific hypothesis highlighted in the discussion of the above models concerning leverage and the housing market. Does a higher incidence of households with high levels of leverage (loan to value ratio) amplify the response of house prices to an income shock? The analysis is similar to that of Lamont and Stein (1999) which examined a sample of 44 US cities for the period 1984-94. The model of Stein (1995) predicts that over and above this general effect of leverage, the presence of negative equity should have an additional effect.

(13) Andrew and Meen (2003) carry out a similar analysis. See also Ortalo-Magné and Rady (1999) for further discussion of the role of young households.
(14) In recent years, the growth of the 'buy-to-let' investor may have displaced the young first-time buyer as the marginal buyer.

Since no appropriate local housing market data are available for the United Kingdom, I construct a data set of house price inflation from the British Household Panel Survey.[15] The details of this procedure are discussed in the next section followed by the empirical model which presents fixed effects panel estimates for house price inflation among the panel of 147 districts for the period 1993 to 2002. To my knowledge this is the first study of local UK housing markets.

During the sample period, the UK housing market experienced quite significant swings in activity. In the early 1990s the market was somewhat depressed and a protracted period of recovery followed, up to the mid-1990s. Negative nominal house price inflation combined with relatively large numbers of households having purchased their home at the peak (Chart 3) and at high loan to value ratios meant that large numbers of households experienced negative equity in the early 1990s. The large numbers of households experiencing negative equity suggests that the model of Stein (1995) which emphasises negative equity in particular may have been pertinent for the early part of the period. Since then, with levels of transactions and, in particular rising house price inflation, the numbers of households with negative housing equity declined markedly. The Department for Transport, Land and the Regions (DETR) estimated that out of around 17 million owner-occupying households, the number with negative equity increased from 78,000 in 1989 to 1.2 million in 1992, with 907,000 estimated for 1995 from which point it declined quite markedly.[16] In the late 1990s and early 2000s, the market was supported by reductions in unemployment alongside falls in nominal and real interest rates. While the housing market during the period showed remarkable variation at the aggregate level, there is even greater variation at the district level. This is exploited below.

4.2 Data description

The data are constructed at the level of UK local authority districts from the British Household Panel Survey (BHPS). The BHPS is a nationally representative survey of households and began in 1991.[17] In its first wave, the survey collected data on 5,500 households. These original sample members are re-interviewed in subsequent years, whether they remain in the original household or

(15) See Benito (2006) for a recent study of consumption using these data.
(16) Net equity in the UK housing stock as a proportion of (annual) post-tax income declined from around 280% in 1989 to less than 150% by 1995, from which point it increased to return to around 280% in 2003 (Source: National Statistics).
(17) The vast majority of interviews take place in the final quarter of each calendar year. Typically around 5% carry over to the first quarter of the following calendar year.

move away to form new households, with each adult with whom they form a new household also being surveyed. Booster samples for Scotland and Wales were introduced in 1999, with Northern Ireland households being included in the sample from 1997. The data give particularly detailed information on employment, income and standard household characteristics.

In order to examine local housing markets, a local identifier in the data is required. There are two types of identifier for residence in the BHPS. The first is at the regional/metropolitan level. With only 19 standard regions this is judged to be too aggregated for the purposes of studying local housing markets with panel data methods, where the cross-sectional dimension of the data is crucial. The second residence identifier is the local authority district. There are 279 such districts in the BHPS, where contiguous districts are combined if their population falls below 120,000. This is the level of disaggregation used in this study. One issue concerns having a sufficiently large number of observations per district (in a particular year) that reliable inferences may be made on the broadest number of districts. There is clearly a trade-off between the two considerations. For this purpose, I select districts for inclusion in the analysis if they have at least 20 observations per district in a particular year. This reduces the number of districts covered from 279 to 147. Reasonable variation in the chosen threshold did not affect the nature of the results much. For the purposes of estimating panel data models, I also select on having a minimum of at least four consecutive years of data on each district.

The house price data used in the paper are subjective estimates of the house value provided by the household. This contrasts with most studies of house prices which use transaction prices. Previous research suggests that the former tend to be positively biased estimates of the latter but that this bias is not correlated with characteristics of the household, the key issue for obtaining unbiased parameter estimates (Goodman and Ittner (1992)).

Average house price inflation in the district is calculated as the mean house price inflation (change in the log house price less RPI inflation) in a particular district for those households in the BHPS who have not moved since the previous wave of the survey. The restriction that individuals have not moved is in order to make sure that a like-for-like house comparison is made across adjacent years.

There is considerable variation across districts in house price inflation experienced in a given year.

For example, in 2002, at the 10th percentile the level of real house price inflation is 9.6%, compared to a figure of 23.4% at the 90th percentile district. Such variation in itself might suggest that models based on national averages alone are unlikely to be appropriate for understanding the housing market since these different districts are likely to have experienced the same or similar variation in construction costs, nominal interest rates, expected inflation and tax rates.

There are two other key variables in the analysis. The first is the local shock variable. Following Lamont and Stein (1999) the average growth rate in household income in the district is used in the first instance. In addition, a subjective measure of a shock is constructed. This employs subjective expectations data to construct a measure of whether the household has experienced a shock regarding its financial situation. In each survey households are asked whether they expect their financial situation to improve, remain about the same or worsen over the next year. In the following survey they are asked how their financial situation actually changed over the past year. Households whose reported experience exceeds (falls short of) what they had previously expected are considered to have experienced a positive (negative) shock. At the district level, the proportion of households that experience each type of shock is employed. This variable has been successfully used as a shock variable in otherwise unrelated studies such as Boheim and Ermisch (2001).

In each year of the survey from 1993, households are asked how much secured mortgage debt they have outstanding. The ratio of this to the house value gives the loan to value ratio. It includes information on whether the household has taken out a remortgage or any further advances secured on the property, as well as repayments of principal, since taking out the original mortgage.

Summary statistics on the main variables of interest are presented in Table C. The data consist of an unbalanced panel with between three and ten years of data for each of the 147 local authority districts between 1993 and 2002.

Real house price inflation averages 4.7% per annum across the districts during the period using the subjective self-reported measure employed here. This compares to an average of 5.1% according to the ODPM measure (deflated by the retail prices index). The average level of house price inflation falls between 1993 and 1995, and then increases–reaching 16.9% in 2002. This also follows the patterns in the aggregate series. The average house price to earnings ratio, which will be employed as our main measure of local housing market ‘fundamentals’, averages 4.6 which

also seems eminently plausible, with a low of 1.4 (in Stoke-on-Trent) and a maximum of 12.4 (in Poole, Dorset).

Loan to value (LTV) ratios are quite low. The average figure, where the average is taken across all households in a district including those who have paid off their mortgage, or are renting, is 0.315 (or 31.5%). Of course this includes those who own their properties outright who represent around one third of all owner-occupiers in the United Kingdom. The average level of leverage (loan to value ratio) ranges from 4.3% (in Bury) to 64.7% (in North Bedfordshire). The proportion of households in a district with an LTV of 80% or more ranges from zero in 23 districts to 47% (in Dartford and Barrow in Furness). The proportion of owner-occupiers with a mortgage, another indicator of a concentration of leveraged households in a local housing market, ranges from 16.1% (in Nottingham) to 88.6% (in Blackpool). 11% of district-year observations have loan to value ratios of 80% or more and the median loan to value ratio is 42.2%. In 35.3% of district-year observations there is some household that has negative equity. Of course, in those districts it is only a small minority of households in this position.

Real household income growth averages 1.4% over the period, with that of first-time buyers, proxied by income growth of those aged 25 to 34, being higher at 3.2%.

The average percentage of households in a district reporting a positive shock to their financial situation is 18.9%, with on average 26.3% of households in a district reporting a negative shock to their financial situation during this sample period. A majority of households do not report having experienced a shock in the sense that their financial situation over the previous year, broadly interpreted, moved in line with what they had expected the previous year, for the year ahead.

Does the ratio of house prices to household labour earnings act as an ‘attractor’ at the district level? There appears to be some tendency for this but it is not strong. A fixed effects regression for the district’s house price inflation on the lagged (log) house price/household income ratio and a set of year effects produces a coefficient (standard error) on the house price/income ratio term of -0.032 (0.012). This suggests that house prices are attracted to a house price/earnings ratio at the district level. But the speed of adjustment towards that equilibrium, at just 3.2% of the gap per year, is very slow.

4.3 Estimation results

The basic estimating equation follows that of Lamont and Stein (1999) and consists of the following:

$$\Delta \ln hp_{it} = f_i + \beta_1 \Delta \ln y_{it} + \beta_2 \ln(hp/y)_{it-1} + \gamma_t + \varepsilon_{it} \qquad \textbf{(1)}$$

where 'i' indexes local authority districts, i=1,2…147 and 't' indexes years t=1993, 1994…2002. f_i are fixed effects for each local authority (intercept dummies) which control for (permanent) unobserved heterogeneity across local authorities in characteristics that determine house price inflation. This might include factors which mean that some districts are prone to having higher house price to incomes ratios than others (eg its inherent 'niceness' and restrictions on the supply of housing). Δlny_{it} is average household income growth, employed following Lamont and Stein (1999) as a measure of local shocks. As an alternative–and a variable which is more likely to be exogenous–is the proportion of households reporting a positive financial shock, as well as the proportion reporting a negative shock.

How leverage affects the responsiveness of house price inflation to shocks is among the key issues addressed. Equation **(1)** is therefore estimated separately for high and low-leverage districts. A number of alternative measures of leverage are considered. That favoured by Lamont and Stein (1999) was the proportion of households with loan to value ratios of 0.80 or more. The median loan to value ratios (over time) for each district are also used to distinguish high and low-leverage districts. γ_t are a set of aggregate effects that control for common, macroeconomic, shocks common across districts. These will control for several of the components of the user cost of housing, in particular nominal interest rates and expected inflation. ε_{it} is a white noise error term.

One further point regarding estimation concerns the use of district-level data. The districts are not independent of one another not least as households would be expected to move between districts in response to shocks. As in Lamont and Stein (1999), such spatial correlation is difficult to adjust for directly but would affect the standard errors, although not the estimated coefficients reported below. Another factor which is not considered explicitly is a role for demographics and population growth. To the extent that districts differ in population growth rates in a stable way, or that this

variation is common across districts over time, then these effects will be controlled for through the fixed effects and time effects, respectively (see Ortalo-Magné and Rady (2004) for a discussion of the effects of demographics).

Estimation results are presented in Table D, which reports estimates of equation (**1**) across the full set of districts. In column 1 a basic specification is reported which considers house price inflation, responding to local income and the error-correction term given by the ratio of house prices to household income. House prices respond positively to local incomes, with a contemporaneous coefficient of 0.040, which is statistically significant, with a *t*-ratio of around 2.0. A 10 percentage point increase in income is associated with a 0.4 percentage point increase in house price inflation in the area. Compared to an average real house price inflation rate of 4.7% during the period, that is not a large effect and is smaller than the effect estimated by Lamont and Stein (1999). It is likely to be longer-term expectations of income that matter more generally, but given that income growth persists, the contemporaneous growth may do a reasonable job of picking up some of this effect.[(18)] Adding a lagged dependent variable to the estimating equation does not change these results a great deal.

Prices are also attracted towards the equilibrium house price/income ratio, with a coefficient of -0.022 which is also statistically significant at conventional levels but suggests a surprisingly slow speed of adjustment. For comparison, at the aggregate level using annual data Muellbauer and Murphy (1997) report a coefficient on their (logged, lagged) house price/income term of -0.12. Classical (additive) measurement error in the house price/income ratio term would bias the coefficient towards zero and this may be a factor.

As a measure of a local income shock, column 2 considers the subjective measures in the form of the proportion of households in a district that experience a positive shock and the proportion experiencing no shock to their financial situation. These coefficients are relative to the base (omitted) group of the proportion of the district that have experienced a negative shock. The two terms are statistically significant. The positive and no shock terms are not significantly different from one another, although the point estimates suggest that local house prices respond more to positive shocks than to no shock.

(18) Following the discussion in Section 2, an average income in the district for younger households was considered. This performed a similar role to the average all-household income measure. The whole-sample measure is used as it is likely to be subject to less sampling error, some districts having only a small number of young households.

Thus far, the evidence has shown that local house price inflation responds significantly to local income shocks and returns to an equilibrium local house price/income multiple, but slowly. The issue emphasised in down-payment models of the housing market is that responsiveness to (income) shocks depends on the presence of highly indebted households in an area. The model of Ortalo-Magné and Rady (2005) implies that this is a general phenomenon while the model of Stein (1995) suggests an added effect in the presence of negative equity. The former will be considered below by a sample-splitting method that considers separately high and low-leveraged districts. Before proceeding to that, Stein's (1995) model implication is considered by the addition of the interaction term between a negative financial shock and the presence of some household(s) in the district with negative equity ($\text{shock}^{-}_{it}\ X\ (\text{LTV}>1)_{it}$). Although the term is negatively signed, it falls short of significance (column 3).

Table E presents the separate estimates for high and low-leverage districts. There are 73 low-leverage and 74 high-leverage districts. The results support the basic suggestion outlined earlier. The results for the low-leverage subsamples reveal that the income shock term is insignificant, with a *t*-ratio of around 1.0. For the high-leverage subsample the same term is statistically significant at the 5% level, with a larger point estimate.(19)

The same models are repeated using the more subjective proportion of those experiencing a positive shock. In this case the differences between the low and high-leverage subsamples are more pronounced and on both indicators of leverage. Using the 80% LTV criterion, the term for the proportion in the area experiencing a positive shock attracts a coefficient (standard error) of 0.112 (0.037) among the highly indebted districts compared to a coefficient (standard error) of 0.054 (0.032) for the sample of districts with fewer highly indebted households. These results support those found by Lamont and Stein (1999) in their sample of 44 US cities.(20)

The discussion above noted that Stein's model emphasises credit constraints applying where there is negative equity. Although there was not evidence for this added effect of a negative financial shock where there is negative equity across the sample as a whole, it may be that this is disguised

(19) The results imply larger responses of house price inflation to income shocks when we do not control for the state of the macroeconomy by dropping the time dummies. A similar equation to that reported in columns 2 and 3 of Table E when the time dummies are dropped results in a coefficient (standard error) on the income growth term of 0.078 (0.046) and 0.114 (0.048) in the low and high-leverage districts, respectively.

(20) Since the loan to value ratio in a district may be endogenous, the sample-splitting was repeated using the initial value of loan to value ratio (rather than its average over the sample period) to classify the districts. The results were similar.

by considering jointly the low and high-leverage districts as was the case above. Table E shows that considering these districts separately, there is evidence of an added effect of an adverse financial shock on house prices where there are some households with negative equity in the districts that are already highly leveraged. In Stein's model, these households are constrained to such an extent that they can no longer move home when there is an adverse income shock because they cannot make the down-payment on any home move, giving rise to a larger negative effect on house prices.

5 Conclusion

The paper has examined the UK housing market and emphasised the role of the down-payment constraint. It has drawn on the models of Ortalo-Magné and Rady (2005) and Stein (1995) that consider the role of credit constraints on price and transactions fluctuations in the housing market. A number of empirical implications for this model were highlighted and confronted with aggregate data for the United Kingdom. The data have borne out each of these predictions, namely i) a positive correlation between house price inflation and transactions; ii) greater volatility of former owner-occupiers' house price inflation than for first-time buyers; iii) the presence of former owner-occupiers in the market increases with house price inflation; and iv) house prices are more sensitive to the incomes of the young, particularly in the early 1990s.

At the district level, the study of Lamont and Stein (1999) on US cities has been replicated using a data set on a larger number of UK districts. It has been found, as they do, that the effect of an income shock on house prices is amplified where there is a larger incidence of households with relatively high loan to value ratios. Additionally, a further role for the presence of households with negative equity was found in influencing the response of house prices to shocks. This is also consistent with an important role for the down-payment constraint. Capital gains on housing are important because they help relax this constraint for some households but the same house price rises exacerbate the constraint on other households.

Tables and charts

Table A: Saving motives (%)

Saving motive	All	Age⩽ 35
Holidays	29.2	24.4
Old age	15.2	2.7
Special events	13.4	15.4
House purchase	**10.4**	**21.9**
Home improvements	8.9	7.3
Car purchase	7.8	12.2
Children	7.2	6.8
Bills	3.6	2.9
Own education	2.7	5.9
Grandchildren	1.1	0.0
Share schemes	0.7	0.7
	100.0	100.0

Source: 2002 British Household Panel Survey for those who save and state a reason.

Note: n(full sample)=3,288; n(aged 35 or under sample)=1,131.

Table B: Sources of finance for house purchase, other than mortgage

Source	% First-time buyers		% Former owner-occupiers	
	2003/04	1993/94	2003/04	1993/94
Savings	56	65	25	40
Proceeds from sale of previous home	4	3	83	76
Gift or loan from family or friend	23	23	4	7
No other source - 100% mortgage	23	12	3	3
Loan to cover deposit/bridging loan from elsewhere	3	6	1	3
Inherited money	3	6	2	3
Windfall	1	1	0	1
Other	2	5	2	1

Source: Survey of English Housing.

Table C: Summary statistics

		mean	st.dev.	minimum	maximum
House price inflation	$\Delta \ln (hp)$	0.047	0.079	-0.195	0.389
House price/household income	hp/y	4.607	1.701	1.442	12.404
Real household income growth	$\Delta \ln y$	0.014	0.065	-0.152	0.171
FTB real income growth	$\Delta \ln y^{FTB}$	0.032	0.061	-0.136	0.202
Loan/value ratio	LTV	0.314	0.107	0.043	0.648
Proportion with 80% LTV	$(LTV \geqslant 0.80)$	0.114	0.096	0.000	0.467
Proportion with 50% LTV	$(LTV \geqslant 0.50)$	0.299	0.142	0.000	0.750
Median LTV	LTV^{med}	0.422	0.161	0.000	0.883
Any negative equity	(LTV> 1)	0.353	0.478	0	1
Proportion with mortgage	$mortpc$	0.525	0.125	0.161	0.886
Positive shock	$shock^{+}$	0.189	0.068	0.000	0.483
Negative shock	$shock^{-}$	0.263	0.077	0.044	0.567
No shock	$shock^{\phi}$	0.548	0.085	0.268	0.914
Observations		1,354			

Note: District-level data from the British Household Panel Survey.

Table D: District-level house price inflation

	[1]	[2]	[3]
$\Delta \ln y_{it}$	0.040 (0.020)		
$shock_{it}^{+}$		0.078 (0.024)	0.073 (0.025)
$shock_{it}^{\phi}$		0.050 (0.020)	0.045 (0.020)
$\ln(hp/y)_{it-1}$	-0.022 (0.010)	-0.019 (0.010)	-0.021 (0.010)
$shock_{it}^{-}$ X (LTV>1)$_{it}$			-0.011 (0.011)
Year effects	yes	yes	yes
District effects	yes	yes	yes
R-squared	0.533	0.541	0.536
Districts	147	147	147
Observations	1,354	1,207	1,207

Note: Estimates are fixed-effects estimates for district-level average house price inflation.

Table E: Sample splits by leverage

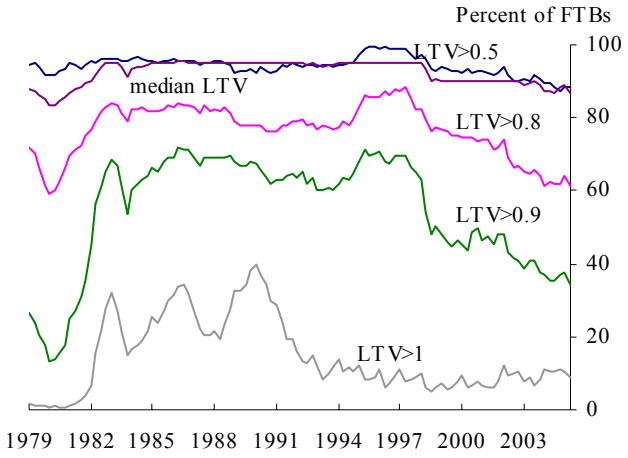
	proportion with 80% LTVs		median LTV	
	LOW	HIGH	LOW	HIGH
$\Delta \ln y_{it}$	0.031 (0.028)	0.051 (0.030)	0.028 (0.029)	0.052 (0.028)
$\ln(hp/y)_{it-1}$	-0.037 (0.014)	-0.015 (0.015)	-0.032 (0.013)	-0.025 (0.015)
Year effects	yes	yes	yes	yes
District effects	yes	yes	yes	yes
R-squared	0.580	0.506	0.566	0.519
Districts	73	74	74	73
Observations	608	599	612	595

Note: Samples are split by the district's average value for the variable that heads the column and whether this exceeds the median for that variable or not.

Table E (cont): Sample splits by leverage

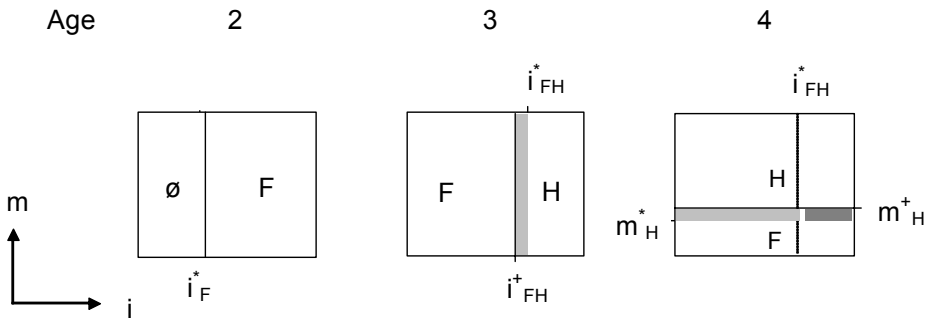
	proportion with 80% LTVs				median LTV	
	LOW		HIGH		LOW	HIGH
$shock_{it}^{+}$	0.054 (0.032)	0.060 (0.033)	0.112 (0.037)	0.096 (0.038)	0.058 (0.034)	0.084 (0.035)
$shock_{it}^{\phi}$	0.040 (0.026)	0.041 (0.026)	0.067 (0.031)	0.052 (0.032)	0.047 (0.027)	0.039 (0.029)
$ln(hp/y)_{it-1}$	-0.036 (0.013)	-0.035 (0.014)	-0.009 (0.015)	-0.012 (0.015)	-0.029 (0.013)	-0.020 (0.015)
$shock_{it}^{-}$ X (LTV>1)$_{it}$		0.005 (0.016)		-0.031 (0.016)		
Year effects	yes	yes	yes	yes	yes	yes
District effects	yes	yes	yes	yes	yes	yes
R-squared	0.583	0.585	0.517	0.507	0.570	0.530
Districts	73	73	74	74	74	73
Observations	608	608	599	599	612	595

Chart 1: Distribution of loan to value ratios of first-time buyers (FTBs)



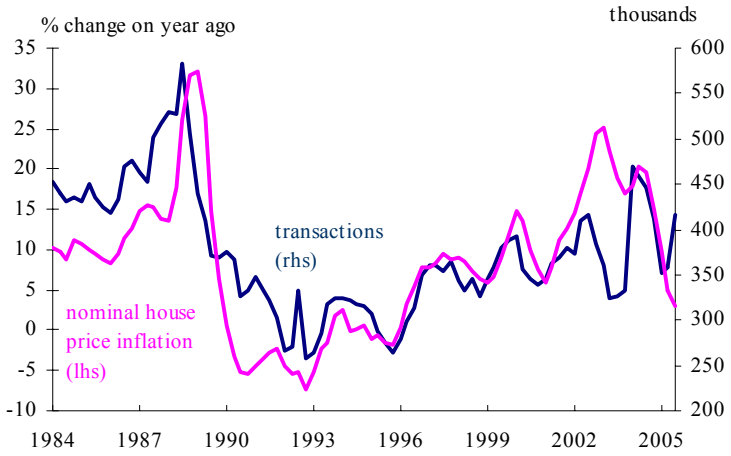
Source: Council of Mortgage Lenders.

Chart 2: Home ownership by age



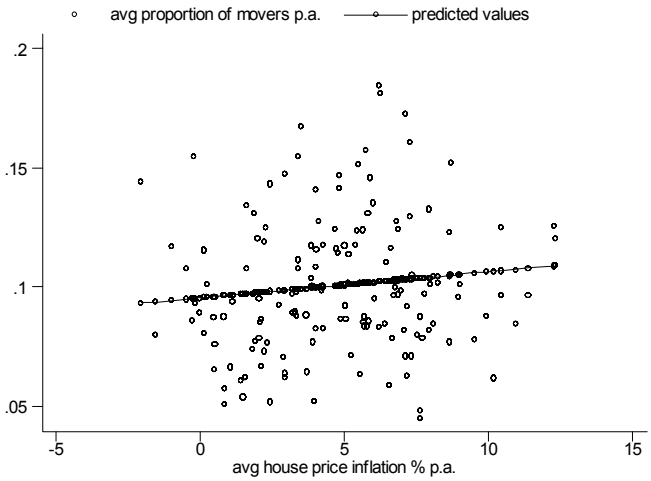
Source: Ortalo-Magné and Rady (2005).

Chart 3: House price inflation and transactions



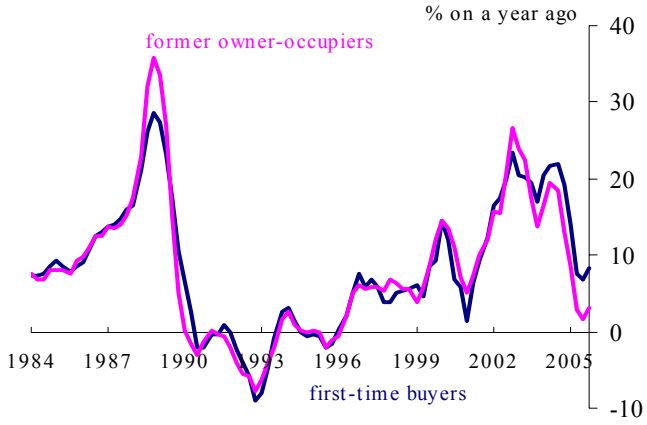
Sources: Lenders' indices (average); land transactions returns or particulars delivered.

Chart 4: Moving home and house price inflation



Source: British Household Panel Survey.

Chart 5: House price inflation of FTBs and former owner-occupiers



St.dev (FOO): 9.2%; St.dev (FTB): 8.5%.

Chart 6: House price inflation and the presence of FTBs

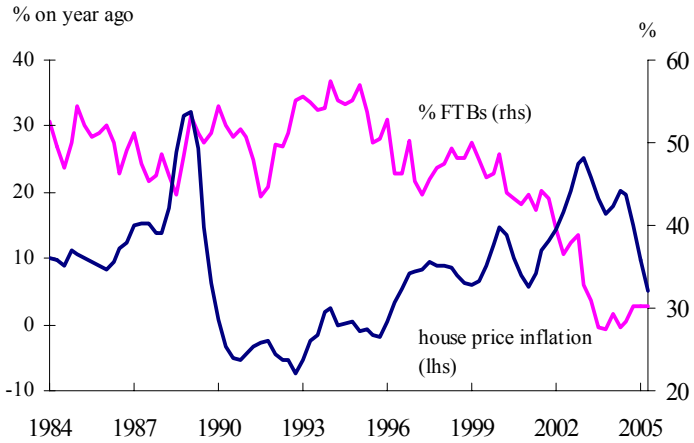
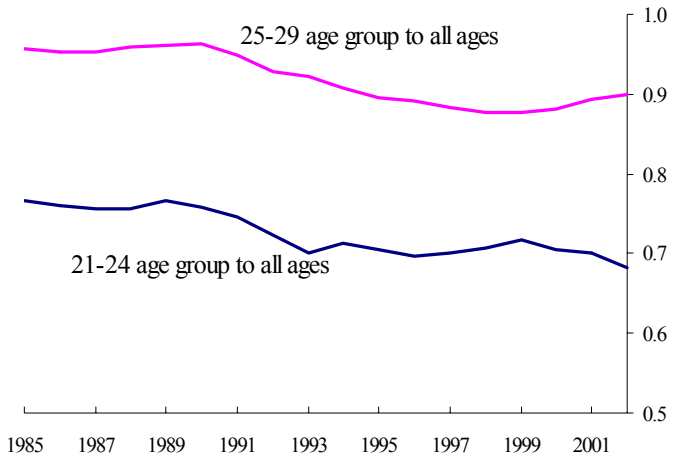


Chart 7: Ratio of young persons' earnings to average earnings



Source: New Earnings Survey.

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