IV – Outlook for the UK housing market

Introduction

Housing continues to be the UK economy's most valuable asset by far. Housing was estimated by the Office for National Statistics to have a total value of £3.9 trillion at the end of 2006, equivalent to 60% of the total value of all UK assets (valued at some £6.5 trillion). In 2006, the total value of housing is estimated to have increased by 10% on the previous year.

Figure 4.1 - Average UK house price 1974Q1-2007Q3

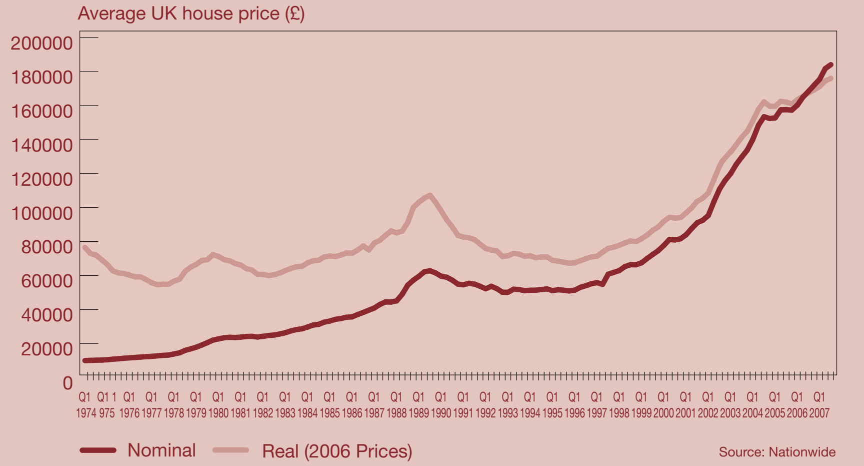
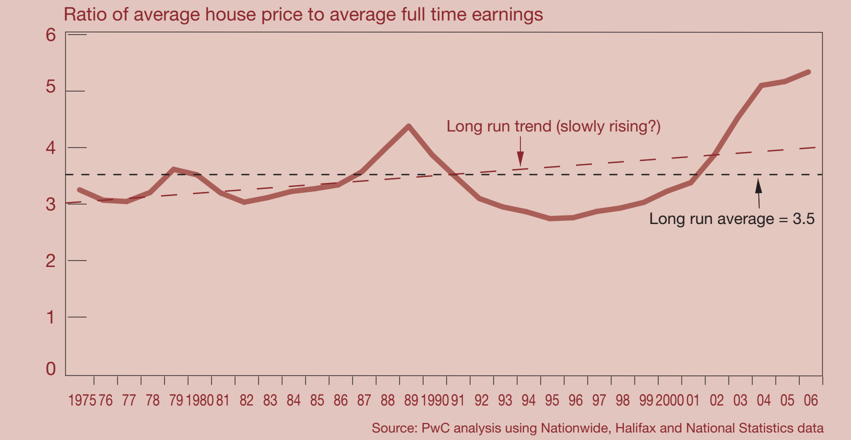


Figure 4.2 – Average house price to earnings ratio (1975-2006)



The weight of housing in total UK assets underlies the importance of a good understanding of the outlook for the housing market in forming views on the broader economy. There are, of course, many organisations and academics that produce house price forecasts, with a correspondingly wide range of views, but past experience suggests that such forecasts are subject to wide margins of error. Given this uncertainty, any investor in housing (which effectively includes all owner occupiers as well as those buying to rent) should be aware not just of the central forecast for house prices, but also the degree of uncertainty that surrounds any such forecast.

Last year, PricewaterhouseCoopers LLP (PwC) presented its findings from research into uncertainty surrounding future UK house price trends[1]. This research produced a broad range of possible outcomes with estimated probabilities using 'fan-charts' for future house prices. It concluded that, while the most likely outcome was a moderate rise in average UK house prices between 2006 and 2010, there was also a significant risk that prices could fall over this period.

In this article we update our earlier findings with the latest data and develop our model further to take better account of the influence of supply constraints on house prices. The analysis below is structured as follows:

- Section IV.1 provides a brief overview of developments in the UK housing market;
- Section IV.2 describes the stochastic model that we have estimated for this analysis, which includes 'random' shocks calculated to reflect the past cyclicality of house prices;
- Section IV.3 presents simulations of house price uncertainty; and
- Section IV.4 provides a summary of the key results.

IV.1 Key developments in the UK housing market

The UK housing market has been highly cyclical – there have been booms and busts as well as periods of relatively stable price inflation. Average UK house prices (in both real and nominal terms) have grown significantly over time (see Figure 4.1), despite some notable periods of weakness such as the early 1990s. However, the cyclicality of the housing market is most apparent when viewing fluctuations in the ratio of average house prices to average earnings (see Figure 4.2).

In the long run, one might expect house prices to move broadly in line with earnings, as the latter ultimately determine the affordability of housing[2]. Figure 4.2 suggests that historically house prices may be regarded as having cycled around an 'equilibrium' level for the house price to earnings ratio, with the peaks in prices being clearly shorter and sharper than the long periods of prices below equilibrium. The late 1980s housing 'boom', for instance, lasted for around four years according to this analysis (1987-90), while the subsequent period of relatively low prices was much longer (1991-2001).

But the level of any such 'equilibrium' average house price is a matter of

[1] The research was published in the November 2006 issue of UK Economic Outlook.

[2] Although it is important to note that the relationship between house prices and earnings need not be a steady one, as the share of earnings spent on housing can change. There is some evidence that the house price to earnings ratio has been rising slowly over time, as shown by the long run trend line in Figure 4.2.

considerable debate with a wide range of views amongst commentators. Figure 4.2 could be interpreted as suggesting that current house prices are far above equilibrium, as the house price to earnings ratio has reached record highs. However, there are arguments to suggest that the equilibrium has shifted upwards significantly in recent years due to lower interest rates, plentiful mortgage credit and constraints on housing supply. As incomes rise, households may also tend to allocate more of their disposable income to housing (in technical terms, it may be a 'superior good'). Nevertheless, we still believe that it is instructive to model house prices as following a cyclical path around some sort of equilibrium level, even if the latter evolves gradually over time.

The other striking feature of this market is its relative short term inertia. For example, during the deep recession of the early 1990s, house prices did not fall overnight but instead declined gradually over a number of years. This is in sharp contrast to other asset markets – price levels in equity and commodity markets can crash over a matter of hours. The housing market itself is very illiquid compared to these other markets and any sharp fall in demand tends to result initially in a sharp fall in transactions rather than a sharp fall in prices. Most houses are owned by individuals, who can delay any sale of the property when facing unusually weak demand conditions. Any model therefore needs to take account of the relatively slow rate of change of house prices.

IV. 2 Stochastic model of house price uncertainty

The key to modelling uncertainty in the housing market is to identify a statistical model that can best simulate the cyclical behaviour that we witness in this market – i.e. large medium term cycles with relatively little short term volatility due to inertia.

To capture these features we have chosen to use a 'mean reversion' model of house prices, in which the rate of growth of prices today is negatively influenced by the level of house prices in the past – i.e. if house prices were above equilibrium in the past then the rate of house price growth is lower, and vice versa. This process naturally results in house prices returning to equilibrium (reverting to the mean) in the long term, but it is possible for prices to 'overshoot' the equilibrium on the return path. This last point is important, as most commentators would agree that house prices 'overshoot' equilibrium in the last downturn (the 1996 house price to earnings ratio was low by historic standards).

In our previous research we assumed that, in the long run, house prices would fluctuate around some 'equilibrium' level relative to average earnings and we therefore sought to model the house price to earnings ratio rather than just the average house price. Interest rates were also included in the analysis, as these were found to be a key driver of buoyant house price trends. In this article we extend the model by also including supply constraints in our analysis[3], since these are commonly believed to be a key driver of house price trends in recent years.

More specifically, we modelled the relationship between the annual change in the house price to earnings ratio and:

- the change in the house price to earnings ratio in the previous year;
- the house price to earnings ratio two years before;
- interest rates (nominal) two years before;
- the change in the (natural log of the) housing stock to households ratio (as an indicator of possible supply constraints);
- a constant term, which acts as a proxy for the 'equilibrium' house price to earnings ratio; and
- an 'error term' that captures the degree of uncertainty.

Table 4.1 – Econometric model for change in the house price to earnings ratio (D.HPE)

Variable	LD.HPE	L2.HPE	L.INT	D.SUPPLY	Constant
Co-efficient	0.3906	-0.1258	-0.0345	-15.9473	0.78045
t-value	*(2.2)*	*(-1.8)*	*(-2.4)*	*(-1.3)*	*(2.7)*

Note: Prefix 'D' indicates change in the variable, and 'L' indicates a lagged variable. Therefore LD.HPE is the change in the house price to earnings (HPE) variable in the previous year. L.INT is the nominal interest rate, lagged one year, which we found to be statistically the most reliable driver. D.SUPPLY is the change in the natural log of the ratio of housing stock to households in the current year.
Source: PwC analysis

The parameters of the model were estimated using standard ordinary least squares (OLS) econometric methods based on annual data for 1975-2006[4]. We also identified the most appropriate model specification (e.g. which lag terms and interest rate variables to include) using standard diagnostic tests. The technical details of our preferred model are set out in Table 4.1. In summary, this model has the following key features:

- the actual house price to earnings ratio was about 10% above the estimated historic equilibrium house price to earnings ratio in 2006, suggesting house prices were around 10% over-valued in that year on average;
- a permanent increase in the interest rate variable by one percentage point would, eventually, reduce house prices by about 27%; the full impact of this change would take up to a decade to become apparent, however, due to the considerable inertia in this market;
- the stochastic model creates housing market cycles of around ten years in length, which is broadly in line with past experience; and
- the simulated house price to earnings ratio can diverge significantly from equilibrium levels, as the results shown later make clear.

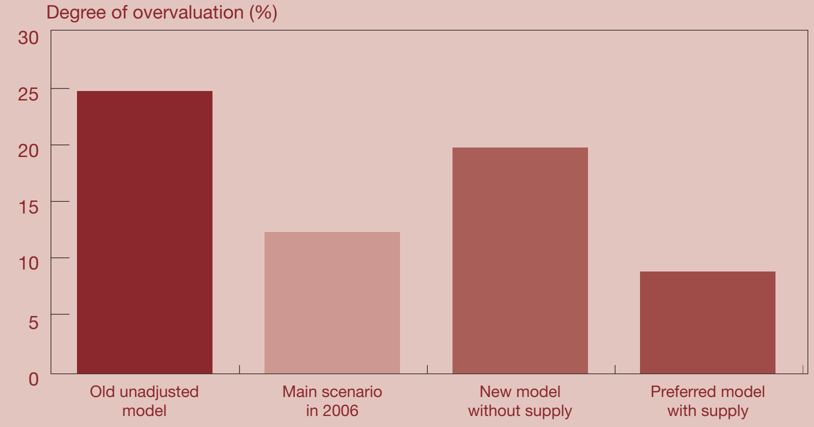
Figure 4.3 shows the degree of estimated house price overvaluation in different versions of our model. Last year we estimated a basic unadjusted model which yielded an overvaluation estimate of around 25%. We felt this was unrealistic and therefore adjusted it to incorporate supply constraints as well as the views of a number of commentators, resulting in an adjusted estimate of 12.5% that we took to be our main scenario for the purpose of forward projections.

[3] In our previous analysis, we allowed for supply constraints through judgemental adjustments to the estimated initial disequilibrium in the house price to earnings ratio at the start of the projections period. This was a rather ad hoc approach, however, which is why we now prefer to address this issue directly in the econometric analysis, although it should be recognised that a single indicator such as the ratio of housing stock to household numbers is subject to some limitations since the number of households will tend to adjust to the available housing stock over time. But better indicators of supply constraints for which long runs of data are available are not easy to find and our approach mirrors that taken in other recent studies (e.g. Meen, 2006).

[4] We constructed a house price index based on a the simple average of the Nationwide and Halifax house price indices, with the value for 2007 being fixed to our estimate for average house prices in 2007 (which we set at £183,417).

Our updated unadjusted model, without taking into account supply constraints, shows an estimated overvaluation of 20%, slightly lower than the previous year's 25% due to new data and a slightly refined model structure. However, our new preferred model, which incorporates supply constraints, shows an overvaluation of approximately 10%. Intuitively, the degree of estimated house price overvaluation should be less once a model takes account of supply constraints, which is what our results show.

Figure 4.3 - Degree of estimated house price: earnings ratio overvaluation



Source: PwC analysis

'Random shocks'

The resulting model can be used to produce 'stochastic simulations' of house prices based on 'random shocks'[5]. Without random shocks, the model would simply produce a 'deterministic' forecast, which would see prices returning to their 'equilibrium' level relative to earnings. However, our model also allows us to include 'random shocks', which can produce prices moving away from the equilibrium in the short term (although they always tend to revert back to the equilibrium in the longer term). These simulation results are presented in Section IV.3 below.

Table 4.2 – Assumptions on random shocks

Form of uncertainty	Measure adopted	Standard deviation
1. Uncertainty of house price to earnings ratio	Error term from the econometric regression of past data (1975-2006)	0.2 (house price to earnings ratio
2. Uncertainty of interest rates	Annual standard deviation of nominal interest rates since Bank of England independence (1997-2006)	1.1% (interest rate)
3. Uncertainty of housing stock to households ratio	Annual standard deviation of housing stock and households (1976-2006)	0.2% (housing stock and households)
4. Uncertainty of inflation	Assume that there is a 95% probability of inflation being within the 1%-3% target range	0.5% (CPI inflation rate)
5. Uncertainty of (long term) real average earnings growth	Standard deviation of 30 year real earnings growth rate (1976-2006)	0.4% (earnings growth rate)

Source: PwC analysis

The 'random shocks' are the key component of a stochastic model. In order to produce simulations of house prices using this model, we need to consider five sources of uncertainty:

1 Uncertainty of the house price to earnings ratio, which is not explained by the cyclical nature of prices or by interest rates or supply constraints. These unexplained movements in prices reflect such things as consumer confidence and taxation[6]. Technically, this is the error term from the econometric regression.

2 Uncertainty of interest rates, which is an exogenous driver in our model. Future interest rates are not certain and we need to add random shocks to interest rates as well. We model this uncertainty based on past fluctuations in interest rates during the period since Bank of England independence in 1997.

3 Uncertainty of the housing stock to households ratio, which is an exogenous driver in our model. The size and number of the future housing stock and households are uncertain. We model this uncertainty based on past fluctuations in these variables applied to government projections of household numbers and targets for growth of the housing stock up to 2020.

4 Uncertainty of the rate of consumer price inflation. We assume that there is a 95% chance of the rate of inflation remaining within the Bank of England's target range (1%-3% for CPI) each year.

5 Uncertainty of average earnings growth, as clearly we need to multiply the house price to earnings ratio by average earnings in order to model average house prices. We model this uncertainty based on past fluctuations in real average earnings growth[7], then add simulated inflation (see 4 above) to produce nominal average earnings growth.

Further details of these random shocks are set out in Table 4.2. In the next section we present results from this model.

IV.3 House price simulation

The model that we estimated using econometric techniques was necessarily based on historic data. There has been considerable change in the UK economy over the past few decades and, like many commentators, we suspect that there has been structural change in the UK housing market. By including supply in this model, we believe that the model better reflects current conditions. Furthermore, by modelling supply constraint uncertainty based on past fluctuations in housing stock and households applied to government projections/targets of households and

[5] We introduce normally distributed random shocks to the model to simulate unexpected shocks in the housing market.
[6] Note that we do not attempt to forecast these key drivers, but instead model them through random simulations.
[7] Real earnings growth has averaged around 2.5% per annum in recent decades (based on the CPI measure of inflation), which we assume continues in the future.

housing stock, we can take account of recently announced government plans to boost housing supply over the period to 2020.

In order to understand the distribution of possible outcomes for house prices, we produced 2,000 randomly-generated simulations using a well-established statistical modelling technique known as 'Monte Carlo simulation'. The key results of this exercise are presented in Figures 4.4, 4.5 and 4.6.

In Figure 4.4, we present the distribution of outcomes as a 'fan diagram', which is derived in a similar way to the Bank of England's well known inflation fan chart. The chart presents ten lines, outlining the nine deciles of the probability distribution lying between 5% and 95%. So, for instance, there is a 5% chance of prices lying below the bottom line in the chart and a 95% chance of prices being above it. The two centre lines – the 45% to 55% probability range – represent the centre of the distribution and could be viewed as the central estimate of this modelling approach. It is clear from Figure 4.4 that there is a non-negligible possibility of falling average house prices over the next few years. The 5% probability line suggests prices falling by over 8% in nominal terms by 2010.

Figure 4.5 presents these results for nominal house price changes in an alternative form that may be easier to interpret, while Figure 4.6 does the same for real house price changes. The charts show the estimated probability of cumulative nominal or real house price growth in the years from 2007 to 2010 and from 2007 to 2020 falling into certain bands.

Figure 4.5 suggests that there is around a 1 in 5 chance of house prices being lower in 2010 than in 2007 in nominal terms (the four columns showing negative price changes sum to 19%), although the central view is that there will be a moderate further rise in nominal house prices over this period, but at a slower rate than in recent years. The outlook for 2020 is much more positive, as earnings growth should push prices higher, although these parameters suggest that there is still a very small chance (0.6%) of lower nominal average house prices in 2020 than 2007.

Figure 4.4 - Fan chart of average nominal house prices

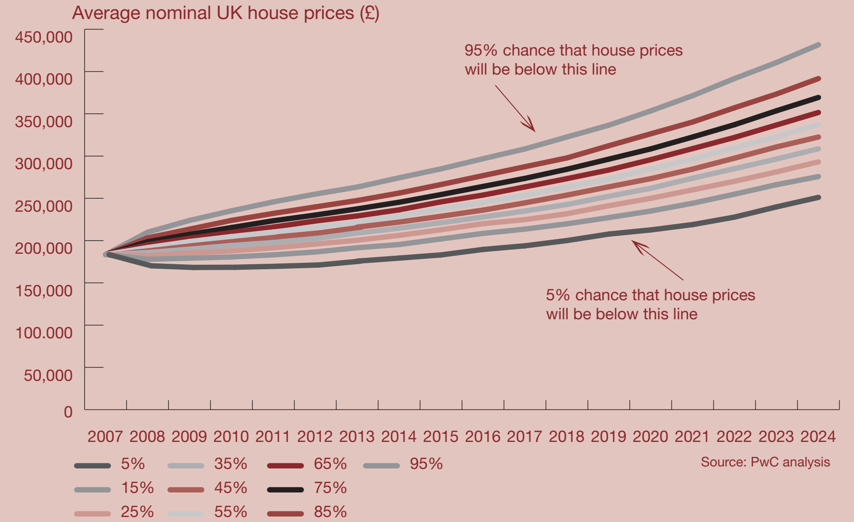


Figure 4.5 – Distribution of projected cumulative nominal house price growth from 2007 to 2010 and from 2007 to 2020

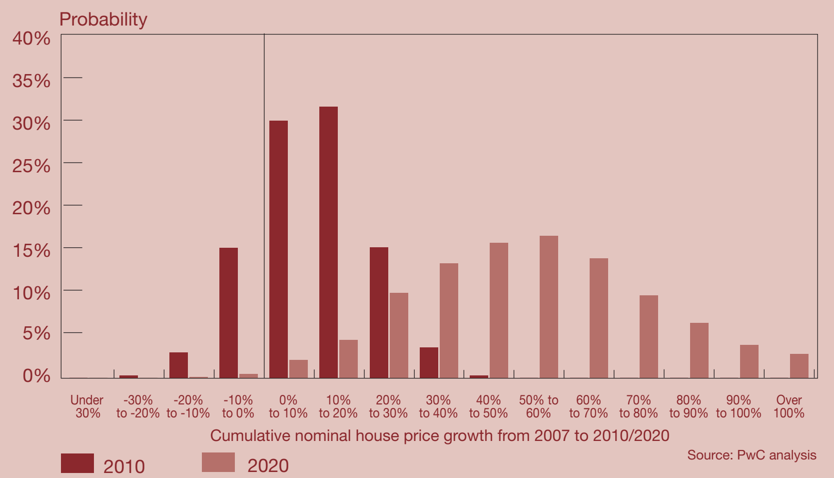


Figure 4.6 – Distribution of projected cumulative real house price growth from 2007 to 2010 and from 2007 to 2020

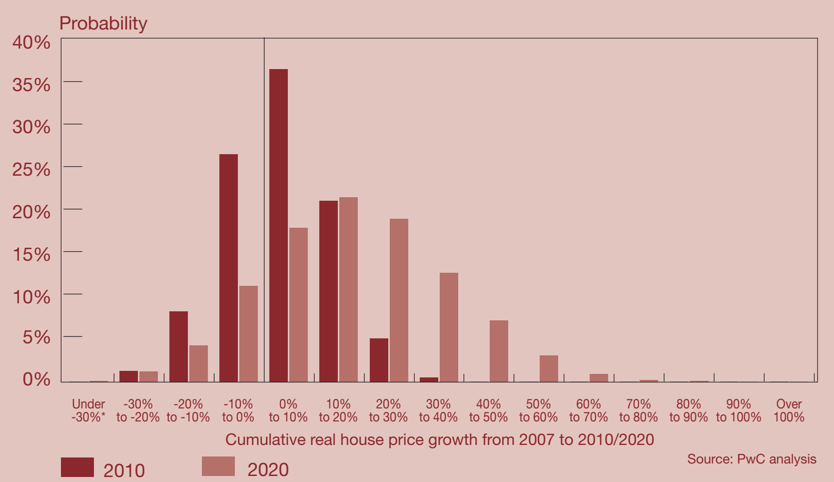


Figure 4.6 shows the same results for real house prices, after adjusting for general consumer price inflation. This shows around a 1 in 3 chance of a real house price fall between 2007 and 2010, but the odds of this lengthen to around 1 in 6 for the period to 2020.

IV.4 Summary of key results

As set out in the introduction, housing is the most important single asset of most UK households, and therefore has a potentially crucial effect on the performance of consumer spending and the wider economy.

Table 4.3 – Summary of house price modelling results

	Approximate probability of a fall in house prices	
	Between 2007 and 2010	Between 2007 and 2020
Nominal terms	1 in 5	< 1%
Real terms	1 in 3	1 in 6

Source: PwC analysis

In this article we have developed probabilistic house price projections that allow estimates to be made of the chances of future house price changes falling into particular ranges for periods up to 2020. The key results are summarised in Table 4.3.

The table shows that there is a 1 in 5 chance of house prices being lower in nominal (i.e. cash) terms in 2010 than in 2007, but a significantly higher probability (around 1 in 3) of house prices being lower in real terms in 2010 than in 2007.

Looking further ahead, there is only a very small chance of house prices being lower in 2020 than in 2007 in nominal terms, but a somewhat higher probability (around 1 in 6) of real house prices being lower in 2020 than in 2007. The most likely outcome, however, is that house prices will continue to rise significantly faster than general price inflation, although probably not as rapidly as in recent years.