Communities and Local Government

Recent Developments in the Communities and Local Government Affordability Model

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Chapter 1: Introduction

In December 2005, the first report on the Communities and Local Government Affordability Model was published (ODPM 2005). The model was developed in response to the recommendations of the Barker Review of Housing Supply (Barker 2004), notably its call for the establishment of affordability targets for housing at both national and regional levels. As the introduction to the first report explained, the model was developed to provide an appropriate methodology whereby affordability targets could be translated into regional housing targets in a manner that was consistent across the regions. The econometric model, therefore, provided an integrated structure for the Government Office Regions (GORs), determining prospective future movements in house prices, earnings, migration patterns, household formation and employment. The interaction between all these factors provided estimates of housing affordability, measured primarily by the ratio of house prices to earnings, both at the lowest quartile, although the model also measures affordability in terms of other indicators, including mortgage repayment to income ratios and the housing user cost of capital. Furthermore, by examining alternative future house building scenarios, the model was capable of examining the impact on affordability of higher levels of construction than were planned under Regional Planning Guidance at that time. A range of possible scenarios was presented in the first report.

The model was well received by its external peer reviewers and has been heavily used within Communities and Local Government for policy analysis, for example in order to examine the implications of revised Regional Spatial Strategies and the Government's commitment to raising the rate of net housing additions to 240,000 units per annum by 2016, signalled in the 2007 green paper, *Homes for the Future: More Affordable, More Sustainable* (Cm 7191). Of course, the model is only one input into the policy-making process and acts as an aid to rather than a replacement for policy. But models never remain constant and develop in response to new policy concerns and intellectual ideas. Furthermore, a range of different concerns was expressed in response to the first report, requiring further research and clarification. This second report is the response to all these issues. Perhaps, inevitably, the model structure has become more complex as a result. This new version of the model, described here, was the basis of the model used for the projections produced by the new National Housing and Planning Advice Unit (NHPAU, 2007),[1] which suggested that affordability would deteriorate, under the plans set out under the Regional Spatial Strategies, up to 2026, a conclusion which has received widespread coverage.

The first set of developments concern the modelling of tenure. In England, the proportion of owner-occupiers has changed little since 2000 and has remained static at about 70 per cent of households. In itself, this is not necessarily cause for concern, since there has been a resurgence in the

1 Also established as one of the recommendations of the Barker Review.

private rental sector since the middle of the nineties and, arguably, a healthy, good quality, rental stock is more suitable to the lifestyles of young, mobile households. However, the failure of households to achieve home ownership has implications for the distribution of wealth and the desire to increase home-ownership rates at a time of rising house prices is understandable. But if ownership has not increased in recent years, then we need to understand the reasons. Is expansion being undermined by poor affordability, credit market conditions or supply shortages, for example. A model of tenure choice has, therefore, been added, based on micro data, distinguishing between ownership and renting in the public and private sectors. This report presents the results of this research.

The second strand of developments discussed in this report arises from comments on the first report. In the earlier study, some of the scenarios run on the model involved large increases in construction. These implied that the growth in housing units might be in excess of the expected number of households.[2] Although such increases were found to have significant effects on affordability, the question arises who would live in the extra homes? Analytically, this turns out to be a difficult, although interesting question, given that, traditionally, planning for housing has been based on matching numbers of units to the number of households. The question is addressed here and it is argued that the addition of affordability targets, on top of traditional goals, fundamentally affects the nature of planning for housing. It raises issues of housing vacancies, demolitions, second homes and the quality of the housing stock. More broadly, the model needs to consider how long-run equilibrium occurs in a housing system.

It is important to stress what this report does not attempt to do. It does not set out the full set of equations in the model, for example house prices, migration and the labour market. Full information on the model's equations and their inter-linkages were set out in the technical appendix accompanying the first report (www.communities.gov.uk/publications/housing/affordabilitytargetsimplications). Here, the report concentrates only on the *extensions* to the model since the first phase, although full details of the equations for these extensions are given.

Chapter 2 provides an overview of the key features of the model. Chapter 3 concentrates on modelling tenure and chapter 4 on issues of long-run equilibrium. Each of the chapters considers both the theory and empirical results. Chapter 5 turns to policy and considers a selection of model simulations, designed to illustrate features of the new model that distinguish it from the previous version and, indeed, from the wider housing literature. Chapter 6 draws conclusions.

2 In fact, the official 2004 based household projections were subsequently revised upwards.

Chapter 2: A brief overview of the model

The key features of the affordability model are shown in the flow chart, figure 1. For the purposes of this overview, it is convenient to treat earnings and the labour market as independent of the rest of the model. These elements have not changed since the earlier version of the model and, consequently, are not discussed here. A fuller flow chart can be found in the first report. However, all flow charts are simplifications and much of the richness of the model cannot readily be portrayed by this means. For example, the model is dynamic and complete adjustment to change does not take place within a single time period. But dynamics cannot easily be represented within a simple flow chart.

In the figure, most (but not all) of the econometric relationships to be modelled are set out on the left-hand side – these cover inter-regional migration, the probability that any individual will form a separate household, tenure choice and the demand for housing. The central column defines the main aggregate outcomes – the total number of households, the allocation of total households across the tenures, house prices, rents and affordability. Vacancies/demolitions/second homes are aggregate outcomes, but are formally modelled. These are discussed in detail in chapter 4. Importantly, all the variables on the left-hand side could be affected by changes in housing costs and, therefore, there is a link back to these variables from the aggregate level of affordability (dotted line), where affordability is determined by market clearing processes. Furthermore, if the future trend in affordability changes relative to the past, all the variables in the model are affected. Note that, here, we are treating affordability as a generic term, rather than as one particular official indicator. The feedbacks to the rest of the model are determined by average house prices, incomes and interest rates, for example.

The box at the top of the figure defines sets of variables that are determined outside the structure of the model. These include the population at the end of the previous year (t-1), births, deaths, and international migration. Some of these variables may also be affected by housing costs, but we judge the likely responses to be fairly low and the central ideas can be illustrated without the addition.[3] As noted above, the box at the bottom of the diagram (average earnings) is treated in a similar manner for the purposes of this chapter. Earnings are the denominator in the government's chosen definition of affordability.

The bottom left-hand corner gives the supply of private housing. Although it might be expected that the variable would be responsive to changes in house prices, across the English regions, Meen (2005) indicates that the price elasticity of *new housing* supply has fallen to close to zero since the nineties.

3 In fact, work is currently underway to endogenise international migration in the model.

In the model, the supply of housing is treated as a policy instrument. In the Barker Review context, if affordability worsens beyond a given target, further construction is brought on to the market. Note that "new housing" is stated in italics above. This emphasises the fact that the housing stock can be increased not only by new building, but also by conversions and renovations of the existing stock.

The equations in the left-hand column employ a combination of micro and aggregate data. The probabilities of household formation and tenure choice are estimated on individual data from the British Household Panel Survey (BHPS), whereas the inter-regional migration and owner-occupier housing demand equations[4] use regional time-series information. In each of the central equations housing costs are an important determinant, but not the only influence. Therefore, table 1 sets out the main[5] influences for each. The relationships for tenure are discussed further in chapter 3. However, it is helpful to discuss the demand for housing here since it highlights a common fallacy that is critical in the context of affordability targets.

Table 1: The Key Equations: Summary of the Main Influences

	Influences
House Prices	Number of households, the stock of dwellings, real earnings, interest rates.
Probability of Household Formation	Marital status, age, gender, children, real housing costs, real incomes, previous household status.
Tenure	Tenure costs, real incomes, credit conditions, previous tenure, marital status, age, children, gender.
Inter-regional Migration	Relative house prices, housing availability, relative earnings, unemployment.

First, an important distinction needs to be made between the number of housing units demanded and supplied and the level of housing services that arises from those units. In much of the time-series literature on house price models a simplifying assumption is made that the supply of housing services is a fixed proportion of the stock of housing units, although, in fact, the expectation is that bigger houses include higher levels of services. The assumption is necessary because no time-series information is published on the supply of services directly. Therefore, in formal house price models, the stock of housing units is employed as a factor affecting prices, rather than the more appropriate concept – the supply of housing services. In many contexts, the simplifying assumption generates only second order problems, but, in the context of the affordability model, the distinction is important. In most instances, we would prefer to model the demand and supply of

4 Strictly, regional house price equations are estimated from which the demand functions can be inferred.
5 In fact, some of the equations include further influences, for example, the house price equations (see Meen *et al* (2005) for full equation details). But those appearing in the table are the key factors for determining the model's properties.

housing services, but with one important exception discussed in chapter 4, we are forced to rely on data for the number of units.

To see why the distinction is important, the traditional planning approach attempts to relate housing construction (or more precisely net additions to the housing stock), measured in units, to the expected future number of households. But it is *not* the case that this will necessarily stabilise affordability. The fallacy lies in treating all units as identical, whereas, as noted above, different houses, in fact, contain different levels of housing services. Consider the following housing services demand equation (1), which is representative of the literature.

$$\ln(H^d) = a_0 + a_1 \ln(Y) - a_2 \ln(PH) + a_3 \ln(HH) - a_4 \ln(r) + \varepsilon_1 \quad (1)$$

where:
H^d = Aggregate demand for owner-occupier housing services
Y = Real average earnings
PH = Real house prices
HH = Total number of households
r = Mortgage interest rate
ε_1 = error term
ln = natural logarithm
a_i = set of coefficients (elasticities)

For a fixed (short run) supply of services, market equilibrium implies the house price equation.

$$\ln(PH) = (a_0 / a_2) + (a_1 / a_2)\ln(Y) + (a_3 / a_2)\ln(HH) - (a_4 / a_2)\ln(r) - (1/a_2)\ln(H^s) + \varepsilon_2 \quad (2)$$

where
H^s = Supply of housing services (assumed in the model's house price equations to be proportional to the stock of units).

If $a_3 = 1$ (i.e. the demand for housing services rises proportionately to the number of households), then equation (2) can be simplified to (3).

$$\ln(PH) = (a_0 / a_2) + (a_1 / a_2)\ln(Y) - (a_4 / a_2)\ln(r) - (1/a_2)\ln(H^S / HH) + \varepsilon_2 \quad (3)$$

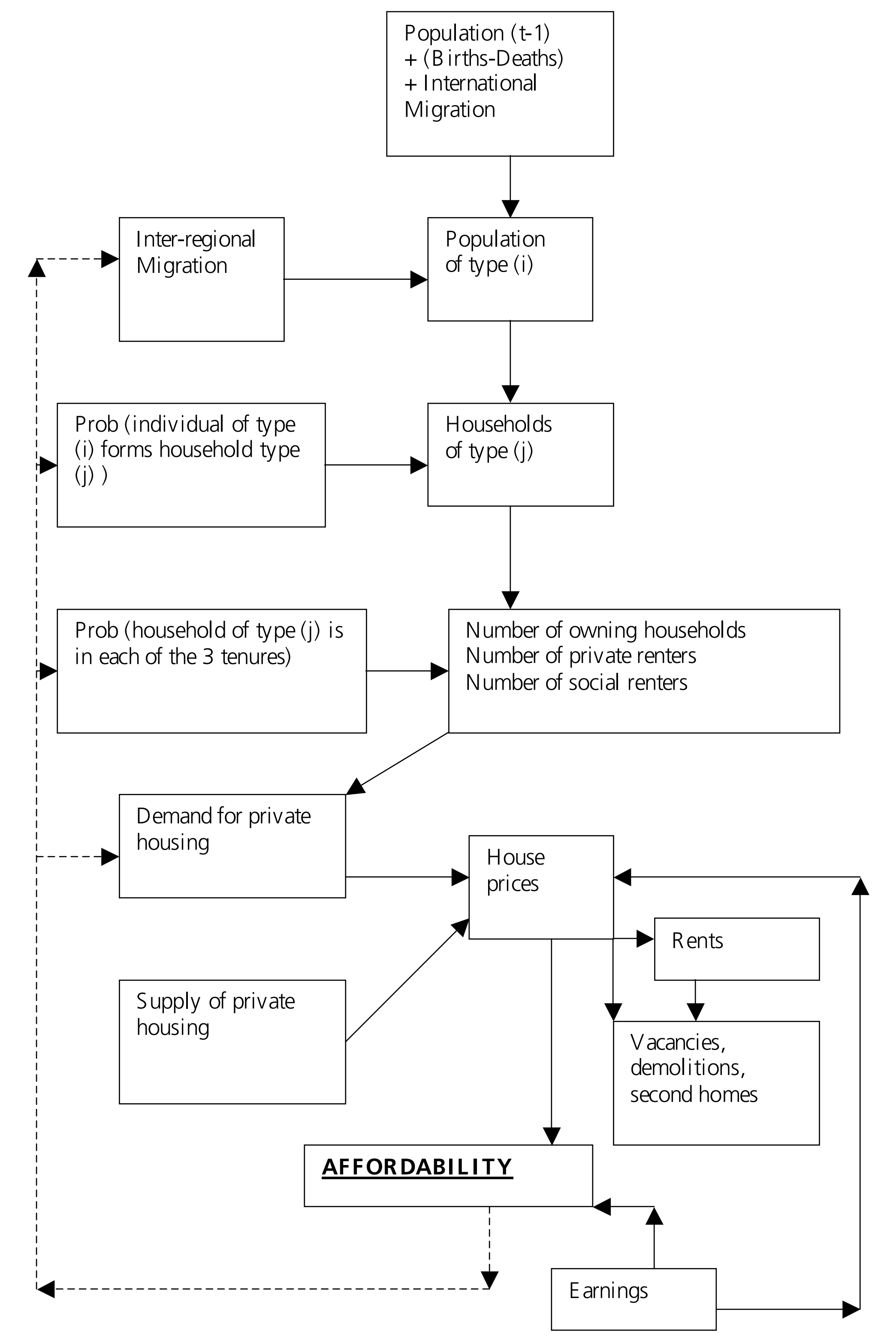
In (3), a proportionate rise in both the housing stock and the number of households leaves real house prices unchanged. But, then, affordability, ln(PH/Y), is constant only if (a_1/a_2) = 1, for given values of the other variables. If (a_1/a_2) > 1, then affordability worsens over time (assuming growing incomes), even if H^S=HH. However, (a_1/a_2) > 1 implies that the income elasticity of housing demand is higher than the price elasticity and, in fact, most time-series studies find this to be the case (e.g. Muellbauer and Murphy 1997). In the affordability model, the income elasticity of demand is approximately one and the price elasticity –0.5, so (a_1/a_2) = 2. Therefore, affordability worsens over time unless supply rises faster than the number of households or some other market stabiliser operates, for example, changes in interest rates. But, of course, house prices are only one of the factors taken into account by the Bank of England in setting interest rates. This is the main reason why the NHPAU concluded that affordability would worsen over the future on RPG construction plans.

In terms of the underlying economics, the equation implies that, as incomes rise, *existing households* demand a higher quantity of housing services than they currently hold. This might imply second homes or bigger houses in better neighbourhoods, for example. It may also involve a tenure change.[6] The model, therefore, introduces a form of filtering of the housing stock, where higher income households move to higher quality homes and the homes they vacate filter down to those further down the income distribution. But notice that the filtering process has little meaning if all dwellings are treated as identical units, rather than varying by size or the quantity of services embodied within each unit. This distinction becomes particularly important in chapter 4 when vacancies and demolitions are discussed, although data deficiencies sometimes mean that slightly uneasy compromises have to be made. In particular, vacancies and demolitions can only be measured in terms of units. But, at this point in the report, the main message is that matching dwelling growth to the expected number of households does not ensure stabilisation of affordability.

A final point is that equation (3) determines house prices in the model. But to determine the distribution of households between tenures, assumptions are needed concerning relative housing costs in each. Because of past constraints on private rents and the administered nature of social rents, relationships from historical data cannot be estimated. But in a market system, it is more relevant to assume a direct relationship between the three tenure prices. In a long-term setting, failure to do so will imply that all households will choose the cheapest sector, for a property of a given quality, in the absence of other constraints (e.g. supply shortages).

6 It could also involve households buying additional homes through Buy-to-Let mortgages.

Figure 1: Flow Chart of the Model



Chapter 3: Modelling tenure

3.1 Macroeconomic trends

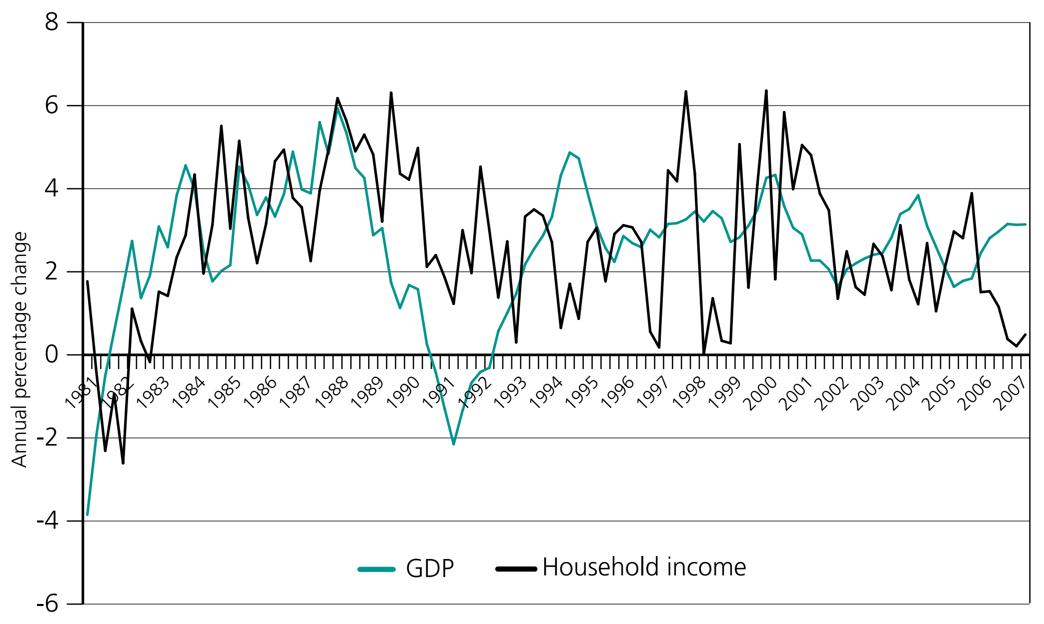
Housing market outcomes depend strongly on underlying macroeconomic conditions. Therefore the first section in this chapter briefly reviews recent changes in some of the main macroeconomic variables. The section also includes an examination of tenure trends over the last two decades, concentrating on two major changes – the rise in the age of first-time purchase and the increasing importance of the private rental market. From this the structure of the model is developed (section 3.2) and empirical results are presented (section 3.3). Key properties and policy implications are drawn out in section 3.4.

As a generalisation, changes in house prices and affordability reflect movements in key macroeconomic indicators, but with a higher degree of volatility. Since 1996, for example, consistent income growth, low interest rates and weak housing supply have all been contributors to the growth in house prices. But there is still considerable disagreement over the extent to which prices can be explained by fundamentals as opposed to speculative bubbles, (Meen 2007). Figure 2 graphs movements in real incomes (and GDP for comparison). The graph shows that, on an annual basis, real household incomes have not fallen since 1982 and survived the recession of the early nineties better than GDP as a whole. Furthermore, although real incomes have not grown at the same rate in recent years as in the previous housing boom of the late eighties, growth has been steady (and arguably more sustainable) around the long-run growth rate of the economy.

Figure 3 graphs the most commonly quoted indicator of housing affordability – the house price to income ratio. Prices are measured here as averages, rather than lower quartiles. The denominator is household disposable income, although using average earnings instead has little effect on the movements in the ratio over time. On this indicator, housing affordability is worse than in the boom of the late eighties. However, considerable caution is needed. The price/income ratio is only one indicator of affordability and the equations in the affordability model (summarised in equation 3) imply that there are a wide range of other factors that affect prices and affordability, in addition to income, notably interest rates, housing supply and demographics. Changes in any of these factors will alter the long-run ratio of house prices to incomes. Most obviously nominal interest rates are now much lower. Since these are capitalised into house prices, the simple house price to income ratios would be expected to be higher than in earlier cycles. As an illustration, figure 4 shows mortgage repayments as a percentage of income for first-time buyers. Although the indicator does not capture the distribution of repayments, it makes the point that repayment ratios are still below those in the late eighties and early nineties on average. On this indicator at least, repayments may not have been the prime constraint affecting first-time buyers in recent years. Nevertheless, the second line of the graph illustrates the increasing deposit requirement, which, we show below, is an important constraint on ownership in the model.

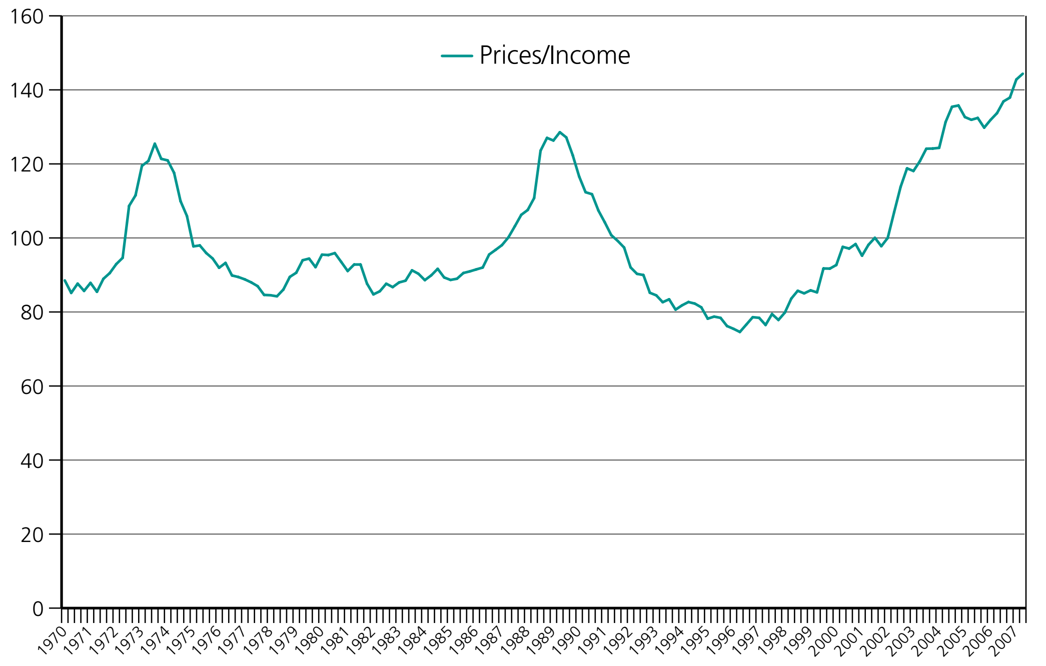
Finally, the fall in the share of mortgages going to first-time buyers in recent years has received considerable comment and a key indicator is shown in figure 5. During the eighties and nineties, the share averaged approximately 50 per cent, but fell to a minimum of around 30 per cent in the early years of this decade. The share has yet to return to the longer-run average.

Figure 2: Household Income and GDP (Annual percentage changes)



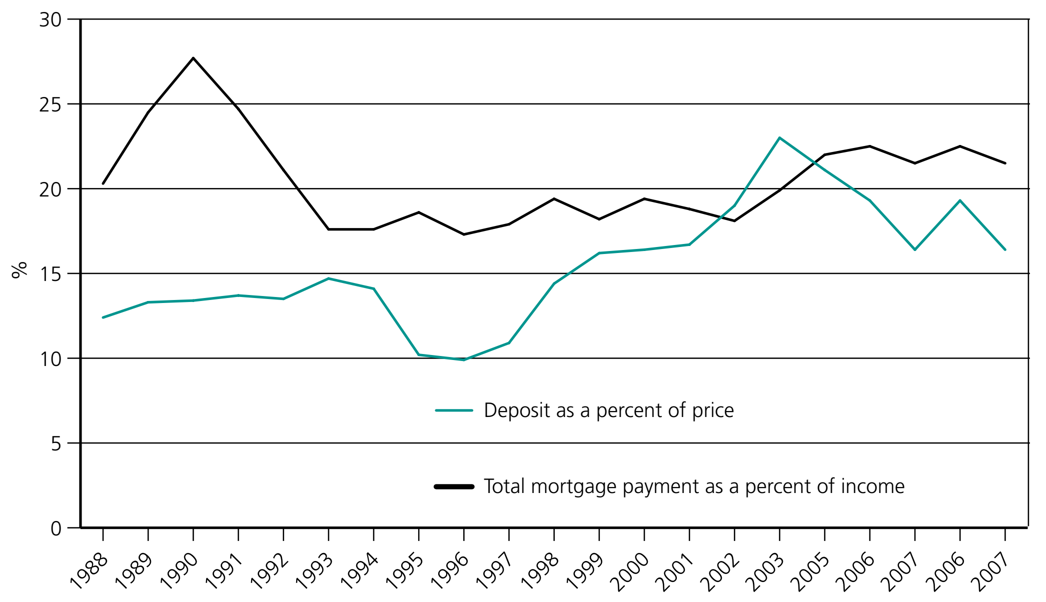
Source: ONS data base, series ABMI and NRJR

Figure 3: National House Price to Income Ratios (2002 Q1=100)



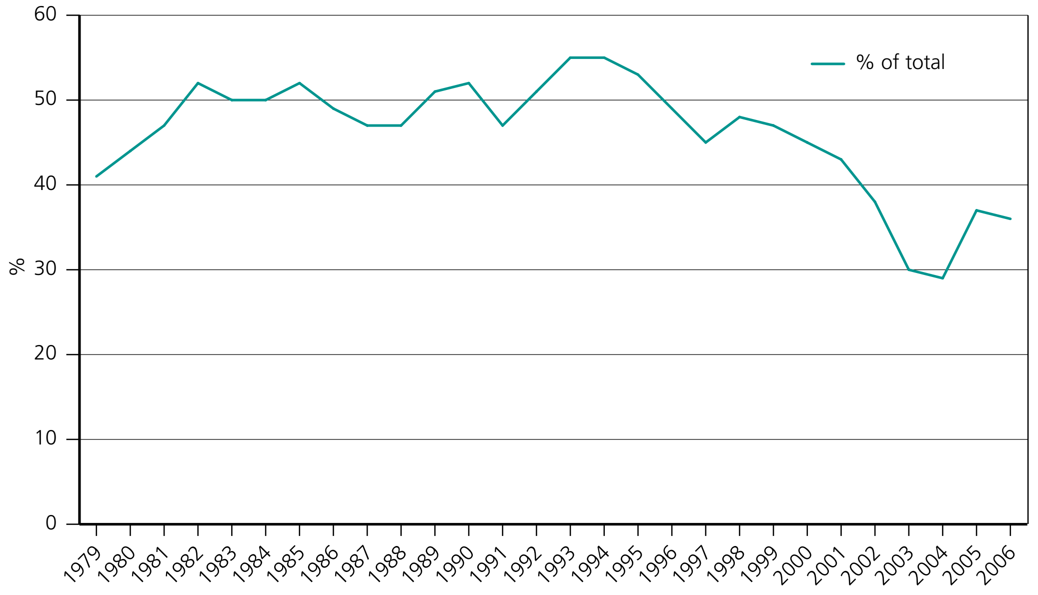
Source: ONS data base, series RPQ and CLG Live Table 594

Figure 4: Mortgage Repayments and Deposits (%)



Source: CLG Live Table 539

Figure 5: Loans to First-Time Buyers (%)



Source: Council of Mortgage Lenders Table ML.2

National trends may disguise regional variations. The central affordability target in the model is the ratio of lower quartile house prices to earnings, where the latter is measured by data taken from the Annual Survey of Hours and Earnings (ASHE) and its predecessor the New Earnings Survey (NES). Values in table 2 approximate the ratios in April of each year in order to match the survey month for ASHE.

The table indicates that the country can be divided into three blocs – the South, Midlands and the North; within each bloc the affordability ratios are similar, but between the blocs, there are major differences. This reflects the fact that, *within* the blocs, house prices have risen at very similar rates over time in both the short run and long run. Furthermore, comparing the blocs, differences in house price growth exist in the short run, but the differences tend towards equalisation over the longer term. This is a manifestation of the ripple effect, where, over successive cycles since the early seventies house prices have risen first in the southern regions with the northern regions catching up at a later date. An alternative way of presenting these relative regional movements is to consider the contemporaneous correlation in annual house price growth. These are shown in table 3, which again illustrates a very strong correlation in growth rates amongst near neighbours. Note that the "South" aggregates the South East and East regions and the "North" aggregates the North West and North East GORs, in order to minimise the problems associated with the switch from Standard Statistical Regions to Government Office Regions bases.

At first sight, table 2 indicates that affordability has worsened noticeably since the late nineties. But the values are the regional reflections of the national trends in figure 3 and take no account of lower levels of interest rates. Nevertheless, on whatever measure, table 2 illustrates differing regional conditions. Consequently affordability and deposit requirement problems are likely to be greater in the South. This is reflected in the results from the model.

Table 2: Lower Quartile House Price to Earnings Ratios (workplace basis)

Region	**1997**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
London	3.99	5.58	6.30	7.31	7.73	8.25	8.50	8.64	9.14
South East	4.32	5.36	5.83	6.90	7.48	8.09	8.62	8.58	8.89
East	3.75	4.43	5.02	5.96	6.68	7.57	8.01	8.03	8.56
South West	4.07	4.81	5.44	6.37	7.11	8.17	8.55	8.47	8.96
East Midlands	3.28	3.52	3.72	4.34	4.88	6.07	6.46	6.69	7.03
West Midlands	3.47	3.62	3.88	4.42	4.98	5.95	6.47	6.78	6.88
Yorks. & Humber	3.15	3.08	3.07	3.25	3.48	4.79	5.32	5.80	6.26
North West	2.99	2.90	2.95	3.10	3.28	4.42	5.00	5.61	5.94
North East	2.86	2.78	2.78	2.85	3.09	4.14	4.75	5.30	5.51
England	3.65	3.98	4.22	4.72	5.23	6.27	6.82	7.12	7.25

Source: CLG Live Table 576

Table 3: Contemporaneous Correlations in the Annual Growth Rates of Regional House Prices (1970-2006)

	London	South	SW	EM	WM	North	YH
London	1	0.932	0.880	0.676	0.707	0.525	0.484
South	0.932	1	0.978	0.854	0.865	0.646	0.640
SW	0.880	0.978	1	0.914	0.927	0.730	0.732
EW	0.676	0.854	0.914	1	0.962	0.873	0.897
WM	0.707	0.865	0.927	0.962	1	0.863	0.881
North	0.525	0.646	0.730	0.873	0.863	1	0.960
YH	0.484	0.640	0.732	0.897	0.881	0.960	1

In addition to the strength of house prices, perhaps the two most important changes over the last ten years were the rise of the age of entry into home ownership and the increasing share of private renting (particularly the elements commonly known as the Buy-to-Let market) in some regions. In fact, the two events were not independent since the improvement in the latter led to an acceptable substitute in terms of housing quality for many, primarily younger, households. Table 4 summarises the tenure trends since the mid eighties, disaggregated by the age of the household head. Here "young" households are defined as those where the age of the head is under 30.

Young adult homeownership rates rose in the second half of the eighties and fell in the nineties and in the current decade, with large falls in both groups identified in the table. The reductions in their homeownership rates coincided with increases in private renting, with the proportions in social renting remaining largely unchanged. Thus, the figures imply a switch away from owner occupation to private renting at an early stage of a person's life-cycle.

There are a number of further points to note. First, there is a correlation between ownership rates and the economic cycle. This is most evident in the second half of the eighties, where the ownership rate amongst all three age groups rose sharply. Expectations of capital gains were high and real income was rising strongly. But the percentage of owners (particularly amongst the 20-24 group) had fallen back again by 1993/94 i.e. before the Buy-to-Let market began to take off. Therefore, the initial decline in young home owners cannot be ascribed to the development of this new sector, but occurred because of underlying market conditions.

Table 4: Trends in Housing Tenure Among Young Adults

Year	Owner occupied	Social rented	Private rented
Aged 20 to 24			**percentages**
1984	35	33	33
1988	41	28	30
1991	38	27	35
1993/4	34	31	35
1996/7	28	28	44
1997/8	26	29	44
1998/9	25	32	43
1999/00	27	28	45
2000/1	26	30	44
2001/2	25	30	44
2002/3	28	30	42
2003/4	25	29	46
2004/5	19	28	53
2005/6	20	28	52

Year	Owner occupied	Social rented	Private rented
Aged 25 to 29			**percentages**
1984	60	24	16
1988	64	23	13
1991	63	21	16
1993/4	59	21	19
1996/7	54	23	23
1997/8	55	22	23
1998/9	52	23	24
1999/00	54	20	26
2000/1	54	21	26
2001/2	50	21	28
2002/3	51	21	28
2003/4	50	20	30
2004/5	49	18	33
2005/6	46	19	34

Source: CLG Survey of English Housing

Second, although not evident from the table, Andrew and Meen (2003) argue that part of the reason for the decline in ownership amongst young households in the first part of the nineties was a change in the income distribution. In particular, the incomes of older households were growing at a faster rate than young households. The inequalities of the early nineties have not currently been fully unwound, although there has been some improvement in the position of young households. But again, this factor implies that there were market tendencies that encouraged a move to private renting, irrespective of the subsequent developments in the private rental market.

Third, the reduction in owners in the 20-24 age group occurred at a similar time to the increased deposit requirement for first-time buyers, shown in figure 4, and the reduction in the percentage of loans to first-time buyers in figure 5. Therefore, the financial constraints, particularly in terms of deposits, provide a *prima facie* case for including such constraints in the Affordability Model.

Table 4 shows that, although the decline in young ownership was not initially contemporaneous with the introduction of Buy-to-Let loans, the proportion of young households in private renting subsequently expanded substantially. Nevertheless, the impact on the size of the private rented sector should not be overstated. Despite the rapid rise in Buy-to-Let loans since the mid-nineties, the improvement in the size of the private rental market can be overstated. In 1991 in England, 9.8 per cent of the dwelling stock was private rentals (including dwellings tied to employment). This had risen to 11.9 per cent in 2006. In London the increase is more noticeable, from 13.3 per cent to 18.7 per cent.[7] In the South East the respective figures are 10.6 per cent and 12.2 per cent. Therefore, despite the publicity surrounding the growth of the sector, the effects are modest in terms of the stock and seen against the historic long-term decline of the sector. Furthermore, the effects are localised, concentrated on London, although it should be noticed that even in the North East, where private renting is relatively small scale, the share rose from 7.2 per cent in 1991 to 9.3 per cent in 2006. Given the younger age distribution of the population in London, it is unsurprising that the strongest rise should be in this region.

3.2 Model structure

3.2.1 Evidence from the literature

The US and Australian literatures, where most previous empirical work has been conducted, typically model the binary choice between ownership and private renting. This may be justified on the grounds that social housing is generally a smaller proportion of the total housing stock than in England, although in some Australian states and US metropolitan areas public housing is an important part of the total. Binary choices are relatively straightforward in modelling terms. But, in England, there are additional technical issues associated with modelling multiple choices since social housing has to be explicitly included. Furthermore, UK housing is not a purely market-driven system and issues of tenure accessibility, supply shortages and rationing, taxes and subsidies all, in principle, need to be taken into account. Therefore not only is it necessary to model three tenures, but also to take account of choices constrained by the institutional framework.

As shown in the last section, the proportion of young households entering ownership has fallen significantly since the early nineties. Although there are a number of potential explanations, such as changes in relative tenure costs, expectations of capital losses and changes in the income distribution, the inability to raise a sufficient deposit is likely to be part of the story, despite increasing reliance on families by some first-time buyers. But this gives rise to a second set of modelling problems – how to incorporate different forms of credit market constraints into the model.

These issues – multiple tenure choices, the incorporation of credit restrictions and, more generally, the complexities of the system – are the novel features to be incorporated into the model.

Until recently, the tenures were fairly distinct. Because of the shortage of good-quality accommodation in the private rental sector, most households who could afford to do so went quickly into the owner-occupier sector after relatively short periods of time in the private rented sector. One of the

7 Note that this refers to the *dwelling stock*, not the *household stock*.

important changes introduced by the expansion in the investment market in recent years is that properties of similar quality to those available in owner-occupation have become available – properties in the two sectors have become more homogeneous. The availability of closer substitutes is expected to affect the responsiveness of tenure to relative prices.

One early strand of the US literature used time-series information to estimate the demand for owner-occupation (for example Rosen and Rosen 1980). Amongst the variables used as determinants was the relative price of owning to renting. Other variables included income and demographic factors. The early US time-series (and cross-sectional studies) typically found a significant impact from relative housing costs, but due to the segmentation of the market, no UK study found an effect (nor in most cases were they tested). The sophistication of studies has improved considerably since the early days, but it remains the case that relative prices, incomes and demographic factors are still key determinants of tenure demand.

A major boost to tenure studies in the US occurred in the late seventies and early eighties. The US, in line with the UK, provided tax breaks for owner-occupied housing. However, the literature pointed out that, particularly at times of high inflation (for example US inflation in 1981 was 10 per cent), the tax advantages caused distortions in the housing market. First, the benefits distorted tenure choices towards owner-occupation – Wood (2001), for example, found that in Australia almost all home owners would have had lower costs due to the tax advantages;[8] second, they raised the real price of housing; third, they distorted portfolio choices towards housing and away from financial assets, which some considered to be more productive (see for example, Ebrill and Possen 1982, Hendershott and Hu 1981, 1983, Summers 1981, Kau and Keenan 1983). Given similar tax advantages and inflation rates in the UK, the same conclusions were reached on UK data by Buckley and Ermisch (1982).

With the decline in inflation rates and the reduction in tax advantages to owner-occupation, less emphasis on these distortionary issues is now evident in the literature. Nevertheless, the literature provided a useful set of models set in a general equilibrium framework that can be used in a variety of other settings. General equilibrium models attempt to trace through the full set of results across markets of, for example, policy changes, rather than looking only at the effects directly on the market of interest. Swan (1984), sets out a fairly early model in which house prices and rents are determined within the structure of a model of tenure choice. One of the issues that arises in the affordability model is the relationship between rents and house prices in a general equilibrium setting.

The models examined so far typically assume that buyers do not face credit market constraints. Since mortgage market liberalisation occurred relatively early in the US, this may have been a reasonable approximation. But, at the time, this was not a reasonable characterisation of the UK market. Meen (1989) pointed out that the distortionary impact of taxation is not valid

8 Despite the fact that Australia does not offer mortgage interest tax relief.

where credit market restrictions occurred. Although households may want to increase their demand for owner-occupied housing to take advantages of the tax breaks, the demand does not become effective if credit restrictions existed.

However, mortgage markets in the UK began to be liberalised from the early eighties onwards. Although, at first sight, it might be expected that the credit rationing literature has become redundant, in fact, the opposite has been the case and there has been, in recent years, an increase in interest in the impact of credit markets on tenure choice. But there have been two major changes. First, the empirical work has been conducted using microeconomic data on individual households, rather than aggregate time series data. Second, the justification for the inclusion of credit market indicators arises from a new source – the economics of asymmetric information. The idea is that lenders, even when they do not face a shortage of funds, will typically require a deposit from most households (despite the availability of 100 per cent mortgages in some cases). The deposit – so that households have an equity stake – attempts to minimise the default risk faced by lenders. Notable US work in this area can be found in Haurin *et al* (1994, 1997). Andrew (2005) has conducted similar work on UK data.

In practice, there are a number of reasons why these constraints matter in the UK context. First, arguably, at a time of low interest rates, the main constraint faced by young potential home-owners is the deposit requirement, forcing them to remain longer in private renting. As shown above, it is certainly the case that the average age of entry into home-ownership has risen considerably since 1990 and this may well be one of the key factors. But this raises a further question. The increase in private renting could be temporary as young households build up their deposits. In a long run analysis, the constraints may be less binding. Furthermore, there is some evidence that young households are overcoming deposit constraints through parental subsidy. If so, credit constraints may be less of an issue. There is also evidence in Australia that parental subsidies are increasing. Between 1981 and 2001, the share of outright owners with heads under 35 increased from 9 per cent to 13 per cent, although the share of owners with a mortgage fell from 47 per cent to 37 per cent. The role of parental contributions in the UK can, however, be over-emphasised. Information is typically obtained from mortgage lenders, but, by definition, this includes only households who are able to achieve ownership status and, therefore, is a non-random sample. The proportion of all new households who receive subsidy is much lower and, as already noted, the percentage of young households who have become owners in recent years has fallen sharply.

Most modern work on tenure choice uses micro household data. One reason is that demand in each tenure varies over the life cycle. Life cycle models form the basis for modern work on tenure, although an early example can be found in Henderson and Ioannides (1983). Such models recognise that the demands for housing by young single-person households with no children will differ considerably from older couples with children, in terms of location, size and quality. But time-series models can rarely capture these demographic influences. Having said this, one of the few UK studies, Andrew and Meen (2003) finds that, although household formation is very sensitive to demographic variables, the choice of tenure is more responsive to economic influences – incomes and relative housing costs – with demographics playing a secondary role.[9] Nevertheless, the micro approach is more robust in tying down the influence of the demographic variables. The models that we set out below use the microeconomic approach and are consistent with the household formation equations developed for the earlier version of the model.

An additional strand of the literature looks at the effect of transactions costs on house purchase. With the exception of on-going work by Mark Andrew, this literature is US orientated, e.g. Harman and Potepan (1988), Haurin and Gill (2002). A key problem is the period over which transactions costs are discounted. For a household that is already credit constrained, transactions costs create an additional hurdle for entry into home ownership – the costs have to be paid up front. But, for unconstrained households, the costs can be spread over the expected length of residence in the dwelling. Therefore, if the household expects to live in the house for, say, seven years, it can spread the costs, by borrowing, over this period. Wood estimated in the mid-nineties for Australia that the contribution of transactions costs to the user cost of capital fell from 1.6 percentage points at a five year holding period to 0.8 percentage points over twenty-five years. Technically, however, the problem is that the expected length of residence is unknown and is endogenous. Accounting for transactions costs in this way is difficult, although Andrew and White (2006) make an attempt. Given that transactions costs appear to be relatively low by international standards in the UK (although compiling comparable data is difficult), these are not taken into account in the model, although it is recognised that this is a potential avenue for further research.

None of the above considers social housing. Movement *out of* social renting can take place by (i) exercising the Right to Buy *in situ* or (ii) moving to a different property in either owner-occupation or the private rental sector (a change in tenure choice). Movements *into* social housing in the framework to be explored more fully below arises from a failure to meet the conditions to enter ownership (low income, credit constraints), from insufficient income to afford the private investment market and from meeting the requirements for housing in the social sector. One approach is that the social sector becomes the "residual", given the high proportion of social sector households that receive benefit. However, this fails to take account of the supply shortages in the social sector. The "residual" approach implicitly assumes that social supply is perfectly elastic, which is unlikely to be the case except in some predominantly Northern low demand areas. In fact, even in low demand regions, the residual approach is unlikely to be adequate. In these areas, many households do have a choice between social housing and the private rented sector and so the relative price of the two sectors is an

9 It may be the case that this ranking is primarily relevant for younger households – the focus of most modelling work on tenure in the literature. However on-going work by Flatau et al (2006) finds that this is less true for middle-aged groups in Australia, because of marriage break up. The same is likely to be true in England.

additional variable to be taken into account. The responsiveness to relative prices would be expected to be higher in regions where shortages are least severe i.e. the elasticities are expected to be lower in the southern regions than in the northern regions.

In general terms, inclusion of a social sector is still consistent with a tenure "choice" or constrained optimisation approach, but the constraints on each choice are complex, depending on the nature of credit markets, the tax treatment of housing and the available benefits in each tenure. But the structure below allows the identification of flows in to and out of each tenure. In principle, tenure choice gives rise to a standard constrained optimisation problem, where demand is a function of incomes/wealth and relative prices. The main difference from the usual demand system is that the dependent variables are discrete and the estimated probabilities sum to unity, so that one tenure has to be a residual for the adding up condition to hold.

Finally, the model has to take into account Right to Buy sales. In fact, the model includes these sales at the aggregate level, rather than looking at the individual options to buy of households who are currently in the social sector, since there is *prima facie* evidence that these move in line with the housing cycle.

3.2.2 The model structure

Formally, as shown in the left hand column of figure 1, the probability that any household, with a given set of characteristics, will be in the three tenures in each time period needs to be modelled. Since the model distinguishes household types by gender, age of the head, marital status, whether children are present and by income, tenure probabilities for all these different groups need to be calculated. Having estimated the probabilities, these are then multiplied by the number of households in each group to obtain the distributions of households by tenure. Calculating the probabilities is clearly a key step in the process. The full set of equations can be found in appendix 1. The equations are estimated on micro data from the British Household Panel Survey.

The model adopts a two stage, hierarchical approach. In the first stage, the probability that each household is an owner or in the rented sector is calculated.[10] In the second stage, the probabilities of being a private or social renter are estimated, conditional on the household being a renter in the first stage. As noted above, these probabilities vary with demographic characteristics. But there are four classes of economic variables, which have a fundamental influence:

- income
- relative housing costs in the tenure
- credit restrictions
- housing supply constraints

10 An alternative approach would be to specify a top hierarchy in which households choose between market and social housing and the market choice is, then, split between owning and private renting.

All the main factors identified as being important in the literature review – both demographic and economic – are incorporated into the model. Unsurprisingly, higher income households have a greater probability of being owners. Furthermore, credit constraints are less likely to be binding since they will find it easier to accumulate the required deposit or meet mortgage repayments. Similarly, those on low incomes have a higher probability, not only of being renters, but also of being in the social sector. Examples are presented below.

Relative tenure prices are particularly important. Arguably, the improvements in private renting in the mid-nineties means that renting provides a closer substitute to ownership in terms of housing quality; therefore we would expect that tenure choices should become more sensitive to the relative costs. This turns out to be the case, although there are conceptual and practical difficulties in measuring the costs. Conceptually the definitions of private and social sector rents are relatively straightforward, but problems arise from the absence of historical runs of data. In practice, we can use rent data published by Communities and Local Government, varying by region or recorded rents in the BHPS. One of the problems is that rent is endogenous in the sense that low income households may pay a reduced or zero rent, because of housing benefits. Therefore, rents are individual specific. It is feasible to use BHPS rental data for those who are currently renters, but we also need the implicit rental for those who are currently owners, which is, of course, not observed. This is necessary in order to calculate relative tenure prices for owners. The model uses Communities and Local Government measures of regional average rents in the private and public sectors. This implies that owners would not be eligible for benefits were they to switch to renting. An alternative would have been to estimate, by regression, the expected rent that a current owner would face in the social and private sectors, given the household's characteristics, including income, from the BHPS data. Wood *et al* (2006) use a related approach for Australia in which they estimate a rent equation used to predict the rent that would be paid if owners rented. They then impute eligibility for public assistance to arrive at the net rent.

More difficult conceptually is the measurement of owner-occupier housing costs. The literature is clear that this should be the housing user cost of capital – the real per period unit cost of owner-occupier housing services.[11] A simple version is given as (4) to demonstrate the issues:

$$UCC = [(1-t)i - \dot{P}H^{e} + \delta + MN + CT + T]PH/P \quad (4)$$

where:

i = the nominal mortgage interest rate
t = tax advantages to owner-occupation
PH = nominal house prices
P = general price level
δ = depreciation rate
MN = maintenance expenditures (as % of property value)

11 This can also be used in the model as an additional indicator of affordability.

CT = property taxes (as % of property value)
T = transactions costs (as % of property value)
(e) superscript represents an expected value
(.) represents the rate of change of a variable

In previous work, we have found that capital gains – an element of the user cost – have had a less than proportionate effect in (4), which implies that nominal interest rates have an additional effect to real interest rates. To see this rewrite equation (4) as (4'):

$$UCC = [(1-t)i - \alpha \dot{P}H^{e} + \delta + MN + CT + T]PH/P \quad (4')$$

Now in (4), the capital gains term has an implicit weight of one (or $\alpha = 1$ in (4')). But our empirical work suggests that the coefficient is much less than one. Indeed, in recent years, we cannot reject a value of zero. On the one hand, at a value of zero, (4') implies that only nominal interest rates affect demand (consistent with front end loading), since the capital gains element drops out of the expression. On the other hand, at a value of unity, only real rates matter and, at intermediate values, both real and nominal rates matter. The model uses a data-determined coefficient value of zero, suggesting that front end loading issues have been the most important in recent years, but it has to be recognised that a case can be made for using (4) in a long-run model, despite what the data may say in the short term.

The definition also highlights two difficult modelling problems. First, the user cost includes transactions costs. As noted above, for those facing binding credit restrictions, the term is the cost of stamp duty, solicitors fees etc, but for those who are unconstrained, the costs are spread over time according to the expected length of residence. But, as noted above, transactions costs are ignored in the model at the current time.

But the more important issue concerns credit constraints. The existence of a credit market constraint, in effect, raises the user cost of capital. Therefore, the constraints modify the prices in the tenure. But the constraint has to be operationalised. US work, followed by Andrew (2005) for the UK concentrates on two potential constraints – an income multiple constraint, which reflects repayments for a given level of interest rates, and a wealth constraint, necessary for the raising of the initial deposit. None, one or both constraints may be binding. For example, at a time of low nominal interest rates, the importance of an income constraint may be limited, but as house prices rise, the ability to meet the deposit becomes more difficult, without relying on family and friends. Benito (2006) argues that the deposit constraint is important in explaining variations in the response of house price inflation to shocks in the UK. Wood *et al* (2006) also find that in Australia between 1996 and 2003, the deposit constraint was much more important than the income constraint. The empirical results from the model find that the constraints are only potentially binding for the under 40 age group. At least historically, the older age groups appear to have accumulated sufficient assets by that stage of their life cycles. However, it has to be recognised that this may not hold in the future and binding credit constraints could be a feature that extend further into housing careers.

In Andrew (2005), the model includes dummy variables for each individual according to whether each constraint is binding or not. Although there are no major data problems associated with the income multiple constraint, the deposit constraint requires information on wealth; direct information is available only in two waves of the BHPS and therefore has to be indirectly imputed since more waves are used in estimation.

One of the important features of such constraints is that they do not necessarily provide a permanent hurdle to home ownership; rather they delay entry until the household can accumulate sufficient resources, through saving, to meet the deposit requirement. The simulations in chapter 5 show the importance of the constraints in practice.

A further issue is the relationship between rents and ownership costs. Since this is a general equilibrium model, both have to be determined within the model. One solution to the problem can be found in Wood *et al* (2006). Their model defines both a reservation rent for landlords and a bid rent for potential tenants in Australia. The two are not necessarily equal because of different tax provisions facing landlords and tenants and also because the two groups may be at different points of the income distribution and therefore have different marginal income tax rates. Households decide between owning and renting according to whether their bid rent is greater than the reservation rent, although the decision is affected by deposit and repayment costs in the same manner as above. However, this approach requires detailed information on landlords – taken from a rental survey in Australia – which is not available for England.

Furthermore, our work suggests that tenure is sensitive to differences in relative tenure costs. Therefore, in models that are simulated over the long run (the model is projected to 2031), relative prices have to be tied together or, eventually, all households may be in the same tenure without some other equilibrating mechanism. Since, under these conditions, the credit constraints are likely to become more or less binding, they are likely to be a part of this mechanism. The model imposes a simple form of the arbitrage relationship, which is broadly consistent with the Wood *et al* approach without the details of the tax system. In equilibrium, this gives (5), using equation (4).

$$R_{pr} / PH = [(1-t)i - \dot{P}H^{e} + \delta + MN + CT + T] \quad (5)$$

Since nominal house prices (PH) are already determined in the model and for given values of the variables in [.], the private sector rent (R_{pr}) is determined. Public sector rents (R_{soc}) are administered rather than market determined, but a simple relationship is added in order to keep gross social sector rents in line with the private sector, (6). (γ) represents the fixed differential between real public and private rents. Again, failure to include an equation may distort tenure choices.

$$R_{soc} = R_{pr} - \gamma \quad (6)$$

Finally there is nothing in the above to reflect the possibility of supply shortages in the tenures. These issues become particularly important in chapter 4, but it is possible, for example, that demand for social housing will exceed supply for a given set of relative prices. If this occurs, the model assumes that the excess is housed in private renting.

3.3 Empirical results

The empirical results of the tenure choice models for the three age groups 20-39, 40-59, 60+ can be found in appendix 1. Each equation is estimated across the BHPS waves from 1991 to 2002, although the first wave is used to construct the lags. Formally, the presented results refer to a probit model with sample selection, where the income variable is instrumented for potential endogeneity. Fixed effects versions were also estimated to allow for possible omitted time constant household characteristics. The bottom halves of the tables set out the factors that determine the probability of *not* being an owner and the top halves model the probability of being in the *private* rental sector, conditional on not being an owner. Data are insufficient (with an important exception) to model separate equations for each region and, therefore, regional dummies are included. The choice of variables is a mixture of demographic and economic and is designed to fit in with the rest of the affordability model. The included variables are also similar to those in Andrew and Meen (2003). Note that inertia is an important part of behaviour. Therefore, one of the most important determinants of current tenure is last year's tenure. Households, typically, do not respond immediately to changes in economic or demographic factors.

3.3.1 Ownership demand

The same specification is employed for each of the three age groups. However the literature implies that coefficients for the under 40 age group are expected to be the most precisely defined. Beyond the age of 40 tenure patterns tend to be more fixed and it might be expected that choice would be less dependent on economic variables, although tenure change would still be affected by family break up, for example. As noted above, the equations for the two older age groups exclude the credit constraints, which were found to be insignificant in the 40-59 age group equation. However, this may well change in the future.

Appendix 1.1 indicates that all the key variables in the 20-39 age group equation are significant. At first sight, income appears to be insignificant. However income also enters through the income multiples term (one of the credit constraints), which is significant. Arguably, there is no need to include a separate income term once the credit restriction is added. Notice also that the under 40 equation does not include an age indicator. Given the increase in the average age of entry to ownership, this might, at first sight, be considered surprising. However, age is, in principle, again captured through the credit restrictions, since the ability to accumulate a deposit is positively related to age. Therefore, the assumption of the model is that the delayed entry is a function of economic influences, and is not related to age *per se*. Both marriage and cohabitation increase the probability of ownership, although those in the latter state have a lower probability than the former. Having children lowers the probability of ownership, conditional on the other variables. The high costs of having children are well known. This also reflects the fact that single parents with children receive higher priority in social housing. For the under 40s, male heads have a higher ownership probability.

The most controversial elements of the equation, however, are the coefficients on the housing user cost and rental terms. Although the coefficients are highly significant for all three age groups, in no case could the restriction that the coefficients are equal and opposite in sign be imposed. Since we expect the relative price to be the appropriate variable, this is disappointing. Furthermore, in a long-run model, this causes difficulty in simulation. Although not entirely satisfactory, the simulation model imposes the theoretical restriction, which is not accepted by the data, that the coefficients are equal, imposing the average of the two cost coefficients.[12]

A second feature of the cost terms concerns the definition of the user cost. In contrast to equation (4), the variables include no capital gains element. Inclusion of capital gains was heavily rejected by the data. In fact, this is consistent with the macroeconomic evidence. Meen and Andrew (1998) suggest that the implicit coefficient on capital gains in the user cost was 0.3 (rather than one) between 1969 and 1996. As noted above, this implies that nominal interest rates as well as real rates affect behaviour. More recent work (Meen 2007), extending the estimation period to 2005, finds that the capital gains coefficient has fallen even further. In other words, nominal rates have become even more important recently. This is consistent with the impact of front-end loading. There is a question, however, in a long-run model, whether a capital gains effect should be imposed in line with theory, despite the empirical evidence. We have chosen not to do so.

We might expect the coefficients to be less well defined in the post 40 age group equations. Indeed, in general, the coefficients are slightly less significant. However, there are surprises. First, the income coefficients are larger for the older age groups. But, as already argued, this is to be expected if the younger age groups face credit restrictions – the implicit coefficient is much larger than the coefficient on the household income coefficient alone. The older age groups have no credit restriction terms. More difficult to justify is the very large income coefficient for the over 60 group. The coefficient is four times greater than for the 40-59 group. Despite the fact that the term is highly significant, estimating adequate relationships for the older age group is difficult and the simulation model restricts the coefficient to be equal to –0.01, i.e. similar to that for the 40-59 group.[13] For the same reason, the

12 As a result, an adjustment also has to be made to the constant for scaling.

13 The restriction is only imposed for those who were not owners in the previous wave. Since those who were previous owners have a probability close to one, the income term has only a small effect and the restriction is unnecessary.

relative cost coefficients for the 60+ group appear high and have been restricted to values of 0.4. The effect of the restrictions is to reduce the sensitivity of the ownership probabilities to economic influences for the over 60s.

3.3.2 Renting demand

The choice between private and social renting is also related to demographic and economic variables. The specification attempts to capture the fact that entry to the social sector is partly administered, with potential entrants needing to meet certain criteria, but households also have some choice based on relative costs, particularly in regions that do not suffer excess demand. A relatively simple specification cannot hope to capture the full complexities of an administered system, but, nevertheless, the results appear to possess some of the expected features. For example, those with children and those on low incomes are more likely to be in the social sector. This is true across each of the three age groups. There is, again, a high degree of persistence between the two rented sectors. Those already in social housing do not quickly move out even if their incomes rise. The persistence is greater for the older age groups.

As expected, relative costs are only significant for the 20-39 age group. In fact, the equation allows differential effects between the four southern regions and the rest of the country. More precisely, since access to social housing is more constrained in the South, we expect the relative price coefficients to be smaller. To capture this, two relative price terms are included; the first *relrsrs* applies to all regions, whereas the effect for the southern regions is the sum of the coefficients on *relrsrs* and *SOUTHRELRSRS*, i.e. 0.563-0.446 = 0.117. Note also that in the renting equation, the restriction that the coefficients on private and social rents are equal can be accepted by the data.

3.4 Key properties and implications

Full simulations on the model are carried out in chapter 5. But here, some of the properties of the equations are illustrated, which are not immediately clear from the estimated equations alone. Two features are illustrated:

(i) the variations in ownership and renting probabilities between different types of households and income groups
(ii) the importance of the credit market variables

Neither of these can be read directly from the equations in Appendix 1. Tenure probabilities are distinguished by:

- gender of the household head
- age (five year age bands from the ages 16-39 plus 40-59 and 60+)
- whether the household has children
- marital status (single or married/cohabiting)

- household income quartile
- tenure in the previous year

Table 5 provides a small illustrative set of the ownership probabilities from the very large number calculated in the full affordability model. Table 6 provides similar information for the social renters. In other words, the estimates are the renting probabilities conditional on not being an owner in the current period.

Table 5: Ownership Probabilities for Previous Renters and Previous Owners (South East, 2003)

Female Head, Aged 30-34, Single, No Children		
	Previous Owner	**Previous Renter**
Income Quartile 2	0.936	0.023
Income Quartile 4	0.961	0.040
Male Head, Aged 35-39, Partner, With Children		
	Previous Owner	**Previous Renter**
Income Quartile 2	0.982	0.078
Income Quartile 4	0.991	0.120

Table 6: Social Renting Probabilities for Previous Social Renters and Non-Previous Social Renters (South East, 2003)

Female Head, Aged 30-34, Single, No Children		
	Previous Social Renter	**Not Previous Social Renter**
Income Quartile 1	0.899	0.167
Income Quartile 4	0.473	0.010
Male Head, Aged 35-39, Partner, With Children		
	Previous Social Renter	**Not Previous Social Renter**
Income Quartile 1	0.980	0.428
Income Quartile 4	0.763	0.064

Table 5 demonstrates the importance of previous tenure. For all chosen household types, the probability of home ownership in the current year for those who were owners last year is well over 90 per cent. Tenure transitions, typically, do not take place rapidly. For previous renters, the one year transitions to ownership are fairly low, although they do differ noticeably between household types and income quartiles. Of course, this does not mean that these households will never enter ownership; rather the transitions are low in any one year.

Similarly, table 6 shows the importance of income to the probability of being in social housing. The probabilities fall sharply in the higher income quartiles for all household types.

In order to provide a feel for the importance of the deposit constraint and how it varies across regions, it is possible to calculate the first year in which the constraint ceases to bind for different types of households (here, chosen to be a married male aged 30-34) at each quartile in the income distribution. Results are shown in table 7, although it should be borne in mind that the results are illustrative and depend on the baseline projections from which they are run. Higher house prices than in the base, for example, would delay entry into ownership further.

Table 7: Years in which the Deposit Constraint Ceases to Bind (Male, 30-34, partner and children)

Region	**Quartile 1**	**Quartile 2**	**Quartile 3**	**Quartile 4**
London	–	–	2025	2016
South East	–	–	2019	2012
East	–	–	2016	2011
South West	–	–	2017	2011
East Midlands	–	2018	2011	2008
West Midlands	–	2021	2011	2009
Yorkshire and Humberside	–	2014	2009	2007
North West	–	2014	2009	2007
North East	2017	2010	2007	2005

The table suggests that, except in the North East, the deposit constraint is binding in all years for the lowest quartile. In the southern regions, the year at which the constraint no longer binds is well into the future even for households in the third quartile. Importantly, note that the figures do not imply that the probability of ownership falls to zero in the presence of the constraint. Rather the probability falls and owners would have to buy a lower value property than they desire. As an illustration, in 2018, the estimated probability of ownership for a household in the South East with the characteristics in table 7 and with an income at the third quartile is 0.13. This jumps to 0.29 when the constraint no longer binds in 2019. Hence, as the literature indicates, housing consumption patterns are not smooth and households have to "jump" the hurdle.

Chapter 4: Long-run equilibrium

This chapter considers the manner in which housing markets adjust in response to increases in housing supply. Clearly, one of the most important mechanisms is through a change in house prices and, consequently, through an improvement in affordability. The first report concentrated on this aspect. But prices do not clear housing markets immediately; markets can remain in disequilibrium for considerable periods of time. In this case, forms of quantity adjustment (to be defined below) take place as well. Furthermore, it is arguable that, because of historical housing supply shortages, some quantity variables have been permanently below their long-run equilibrium values, notably vacancies and demolitions. Therefore, if higher levels of new construction occur in the future, then vacancies and demolitions become part of the long-run adjustment process in addition to prices. This chapter is concerned with the determination of the long-run equilibrium structure of the affordability model. As a part of this, the model has to move away from the traditional planning assumption that all housing units are treated equally. Instead the model needs to take account of the fact that different types of dwellings contain different quantities of services. This leads to a process of filtering of the housing stock and provides an approach to the question raised in the Introduction, *who will live in the extra homes?* It is, however, important to note that this question arose from the suggestion that there would be an excess of dwellings over expected household formation if housing construction was increased significantly in order to improve affordability. The model does not attempt to answer the more difficult, but interesting question of which types of households would occupy the new housing. To approach this issue would require a detailed analysis of housing sub-markets identified both spatially and by dwelling/household types. Regional models are not well-suited to answering such questions.

The nature of the required adjustment is also highlighted in the conventional relationship (7), which relates the number of households to the number of housing units. It is important to stress that the relationship here is determined in terms of *units* rather than housing services, which were the focus of attention in chapter 2. However, we demonstrate below that the distinction between services and units is important to the model in the determination of demolitions. (7) lies behind the conventional planning view that changes in net additions to the housing stock have to match the expected increase in the number of households (taken from official household projections). However, it was shown in chapter 2 that this rule is insufficient to ensure stability in housing affordability. Typically, affordability will worsen over time.

$$\Delta HH = \Delta HS - \Delta SEC - \Delta VAC + CONV - DEM + \Delta SHARE \quad (7)$$

HH = number of households
HS = number of new housing units
SEC = second homes
VAC = vacancies
CONV = net gains from conversions and changes in property use
DEM = demolitions
SHARE = sharing households – the number of dwellings shared (excess sharing households)

But more generally, in response to supply shocks, notably an increase in new housing supply (ΔHS), adjustment to a new equilibrium under (7) can take place through a combination of any of these quantity variables as well as through prices. Therefore, a well-defined model equilibrium should be based on the equilibrium to all these variables. In fact, the first report showed that only a proportion of the adjustment occurs through an increase in the number of new households (approximately a third). In other words, an increase in new housing construction is not usually matched by a corresponding increase in new households in any region.[14] Therefore, for equilibrium, second homes, vacancies, conversions, demolitions or sharing must adjust. It has been argued that, historically, vacancies and demolitions have not fulfilled this role. For example, demolitions have been low since the ending of the major slum clearance programmes that took place between the fifties and seventies (figure 6). Similarly, vacancies appear to have been low by international standards. However, there are two weaknesses in this argument. First, historical levels of demolitions and vacancies reflect past housing market shortages. Where house prices are high, the opportunity cost of holding homes empty is also high. Similarly the expected life of a dwelling rises, reducing demolitions. Under a system that improves affordability and reflects the market, both vacancies and demolitions would be expected to be higher than in the past. Second, although (7) must hold, it is insufficient since it is defined in terms of units rather than reflecting differences in the quantity of housing services within each unit. As we stressed in chapter 2, typically a four bedroom house contains more services than a two room flat, but (7) does not take that into account.

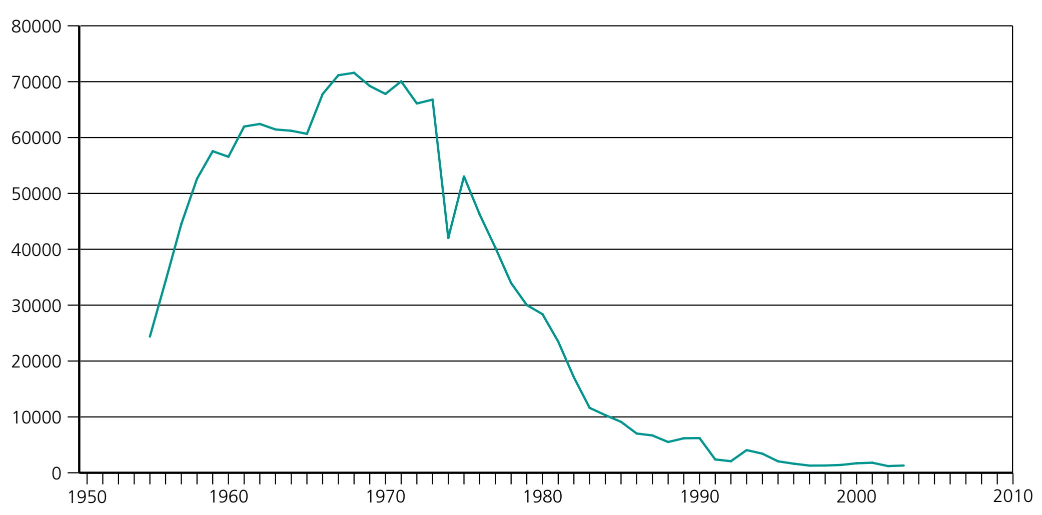
The modelling in this chapter is designed to ensure (7) holds, but also reflects housing quality. Therefore, the sections consider the variables in equation (7), although the determination of the number of households (*HH*) is not discussed since this is covered in earlier reports (see ODPM 2005, Meen and Andrew 2007). Furthermore, since they play only a small role in the adjustment process in the simulations in chapter 5, conversions and changes in use are not discussed in detail. This allows the paper to concentrate on the central roles of vacancies and demolitions. In fact, long time series of data on conversions and changes in use are not available at a regional scale. Consequently, the model contains simple iterating relationships, estimated across a regional panel, where conversions are related to real house prices

14 There are, however, exceptions. In "unbalanced" increases in construction, migration flows may induce equal increases in the number of households (see the first report).

and changes in use are related to house prices relative to commercial property returns.[15]

Figure 6: Total Houses Demolished or Closed Under Slum Clearance (Nos. England and Wales)

(figures for 1974 onwards relate to financial years)



Source: Housing Statistics (various years)

4.1 Modelling demolitions

One of the problems in modelling demolitions in England is that the quantity and quality of past data are limited, reflecting the low historical levels. Furthermore, since the data reflect past housing shortages, they may not be relevant to a world in which construction levels are higher. Consequently, standard empirical models estimated on past data are unlikely to be relevant and the analysis has to return to first principles. Analogies can be drawn from the commercial property literature and then the differences that arise in residential markets highlighted.

4.1.1 Commercial property, obsolescence and demolitions[16]

At any time the value of a building depends on its ability to generate income and the level of its maintenance and running costs. Over time the value of a building will normally fall as its income potential declines because it becomes less suitable for modern use as technology changes and its operating and maintenance costs increase. Redevelopment is viable when the net present value of a redevelopment scheme, including the value of the buildings created and the costs of demolition and construction, exceeds the net present value of the existing use. This condition identifies the date at which an existing building becomes economically obsolete. In fact, existing buildings may become physically obsolete, i.e. operating costs exceed revenue, before there is a profitable new use to replace them – the

15 There is also no time-series information available on changes in excess sharing and this element becomes, in effect, the residual in the system.
16 Parts of this sub-section rely on work by Eamonn D'Arcy.

implication of this is that land values are negative once the costs of site clearance and reconstruction are taken into account. The site may remain derelict and vacant until new opportunities become available.

In Britain there are many examples of economic obsolescence within 25 years in the office market where 1960s offices were unsuited to modern office technology. In extreme cases new developments have become economically obsolete on or before completion in some industrial developments in the London Docklands.

External (social) costs and benefits also influence the socially optimal timing of development. Where the benefits are positive, the expected life of the building is prolonged and redevelopment postponed. This situation may arise, for example, in the context of buildings which have either historic importance or architectural merit. Equally, the social costs of existing buildings may be so high, that the socially optimal redevelopment period may be brought forward. For example, high levels of crime in the most deprived areas might advance the case for slum clearance.

The question therefore arises why housing markets do not appear to operate in the same way in England. There is some evidence that housing markets in the US do follow these principles approximately. Houses should become physically obsolete when (imputed or market) rents are exceeded by maintenance expenditures. Furthermore, under economic obsolescence, houses should be demolished and replaced when the net present value of the rental stream is lower than under an alternative use.

These conditions incorporate the effects of technological change. In commercial markets, the rents of buildings that are unfit for modern purposes will fall, leading to faster rates of demolition. In principle, dwellings can also become unfit for modern styles of living (see Kintrea (2005)), leading to lower prices. Arguably, this is one reason why dockland developments in major cities are popular amongst young, high income households without children – they suit the modern lifestyle of this socio-economic group.

Although comparisons are difficult, it appears to be the case that the lives of residential properties are longer than for commercial properties. Furthermore English dwellings are noticeably older than in the US, for example table 8 sets out the distribution of the age of the housing stock in England. Approximately 40 per cent of the stock was built prior to the Second World War and the privately rented stock is noticeably older. By contrast, social housing is typically newer as a result of post-war building programmes. Age is, of course, an imperfect proxy for quality and the very oldest buildings take on historic importance. By contrast, as table 9 shows, less than 20 per cent of the US stock was built prior to the war.

A number of structural differences between housing and commercial markets might be identified that contribute to extending the life of existing dwellings beyond that typically found for offices. In general, these relate to forms of market failure arising from controls or externalities. International differences in these factors add to variations in the ages of housing stocks.

Table 8: Age Distribution of the English Housing Stock (%)										
All households										
Year Built										
Tenure	Before 1800	1800-1850	1851-1900	1901-1918	1919-1930	1931-1945	1946-1964	1965-1980	1981-1984	1985 or later
All owners	2	2	8	7	6	14	20	21	5	14
All social sector tenants	0	0	2	3	4	12	32	27	7	12
All rented privately	4	3	15	15	8	10	13	13	5	14
All tenures	**2**	**2**	**8**	**8**	**6**	**13**	**22**	**21**	**5**	**14**

Source: Survey of English Housing 2004/2005

Table 9: Age Distribution of the US Housing Stock (%)	
	%
Before 1920	8.0
1920-29	4.5
1930-39	5.3
1940-49	6.7
1950-59	11.1
1960-69	12.8
1970-74	9.3
1975-79	10.2
1980-84	6.3
1985-89	7.3
1990-94	5.9
1995-99	7.3
2000-04	5.2
Total	100.0

Source: American Housing Survey 2003, Table 1A-1

Redevelopment of residential sites differs from commercial projects, because of the absence of concentration of property rights, particularly in the owner-occupier sector. A hectare of land, for example, might have 25 different owners at the average density. The diversity of **property rights**, the consequent difficulty of assembling large land packages and arguments over compensation have hampered slum clearance programmes since at least the

19th century. Property rights can be seen as a form of transaction cost (see Webster and Wai-Chung Lai 2003), therefore lengthening the time to redevelopment.

Land use controls, zoning, and building regulations may all prevent redevelopment schemes from occurring at the optimal time. There are two reasons why these might be stronger for housing than for commercial development. First, local authorities might be keener to attract jobs than the associated residential development necessary to house the extra workers. Therefore, industrial controls tend to be weaker than on residential developments. Second, building codes and minimum housing standards may prevent the filtering of the housing stock from working in the manner predicted by theory. Evidence for this in the US is discussed in the next sub-section.

Externalities and the possible social value of buildings are discussed above. Both residential and industrial buildings may exhibit architectural merit and might be listed. But whether this is likely to be more of a significant factor for houses than industrial or commercial development is unclear. However, attachment to place is more important for households. There is strong evidence that households move only short distances in order to preserve ties with families and friends. Arguably, they also have an attachment to their dwelling since houses in different locations are imperfect substitutes. But the attachment will not be reflected in market values since the externality is household-specific. Consequently, we might expect to observe a higher level of improvements to existing dwellings rather than demolitions and redevelopment. In Britain in 2005, new private sector housing construction and repair, maintenance and improvement expenditures were approximately equal.

4.1.2 What does the literature say?

In their model of "tear downs" in the Chicago market, Dye and McMillen (2007) argue that homes selected for demolition are far from random. Developers seek "older, smaller homes on large lots to replace with new houses built to the limits of local building codes and zoning regulations". Anecdotally, in-fill building in the UK often appears to entail the demolition of older homes on larger sites. Dye and McMillen also find that older, cheaper homes in the midst of high-demand areas are more likely to be cleared. All of these findings are consistent with the standard life-cycle model, allowing for the special conditions of the housing market.

These observations suggest that any model of housing demolitions has to be tied up with dynamic theories of urban change. Issues of demolitions, conversions and vacancies are all part of the same general process of urban dynamics. Models of filtering and models that stress the ageing of the housing stock provide valuable insights.

The seminal work of Grigsby (1963) and Grigsby *et al* (1987) provides the natural starting point for models of filtering (see Megbolugbe *et al* (1996) and Galster (1996) for summaries of the importance of Grigsby's work).

Although a number of related approaches have been employed, filtering can be defined as "the process by which dwellings descend over time from higher to lower income households". An important feature of this process is that sub-standard housing in the most deprived areas is not an inevitable outcome of physical depreciation. The stock can be maintained almost indefinitely if the incentives are sufficiently strong for the required maintenance expenditures to be undertaken. Rather, in line with the models above, deterioration is the outcome of an economic decision not to undertake the maintenance. This decision, in turn, depends on relative shifts in demand and supply, not only for individual properties, but also for the neighbourhood since the neighbourhood provides an externality. Although much of Grigsby's work was concerned with neighbourhood decline – the best quality and newest housing originally built for higher income groups eventually moves downmarket – shifts in demand may also cause upward price pressures, leading to gentrification.

Filtering is, in principle, consistent with the implicit assumptions of the affordability model. However the evidence is not clear cut that filtering, in practice, works efficiently. US work by Malpezzi and Green (1996) finds that filtering appears to operate, but its progress may be impeded by land-use controls. Although housing quality for low income households has improved over time, they are required to devote higher shares of their incomes to housing. The increase might reflect the desires of households, but, alternatively, could also reflect a form of market failure. Building code regulations, for example, truncate the filtering process, since quality is not allowed to fall below a certain level. The authors show that the supply of low income housing has fallen in the US and the relative price risen, consistent with the effect of controls. Furthermore, they demonstrate that a city that makes it easier for any type of housing to be built will enhance the stock of low-cost housing. But restrictions on any kind of housing (including high quality housing) will restrict the available stock of low-cost dwellings.

Ageing obviously plays an important role in filtering models, but models from a different tradition also stress the idea that high income households prefer to live in newer dwellings, at least in the US. This is less clearly the case in the UK, but these models are used to explain gentrification. A recent example is the work of Brueckner and Rosenthal (2005), who argue that newer dwellings yield higher housing services. Traditionally, these have been in the suburbs as development proceeds outwards from the city centre. But, subsequently, when the urban core is redeveloped, higher income households prefer to return to the centre since the housing stock will be younger and of higher quality and access to the centre is improved. Therefore gentrification takes place. Consequently, the model, places the age of the dwelling stock as the key driver of neighbourhood dynamics. Further support for the role of the age of the dwelling stock in renovation and gentrification is provided in Helms (2003), who estimates models of renovation expenditures in Chicago. Although age remains a key driver, he finds that both individual and neighbourhood characteristics are important.

There is empirical evidence from the US literature to support the view that redevelopment occurs when the price of land for new development exceeds the price of land in its current use by the cost of demolition. In most applications, demolition costs are considered small and are ignored.[17] In this field, the appropriate rule was originally developed in Brueckner (1980) and Wheaton (1982). But the first rigorous tests appear in Rosenthal and Helsley (1994). Subsequent to Rosenthal and Helsley's work on Vancouver housing markets, Munneke (1996) applied the same model to industrial and commercial development in Chicago. Dye and McMillen (2007) extend the model in the Chicago metropolitan housing market. McGrath (2000) adjusts the model to allow for contamination risk in industrial developments, again in Chicago. But all these studies find support for the valuation rule.

The problem, however, is that the methods of these studies cannot be used directly in England. The tests in all the studies are based on micro data sets for properties recently sold that explicitly identify whether the properties are to be developed or not. No such data sets exist in England.

4.1.3 Data on demolitions in England

Early data, shown in figure 6, concentrated on demolitions under slum clearance programmes. But these, of course, do not arise from market-driven decisions. The sharp increase in demolitions in the sixties and seventies is immediately evident, peaking at approximately 70,000 dwellings per annum. But slum clearances are only part of the total. During the current decade total demolitions have averaged approximately 22,000 units per annum. In 2005/06, this amounted to 0.9 per cent of the housing stock. Also, the numbers have increased since the early nineties, when demolitions were approximately 8,000 per annum. Most of these demolitions will have been in the social sector, though even the majority of private sector demolitions are likely to be due to government sponsored initiatives.

4.1.4 Introducing housing quality

As noted above, past data provide little guide to the expected level of demolitions in a market-based system, if housing supply shortages are less evident. But it is precisely this scenario that the affordability model is required to analyse. Therefore, from sections 4.1.1-4.1.3, an alternative approach is to consider which properties are most likely to be demolished if all the remaining variables in equation (7) are at their equilibrium values. These values are considered in later sections, but the fundamental problem is to provide a link between the number of demolitions measured in units (necessary for equation 7 to hold) and the implied reduction in housing services arising from these demolitions. This, in turn, affects the level of house prices in the model.

From the filtering and valuation models, the dwellings most likely to face demolition are those that have the lowest market values relative to the value of a comparable new property. The values of these dwellings tend towards the underlying land value. If new properties contain the highest levels of

17 Rosenthal and Helsley (1994) find that demolition costs in Vancouver are only 1.7 per cent of the average price of redeveloped properties, although costs can clearly be much higher where land is contaminated (McGrath 2000).

housing services and depreciation of older dwellings is straight line (Brueckner and Rosenthal 2005), it is possible to define the point of economic obsolescence, when demolition occurs. But, in Britain, straight line depreciation is probably not a reasonable approximation. Older Victorian dwellings in cities may well yield higher services than properties constructed in the 1960s and 1970s, particularly since only the best parts of the Victorian housing stock will have survived until today. Furthermore, given regular renovation of the stock, only the shell of the dwelling may be truly Victorian. Therefore, estimating which properties are the prime candidates for demolition becomes more complex and requires the model to consider explicitly housing quality and the quantity of housing services contained within different units of the dwelling stock. Returning to equation (7), each unit is no longer treated as identical and the standard approach of matching numbers of households to numbers of dwelling units is no longer sufficient. It is useful to introduce the concept of an effective housing stock, where each unit is weighted by the implied volume of housing services. In principle, estimates of the weights can be obtained by hedonic analysis, using data on house prices and dwelling characteristics, taken from the Survey of Mortgage Lenders (SML). From the hedonic equations it is possible to obtain an estimate of the relationship between house prices and property age, which, in turn, generates the deprecation rates. In practice, however, the main constraint is that the SML has information only on a limited range of dwelling characteristics. Therefore, property age may be picking up the effects of other omitted variables, which are correlated with the age of the property.

Nevertheless, the hedonic equations are estimated on pooled data covering the years 1997, 1999 and 2001. The SML did not include data on age after this date. Pooling requires the inclusion of year dummy variables (YR1999, YR2001). 1997 is the default year. The hedonic equation takes the form of (8). The SML identifies the following categories for the ages of dwellings:

- new
- built post 1980
- built 1960-1980
- built 1940-1960
- built 1919-1939
- built pre-1919

In addition the SML includes information on the type of property (detached, semi, terraced, flats), the number of rooms, which acts as a proxy for the size of the dwelling, and location down to local authority level. Flats built before 1919 were used as the reference category. As noted above, this is a limited specification relative to the large numbers of variables typically included in hedonic equations. From the perspective of the model, the main omissions are any direct indicators of property size or neighbourhood quality.

The results are shown in table 2.1 in appendix 2.[18]

18 The model also tested interactions between the variables in equation (8). These do not change the conclusions and are not presented here.

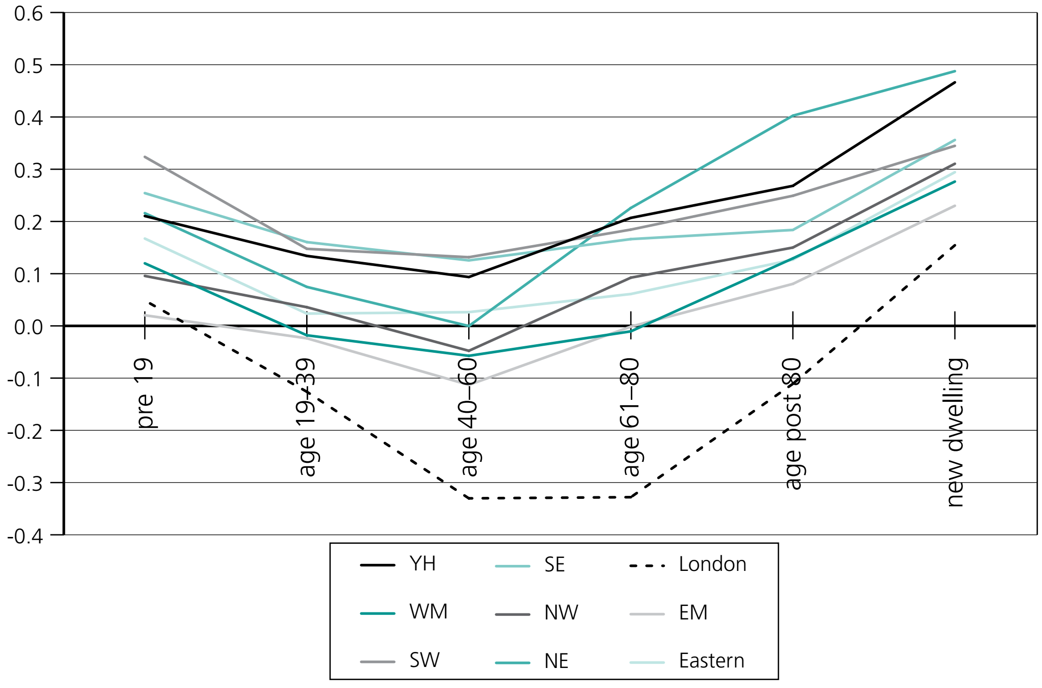
$$\ln(PH)_j = a_1 + a_2 Size_j + a_3 Type_j + a_4 Age_j + a_5 LA_j + a_6 YR + \varepsilon_{2j} \quad (8)$$

PH_j	= House sale price
Size	= Size of property measured in the number of rooms
Type	= Dummies for the type of property (detached, semidetached, terraced, etc)
Age	= Dummies for the time period when the property was built
LA	= Dummies for the local authority in the region
YR	= Year dummy
ε	= error term
j	denotes a region

The coefficients on the *Age* variables provide an estimate of annual depreciation rates, varying by region and by property type. The results in appendix 2 show a considerable degree of consistency across the regions. For example, an additional room adds approximately 12 per cent to the property value in all regions. One of the main differences, however, is that terraced properties attract a premium (over flats) in London, the South East and East, but receive a lower price in the northern regions, notably the North West, where terraced prices of a given vintage and size are 20 per cent lower than the price of flats. New properties in all regions attract a premium. One of the most striking features of the London results is the U-shaped relationship between price and property ages, see figure (7). Properties built between 1950 and 1980 are 30 per cent below those of pre-1919 properties. This appears to reflect the attractiveness of pre-1919 (terraced) properties built in London, which typically have undergone substantial renovation. The U-shape depreciation curve is less pronounced in the other regions, although it still exists. Straight line depreciation does not appear to be an appropriate assumption in England. However, although the equations are well-determined statistically and the results appear intuitively plausible, the health warning from above should be emphasised. It is possible (although not testable on the SML data set) that the age indicators are partly capturing omitted other factors, such as property size.

For the affordability model as a whole, the most important conclusion from the equations is that, in all regions, post-war properties have the lowest price relative to newly-built properties of comparable types, not the oldest Victorian and Edwardian dwellings. In terms of market adjustment, the post-war dwellings are the more likely candidates for demolition. In the model, if demolitions are required, this vintage of dwellings is assumed to be demolished first.

Figure 7: The Relationship between House Prices and Age



The measure of the effective housing stock follows from the hedonic equations. As noted above, there are no official estimates of the stock of housing services that can be used in time-series estimates of house price equations instead of the number of units. Consequently, applications of the standard life-cycle housing model generally use the simplifying assumption that the stock of housing services is directly proportional to the number of units. But, for the affordability model, this simplification needs to be relaxed. Apart from being the more appropriate concept theoretically, operationally it is a necessity. This is because, in terms of units, a one unit increase in new completions, offset by an increase in demolitions has no effect on the dwelling stock, also measured in terms of units, and consequently no effect on house prices. But a new dwelling is likely to contain more services than the demolished dwelling. Therefore, the *effective* housing stock is defined, which attempts to weight each unit by its implicit quantity of services.

Each unit (*i*) is weighted by its marginal utility μ_i, which assumes that a four bedroom house, for example, has a higher marginal utility than a two bedroom flat. The effective housing stock is given by (9):

$$HS^e = \sum_{i=1}^{n} \mu_i X \quad (9)$$

where (*n*) is the number of different property types *X*, which is in principle equal to the number of properties in the country if all are different.

Under competition, relative marginal utilities are reflected in the relative prices (10).

$$\mu_i / \mu_j = P_i / P_j \quad (10)$$

and estimates of the relative prices of the different property types can be obtained from the hedonic equations in appendix 2.

$$HS^e = \sum \hat{P}_i X_i \quad (11)$$

where

$\hat{P}_i$ = predicted price from the pooled equations for each of the properties (*i*), i.e. distinguished by rooms, type, age etc.

In fact, the predicted price is not used directly since weights are required. Therefore, one dwelling type, (the most common property nationally), is chosen as a numeraire and given a weight of one. The weight of other property types becomes:

$$w_i = \hat{P}_i / \hat{P}_{\text{mod}\,al} \quad (12)$$

So the properties with the highest utilities receive weights greater than one.

$$HS^e = \sum w_i X_i \quad (13)$$

Therefore if new properties are built (high weight) and low weight dwellings are demolished, the effective stock rises. However, there is a further conceptual problem. (10) does not hold where there are externalities. In this case, the main externality is likely to be attachment to place. As noted earlier, the fact that a household has lived in a dwelling for twenty years raises the utility of the property to that individual, but does not raise the market price, since the attribute is specific only to that household. Further problems arise through property rights discussed above. So the effective housing stock to *existing residents* may be higher than in (13).

Finally, the effective stock replaces the actual stock in the house price equations. However, the equations cannot be re-estimated because we only have the stock at one point in time (estimated for 2001). If the effective stock is the "true" measure reflecting housing services, then there is an errors in variables problem. Although we have to assume the same coefficient as currently on the stock (–2.0), the direction of bias is known and the elasticity is likely to be underestimated (in absolute terms). Consequently, the effect of an increase in housing construction on affordability may also be underestimated.

4.2 Modelling vacancies

4.2.1 General principles

As noted above, a key objective of recent developments in the affordability model is to ensure that the model has a well-defined equilibrium, consistent with equation (7). Vacancies play an important part in this. In the property literature this equilibrium is sometimes known as the natural vacancy rate and has an analogy to the labour market literature and the natural unemployment rate. However, the natural vacancy rate is often operationalised as an average of past vacancy rates, which implicitly smoothes out cyclical variations. However, this is unsatisfactory if, because of housing shortages, vacancies have never reached an equilibrium. We therefore attempt to model movements in vacancies explicitly and solve the equations for their equilibrium to obtain an estimate of the rates to which the model should converge. However, this may well mean that vacancy rates are higher than observed historically. Although there is a tendency to believe that vacant dwellings are a loss to society that need to be filled before new construction takes place, in fact a well-functioning housing market requires a certain number of vacant dwellings for the efficiency of the market and to aid household mobility.

Although the final output needs to be in terms of *regional* vacancies, the modelling is conducted at the local level. Because of the spatial fixity of the housing stock, vacancies are primarily a local phenomenon. Two adjacent neighbourhoods may exist where vacancies are high in one and low in another, but the stock cannot be moved across boundaries to equalise conditions, although households can, of course, move. This perhaps matters most in low demand areas, where vacancies are particularly high. There is no guarantee in these areas that household inflows will occur. Indeed, the vacancies are more likely to reinforce outflows through cumulative decline. Furthermore, at local levels, household change takes place primarily through migration rather than natural increase. Therefore, the factors that affect local migration flows are likely to be important determinants of vacancies.

One final important point needs to be borne in mind. Given equation (7), one variable has to be defined as a "residual" to ensure that the identity holds. The model implies that, once vacancy rates have reached an equilibrium, demolitions fulfil this role, with the distribution of types of properties to be demolished determined in the manner described in the last sub section.

4.2.2 Data

There are two possible data sources for vacancies; (i) The English House Condition Survey, (ii) HIP operational data. At the regional and national level, HIP data are not the recommended source for the private sector. However, they are the only available source at the local authority level and are used here. This source also identifies properties that have been vacant for more or less than six months. For the private sector, owner-occupier and renting vacancies are considered together, given the possibility of substitution between the two sectors. Typically, estimation includes 310 local authorities for which information is consistently available. Vacancy data are available from this source between 1990 and 2003. In each case vacancies are measured at 1st April of each year. In practice, the independent variables to be used in estimation are not available over this time period, so the full panel data structure cannot be exploited. Nevertheless, it is possible to add some dynamics. Most of the other data are taken from the 2001 census. But, in addition, the 2000 Index of Multiple Deprivation is used and local house price data from the Land Registry.

4.2.3 Model structure and empirical results

Vacancies are the difference between housing supply and demand, both measured as stocks.

$$VAC_i = HS_i - HD_i \quad (14)$$

HD = housing demand in units
HS = Housing supply in units
VAC = Vacancies in units
i represents a spatial subscript (local authorities), subsequently suppressed for convenience.

Housing demand includes second as well as first homes. The local authority housing demand equation is based on the work of Meen (2007) and can be written as (15).

$$HD = \beta_1(PH / P) + \beta_2(Y) + \beta_3(IMD) + \beta_4(HH) + \beta_5 \Delta UP \quad (15)$$

P = general price level index
Y = real income
IMD = index of multiple deprivation
HH = number of households
PH = local house price index
ΔUP = change in the unemployment rate

Conditional on the dwelling stock, this gives rise to the vacancies equation (16).

$$VAC = f(HS, (PH / P), Y, IMD, HH, \Delta UP) \quad (16)$$

Note that *IMD* appears directly as a determinant of house prices in Meen (2007). It is also correlated with real household income. But we have also found *IMD* to be an important determinant of migration flows (Meen *et al* 2005). As noted above, at the local level, migration is a major way in which population increases or decreases. Overall, therefore, we expect deprivation to be an important factor in determining vacancies.

Since demand does not respond immediately to changes in the variables in (15), vacancies in (16) would also be expected to adjust with a lag. Equation (17) sets out one possible specification.

$$VAC = \gamma_0 + \gamma_1 VAC_{-1} + \gamma_2 IMD_{-1} + \gamma_3 \Delta UP_{-1} + \gamma_4 HS_{-1} + \gamma_5 (HS - HH)_{-1} + \gamma_6 (PH / P) + \gamma_7 Y + \varepsilon \quad (17)$$

where:
ε = error term

The equation can be estimated, distinguishing between properties that have been vacant for more or less than six months. The estimation results for the former are given in table 2.2 in appendix 2. Note that house prices and incomes have been dropped, because of their correlation with *IMD*. Solving the equation for its long-run solution yields equation (18). The solution is derived under the assumption that *HS*=*HH*, so that even if the number of units and the number of households match, there will still be a positive level of vacancies.

$$VAC^* = -782.7 + 15.162(IMD) + 0.0193(HS) \quad (18)$$

Therefore, the vacancy rate depends on demand in each area, where the level of deprivation is the key indicator and supply is represented by the housing stock. If *IMD*= 0 and ignoring the constant, vacancies are 1.93 per cent of the private sector housing stock. But the rate is higher in areas of low demand. Table 10 sets out the rates in each region, allowing for the levels of deprivation. Although these may appear quite low, it should be remembered that they refer to vacancies in excess of six months, which are approximately 50 per cent of the total. These are important as a bench mark for the solutions to the full affordability model.

Table 10: Estimated Vacancy Rates (more than six months)

Region	Estimated Vacancy Rate (%)
North East	2.02
Yorks & Humber	1.77
E Midlands	1.37
East	1.17
London	1.78
South East	1.10
South West	1.25
W Midlands	1.62
North West	1.75

Table 2.3 in appendix 2 presents the results in slightly different form using (18) as the measure of the equilibrium vacancy rate (*VAC**).[19] This implies that approximately 44 per cent of the disequilibrium in the vacancy rate is eliminated each year. Therefore, vacancies tend towards the equilibrium fairly

19 Note that "equilibrium" is used in a statistical sense, i.e. the level to which vacancies return following a shock to the system, conditional on the values of the other variables in the equation. This allows the equation to be written in error correction form.

quickly. Finally, as noted above, the adjustment is affected by the difference between the housing stock and the number of households (*HS-HH*). In practice, this influences the speed of adjustment since it captures an additional form of disequilibrium.

The results so far are concerned with properties that are vacant for more than six months. But the model also includes short-term vacancies. In this case we would expect movements to be similar across the regions, since similar institutional factors are in operation. In particular, the central variable affecting vacancies in excess of six months – the deprivation rate – would be expected to be less important than in the earlier equations and, indeed, turns out to be insignificant. Given the insignificance of deprivation, the equation implies that the primary driver of short-term vacancies is the deviation between the housing stock and the number of households.

4.3 Modelling second homes

In equation (7), second homes have to be taken into account as a component of housing demand. However, not all second homes are included in this category; in particular second homes that are held as an investment to be let out in the private rental market, e.g. Buy to Let properties, do not "use up" dwellings. In other words they have no net effect. In addition to investment motives, second homes are held for a variety of purposes (and often for more than one purpose). Some of these motives are temporary – dwellings that are going through probate, homes required for individuals working away, homes bought for student offspring. These are typically fairly small categories and can be ignored for our purposes. But for the model, holiday homes or weekend cottages (as defined in the Survey of English Housing) have to be explicitly modelled. Because they add to demand, they influence house prices, although the spatial pattern across the country is far from uniform.

Modelling employs household data from the 2002 Survey of English Housing (SEH) and uses a probit equation to estimate the probability that a household with a given set of characteristics will own a holiday home. The sample used in estimation is restricted to those households who already own a first home as owner-occupiers. In total, 11,238 observations are used, although only 174 have a holiday home.

The independent variables used in estimation are determined by the structure of the tenure equations considered in chapter 3. The model gives tenure disaggregated by household age, gender, presence of children, marital status and income. Therefore, the same variables are used to determine the probability of having a holiday home. Multiplying the probabilities by the number of households of each type yields the expected number of households with holiday homes. This variable feeds into the aggregate house price equations.

Table 2.5 in appendix 2 sets out the estimated equation. Although the coefficients cannot be interpreted as marginal effects, households whose principal residence is in London have the highest probability of owning a holiday home. Of course, this does not mean that the second home is also in London. The North East is the default region and households from this region have the lowest probabilities of owning a second home, holding other factors constant. The regional ranking is closely correlated with the ranking of house prices, which are not separately included in the equation, but are captured by the regional dummies. For households, who already have a first home, house prices provide collateral for the second dwelling.

Table 2.5 suggests that gender and marital status do not have strong effects on the probability of owning a holiday home. But income and age are important influences. Age has a non-linear effect and simulations on the equation estimate that more than 90 per cent of holiday home owners are over the age of 40.

Table 11 shows the probabilities of holiday home-ownership for a selection of household types. As expected, in general, the probabilities are low; as an extreme case, a married male in London with children, aged 45, with an income in the forth quartile has a probability of 5.5 per cent. But the table shows the probabilities fall sharply with income.

Table 11: Probabilities of Owning a Holiday Home (selected households and locations, 2002)

Household Type	Probability (%)
London, male, children, married, income quartile 4, age 45	5.5
North East, male, children, married, income quartile 4, age 45	0.7
South East, male, children, married, income quartile 2, age 45	1.1
South East, male, children, married, income quartile 2, age 25	0.0
South East, female, no children, single, income quartile 4, age 25	0.3
South West, female, no children, single, income quartile 4, age 35	1.3

As noted above, from the estimated probabilities and the number of households in each group, the expected total number of households with holiday homes can be computed.[20] On the basis of SEH data, 75 per cent of these homes are assumed to be in England. Furthermore, the same source is used to allocate the holiday homes to specific regions. Unsurprisingly, the

20 Although there are no exact published figures with which comparisons can be made, information available from CLG live tables on second homes are an aid and adjustments to the model predictions have been made to reflect this external information.

highest percentages of holiday homes are located in the South West and South East.

4.4 Modelling Right to Buy sales

Across the public and private sectors together, transfers net out. But the model needs to distinguish the public and private sectors. This means that Right to Buy, (RTB), sales in particular have to be modelled explicitly.

Although Right to Buy sales first began in 1980 and the strongest growth was during the eighties, arguably the early years were atypical as the market adjusted to a new equilibrium. Estimation from the eighties is also complicated by the change from Standard Statistical Regions (SSRs) to Government Office Regions (GORs). Therefore, the equations in the model are based on a shorter time span,1991/92 to 2005/6, but attempt to overcome the limited period by using regionally pooled data.

The determinants of RTB sales are assumed to be the local authority housing stock, the average RTB discount percentage, the mortgage interest rate, and house prices (both the level and rate of change). Therefore, the relationship emphasises the post-discount mortgage payment faced by purchasers. Increases in the discount percentage and higher (expected) capital gains raise sales, but increases in interest rates, which raise borrowing costs, reduce demand. Table 2.6 sets out the results from an initial version, including a lagged dependent variable. Note that the table includes no income measure. Although this might be expected to be important, we found no consistent effect on sales.

In table 2.6 the coefficients are in line with expectations. Higher interest rates and the level of real house prices reduce RTB demand, whereas an increase in the discount and higher capital gains increase demand. Furthermore, the relative sizes of the coefficients suggest a simplification of the variables into a single measure of housing costs. This is given by equation (19) and has a ready interpretation as a form of housing user cost of capital (see chapter 3).

$$COST = [(1 - DISC) * RBM - \gamma \Delta \ln(PH)_{-1}] * PH / P \quad (19)$$

where:
P = General price index
RTB = Right to Buy Sales (numbers)
DISC = Average RTB discount
RBM = Mortgage interest rate
PH = House price index

(γ) lies between zero and one and has been used in previous work on owner-occupation. A value of one implies that decisions are determined by real interest rates alone; a value of zero implies that only nominal rates matter. Past work has found that the value lies between 0.1 and 0.3. (γ) takes a value of 0.15 in table 2.7.

Chapter 5: Model simulations

The model is now large and its complexity has increased since the first version. Furthermore, some aspects of the model are non-linear and, therefore, the model responds differently to policy changes according to the underlying position in the base scenario from which simulations are run. This chapter attempts to illustrate the central characteristics of the model through a series of simulations. The limitations of such exercises should, however, perhaps be stressed. Models are primarily a tool to aid thought and to help, rather than replace, policy makers and planners. Models help us to think in a more consistent framework; often the indirect effects of policy actions are not immediately clear and models can help us to highlight such effects. But the affordability model looks well into the future (2031 in the simulations below) and the margins of error are inevitably large. Unforeseeable national and international shocks are bound to mean that affordability (on whatever measure) cannot be predicted with a high degree of precision twenty years into the future. Therefore, we need to be modest about what models can achieve, but, nevertheless, they can be very useful as a means of simulating the effects of alternative policy scenarios.

The questions that the model attempts to examine are:

(i) By how much can affordability be improved by increases in housing construction? The 2007 green paper raises the target to 240,000 net additions by 2016. This was the primary question that the original model was set up to answer. But the issue is now whether the answer changes significantly given the subsequent model developments. The chapter also discusses whether there is some point beyond which further construction has a diminished effect on affordability. This is one example of a non-linearity. As part of the simulations, the question of who would live in the homes is addressed.

(ii) Where should any increases in housing be concentrated to maximise effect?

(iii) What are the constraints on raising home-ownership rates from the current level of approximately 70 per cent?

(iv) Now that the model distinguishes the effective housing stock, are there lessons for the types of dwellings that should be constructed as well as the number of units? This is tied up with filtering of the housing stock.

(v) Is it feasible to set targets for net additions to the housing stock, rather than gross housing starts? Although policy is currently set in terms of the former, the fact that demolitions are determined within the model raises interesting questions concerning the appropriate target.

Before the results of the scenarios are discussed, the chapter sets out the main features of the baseline scenario from which the simulations are run.

5.1 The baseline

The base case has to make assumptions concerning the level of housing construction in each of the years between 2008 (the starting point) and 2031. However, it should be noted that in both the baseline and later simulations, there is an important difference in methodology from that employed by the NHPAU in its reports. The NHPAU generally concentrates on *net additions* and in its simulations of the effects of increasing construction (NHPAU 2007), the Unit assumes that net additions remain constant at the levels reached in 2016 in subsequent years. By contrast, here, the emphasis is on *gross starts*. Because of the endogeneity of demolitions, there is not necessarily a one-to-one relationship between starts and net additions, particularly at high levels of construction.

In the base case, we have assumed that total housing starts in England are approximately 160,000 units per annum throughout the period. These figures are derived as the average for the period 2004-2006. They yield values for net additions to the housing stock of approximately 180,000 units per annum, although these are slightly lower in the later years of the baseline due to the endogeneity of demolitions. The difference between starts and net additions also reflects conversions and changes in use. The level is higher, however, than for most of the period since the early nineties. Furthermore, they are noticeably higher than original plans under regional planning guidance (150,000 per annum). Therefore, the base case already includes recent successes in raising housing construction from the levels of the early nineties.

Table 12 summarises some of the other key assumptions and outputs in the base case for England as a whole. The table indicates nominal income growth of slightly greater than 5 per cent and real growth of approximately 2.5 per cent. These are similar to the projections in the first report. Therefore, little of the difference in the results for affordability since the original report arises from the labour market elements of the model.

Demolitions in the base case show only minor changes between the two sub-periods and are similar to values in recent years. Notice that the table concentrates on private sector demolitions; although the historic disaggregation of the data between the private and public sectors is subject to error, the table uses private demolitions as the sector that faces market pressures. Since annual net additions are approximately 180,000 per annum, but official household projections are 223,000 per annum, demolitions are unlikely to rise significantly. As noted in chapter 4, housing shortages extend the effective life of dwellings.

Table 12: Key Assumptions and Outputs in the Base Case (England)		
	Av. 2006-2016	**Av. 2016-2031**
Average earnings (% pa)	5.1	5.1
Mortgage rate (%)	5.60	5.75
Consumers expenditure deflator (% pa)	2.5	2.5
Net Additions (000s final year)	180	176
Ownership rate (% final year)	70.0	68.5
Private demolitions (000s)	7580	8150
Affordability (lower quarter, final year)	7.95	10.30

However, this highlights an important assumption of the model. Housing shortages would be expected to lead to worsening affordability. Indeed, table 12 indicates that, nationally, affordability would worsen to 7.95 by 2016 and to 10.30 by 2031, compared with 7.1 in 2006.[21] Furthermore, chapter 2 demonstrated that, even if new construction matched household formation, affordability would be expected to deteriorate. But, from Figure 1, the model would predict a reduction in the rate of household formation in response to the worsening affordability. In fact, the model suggests that there would be little, if any, increase in household representative rates or, equivalently, the average household size would not decrease over the future. By contrast, official household projections indicate a reduction in average household size from 2.34 in 2004 to 2.09 in 2029.

The model in the base case, therefore, indicates lower levels of household formation than in the trend-based official projections in response to worsening affordability. But since housing is generally considered a merit good and failure to provide adequate housing may lead to externalities, such as poor educational and workplace performance, it may be argued that reliance on a pure market outcome is inappropriate. Equally, it might be argued that official household projections are not a measure of housing need, but nevertheless the model assumes that the official household projections have to be met and those that are not housed in the market sector[22] (as estimated by the model) receive subsidised housing either in the social or private rental sectors. This accounts for the fact that the ownership rate changes little from current levels by 2016 and, indeed, falls by the final year. Meeting official household numbers lowers the ownership rate since those who cannot afford owner-occupation costs are housed in the rental sectors. Leaving the outcome to the market alone would lead to higher rates of ownership since lower income groups would be unable to form households.

21 The estimates are presented to two decimal places for illustration. But this is a spurious degree of accuracy. Commentators rarely agree on what is likely to happen to house prices over the next year, let alone the next 25 years. However, concentration on the longer term allows us to avoid the complications associated with the short-run cycle and, arguably, from Chapter 2, we understand more about the long-run trends than the cycle.

22 Note, "market sector" is not the same as owner-occupied housing, since some households will also pay market rates in the rental sector.

Two further factors that affect the ownership rate need to be mentioned. First, as discussed in chapter 2, the model assumes that (unsubsidised) housing costs in the three tenures change in line with each other. If private rental costs rose faster than ownership costs, home ownership would be larger than in table 12, although ownership would still be constrained by the credit constraints discussed earlier. Second, ownership rates are affected by transfers, such as Right-to-Buy sales. Indeed, these have had a major impact on ownership in the past. However, from equation (19), if real house prices are rising strongly, as in the base scenario, the cost of purchase is also high unless the average discount is raised to offset the increase in costs. Since the model does not make this assumption and projects the discount at a similar level to recent years, RTB sales fall over the projection horizon and, in fact, make little contribution to raising ownership rates in the base case and the subsequent simulations. Of course, policies that were successful in raising RTB sales would generate higher levels of ownership than given in this paper.

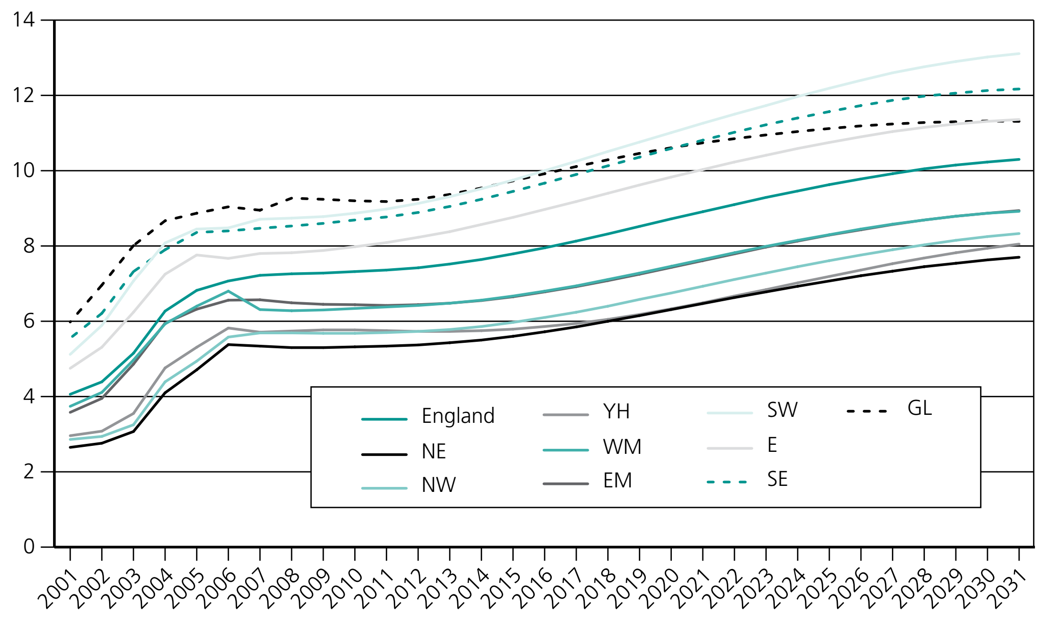
Home-ownership rates are calculated from the proportion of households who own a dwelling, but some households also own additional homes. As explained in the last chapter, for our purposes, the important figure is the proportion of households who own holiday homes. In practice, distinguishing houses that are purely for holidays is difficult, since they may be held for multiple purposes. Therefore, the figures in table 13 are approximate and require an element of judgement. However, the most important features of the table are the expected rise in the percentage over the future, reflecting real income growth and the spatial dispersion of holiday home owners. Note that the table shows the principle location of households who own holiday homes, *not* the spatial distribution of holiday homes.

Table 13: Percentage of Households who Own Holiday Homes (%)

	2008	2012	2016	2026	2031
Greater London	1.6	1.9	2.2	3.0	3.5
South East	0.9	1.1	1.2	1.7	2.0
East	0.8	1.0	1.1	1.5	1.8
South West	1.1	1.2	1.3	1.7	2.0
East Midlands	0.4	0.5	0.6	0.8	0.9
West Midlands	0.8	0.9	1.0	1.4	1.6
Yorks & Humber	0.8	0.8	0.9	1.2	1.4
North West	0.9	1.0	1.1	1.5	1.8
North East	0.3	0.3	0.3	0.5	0.6

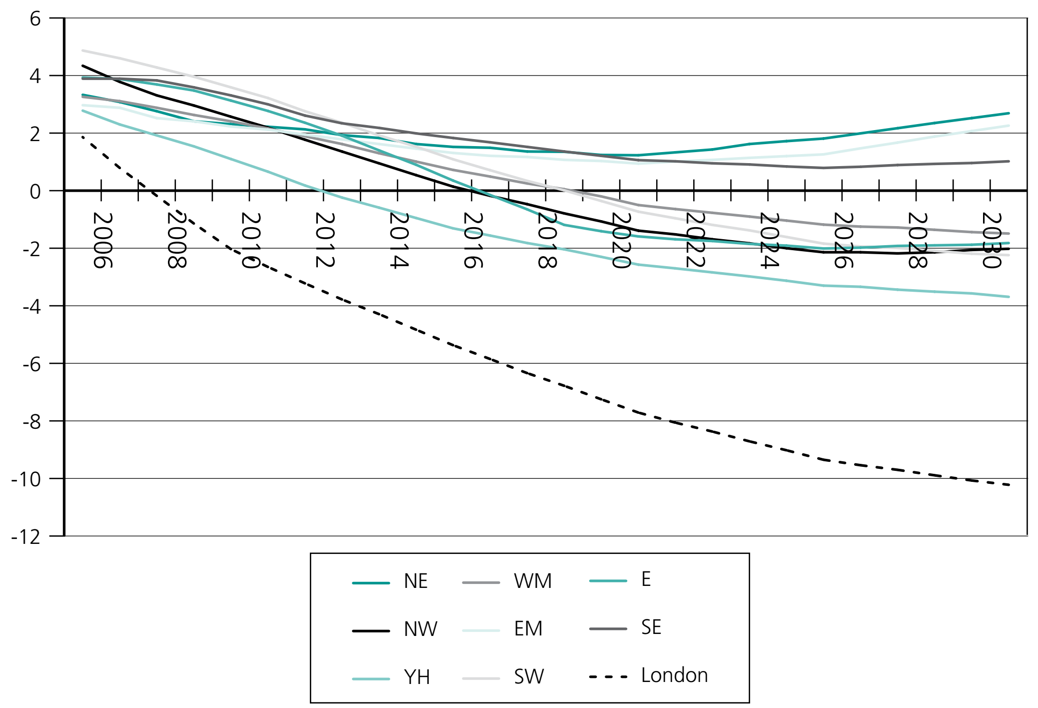
Against this background, figure 8 graphs affordability in each of the regions. A feature is the relative stability of the ratios in the first part of the period, but a worsening in the second part. This reflects the cycle and most commentators expect a weakening of the market in the short term. Arguably, there could be a stronger "dip" in the ratios over the next two years, with prices growing significantly slower than earnings. It is important to stress that Figure 8 does not reflect a central view of the outlook for regional affordability. Construction is below the 240,000 target for net additions set out in the green paper. An assumption that construction is equal to the average of the 2004-2006 period is simply a reasonable approximation to recent behaviour as a starting point.

Figure 8: Regional Affordability (Lower Quartile, Base Case)



The central innovation of chapter 4 is to ensure that the model has a well-defined long-run equilibrium, achieved through a combination of price adjustment, variations in household formation, changes in vacancies and demolitions. However, since we assume that official projections have to be met, one of the adjustment variables (household formation) is cut off from the system. Under these circumstances it is possible, with relatively low levels of construction, that vacancies never achieve their equilibrium values according to the equations given in tables 2.3 and 2.4. Figure 9 shows that this is the case. The figure highlights a possible inconsistency between construction levels and household projections, even though construction in the base is relatively high compared with the period since 1990. Successive upward revisions to the household projections worsen the problem. In many regions, the vacancy rates become negative by the end of the period; London is particularly noticeable. An alternative interpretation of this finding is that an increase in the number of sharing households will be required over the future. But we stress again that this does not represent a central projection, nor does it reflect current policy.

Figure 9: Regional Vacancy Rates – 180,000 Case



5.2 The 240,000 Units Case

The first simulation does not attempt to model the effects of the housing green paper target to achieve 240,000 net additions per annum by 2016. This is principally because it focuses on housing starts, a distinction which is highlighted above. Also, the model would require further information not available from the green paper directly. First, the precise time profile of construction is not discussed in the green paper; second, the regional distribution is not given, although the Regional Spatial Strategies provide information on pre-green paper plans. Third, the 240,000 units have to be distributed between the private and social sectors. Regional planning guidance allocates future targets for net additions to the housing stock between affordable and mainstream housing. However, the former is not the same as social housing since it includes shared ownership schemes for example. The distinction matters for housing analysis since shared ownership is more likely to behave like mainstream owner-occupation in terms of its pressures on house prices than social rental housing.

The simulation assumes a gradual build up over the period from 2008 to 2016 to 240,000 units and, in terms of input, changes are to housing starts, rather than net additions, because of the endogeneity of demolitions. Starts are assumed to remain at the higher level after 2016.

In order to obtain the regional distribution, it would have been possible simply to scale the figures in the regional spatial strategies. However, an alternative approach is used, whereby the difference between the 240,000 and 180,000 unit cases are distributed according to the level of vacancies shown in figure 9. Therefore, London obtains a disproportionate share of the additional homes. Finally, given the distinction between social and affordable housing, we have generally assumed that the majority are in the latter category. Results are unlikely to be highly sensitive to modest variations in these assumptions.

Numbers of private and social housing starts in each region are shown in table 14, along with net additions and affordability. Table 15 provides comparable information, measured as differences from the base scenario. The final row of the table indicates that by the final year, the additional 60,000 starts might lead to an improvement in affordability of approximately one point in the final year. The first report suggested that a 100,000 increase in housing construction between 2006 and 2016 would also improve affordability by approximately one point. Despite the similarity in the results, the findings are not completely comparable. First, here, construction increases gradually over time to reach its maximum only in 2016. Second, the size of the construction increase is rather smaller at 60,000 per annum. Third, as discussed in chapter 4, the model now employs the concept of the effective housing stock, so that new construction has a greater effect on prices than in previous versions. Nevertheless, despite all the caveats, the fundamental results of the earlier study do not change.

Table 14: Construction and Affordability (240,000 units case, selected years)

Year	**2008**	**2012**	**2016**	**2026**	**2031**
Greater London					
Private Starts (gross)	18644	23644	27644	27644	27644
Social Starts (gross)	6759	10759	10759	10759	10759
Net Additions	24978	34325	41228	40961	40830
Affordability (lower quartile)	9.27	9.19	9.61	10.20	10.28
South East					
Private Starts (gross)	28063	30063	31063	31063	31063
Social Starts (gross)	4691	4691	4691	4691	4691
Net Additions	33683	35921	37810	37532	37394
Affordability (lower quartile)	8.53	8.86	9.49	11.13	11.52
East					
Private Starts (gross)	21578	25578	28578	28578	28578
Social Starts (gross)	3050	4050	4050	4050	4050
Net Additions	23153	29545	33500	33376	33315
Affordability (lower quartile)	7.82	8.18	8.67	9.69	9.98

Year	2008	2012	2016	2026	2031
South West					
Private Starts (gross)	18952	22952	25952	25952	25952
Social Starts (gross)	2340	3340	3340	3340	3340
Net Additions	23302	27814	31772	31658	31601
Affordability (lower quartile)	8.74	9.07	9.67	10.99	11.46
East Midlands					
Private Starts (gross)	18716	21716	21716	21716	21716
Social Starts (gross)	1693	1693	1693	1693	1693
Net Additions	16800	24548	24501	18854	15583
Affordability (lower quartile)	6.49	6.42	6.65	7.83	8.26
West Midlands					
Private Starts (gross)	16174	19174	19174	19174	19174
Social Starts (gross)	1732	1732	1732	1732	1732
Net Additions	12793	19139	18972	18563	18361
Affordability (lower quartile)	6.28	6.40	6.67	7.84	8.18
Yorkshire and the Humber					
Private Starts (gross)	17264	20264	20264	20264	20264
Social Starts (gross)	1382	1482	1482	1482	1482
Net Additions	19449	22917	22743	22315	22104
Affordability (lower quartile)	5.74	5.72	5.75	6.70	7.19
North West					
Private Starts (gross)	22508	25508	25508	25508	25508
Social Starts (gross)	1862	1862	1862	1862	1862
Net Additions	16869	23465	23183	22489	22148
Affordability (lower quartile)	5.69	5.72	6.00	7.26	7.70
North East					
Private Starts (gross)	8227	8227	8227	8227	8227
Social Starts (gross)	1538	2538	2538	2538	2538
Net Additions	5341	8499	8384	8104	5740
Affordability (lower quartile)	5.30	5.35	5.61	6.72	7.10

Year	2008	2012	2016	2026	2031
England					
Private Starts (gross)	170126	197126	208126	208126	208126
Social Starts (gross)	25047	32147	32147	32147	32147
Net Additions	176366	226173	242093	233852	227076
Affordability (lower quartile)	7.26	7.40	7.77	8.99	9.37

Table 15:Construction and Affordability (240,000 units case, selected years) – Differences from Base Case

Year	2008	2012	2016	2026	2031
Greater London					
Private Starts (gross)	1000	6000	10000	10000	10000
Social Starts (gross)	1000	5000	5000	5000	5000
Net Additions	0	7995	14973	14891	14850
Affordability (lower quartile)	0.00	–0.05	–0.32	–0.99	–1.03
South East					
Private Starts (gross)	1000	3000	4000	4000	4000
Social Starts (gross)	1000	1000	1000	1000	1000
Net Additions	0	2996	4985	4953	4936
Affordability (lower quartile)	0.00	–0.03	–0.18	–0.59	–0.65
East					
Private Starts (gross)	1000	5000	8000	8000	8000
Social Starts (gross)	1000	2000	2000	2000	2000
Net Additions	0	5998	9988	9956	9939
Affordability (lower quartile)	0.00	–0.05	–0.30	–1.21	–1.38
South West					
Private Starts (gross)	1000	5000	8000	8000	8000
Social Starts (gross)	1000	2000	2000	2000	2000
Net Additions	0	5998	9989	9957	9942
Affordability (lower quartile)	0.00	–0.05	–0.33	–1.41	–1.65
East Midlands					
Private Starts (gross)	1000	4000	4000	4000	4000
Social Starts (gross)	1000	1000	1000	1000	1000
Net Additions	0	4997	4989	–562	–3786
Affordability (lower quartile)	0.00	–0.02	–0.13	–0.61	–0.68

Year	2008	2012	2016	2026	2031
West Midlands					
Private Starts (gross)	1000	4000	4000	4000	4000
Social Starts (gross)	1000	1000	1000	1000	1000
Net Additions	0	4988	4957	4879	4840
Affordability (lower quartile)	0.00	–0.02	–0.12	–0.60	–0.74
Yorkshire and the Humber					
Private Starts (gross)	1000	4000	4000	4000	4000
Social Starts (gross)	1000	1100	1100	1100	1100
Net Additions	0	5089	5058	4983	4945
Affordability (lower quartile)	0.00	–0.01	–0.11	–0.66	–0.86
North West					
Private Starts (gross)	1000	4000	4000	4000	4000
Social Starts (gross)	1000	1000	1000	1000	1000
Net Additions	0	4984	4942	4837	4785
Affordability (lower quartile)	0.00	–0.01	–0.09	–0.50	–0.63
North East					
Private Starts (gross)	1000	1000	1000	1000	1000
Social Starts (gross)	1000	2000	2000	2000	2000
Net Additions	0	2990	2977	2944	701
Affordability (lower quartile)	0.00	–0.02	–0.10	–0.49	–0.60
England					
Private Starts (gross)	9000	36000	47000	47000	47000
Social Starts (gross)	9000	16100	16100	16100	16100
Net Additions	0	46035	62860	56837	51151
Affordability (lower quartile)	0.00	–0.03	–0.18	–0.79	–0.92

Although not shown in the table, private demolitions for England as a whole between 2006 and 2016 average 7,600 – levels similar to those in table 12 for the base case. However, the average between 2016 and 2031 is 12,500, compared with 8,150 in the base and reach 20,000 by the final year. Therefore, in the second part of the simulation, demolitions rise significantly. New construction replaces part of the existing stock. Consequently increases in gross starts do not lead to a proportionate rise in net additions and the quality of the housing stock improves.

The difference between the 240,000 case and the 180,000 scenario is that construction now increases faster than the official household projections. In some regions, this allows vacancy rates to reach an equilibrium and any additional units can be employed to improve housing services for existing households. But since equation (7) must still hold,[23] filtering implies that the poorest parts of the housing stock could be demolished. Figure 10 shows the private sector vacancy rates in the new scenario are considerably higher than in figure 9. But London still stands out as the area with below equilibrium vacancies and there is scope for redistributing further the 240,000 units of new construction towards London, in which case national demolitions would be lower. But, in general, approximately 240,000 units are sufficient to meet official household projections and to restore vacancies to equilibrium. However, this does not necessarily guarantee that affordability is stabilised. The next two simulations consider the impact of higher numbers of units versus changes in the type of dwellings constructed i.e. higher quality.

Figure 10: Regional Vacancy Rates – 240,000 Case

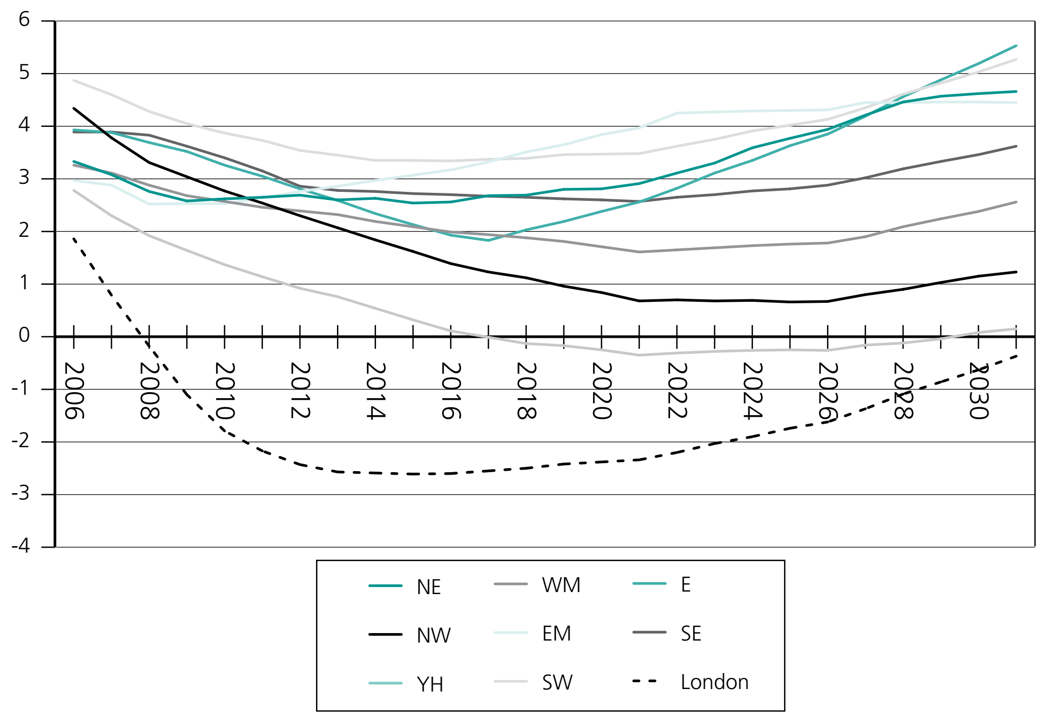


Table 16 considers changes in home-ownership rates compared with the base scenario. In order to understand the impact of higher construction, it is helpful to summarise the key influences on ownership rates. First, in the absence of constraints, relative tenure prices have a strong effect. But, as noted above, by assumption, rents change in line with ownership costs and consequently the changes in ownership rates in the simulation cannot be attributed to this source. Second, demographics are important determinants of tenure – younger households have higher probabilities of renting – but the simulation does not change the demographic profile of households. Third, ownership rates are affected by credit constraints. The central role of sustained increases

23 The induced effects on second homes, conversions and changes in use are small.

in private housing supply is to generate some relaxation of these constraints. In the short and medium term – for example up to 2016, the increases in ownership rates are modest. This reflects the finding in table 7 that the credit restrictions remain binding until well into the projection period and, generally, the improvement in affordability arising from the increase in supply is insufficient to overcome the credit constraints in the short term. But, in the long run, increases in housing supply lead to sustainable, i.e. permanent, increases in home ownership as affordability improves in a manner that demand subsidies cannot. Demand subsidies are typically capitalised into higher house prices. The increases in London are particularly large, but this primarily reflects the above average increases in construction (table 15).[24]

Table 16: Home Ownership Rates, %, (Differences from Base Case in brackets, percentage points)

	2008	2012	2016	2026	2031
England Owners (%)	69.38 (0.00)	69.62 (0.01)	70.14 (0.15)	70.92 (1.18)	70.28 (1.89)
London Owners (%)	55.94 (0.00)	56.56 (0.04)	57.29 (0.41)	58.69 (3.44)	57.86 (4.54)
SE Owners (%)	70.02 (0.00)	72.20 (–0.04)	72.85 (–0.09)	73.05 (0.35)	71.27 (0.74)
East Owners (%)	70.19 (0.00)	69.93 (0.03)	70.41 (0.28)	71.11 (1.71)	70.47 (3.06)
SW Owners (%)	71.61 (0.00)	70.83 (0.04)	70.94 (0.44)	72.27 (1.78)	72.24 (3.20)
EM Owners (%)	74.47 (0.00)	74.77 (0.01)	75.20 (0.05)	76.79 (0.43)	76.89 (0.68)
WM Owners (%)	70.88 (0.00)	71.67 (0.01)	72.35 (0.06)	72.88 (0.62)	71.96 (1.03)
YH Owners (%)	71.03 (0.00)	70.99 (0.01)	71.46 (0.05)	72.78 (0.51)	73.17 (1.06)
NW Owners (%)	74.20 (0.00)	74.84 (0.01)	75.32 (0.05)	75.22 (0.37)	74.76 (0.64)
NE Owners (%)	66.62 (0.00)	67.68 (0.01)	68.35 (0.07)	69.06 (0.43)	68.51 (0.68)

24 In addition, the fact that ownership rates are lower in London than elsewhere means that there is a greater catch up to the mean.

5.3 The 290,000 Units Case

The third case considers even higher levels of construction, i.e. an additional 50,000 units compared with the previous case. The new distribution of gross housing starts is given in table 17. Figure 11 shows affordability for England as a whole and compares the outcome with the two previous cases. Clearly, affordability improves further. In 2031, national lower quartile affordability stands at 8.79. However, the 50,000 increase from the previous case improves affordability by 0.60 percentage points, whereas the 60,000 rise in construction between the 180,000 and 240,000 cases raised affordability by more than 0.9 points. Therefore, the model exhibits a degree of non–linearity, although we should not overstate the extent and the model suggests that there may be some point beyond which increases in construction have only a limited effect on affordability if the types of properties constructed are similar to those built in the recent past. The caveat is important and we return to the issue in the next simulation.

Although the housing stock is higher in this scenario, table 17 indicates that net additions in 2031 are (i) lower than in 2016 (216,000 compared with 290,000) and (ii) lower than in the 240,000 scenario (216,000 compared with 227,000). These again illustrate the equilibrium in the model and the implied levels of demolitions. At much higher levels of construction in excess of household formation, vacancy rates reach their equilibrium more quickly, implying that there is greater scope for improving the quality of the stock in the later years. Under this scenario, private sector demolitions for England as a whole average 55,000 between 2016 and 2031, reaching 95,000 in the final year. Figure 12 graphs the regional vacancy rates and shows that all regions exhibit positive vacancies over the longer term.

Although not shown in the tables, the simulation still does little to improve ownership rates by 2016, but raises the rate by 2.8 percentage points in the long run. Therefore the same points raised in the previous simulation still hold. Credit constraints remain binding in the shorter term, but, in the long run, increases in production are necessary to raise sustainable owner occupation.

Table 17: Construction and Affordability (290,000 units case, selected years)

Year	**2008**	**2012**	**2016**	**2026**	**2031**
Greater London					
Private Starts (gross)	19644	27644	35644	37644	37644
Social Starts (gross)	6759	10759	13759	13759	13759
Net Additions	24978	38320	50209	53866	35836
Affordability (lower quartile)	9.27	9.16	9.43	9.42	9.57

Year	2008	2012	2016	2026	2031
South East					
Private Starts (gross)	29063	34063	35063	35063	35063
Social Starts (gross)	4691	5691	5691	5691	5691
Net Additions	33683	40916	42792	40571	35332
Affordability (lower quartile)	8.53	8.82	9.30	10.58	10.99
East					
Private Starts (gross)	22578	30578	36578	36578	36578
Social Starts (gross)	3050	6050	6050	6050	6050
Net Additions	23153	35543	43488	27604	25780
Affordability (lower quartile)	7.82	8.14	8.40	8.90	9.41
South West					
Private Starts (gross)	20952	28952	34952	34952	34952
Social Starts (gross)	2340	5340	5340	5340	5340
Net Additions	23302	34810	34440	29720	27075
Affordability (lower quartile)	8.74	9.01	9.30	10.34	10.94
East Midlands					
Private Starts (gross)	19716	23716	26716	26716	26716
Social Starts (gross)	1693	2693	2693	2693	2693
Net Additions	16800	26546	28804	18666	15562
Affordability (lower quartile)	6.49	6.41	6.55	7.39	7.75
West Midlands					
Private Starts (gross)	16174	20174	23174	23174	23174
Social Starts (gross)	1732	2732	2732	2732	2732
Net Additions	12793	20139	23961	19376	17046
Affordability (lower quartile)	6.28	6.40	6.60	7.35	7.62
Yorkshire and the Humber					
Private Starts (gross)	17264	21264	24264	24264	24264
Social Starts (gross)	1382	2482	2482	2482	2482
Net Additions	19449	23917	27732	27228	26979
Affordability (lower quartile)	5.74	5.72	5.71	6.25	6.58

Year	2008	2012	2016	2026	2031
North West					
Private Starts (gross)	22508	26508	29508	29508	29508
Social Starts (gross)	1862	1862	1862	1862	1862
Net Additions	16869	23465	27167	27368	26975
Affordability (lower quartile)	5.69	5.72	5.94	6.84	7.19
North East					
Private Starts (gross)	8227	10227	10227	10227	10227
Social Starts (gross)	1538	3538	3538	3538	3538
Net Additions	5341	11489	11348	6424	5429
Affordability (lower quartile)	5.30	5.34	5.50	6.30	6.63
England					
Private Starts (gross)	176126	223126	256126	258126	258126
Social Starts (gross)	25047	41147	44147	44147	44147
Net Additions	176366	255146	289941	250823	216013
Affordability (lower quartile)	7.26	7.38	7.62	8.42	8.79

Figure 11: Affordability in the 3 Cases (England)

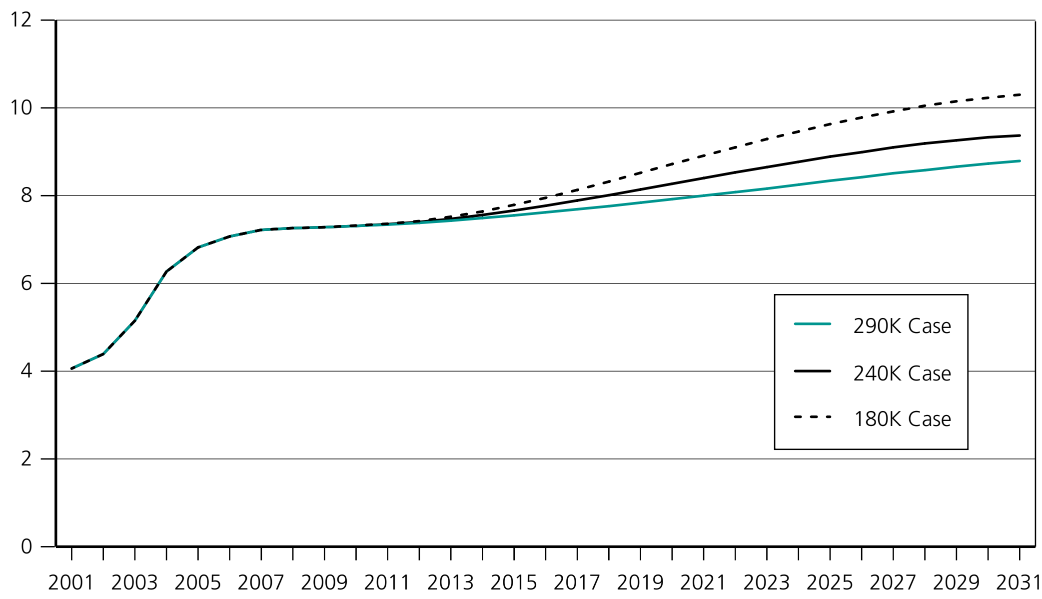
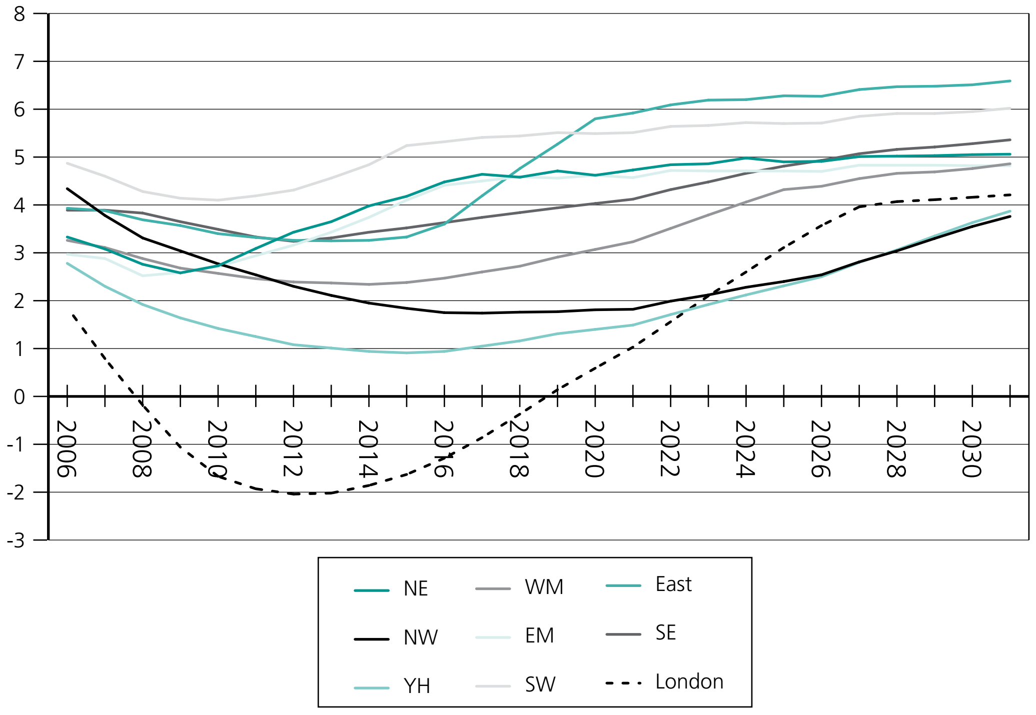


Figure 12: Regional Private Sector Vacancy Rates (290,000 case)



Finally, table 18 draws together the results, for England as a whole, across the three cases, highlighting the implications for affordability and owner-occupation. Higher levels of housing construction certainly produce significant permanent improvements in both variables, but the table demonstrates that this is a long-term, rather than short-term strategy.

Table 18: Housing Affordability and Home-Ownership (summary for England)

	2006	2012	2016	2026	2031
Baseline					
Affordability	7.1	7.4	8.0	9.8	10.3
Ownership (%)	69.4	69.6	70.0	69.7	68.4
240,000 Case					
Affordability	7.1	7.4	7.8	9.0	9.4
Ownership (%)	69.4	69.6	70.1	70.9	70.3
290,000 Case					
Affordability	7.1	7.4	7.6	8.4	8.8
Ownership (%)	69.4	69.6	70.3	71.7	71.3

5.4 Improving the quality of the housing stock

The previous simulation suggested that there may come a point at which building extra units has limited effect on house prices. Chapter 4 demonstrated that the model has attempted to capture some elements of quality improvement through the introduction of an effective housing stock. Furthermore, chapter 2 argued that an important reason why affordability is expected to worsen over the future arises from increasing demand for housing services from existing households, whose real incomes are rising. This group are likely to require higher quality homes. However, the simulations so far have all assumed that new dwellings reflect the recent experience in terms of the types of dwellings constructed. Alternatively, as incomes grow, it could be assumed that higher quality than average homes are constructed. Therefore, this stresses that a concentration on the number of housing units alone is not sufficient. The model can be used to illustrate that further improvements in affordability compared with the previous cases could be obtained if more construction were at the higher end of the market. It may not be appropriate, for example to build 240,000 starter homes. The filtering processes described in chapter 4 would still suggest that homes become available at the lower end of the market.

At first sight, this might suggest a call for larger homes with correspondingly greater land requirements. In fact, this cannot be inferred from the model. It is possible that higher levels of housing services – for example, through the quality of design – can be incorporated within limited urban space. Space is substitutable for other services. However, the model can give an indication of the possible effects on affordability from constructing larger than average homes. As a broad guide, the 240,000 unit scenario was re-run under the extreme (and unrealistic) assumption that all the new homes in the South East, South West and East were medium-sized detached dwellings. By the second half of the simulation period, the model suggested that affordability might improve by a further percentage point in each of the three regions. To repeat, the assumptions are extreme, but they illustrate that housing quality matters to improving affordability.

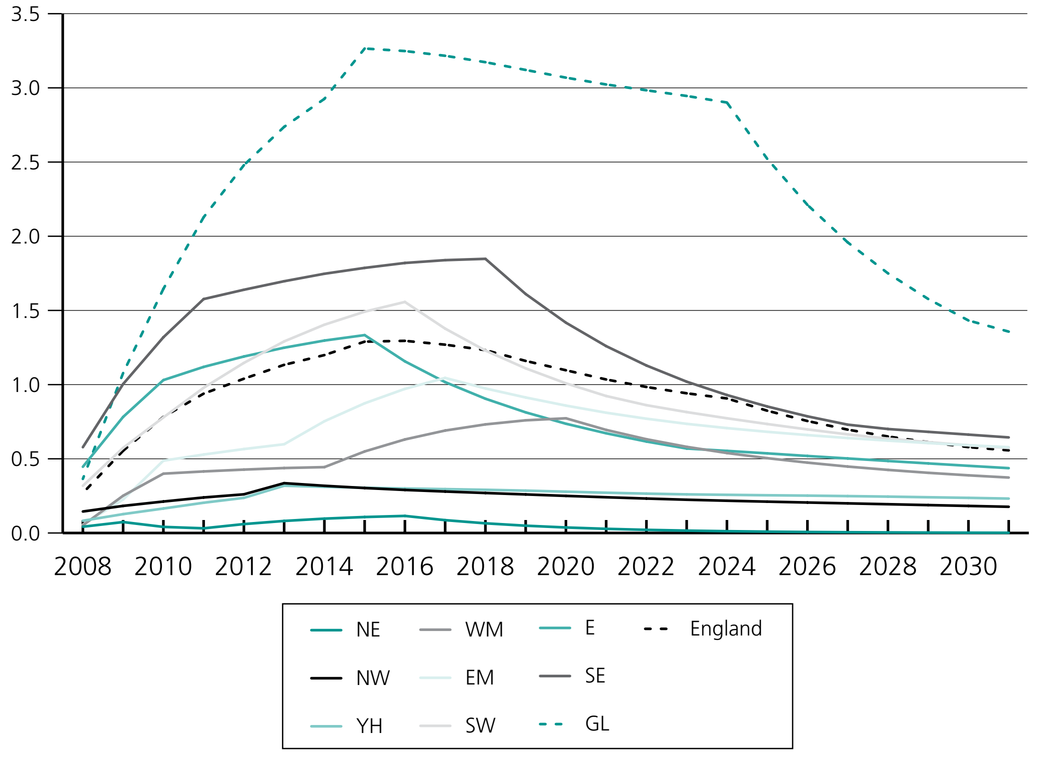
5.5 Relaxing deposit requirements

The simulations so far have all operated on the supply-side of the market, but they illustrate the difficulty of improving ownership rates in the short to medium term. The inability of younger, lower income households to meet the required deposit is an important factor. Shared ownership initiatives are one policy approach designed to reduce the significance of these barriers. However, the earlier simulations have shown that, at least for some households (see table 7) – others are never likely to achieve ownership – deposits are a temporary barrier. Ownership may be delayed as the deposit is accumulated, but eventually the hurdle is overcome and long-run ownership depends on the provision of adequate housing supply.

This final simulation examines the impact of reducing deposit requirements, although it should be borne in mind that this potentially adds to housing market risk. One of the reasons deposits are required is because of problems of asymmetric information between borrowers and lenders. Therefore, the simulation should be seen as illustrative of model properties rather than a policy recommendation.

Figure 13 shows the effect on the ownership rate, using the base scenario, of cutting the deposit requirement to 5 per cent. In fact, in the base case, deposits vary between the regions between 7 per cent and 13 per cent. Deposits are lower in the North than in the South. Therefore, the simulation represents different size changes between the areas. Nevertheless, distinctive features stand out. First, as expected, the short and medium term effects of reducing the deposit are greater than the longer term, since the deposit represents a temporary hurdle. For England as a whole, the increase in ownership rates peaks at 1.3 percentage points in 2016, but has fallen back to 0.6 points by the end of the simulation period. Second, the effects are biggest in the South, notably London. This is partly because the required deposit in the base is larger in these regions, but, nevertheless, higher prices imply that the constraint binds more strongly in the base.

Figure 13: Reducing Deposit Requirements (difference from the 180,000 case)



Chapter 6: Conclusions

This report presents the results from recent developments in the Communities and Local Government Housing Affordability Model, which is now regularly used both within the Department and by the National Housing and Planning Advice Unit. It lies behind, for example, affordability projections published by NHPAU in October 2007. The two major developments covered by the report are a new model of housing tenure and a new structure to determine the long-run equilibrium for the model. The former allocates households between owning and the two rental sectors. The latter requires a consideration of vacancies and demolitions.

This report sets out the underlying theory of the new model, relating its structure to parts of the academic literature. The results of econometric estimation are also presented. But sets of equations, by themselves, are not always adequate as a way of presenting the properties and policy implications. Therefore, a base scenario is constructed and a series of simulations run from the base. In line with the main function of the model, most of the simulations have operated on the supply-side of the market and involve increases in housing supply of different sizes. The exception is a simulation that examines the impact of relaxing deposit requirements for first-time buyers to show how this impacts on the time profile of housing demand.

Chapter 5 set out a series of questions, to which answers can now be provided. First, it seems clear that levels of housing construction of 180,000 units per annum in England will be insufficient to stabilise affordability. This is in line with the recent conclusions of NHPAU (2007). The report does, however, by-pass the important question of how higher levels of construction might be achieved. Does the construction industry have sufficient capacity and are the industry incentives sufficient to bring forth a large increase in supply, even if land supply is adequate? But current levels of construction are insufficient to match the revised household projections published in 2007. Furthermore, the report shows that additional housing services are required to meet the increasing demands of existing households. One of the most important innovations of the report is to move away from matching numbers of households to numbers of units. This is inadequate if improved affordability is to be a policy goal. This, in turn, is tied up with the quality of housing and the type of new dwellings to be completed as much as with the numbers of units.

Despite the changes to the model, the broad conclusions arising from the previous version remain intact. Allowing for the quality of the housing stock increases the responsiveness of house prices to changes in the level of construction, but the differences are not dramatic and large increases in construction are still necessary to induce major improvements in affordability. The simulations indicate that, in the long run, i.e. by 2031, an increase in construction from 180,000 per annum to 240,000 per annum might improve affordability by approximately one percentage point.

The simulations suggest that there may be a limit to the extent to which affordability can be improved by further new construction. The improvements from increasing construction to 290,000 units from 240,000 dwellings are slightly smaller than the increase from 180,000 to 240,000 houses. But the results also suggest that it is possible to substitute quality for numbers in order to improve affordability. Therefore, the types of properties to be constructed are important, particularly at high levels of construction. The model does not suggest that all units should be at the bottom end of the market or aimed exclusively at first-time buyers.

Since the model exhibits a non-linear response of affordability to changes in housing construction, this implies that higher levels of construction are most effective when concentrated on the areas of greatest shortage, primarily in the southern regions. Furthermore, for similar reasons, the largest effects on home-ownership rates are likely to occur in these regions, at least in the long run, since these are the regions where, currently, credit constraints are most binding.

The model attempts to answer the question of, who would live in the extra homes. First, construction at 180,000 units is insufficient even to meet expected future household formation. These levels imply worsening affordability, falling vacancies and no improvements to the quality of the housing stock. Arguably, at these levels, official household projections will not be met, implying lower household representative rates and higher average household sizes. Higher levels of construction (240,000 dwellings per annum), which are slightly greater than household projections, allow the restoration of vacancy rates towards their equilibrium, although outcomes depend on the regional distribution of new construction. There is little evidence that demolitions would be significant at this level of construction.

At 290,000 units per annum, the model suggests that vacancies would return to equilibrium in the long run and demolitions would be significant in the later years of the simulation. There is, of course, a question whether construction of 290,000 units could be maintained indefinitely, rather than as a short-run cyclical response. It might be argued that higher levels of vacancies and demolitions do not justify greater new construction, given the associated potential environmental problems. But it needs to be borne in mind that a certain level of private sector vacancies is necessary for the efficient operation of housing markets. Furthermore, turnover of the housing stock through demolitions and re-building is necessary to improve the quality of the housing stock and to make it more suitable for the demands of modern living. Although not discussed in this report, questions of energy efficiency are relevant. One of the arguments of this report is that housing shortages in the past have led to vacancies and demolitions below those expected in equilibrium.

Targets for housing construction set in regional planning guidance are in terms of net additions to the housing stock. But the simulations in this report employ changes to gross housing starts. The difference between the two concepts is conversions, changes in use and demolitions. The distinction is not crucial when construction rates are below rates of household formation. However, at high levels of construction, the simulations show that demolitions increase well above their historical levels. Formally, in this case, demolitions are endogenous and are determined within the structure of the model. Therefore, it may not be possible to determine targets for net additions, even if high levels of gross starts were to be achievable.

The final simulation concerned the demand side of the market and showed the importance of the credit restrictions faced by first-time buyers in raising the ownership rate from the current 70 per cent level. Shared-ownership schemes attempt to address these problems. The simulations suggest that increases in new housing are unlikely to raise ownership significantly in the short and medium term, because of credit conditions. But relaxing the constraints brings forward the date at which first-time buyers can enter the market. But this only brings a short-term benefit. Long-run sustainable home ownership still depends on increases in housing supply.

Finally, as noted in the introductory chapter, models continuously change and there are a number of directions in which the affordability model could develop. There are two main strands of on-going research; the first deals with the incorporation of international migration flows, which are currently exogenous to the model. In particular, work is investigating whether migrant housing demands differ from domestic residents. Second, further work is being undertaken on the determinants of the earnings distribution in each region. However, there are a number of additional research possibilities for the longer term.

First, the regional spatial structure is taken as given. But a finer spatial scale of analysis would open up a rich set of further issues. Within regions lies a multiplicity of inter-linked local housing sub-markets, distinguished by housing type and neighbourhood, for example. Defining the spatial dimensions of housing sub markets is notoriously difficult and it is unlikely ever to be feasible to construct a local housing model for the country as a whole along the lines of our regional model. Nevertheless, there may be a case for modelling a sample of sub markets, for example, a selection of urban and rural areas. Modelling at the aggregate regional scale disguises different problems faced by communities.

Second, and related to the sub-market theme, the supply side of the model, i.e. new housing construction remains simple. New construction is the main policy instrument to improve affordability and, as such, is exogenous. But our understanding of the factors that drive new private sector supply, and how builders respond to incentives, remains limited. As an exogenous variable, in the longer term, supply does not respond to rates of return or observed changes in vacancy and demolition rates. In this sense, the model could be considered as short-run, despite the length of the time frame used in simulation, and outcomes are conditional on the size of the housing stock. It would be valuable to understand better the reasons for the fall in housing supply elasticities since the nineties, noted in the Barker Review and to build the regulatory system directly into the model. Also it would be valuable to model the changes in the distribution of types of new dwellings, which have taken place in recent years. For example, most regions have experienced an increase in the share of flats.

Third, the model suggests that credit conditions are an important part of the explanation of declining rates of homeownership amongst the youngest cohorts. However, the treatment of housing finance in the model is limited. For example, there is no attempt to model the institutional structure of mortgage markets and how this affects deposit requirements and income multiples. Furthermore, questions of the ability of young households to achieve home-ownership are now closely tied into inter-generational wealth transfers. At one level, this is linked to the ability of households to raise a deposit through parental gifts. But the issues are wider.

Fourth, most research for the model has concentrated on the housing requirements for younger households. However, an increasingly important issue for the future will be the housing requirements of an ageing population.

Finally, more research on the relationship between rents, housing asset prices and the user cost would be desirable. The model adopts simplifying assumptions necessary to maintain tenure shares in the long run. Historically, because of rental controls, obtaining high quality data on free market rents in this country was difficult and, therefore, the relationships were difficult to test. But the expansion of the private rental market since the mid-nineties opens up the prospect that more research will be feasible in the future.

Appendix 1: The Tenure Equations

The variables in the following table are used in the probit equations for each of the age groups below.

The Determinants of Tenure Choice

Variables	Definition
headage	age of head
headagesq	age of head squared
nchild	no. of children
Imaritals-1	spouse present and married
Imaritals-2	spouse present and cohabiting
Iheadmale	male head of household
rahincome	real household income (£1,000)
ImodW3C	Indicator of binding deposit constraint (0,1)
ImodY3C	Indicator of binding income multiple constraint (0,1)
rsrs	real social rents (£1,000)
UCC	housing user cost (£1,000)
rrent	real private rents (£1,000)
relrsrs	rsrs – rrent
SOUTH	Southern Regions (London, SE, EA, SW)
SOUTHRELRSRS	SOUTH*relrsrs
Illoo	In owner occupation in the previous period
Ilsrs	In social renting in the previous period
Illoun	Regional unemployment rate
Iregion, Iyear	Region and time dummies (London is the default)

Age Group 20-39

Probit model with sample selection

Number of obs = 10760
Wald chi2(24) = 627.87
Log pseudolikelihood = –2118.611
Prob > chi2 = 0.0000

(Std. Err. adjusted for 2029 clusters in pid)

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRS						
_Imaritals~1	-.3862556	.1475167	-2.62	0.009	-.6753831	-.0971281
_Imaritals~2	-.6587854	.144766	-4.55	0.000	-.9425215	-.3750492
nchild	-.2633698	.0437777	-6.02	0.000	-.3491724	-.1775671
relrsrs	.5630189	.1490939	3.78	0.000	.2708002	.8552376
SOUTHRELRSRS	-.4461815	.1321135	-3.38	0.001	-.7051192	-.1872439
rahincome	.0362085	.0118114	3.07	0.002	.0130586	.0593584
_Ilsrs_1	-2.24149	.1118524	-20.04	0.000	-2.460717	-2.022263
_Iregion_3	-.235173	.1853999	-1.27	0.205	-.5985501	.128204
_Iregion_4	-.1858673	.2519346	-0.74	0.461	-.67965	.3079153
_Iregion_6	.5081146	.3691341	1.38	0.169	-.2153749	1.231604
_Iregion_7	.7268218	.4896101	1.48	0.138	-.2327964	1.68644
_Iregion_9	.309087	.3629644	0.85	0.394	-.4023102	1.020484
_Iregion_12	.5526323	.4015803	1.38	0.169	-.2344505	1.339715
_Iregion_15	.2776147	.3977506	0.70	0.485	-.5019622	1.057192
_Iyear_93	-.1636161	.190791	-0.86	0.391	-.5375597	.2103275
_Iyear_94	.3852761	.2364123	1.63	0.103	-.0780835	.8486356
_Iyear_95	.6256439	.2177403	2.87	0.004	.1988807	1.052407
_Iyear_96	.6466834	.2214474	2.92	0.003	.2126545	1.080712
_Iyear_97	.5866472	.2112057	2.78	0.005	.1726916	1.000603
_Iyear_98	.2969046	.2112833	1.41	0.160	-.117203	.7110122
_Iyear_99	.4148454	.1929583	2.15	0.032	.036654	.7930368
_Iyear_100	.2792461	.2343637	1.19	0.233	-.1800984	.7385905
_Iyear_101	.2535511	.2150305	1.18	0.238	-.1679009	.6750031
_Iyear_102	.6689361	.2555974	2.62	0.009	.1679745	1.169898
_cons	.8572983	.3433667	2.50	0.013	.184312	1.530285
nothomeown						
_Imaritals~1	-.5791168	.1067575	-5.42	0.000	-.7883577	-.3698759
_Imaritals~2	-.4663289	.1115581	-4.18	0.000	-.6849787	-.2476792
nchild	.0614654	.0297596	2.07	0.039	.0031377	.1197932
rahincome	-.0087143	.0065048	-1.34	0.180	-.0214634	.0040348
UCC	.4506131	.0501041	8.99	0.000	.3524109	.5488153
rrent	-.6476139	.0397058	-16.31	0.000	-.7254359	-.5697919
_ImodW3C_1	.5796116	.0892158	6.50	0.000	.4047519	.7544713
_ImodY3C_1	.594727	.1589363	3.74	0.000	.2832175	.9062365
_Iloo_1	-2.334171	.079913	-29.21	0.000	-2.490798	-2.177545
_Iheadmale_1	-.088504	.0704607	-1.26	0.209	-.2266045	.0495965
lloun	-.0954566	.0539761	-1.77	0.077	-.2012478	.0103346
_Iregion_3	-.8792557	.2990344	-2.94	0.003	-1.465352	-.2931591
_Iregion_4	-1.443472	.3212955	-4.49	0.000	-2.0732	-.8137449
_Iregion_6	-1.832719	.3450203	-5.31	0.000	-2.508947	-1.156492
_Iregion_7	-1.878633	.2662473	-7.06	0.000	-2.400468	-1.356798
_Iregion_9	-1.985992	.2828285	-7.02	0.000	-2.540325	-1.431658
_Iregion_12	-1.832166	.3099104	-5.91	0.000	-2.43958	-1.224753
_Iregion_15	-1.382236	.2543178	-5.44	0.000	-1.880689	-.883782
_Iyear_93	.2055525	.1198366	1.72	0.086	-.0293229	.4404279
_Iyear_94	1.273524	.1661516	7.66	0.000	.9478733	1.599176
_Iyear_95	1.117439	.1670365	6.69	0.000	.7900539	1.444825
_Iyear_96	1.472818	.2091865	7.04	0.000	1.06282	1.882816
_Iyear_97	.8064885	.2188505	3.69	0.000	.3775493	1.235428

	Coef.	Robust Std. Err.	z	P> l z l	[95% Conf.	Interval]
_lyear_98	.2972877	.2376994	1.25	0.211	-.1685946	.7631701
_lyear_99	.5666545	.2540624	2.23	0.026	.0687013	1.064608
_lyear_100	.3285201	.2684908	1.22	0.221	-.1977123	.8547525
_lyear_101	.7021544	.2860919	2.45	0.014	.1414245	1.262884
_lyear_102	.8087155	.2675215	3.02	0.003	.284383	1.333048
_cons	2.54902	.9306644	2.74	0.006	.7249517	4.373089
/athrho	1.08107	.1245022	8.68	0.000	.8370503	1.32509
rho	.7935956	.0460915			.6842435	.8680442

Age Group 40-59

Probit model with sample selection	Number of obs	=	14385
	Wald chi2(24)	=	451.48
Log pseudolikelihood = –1125.994	Prob > chi2	=	0.0000

(Std. Err. adjusted for 2298 clusters in pid)

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRS						
_Imaritals~1	-.3624659	.1817137	-1.99	0.046	-.7186183	-.0063136
_Imaritals~2	-.2762198	.2767433	-1.00	0.318	-.8186267	.2661871
nchild	-.1176934	.054362	-2.16	0.030	-.224241	-.0111458
relrsrs	.2520451	.18233	1.38	0.167	-.1053151	.6094053
SOUTHRELRSRS	-.0580868	.1639664	-0.35	0.723	-.379455	.2632814
rahincome	.0442983	.0165071	2.68	0.007	.011945	.0766517
_Ilsrs_1	-3.181236	.2108743	-15.09	0.000	-3.594542	-2.76793
_Iregion_3	.106943	.2184091	0.49	0.624	-.321131	.535017
_Iregion_4	-.1238355	.2968512	-0.42	0.677	-.7056532	.4579822
_Iregion_6	.0310534	.422167	0.07	0.941	-.7963787	.8584856
_Iregion_7	-.5540409	.4852137	-1.14	0.254	-1.505042	.3969605
_Iregion_9	-.698777	.4270375	-1.64	0.102	-1.535755	.1382011
_Iregion_12	-.7520184	.4986178	-1.51	0.132	-1.729291	.2252546
_Iregion_15	-.2818168	.4198134	-0.67	0.502	-1.104636	.5410024
_Iyear_93	-.4418055	.3010435	-1.47	0.142	-1.03184	.1482289
_Iyear_94	.2673752	.2690931	0.99	0.320	-.2600376	.7947879
_Iyear_95	.2511269	.2599896	0.97	0.334	-.2584434	.7606973
_Iyear_96	-.55394	.2831697	-1.96	0.050	-1.108942	.0010624
_Iyear_97	.1635018	.2774921	0.59	0.556	-.3803728	.7073765
_Iyear_98	.2005384	.2567372	0.78	0.435	-.3026573	.7037341
_Iyear_99	-.1237935	.3155404	-0.39	0.695	-.7422412	.4946542
_Iyear_100	-.3462796	.2662279	-1.30	0.193	-.8680766	.1755175
_Iyear_101	.1481982	.2804758	0.53	0.597	-.4015242	.6979206
_Iyear_102	.1973793	.3217355	0.61	0.540	-.4332107	.8279694
_cons	1.440063	.4256575	3.38	0.001	.6057899	2.274337
nothomeown						
headage	-.2573231	.1090053	-2.36	0.018	-.4709696	-.0436765
headagesq	.0025907	.0010933	2.37	0.018	.0004478	.0047335
_Imaritals~1	-.2723898	.141716	-1.92	0.055	-.5501481	.0053686
_Imaritals~2	.0946911	.2017497	0.47	0.639	-.3007309	.4901132
rahincome	-.0122691	.0085933	-1.43	0.153	-.0291116	.0045734
UCC	.3539106	.0807142	4.38	0.000	.1957137	.5121076
rrent	-.6843327	.065266	-10.49	0.000	-.8122517	-.5564137
_Iloo_1	-3.482102	.1179435	-29.52	0.000	-3.713267	-3.250937
lloun	-.2433731	.058358	-4.17	0.000	-.3577527	-.1289935
_Iregion_3	-1.719322	.3550864	-4.84	0.000	-2.415279	-1.023366
_Iregion_4	-2.571994	.3743136	-6.87	0.000	-3.305635	-1.838353
_Iregion_6	-2.758991	.4037626	-6.83	0.000	-3.550351	-1.967631
_Iregion_7	-2.474502	.3278132	-7.55	0.000	-3.117004	-1.832
_Iregion_9	-2.556238	.3411352	-7.49	0.000	-3.224851	-1.887626
_Iregion_12	-2.393458	.3601108	-6.65	0.000	-3.099262	-1.687654
_Iregion_15	-1.725953	.3375124	-5.11	0.000	-2.387465	-1.06444
_Iyear_93	-.1242426	.1451135	-0.86	0.392	-.4086598	.1601747
_Iyear_94	.8754759	.2394149	3.66	0.000	.4062313	1.34472
_Iyear_95	.7617539	.2613883	2.91	0.004	.2494422	1.274066
_Iyear_96	1.05285	.3049634	3.45	0.001	.4551324	1.650567
_Iyear_97	.2323251	.2794619	0.83	0.406	-.3154102	.7800603
_Iyear_98	-.2507849	.2689986	-0.93	0.351	-.7780124	.2764426
_Iyear_99	.0783699	.2979526	0.26	0.793	-.5056066	.6623463

	Coef.	Robust Std. Err.	z	P> | z |	[95% Conf.	Interval]
_Iyear_100	-.4315679	.3085024	-1.40	0.162	-1.036222	.1730857
_Iyear_101	-.1778857	.3399739	-0.52	0.601	-.8442223	.4884509
_Iyear_102	.2252109	.3252742	0.69	0.489	-.4123148	.8627366
_cons	12.47509	2.891181	4.31	0.000	6.808478	18.1417
/athrho	.6226962	.2624645	2.37	0.018	.1082752	1.137117
rho	.5530025	.1821998			.107854	.8134411

Age Group 60+

Probit model with sample selection

Log pseudolikelihood = –761.6014

Number of obs	=	10562
Wald chi2(21)	=	577.08
Prob > chi2	=	0.0000

(Std. Err. adjusted for 1490 clusters in pid)

	Coef.	Robust Std. Err.	z	P> l z l	[95% Conf.	Interval]
PRS						
nchild	-.4242258	.121486	-3.49	0.000	-.6623339	-.1861177
rahincome	.0250947	.0139003	1.81	0.071	-.0021493	.0523387
_Ilsrs_1	-3.138296	.1835342	-17.10	0.000	-3.498017	-2.778576
_Iheadmale_1	-.2394267	.1342925	-1.78	0.075	-.5026352	.0237819
_Iregion_3	.1789501	.1670708	1.07	0.284	-.1485026	.5064029
_Iregion_4	.000348	.2342593	0.00	0.999	-.4587918	.4594877
_Iregion_6	-.1364571	.2227489	-0.61	0.540	-.5730369	.3001227
_Iregion_7	-.2460694	.251557	-0.98	0.328	-.7391121	.2469733
_Iregion_9	-.5110795	.3425481	-1.49	0.136	-1.182461	.1603024
_Iregion_12	-.2907376	.2606931	-1.12	0.265	-.8016867	.2202115
_Iregion_15	-.4298864	.2569569	-1.67	0.094	-.9335127	.0737398
_Iyear_93	-.0098999	.3481714	-0.03	0.977	-.6923034	.6725036
_Iyear_94	-.5648851	.3428454	-1.65	0.099	-1.23685	.1070795
_Iyear_95	-.0407118	.2911939	-0.14	0.889	-.6114414	.5300177
_Iyear_96	-.1756722	.2980899	-0.59	0.556	-.7599178	.4085733
_Iyear_97	-.0916027	.2796517	-0.33	0.743	-.63971	.4565045
_Iyear_98	-.1764421	.2427905	-0.73	0.467	-.6523027	.2994185
_Iyear_99	.0478446	.2798239	0.17	0.864	-.5006002	.5962895
_Iyear_100	-.2330903	.2444083	-0.95	0.340	-.7121217	.2459411
_Iyear_101	.2634857	.2635102	1.00	0.317	-.2529848	.7799562
_Iyear_102	-.192343	.2684767	-0.72	0.474	-.7185476	.3338616
_cons	.9807807	.306511	3.20	0.001	.3800301	1.581531
nothomeown						
headage	-.2222441	.1280093	-1.74	0.083	-.4731377	.0286495
headagesq	.0015146	.0008869	1.71	0.088	-.0002238	.0032529
rahincome	-.0470535	.010767	-4.37	0.000	-.0681564	-.0259506
UCC	.6059272	.0891009	6.80	0.000	.4312927	.7805617
rrent	-.7450923	.0629744	-11.83	0.000	-.8685198	-.6216647
_Iloo_1	-3.772672	.1521057	-24.80	0.000	-4.070794	-3.47455
lloun	-.1960364	.0947325	-2.07	0.039	-.3817088	-.010364
_Iregion_3	-.7072187	.5923128	-1.19	0.232	-1.868131	.4536931
_Iregion_4	-1.61752	.5969233	-2.71	0.007	-2.787468	-.4475723
_Iregion_6	-1.47562	.6166811	-2.39	0.017	-2.684293	-.2669474
_Iregion_7	-1.107041	.484232	-2.29	0.022	-2.056119	-.157964
_Iregion_9	-1.369424	.5462178	-2.51	0.012	-2.439991	-.2988566
_Iregion_12	-1.227725	.5632468	-2.18	0.029	-2.331669	-.1237819
_Iregion_15	-.89795	.478417	-1.88	0.061	-1.83563	.0397301
_Iyear_93	.4339941	.1811502	2.40	0.017	.0789462	.7890419
_Iyear_94	1.624607	.2861557	5.68	0.000	1.063752	2.185462
_Iyear_95	1.734168	.3040267	5.70	0.000	1.138287	2.33005
_Iyear_96	1.581205	.4407174	3.59	0.000	.7174145	2.444995
_Iyear_97	.8684477	.3461547	2.51	0.012	.1899969	1.546898
_Iyear_98	.2408472	.4274805	0.56	0.573	-.5969992	1.078694
_Iyear_99	.7786878	.4850573	1.61	0.108	-.1720069	1.729383
_Iyear_100	.1138931	.452296	0.25	0.801	-.7725908	1.000377
_Iyear_101	.4126077	.485537	0.85	0.395	-.5390273	1.364243
_Iyear_102	.8010617	.4646833	1.72	0.085	-.1097008	1.711824
_cons	11.35014	4.431764	2.56	0.010	2.664043	20.03624
/athrho	.2927256	.1331244	2.20	0.028	.0318065	.5536447
rho	.2846416	.1223386			.0317958	.5032469

Appendix 2: Equations to Determine the Model Long-Run Equilibrium

The Variables in the Hedonic Equations

Variables	**Definition**
norooms	Number of rooms in the property
Detach	Dummy = 1 if detached property
Semidet	Dummy = 1 if semi-detached property
Terrace	Dummy = 1 if terraced property
newdwel	Dummy = 1 if newly-built property
age19-39	Dummy = 1 if property built between 1919 and 1939
age40-60	Dummy = 1 if property built between 1940 and 1960
age61-80	Dummy = 1 if property built between 1961 and 1980
agepost80	Dummy = 1 if property built after 1980
yr1999	Dummy = 1 if observation in 1999
yr2001	Dummy = 1 if observation in 2001

Table 2.1 Hedonic Price Equation: Pooled Data, 1997, 1999, 2001 (local authority dummy variables are excluded from the table)

London			**E Midlands**		
	Coefficient	**t-value**		**Coefficient**	**t-value**
(Constant)	11.006	433.99	(Constant)	9.819	275.17
norooms	0.120	34.98	norooms	0.126	38.48
detach	0.611	27.93	detach	0.622	26.64
semidet	0.330	21.09	semidet	0.223	9.75
terrac	0.203	16.28	terrac	0.021	0.93
newdwel	0.082	3.83	newdwel	0.090	5.46
age19-39	-0.162	-12.56	age19-39	-0.085	-5.11
age40-60	-0.311	-18.31	age40-60	-0.177	-10.59
age61-80	-0.297	-17.60	age61-80	-0.125	-8.22
agepost80	-0.119	-7.26	agepost80	-0.049	-3.39
yr1999	0.358	34.70	yr1999	0.140	13.24
yr2001	0.707	56.84	yr2001	0.385	33.36
South East			**W Midlands**		
(Constant)	10.182	560.03	(Constant)	10.176	348.73
norooms	0.111	59.25	norooms	0.115	32.66
detach	0.655	60.24	Detach	0.578	26.31
semidet	0.304	29.66	semidet	0.194	9.46
terrac	0.161	16.99	Terrace	-0.041	-2.01
newdwel	0.048	4.21	newdwel	0.126	6.65

Table 2.1 Hedonic Price Equation: Pooled Data, 1997, 1999, 2001 (local authority dummy variables are excluded from the table)

South East			**W Midlands**		
	Coefficient	**t-value**		**Coefficient**	**t-value**
age19-39	-0.108	-10.43	age19-39	-0.111	-6.41
age40-60	-0.189	-18.38	age40-60	-0.184	-10.50
age61-80	-0.156	-17.61	age61-80	-0.133	-8.17
agepost80	-0.116	-12.67	agepost80	-0.018	-1.07
yr1999	0.268	37.69	yr1999	0.140	12.95
yr2001	0.593	71.35	yr2001	0.381	30.44
East			**Yorkshire and Humberside**		
(Constant)	9.909	338.09	(Constant)	9.970	293.77
norooms	0.122	42.76	norooms	0.136	40.62
detach	0.609	37.58	Detach	0.442	18.13
semidet	0.288	18.21	semidet	0.068	2.88
terrac	0.120	8.03	Terrace	-0.157	-6.78
newdwel	0.065	4.25	newdwel	0.134	7.65
age19-39	-0.123	-7.60	age19-39	-0.059	-3.75
age40-60	-0.201	-13.09	age40-60	-0.146	-8.56
age61-80	-0.179	-13.72	age61-80	-0.061	-3.98
agepost80	-0.119	-9.15	agepost80	0.003	0.19
yr1999	0.174	14.50	yr1999	0.092	8.33
yr2001	0.520	40.29	yr2001	0.245	20.58
South West			**North West**		
(Constant)	10.376	493.25	(Constant)	10.305	336.02
norooms	0.119	44.39	norooms	0.136	40.23
detach	0.509	32.80	Detach	0.427	19.51
semidet	0.162	10.73	semidet	0.060	2.91
terrac	0.015	1.04	Terrace	-0.211	-10.48
newdwel	-0.016	-1.10	newdwel	0.160	9.81
age19-39	-0.138	-9.18	age19-39	-0.054	-3.64
age40-60	-0.220	-15.06	age40-60	-0.124	-7.56
age61-80	-0.174	-14.12	age61-80	-0.044	-2.97
agepost80	-0.135	-11.56	agepost80	0.029	1.89
yr1999	0.205	21.02	yr1999	0.106	10.66
yr2001	0.534	46.78	yr2001	0.296	26.25
North East					
(Constant)	9.635	187.27			
norooms	0.157	26.53			
detach	0.517	16.42			
semidet	0.188	6.67			
terrac	-0.020	-0.74			
newdwel	0.163	5.54			
age19-39	-0.134	-5.11			
age40-60	-0.252	-9.36			
age61-80	-0.056	-2.25			
agepost80	0.114	4.26			
yr1999	0.140	7.77			
yr2001	0.263	13.03			

Table 2.2 Modelling Vacancies (more than six months)

Dependent Variable: VAC
Included observations: 310

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-344.0854	99.90553	-3.444107	0.0007
VAC(-1)	0.560527	0.042898	13.06665	0.0000
IMD(-1)	6.663811	3.035397	2.195368	0.0289
ΔUP(-1)	156.9278	132.0186	1.188680	0.2355
HS(-1)	0.008469	0.001432	5.914437	0.0000
(HS-HH)(-1)	0.033157	0.010656	3.111732	0.0020
DUMNW	198.7301	82.14032	2.419398	0.0161
DUMWM	153.6739	90.75966	1.693196	0.0914

R-squared	0.808542	Mean dependent var	893.9935
Adjusted R-squared	0.804105	S.D. dependent var	998.1961
S.E. of regression	441.8022		

DUMNW, DUMWM are dummy variables for the NW and WM. These were insignificant in the other regions. Remaining variables are defined in the main text.

Table 2.3 Modelling Vacancies (more than six months) – Alternative Form

Dependent Variable: ΔVAC
Included observations: 310

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.486379	43.76429	-0.011114	0.9911
(VAC-VAC*)(-1)	-0.439528	0.042489	-10.34462	0.0000
ΔUP(-1)	157.0110	103.1454	1.522231	0.1290
(HS-HH)(-1)	0.033093	0.008677	3.813916	0.0002
DUMWM	153.6085	87.33242	1.758895	0.0796
DUMNW	198.7797	77.94000	2.550419	0.0112

R-squared	0.280923	Mean dependent var	-4.680645
Adjusted R-squared	0.269096	S.D. dependent var	515.0679
S.E. of regression	440.3466		

Remaining variables are defined in the main text.

Table 2.4 Modelling Vacancies (less than six months)

Dependent Variable: VAC – short term
Included observations: 305 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	227.4054	60.94968	3.731036	0.0002
VAC – short term (-1)	0.588307	0.035782	16.44159	0.0000
HS(-1)	0.001433	0.000723	1.981970	0.0484
(HS-HH)(-1)	0.033552	0.011913	2.816442	0.0052
DUMWM	-222.5154	103.4615	-2.150706	0.0323
DUMNW	-218.0787	92.34019	-2.361688	0.0188
DUMEM	-184.2574	98.44058	-1.871763	0.0622

R-squared	0.653208	Mean dependent var	873.5836
Adjusted R-squared	0.646225	S.D. dependent var	873.4594
S.E. of regression	519.5245		

DUMNW, DUMWM, DUMEM are dummy variables for the NW, WM and EM. Remaining variables are defined in the main text.

Table 2.5 Modelling Holiday Homes

Dependent Variable: HOLIDAY
Method: ML – Binary Probit (Quadratic hill climbing)
Included observations: 11238 after adjustments

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Constant	-11.00294	0.763209	-14.41667	0.0000
NW	0.522690	0.272750	1.916373	0.0553
YH	0.430454	0.285050	1.510099	0.1310
EM	0.232349	0.297404	0.781255	0.4347
WM	0.500633	0.278381	1.798372	0.0721
EAST	0.533909	0.272894	1.956473	0.0504
GL	0.846673	0.266258	3.179897	0.0015
SW	0.586188	0.272993	2.147265	0.0318
SE	0.610016	0.263955	2.311058	0.0208
MALE	-0.091931	0.083877	-1.096024	0.2731
MARRIED	0.243535	0.125366	1.942592	0.0521
SINGLE	0.231047	0.177179	1.304030	0.1922
ln(Income)	0.504907	0.049021	10.29986	0.0000
AGE	0.092186	0.019120	4.821508	0.0000
AGE^2	-0.000650	0.000173	-3.756130	0.0002

S.E. of regression	0.121689	Akaike info criterion	0.140475
LR statistic (14 df)	247.0945	McFadden R-squared	0.137599
Obs with Dep=0	11064	Total obs	11238
Obs with Dep=1	174		

Table 2.6 Right to Buy Sales

Dependent Variable: ln(RTB/LAST)
Method: Pooled Least Squares
Sample: 1992 2005
Total pool (balanced) observations: 126

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.593830	0.304968	1.947187	0.0540
Ln(RTB/LAST)(-1)	0.868007	0.071295	12.17492	0.0000
Δln(PH/P)	1.166394	0.386478	3.018009	0.0032
ln(PH/P)(-1)	-0.641676	0.148517	-4.320539	0.0000
DISC	0.865733	0.536490	1.613698	0.1094
RBM	-0.133052	0.028872	-4.608344	0.0000
Fixed Effects				
NE	0.116621		E	-0.084166
NW	0.074886		GL	-0.100572
YH	0.095916		SE	-0.089235
EM	0.052554		SW	-0.092414
WM	0.026410			

R-squared	0.811957	Mean dependent var	2.650873
Adjusted R-squared	0.790130	S.D. dependent var	0.428465
S.E. of regression	0.196286		

Variables are defined in the main text, except RTB = number of Right-to-Buy sales and LAST = local authority housing stock, measured in numbers of units.

Table 2.7 Right to Buy Sales – Restricted Version

Dependent Variable: ln(RTB/LAST)
Method: Pooled Least Squares
Sample: 1992 2005
Total pool (balanced) observations: 126

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	1.219321	0.228644	5.332826	0.0000
ln(RTB/LAST)(-1)	0.636748	0.071344	8.925099	0.0000
COST	-0.134961	0.029517	-4.572326	0.0000
Fixed Effects				
NE	0.078238		E	-0.008849
NW	-0.023683		GL	-0.043026
YH	0.020519		SE	-0.028203
EM	0.027305		SW	-0.056123
WM	0.033823			

R-squared	0.677900	Mean dependent var	2.650873
Adjusted R-squared	0.649891	S.D. dependent var	0.428465
S.E. of regression	0.253522		

References

Andrew, M. (2005) " The Changing Route to Owner Occupation: Household Formation and the Impact of Borrowing Constraints on Young Adult Homeownership in Britain", *University of Reading, mimeo*.

Andrew, M. and G. Meen (2003). "Housing Transactions and the Changing Decisions of Young Households in Britain: The Microeconomic Evidence". *Real Estate Economics*, 31(1): 117-138.

Andrew, M. and M. White (2006) "Explaining the Route to Owner Occupation: The Role of Transactions Costs", *University of Reading, mimeo*.

Barker, K. (2004). *Review of Housing Supply: Final Report – Recommendations.* (London. HMSO).

Brueckner, J.K. (1980), "Residential Succession and Land-Use Dynamics in a Vintage Model of Urban Housing", *Regional Science and Urban Economics*, 10: 225-240.

Brueckner, J.K. and S.S. Rosenthal (2005), "Gentrification and Neighborhood Housing Cycles: Will America's Future Downtowns Be Rich?", *mimeo.*

Buckley, R and J. Ermisch (1982), "Government Policy and House Prices in the United Kingdom. An Econometric Analysis", *Oxford Bulletin of Economics and Statistics*, 44(4): 273-304.

CM 7191 (2007), *Homes for the Future: More Affordable, More Sustainable*. CLG. London.

Dye, R.F. and D.P. McMillen (2007), "Teardowns and Land Values in the Chicago Metropolitan Area", *Journal of Urban Economics*, 61(1): 45-63.

Ebrill, L.P. and U.M. Possen (1982), "Inflation and the Taxation of Equity in Corporations and Owner-Occupied Housing", *Journal of Money, Credit and Banking*, XIV(1): 33-47.

Flatau, P., Hendershott, P., Ong, R., and G. Wood (2006), "Divorce, Separation and Homeownership in Australia", *mimeo.*

Galster, G. (1996), "William Grigsby and the Analysis of Housing Sub-Markets and Filtering", *Urban Studies*, 33(10): 1797-1805.

Grigsby, W.G. (1963), *Housing Markets and Public Policy*. University of Pennsylvania Press. Philadelphia.

Grigsby, W., Baratz, M., Galster, G., and D. Maclennan (1987), *The Dynamics of Neighbourhood Change and Decline*. Pergamon. Oxford.

Harmon, O.R., and M.J. Potepan (1988), "Housing Adjustment Costs: Their impact on Mobility and Housing Demand Elasticities", *AREUEA Journal*, 16(4): 459-492.

Haurin, D.R., and H.L. Gill (2002), "The Impact of Transactions costs and the Expected Length of Stay in Homeownership", *Journal of Urban Economics*. 51: 563-584.

Haurin, D.R., P.H. Hendershott, and D. Kim. (1994). "Housing Decisions of American Youth." *Journal of Urban Economics* 35: 28-44.

Haurin, D., P. Hendershott, and S. Wachter. (1997). "Borrowing Constraints and the Tenure Choice of Young Households. *Journal of Housing Research* 8(2): 137-154.

Helms, A.C. (2003), "Understanding Gentrification: An Empirical Analysis of the Determinants of Urban Housing Renovation", *Journal of Urban Economics*, 54: 474-498.

Hendershott, P.H. and S.C. Hu (1981), "The Allocation of Capital Between Residential and Non-Residential Uses, Taxes, Inflation and Credit Market Constraints", *Journal of Finance*, XXXVIII(3): 795-812.

Henderson, J.V. and Y.M. Ioannides (1983), "A Model of Housing Tenure Choice", *American Economic Review*, 73(1): 98-113.

Kau, J.B. and D. Keenan (1983), "Inflation, Taxes and Housing: A Theoretical Analysis", *Journal of Public Economics*, 21(1): 93-104.

Kintrea, K. (2005). "Visions of Housing Futures: Incipient Obsolescence?" *paper presented to the Housing Studies Association Conference, University of York.*

McGrath, D.T. (2000), "Urban Industrial Land Redevelopment and Contamination Risk", *Journal of Urban Economics*, 47: 414-442.

Malpezzi, S.and R.K. Green (1996), "What Has Happened to the Bottom of the US Housing Market?", *Urban Studies*, 33(10): 1807-1820.

Megbolugbe, I.F., Hoek-Smit, M.C., and P.D. Linneman (1996), *Urban Studies*, 33(10): 1779-1795.

Meen, G.P. (2007), "Ten New Propositions in UK Housing Macroeconomics: An Overview of the First Years of the Century", forthcoming *Urban Studies*.

Meen, G.P. (2005), "On the Economics of the Barker Review of Housing Supply", *Housing Studies* 20(6): 949-971.

Meen, G.P. (1989), "The Ending of Mortgage Rationing and its Effects on the Housing Market: A Simulation Study." *Urban Studies* 26(2): 240-252.

Meen, G.P. and M Andrew (2007), "Planning for Housing in the Post-Barker Era: Affordability, Household Formation and Tenure Choice", *forthcoming Oxford Review of Economic Policy*.

Meen, G. P. and others, (2005). *Affordability Targets: Implications for Housing Supply. Technical Appendix*. ODPM.

Muellbauer, J., and A. Murphy. (1997). " Booms and Busts in the UK Housing Market." *Economic Journal* 107(445): 1701-1727.

Munneke, H.J. (1996), "Redevelopment Decisions for Commercial and Industrial Properties", *Journal of Urban Economics*, 39: 229-253.

National Housing and Planning Advice Unit (NHPAU), (2007), *Developing a Target Range for the Supply of New Homes Across England*.

ODPM (2005). *Affordability: Implications for Housing Supply*. London. ISBN: 1851127992.

Rosen, H.S. and K.T. Rosen (1980), "Federal Taxes and Homeownership: Evidence from Time-Series". *Journal of Political Economy*, 88(1): 59-75.

Rosenthal, S.S. and R.W. Helsley (1994), "Redevelopment and the Urban Land Price Gradient", *Journal of Urban Economics*, 35: 182-200.

Summers, L.H. (1981), "Inflation, the Stock Market and Owner-Occupied Housing", *American Economic Review, Papers and Proceedings*, 429-434.

Swan, C. (1984), "A Model of Rental and Owner-Occupied Housing", *Journal of Urban Economics*, 16(3): 297-316.

Webster, C. and L. Wai-Chung Lai (2003), *Property Rights, Planning and Markets*. Edward Elgar. Cheltenham. UK.

Wheaton, W.C. (1982), "Urban Residential Growth Under Perfect Foresight", *Journal of Urban Economics*, 12: 1-21.

Wood, G. (2001), "Are there Tax Arbitrage Opportunities in Private Rental Housing Markets?", *Journal of housing Economics*, 10: 1-20.

Wood, G., Watson, R., and P. Flatau (2006), "Microsimulation Modelling of Tenure Choice and Grants to Promote Home Ownership", *Australian Economic Review*, 30(1): 14-34.

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