ACCEPTED VERSION

Chris Leishman
Housing supply and suppliers: are the microeconomics of housing developers important? Proceedings of After the Crisis: Housing Policy and Finance in the U.S. and the U.K., as published in Housing Studies, 2015 / vol.30, iss.4, pp.580-600.

Housing supply and suppliers: are the microeconomics of housing developers important?

Chris Leishman, Heriot-Watt University, Edinburgh EH14 4AS
c.leishman@hw.ac.uk; +44 131 451 4609

Article published in *Housing Studies*: This is the author's final version before copy editing, as accepted for publication in *Housing Studies* and prepared for open access repository

Housing supply and suppliers: are the microeconomics of housing developers important?

Abstract

In this paper I review the US, UK and international literature on the responsiveness of housing supply to demand. This is a well developed area of the literature, but I put forward two new arguments: that developers face downward sloping demand curves in the housing market, and that housing developers as firms are sufficiently heterogenous that their output decisions cannot be generalised. I draw on the international literature but use the recent UK experience as a lens, arguing that the post Barker review planning policy and housing supply reforms did not yield as much additional housing supply as had been hoped and expected by policy markets and the housing development industry itself. After introducing two specific propositions, I present new statistical estimates that are at least highly suggestive that firm-specific factors are of importance in understanding supply responsiveness.

1. Introduction

It has long been recognised that the responsiveness of market-provided housing supply to changes in housing costs varies quite widely between countries. The relatively weak responsiveness of supply in the UK compared with the U.S. is probably the best documented example in the literature, but one recent study has found perhaps three groups of nations with similar degrees of supply responsiveness. The UK is an interesting case in that a concerted programme of planning policy and housing supply reform recently took place, granting an opportunity to examine the extent to which differences between the UK and other countries might be either structural, or the result of policy.

In this paper I provide an historical narrative that is at least suggestive that outcomes in the housing development industry and, consequently, the housing market, did not match the expectations of those setting the UK housing policy agenda in the period 2000-2010. I consider a set of casual, descriptive statistical evidence before introducing two propositions that might be important in developing our understanding of housing supply and affordability. One of these is essentially a new proposition – that developers face downward sloping demand curves in the housing market. The other is a development of ideas recently put forward by others – notably Ball et al (2010) – that the decisions of individual housing development companies may depend in part on firm-specific factors. In most studies of new housing supply hitherto, housing developers are implicitly assumed to be homogenous, each with identical behaviour in the housing and land markets.

In the next section I briefly introduce the salient features of the British planning system insofar as it concerns the economics of residential development land supply. In sections 3 and 4 I review the literature to succinctly set out what we already know, from economic theory and related empirical evidence, about the responsiveness of new housing supply. I then develop my main arguments about the potential importance of understanding housing development as an industry, and housing developers as firms. Section 5 reviews aggregate, descriptive evidence on the effects of planning policy reform on housing supply in the UK. Section 6 presents a series of econometric results designed to illuminate the propositions that I have tried to develop in this paper and section 7, of course, discusses the findings and makes suggestions for continuing the development of a research agenda.

2. The responsiveness of new supply to housing market pressure

In the UK, the majority of new housing completions are provided by speculative housing developers, most of whom operate simultaneously in the housing and land markets. Developers enjoy an uneasy relationship with the planning system, relying on it to aid in the identification of land with development potential and, ultimately, provide the planning permissions necessary to pursue development. An important

feature of the British planning system is its emphasis on flexibility rather than prescription. Development plans carry considerable weight, but are still essentially indicative rather than prescriptive: a developer submitting a planning application for land which is identified in a development plan as suitable for housing development cannot guarantee that permission will be obtained. This flexibility has been argued by some to create uncertainty, and to promote 'rent seeking behaviour', or the expenditure of resources by developers in the hope of realising betterment (a rise in land value associated with the grant of planning permission or development rights). A number of studies in the late 1980s through the mid 1990s explored the notion that the planning system, by restricting the supply of housing development land, was slowing down the rate of development and pushing up housing prices (see, inter alia, Bramley, 1993; Bramley and Watkins, 1996; Cheshire and Sheppard, 1989; Evans, 1991, 1996).

Although the origins of the system date to the 19th century, the modern planning system was essentially designed in the immediate post war period and introduced by the 1947 Town and Country Planning Act. Subject to adaptation and modification rather than full-scale replacement periodically in the 20th century, critics began to argue quite strongly by the late 1990s that the system was no longer coping well with the pressure for urban development (Cullingworth, 1997). However, although the UK economy had recovered from a recession in 1991, the mid-1990s were a period of weak housing market activity. It was not until a change of Government in 1997, with significant policy reform and independent status conferred on the UK's central bank (the Bank of England) that economic and housing market activity began to accelerate. Thus, the very late 1990s and early 2000s were a period in which the planning system began to face fresh and much more significant challenges than hitherto. In a period of rising economic prosperity, falling real interest rates and population growth, the speculative housing development industry and its relationship with the planning system were about to become subject to great policy interest.

In March 2003 the UK Government commissioned the now much-cited Barker Review of Housing Supply and Affordability. The Review triggered a period of intense debate

concerning the relationships between the supply of housing and housing affordability on one hand, and between the planning system and the supply of new-build housing on the other. It also signalled the arrival of perhaps one of the most co-ordinated interplays between academic and policy research interests in the post-war period, at least within the fields of planning and housing economics. Almost immediately after the publication of the Barker (2004) report, the UK Government commissioned a series of research projects designed to lead to the creation of a set of 'policy tools' or simulation models drawing on formal econometric modelling of the housing system. The most prominent of these was a simulation model designed to give guidance about the likely future affordability of owner occupied housing based, in part, on projected rates of new-build housing completions (see Meen et al, 2005). In 2008, the Scottish Government added a similar simulation model to its suite of policy tools (see Leishman et al, 2008). Following a conceptual approach related to the Meen et al (2005) models, the Scottish model approach nevertheless reflected a number of important differences. In particular, the housing market was assumed to operate primarily at the sub-regional spatial level. By contrast, the initial estimations of the long-run model in England focused on the regional scale.

It is not a particularly bold claim that the significance of new supply to house price change, levels and housing affordability was under estimated in the UK prior to the Barker Review. Most published studies of the national and regional UK housing markets concentrated on cycles in housing demand and house prices. Most conceptualised house price growth as a function of lagged house values, real house price levels and real household incomes. The appearance of lagged price growth in models is often justified on the basis that it captures a momentum effect while coefficients on real house price and household income levels capture the long-run relationship between prices and earnings, with periodic tendency for the market to correct over-shoots. Indeed, during the past two decades econometric models of the housing market have become increasingly sophisticated in their treatment of house price dynamics, including accounting for the role of expectations and the estimation of co-integration or error correction models in an attempt to capture long-run

relationships (see, for example, Meen 1996, 1999, 2001; Meen et al 2005; Giussani and Hadjimatheou 1991; Muellbauer and Murphy 1997).

The Barker Review helped to stimulate interest in the further development of housing market models. In particular, the Review emphasised the potential for the supply of housing to influence the affordability of housing in the long run, irrespective of apparently weak relationships in the short-run. The Barker report (2004) reflected growing policy concern that the stock of dwellings in England did not generate a supply of housing adequate to meet the demands of households, nor future demands implied by rates of household formation. The Review also focused in particular on empirical evidence that new-build supply does not appear to be responsive to changes in house prices, even in the long-run. The perceived knock-on impacts of these phenomena were described by Barker as high long run real house price growth, associated with deteriorating affordability. Other economic impacts include rising latent housing demand as well as restricted labour mobility, which itself is then associated with poor regional housing and labour market adjustment. The key recommendations of the Barker reports focused particularly on the planning system, acknowledging that land supply is the main constraint to increasing the supply of housing. Among other things, the review proposed regional affordability targets and called for a stronger evidence base to monitor the levels of construction output required to deliver improved affordability.

3. What do economic theory and evidence tell us about housing supply responsiveness?

The price elasticity of new housing supply, meaning the responsiveness of supply to a change in the price of housing, is relatively low in the UK compared with some other countries – particularly the U.S. Barker (2004) concludes that the price elasticity of new housing supply averages around 0.3 in the UK, though with regional variations. Pryce (2003) finds evidence that elasticities differ between periods of housing market growth and slump (0.58 and 1.03 respectively). This is suggestive that the development industry is slower to contract than to expand, but that the capacity to

expand again is retained, at least to an extent, following a period of contraction. Malpezzi and Maclennan (2001) found, not only that UK elasticities are considerably lower than in the U.S., but that they were much lower, in both countries, post-war compared to the pre-war period (between 1.4 and 4.2 pre-war in the UK and 0.0 to 0.5 post-war compared with 4.4 to 10.4 pre-war and 1.1 to 12.7 post-war in the U.S.).

In fact, Caldera and Johansson (2013) describe the UK as belonging to a group of OECD countries that are characterised by low responsiveness of housing supply to housing market pressure. They found evidence to suggest that OECD countries belong to three groups characterised as 'highly responsive' (including the U.S., Canada, Sweden and Denmark), 'responsive' (New Zealand, Australia, Ireland, Norway and Spain) and 'unresponsive' (including the UK, Netherlands, Switzerland, Austria, Italy, Belgium, France). They go on to demonstrate some correlation (between -0.33 and -0.56) between population density / a regulation index, and supply responsiveness. Their regulation index is based on the number of days' delay involved in obtaining a building permit or similar.

Focusing more specifically on the UK, another strand of the literature deals with the possible impacts of the planning system on the supply of land suitable for housing development. It is probably fair to say that commentators are far further from agreement on this question than on the supply elasticity issue. However, it is not stretching the truth to state that there is acceptance that planning controls are at least part of the explanation for the lower price elasticity of supply in the UK compared, in particular, with the U.S. The scale of the effect is still subject to debate. Bramley (1993) argues that an increase in the supply of land with planning permission would primarily lead to an increase in housing construction, but with minimal impact on housing prices, a finding reiterated by Bramley and Watkins (1996) and Leishman & Bramley (2005). Cheshire & Sheppard (1989, 2004) suggest that the main impact of tight planning controls is on the density of housing development, although they also find evidence of a price effect. Evans (1991, 1996) argues that planning impacts most noticeably on housing quality and levels of consumption, rather than prices.

These strands of the literature deal with the responsiveness of new-build supply and the possible influences of planning controls very much in an aggregate sense. Turning to a disaggregated (microeconomic) analysis has the potential to allow us to pose certain questions of policy as well as theoretical interest: how do housing developers respond to housing market conditions? How does the availability of land, materials and finance shape firms' output levels and decisions on what to build and where? Some insights to these questions are already available from the literature. For example, there have been a number of studies of housing production, concerned mainly with the elasticity of substitution between land and non-land inputs to production (see, for example, Sirmans et al, 1979; Färe et al, 1981; McDonald, 1981). McDonald (1981) reviews a number of previous studies and shows that estimates of the elasticity of substitution (σ) vary considerably, but are generally less than one. Thorsnes (1997) points out that most previous studies use estimates of land value and that measurement error generally biases estimates of σ downwards. Using disaggregated data on 219 single development lots in Portland, he estimates σ using constant elasticity of substitution (CES) and variable elasticity of substitution (VES) specifications and finds that the estimates are not significantly different from one. More recently, Epple et al (2010) demonstrate that it is possible to estimate the housing production function in the absence of separately observed housing and land price, assuming constant returns to scale and constant elasticity of substitution.

Surprisingly, there are few equivalent published studies with a focus on the microeconomics of the housing development industry in the UK - most of the published work in this area has been focused on the U.S. One exception is a recent study published by Ball et al (2010) involving a test of whether supply elasticities vary between firms. This study used company level data derived from publicly quoted housebuilding companies in the UK. Although they examined whether interest rates or leverage ratios affected the supply elasticity of firms, they found that these variables were not statistically significant. Interestingly, they did report a substantial discontinuity between the performance of the top 11 firms and all other (smaller) firms in the industry. In particular, they noted that the largest firms seemed much better placed to take advantage of improved demand in the housing market

upswing. It is also interesting to note that these results, based on econometric analysis, appear at face value to conflict findings by Adams et al (2009) who report based on qualitative data that larger housing developers have a preference for altering the pricing of a housing development in progress rather than altering planned output if the level of demand proves lower or higher than expected at the outset of development. Taken together, these studies seem to suggest that larger developers are better placed to react to changes in demand at the aggregate or company level, than in a local context or on a specific development site.

It is also notable that few of the microeconomic studies referred to above have drawn on disaggregated data. Thorsnes (1997), Epple et al (2010) and Ball et al (2010) are recent exceptions. This paper is motivated as a contribution to a research agenda that reflects the heterogeneity of housing developers, land markets, housing markets, and the potential importance of sub-regional housing market context. The next section develops these ideas into more formal propositions before introducing a methodological approach and associated empirical work.

4. Two microeconomic propositions relevant to new housing supply

Housing developers are not homogenous firms as implicitly assumed in almost all macro, and some micro economic, studies. The behaviour of firms may vary for a number of reasons:

First, firms' land holdings differ (a well-documented reason for the high level of merger and takeover activity in the industry), so firms' assessments of the cost of land relative to non-land inputs may vary. In other words, from the perspective of a developer the cost of land may extend beyond the simple financial cost – land cannot necessarily be purchased immediately even at the going market price, but acquisition is also a matter of timing and involves internal costs such as the maintenance of a professional team dedicated to identifying land with development potential, acquiring it and securing planning permission. Thus, a firm with an abundant supply of land may very well assess the cost of this production input differently compared to

one struggling to acquire sufficient land with planning permission to maintain a planned level of output.

Second, capital intensity may differ between, for example, firms with a greater focus on higher density development compared with those focusing on lower density, housing development. To put this another way, for a given production technology, different firms may have a lower / higher emphasis on labour or capital inputs depending on the type, style or scale of development favoured by the firm.

Third, production technology may differ between firms, or firms may face more than one possible production function. For example, there may be a choice between off-site and on-site fabrication. Alternatively, some firms might have particularly well developed, stable and highly skilled workers compared with market norms.

Fourth, smaller firms may have more restricted access to capital, or more expensive lines of borrowing, than larger firms. Firms may also view the cost of capital differently depending on their balance between external borrowing and retained earnings as sources of investment capital.

The four aspects of the heterogeneity of housing developers noted above are doubtless not exhaustive but are sufficient to allow me to introduce my first testable proposition:

> Housing developers are not homogenous, and their decisions on what and how much to build depends in part on their land holdings and costs of borrowing.

I now turn to the demand side of the housing market, to develop a second proposition. Much is assumed about the determination of prices in the new-build sector of the owner occupied housing market, but there are good reasons for doubting elements of the received wisdom. In assuming that price levels prevailing in the existing housing stock automatically set prices for new-build housing, a great deal

is presumed about the behaviour of consumers (house buyers) and firms (housing developers). To illustrate, let us first recognise that the demand and supply of new-build housing is a small element of total demand and supply for owner occupied housing. New housing supply adds approximately 1% to the housing stock each year in the UK and, given that housing units transact on average once every 6-10 years, the implication is that new housing supply represents around 10% of total housing supply in a given year.

Figure 1 represents the generally accepted view of the relationship between price determination in the second-hand and new-build sectors of the owner occupied housing market. In the left pane, the supply of existing housing interacts with demand to establish an equilibrium price level P_1. At this point, we should recognise that the determination of supply from the existing housing stock is not straightforward, for a number of reasons. Although one element of supply is readily explainable with reference to household dissolution, another element is a consequence of change in housing demand. Existing owner occupier households deciding to 'trade up' will demand a larger / higher quality housing unit than the one they currently occupy; the latter is then offered for sale, i.e. enters supply. We can abstract housing demand more readily if we consider demand for and supply of housing services. In that case, a household trading up demands a higher quantity of housing services than the quantity that they offer for sale, hence we can consider net additional demand for housing services. One difficulty with this concept is that we traditionally think about the new-build sector as constructing and supplying new housing units, rather than quantities of housing services. Another issue is that recent work on modelling housing supply and affordability suggests that the ratio of households to housing units is an important driver of house price change in the long run.

For the moment, let us assume that households do not trade up but that an increase in housing demand arises for demographic reasons. The demand curve shifts to DS_1 in figure 1 and the price level rises to P_2. The price levels P_1 and P_2 imply a horizontal demand curve faced by housing developers, shown on the right pane. This is

consistent with the received view that developers are price takers and that their development decisions are therefore related to non-price factors including the level of construction costs, the cost of borrowing, the cost and availability of land, and the ease or difficulty in obtaining planning permission. A shift in the new-build supply curve might reflect change in the costs of construction or borrowing. This is shown as a movement from SN_1 to SN_2 in the right pane of figure 1. The price of new-build housing is unaffected, but the quantity constructed, supplied and traded rises from Q_{N1} to Q_{N2}. There is no feedback loop to the equilibrium price of the housing stock.

[Figure 1 goes here]

The simple static analysis shown in figure 1 can say nothing about any dynamic relationships that may exist, for example, between new-build supply in the short run and price levels in the long run. This omission is at the heart of concerns raised during the Barker Review, and explored by a number of subsequent studies of housing prices and affordability. Meen (2005, 2008, 2011) formalises the dynamic relationship by recognising that supply is a derivation from the housing stock, and is influenced by 'pressure' on that stock, represented as the ratio of owner occupier household to dwellings. Following Barker (2004) logic, persistently low levels of new housing completions allow a build-up of latent demand, manifest in a rising ratio of households to dwellings. Alternatively, we can say that the price elasticity of supply is a function of the adequacy of the housing stock to meet housing demand. In practical terms, we can predict that when household dissolutions lead to inheritance of housing units then these are less likely to be supplied to the market when the housing stock is under pressure than when it is not. Instead, such units may be consumed as second homes or offered to prospective renters. For the same reasons, a general increase in wealth has a similar outcome: relative scarcity and high levels of price appreciation encourage those trading up to withhold their previous housing unit from the market, and to consider it as a second home or privately rented investment instead.

Are housing developers price takers?

The tractability of the housing development industry as a policy tool that can be used to modify long-run housing outcomes depends on the relationship between new-build and stock housing prices. If housing developers are price-takers, following price signals set in the second-hand housing market as shown in figure 1, then reduction or removal of supply-side constraints will lead to a rise in new housing completions provided that the development hurdle is reached (i.e. stock price levels exceed development costs). Indeed, this logic lies at the heart of UK government policy between the Barker Review and the change of government in 2010: regional housing targets were accompanied by pressures on local authorities to identify and release more land for housing development. At one stage in this period, the government gave consideration to the idea of 'automating' additional land release when housing market price signals suggested an inadequate supply of new housing (CLG, 2007).

Despite significant government efforts to reduce supply-side constraints, by 2006 there were emerging concerns that the response of the housebuilding industry, i.e. the additional provision of new housing completions, was falling short of government expectations. One possible explanation has been put forward by Levin and Pryce (2009) is that the steep fall in long term interest rates between 1996 and 2007 "raised the prices of all high duration assets including building land." They use this argument, together with the residual theory of land value, to explain why developers did not increase supply as much as might have been expected despite being faced with rapidly rising house prices. A simpler explanation, but along similar lines, is that lower levels of real interest rates effectively mean lower opportunity costs for holding land. However, as mentioned earlier, concerns about the muted response by the housing development industry to planning reform and a boost to the supply of land arose around the same time as two further studies of housing development were undertaken: the Callcutt Review (Callcutt, 2007), and a market study by the Office of Fair Trading (OFT, 2008). The latter concluded that there is little evidence to suggest that the market for newly constructed homes is not competitive and pointed out that, although the industry is dominated by a small number of large firms, the industry is characterised by takeovers and mergers.

Callcutt (2007) reported improved levels of customer satisfaction compared to the earlier, much more negative, evidence reviewed by Barker (2004). Despite this, the main conclusions of Adams et al (2009), reporting on research funded by the UK government's Department of Communities and Local Government, suggest a complex and subtle set of relationships between housing developers and land owners, and between the new-build and second-hand sectors of the housing market. They argue that, in a rising housing market and with intense competition for development land, developers are compelled to assume strong rates of house price appreciation in order to maximise the amount they bid for land. These assumptions then effectively tie developers to slow rates of delivery to ensure that housing prices rise sufficiently between land purchase and completion to allow profits to be made.

Adams et al (2009) speculate that there are limits to the rate at which new housing completions can be absorbed into the housing stock. Based on detailed qualitative evidence, their suggestion is that housing developers do not compete with each other on price, but are careful to manage new-build supply in a local housing market to ensure that rates of purchase reconcile with rates of completion. Assuming that this is true, we can revisit the analysis shown in figure 1 and ask how might housing market outcomes be different if housebuilders face downward sloping, rather than horizontal, demand curves? The revised analysis is shown in figure 2.

[Figure 2 goes here]

In figure 2, I have redrawn the stock supply curve in panel (a) to demonstrate low price elasticity. Panel (b) represents the market for newly constructed dwellings. The x axes are not drawn to scale but we might assume that the stock price level, P_1 initially, suggests a horizontal demand curve faced by housing developers. This curve remains horizontal to a point, and we might think of this quantity demanded, QN_1, as representing perhaps 10% of total (new and stock) transactions volume. Assume that newly constructed units of housing are a substitute for stock supply. Hence, if housing developers attempt to increase supply beyond QN_1 then this requires

successful marketing to consumers progressively less predisposed to new-build housing rather than second-hand alternatives. In effect, developers must mark down new housing relative to second-hand alternatives, and at an increasing rate beyond Q_{N1}. We can easily see that developers must sell at price P_{2n} in order to increase their output from Q_{N1} to Q_{N2}. An increase in stock demand for housing, shown as a shift from DS_1 to DS_2 in panel (a) increases the stock price level to P_2. This higher price level implies a higher level of new housing output, but developers seeking to win a greater proportionate share of total housing transactions must again begin to move along the increasingly elastic portion of the demand curve for new housing, resulting in a decrease in new-build housing price to P_{4n}.

Assuming that this analysis holds, what are the implications for the level of new housing supply? The answer depends on the position of firms' long-run cost curves. In panel (b) of figure 2, a marginal revenue curve is shown, drawn roughly in relation to demand curve DN_1. Two possible locations for the firm's long-run marginal cost curve are shown: LMC_1 and LMC_2. We can easily see, assuming the objective of the firm is profit maximisation, that LMC_1 implies that firms are unable to move from SN_1 to SN_2. However, LMC_2 implies that excess profits are made at P_1Q_{N1} which makes it possible for the firm to shift supply from SN_1 to the profit maximising SN_2.

The analysis above is entirely theoretical, and conjectural, being hitherto untested by empirical evidence. To state the second proposition more formally:

> Housing developers face downward sloping demand curves in local markets for new-build housing.

5. Did planning for housing policy make a difference?

As noted earlier in the paper, a significant and concerted programme of policy reform, informed by government commitment to research evidence, followed the Barker Review. The planning system was subjected to significant reform and directed towards a top down output orientated approach to housing supply (with initially

national, followed by regional housing completions targets). Despite this, total housing completions rose relatively slowly, and at a far lower rate than required by government targets, as shown in figure 3.

[Figure 3 goes here]

The rise in housing completions in England in the past 2004 period was not obviously higher than in the preceding 3 to 4 years. Bearing in mind that this period was also characterised by a rapidly rising housing market, in which housing developers would be expected to respond strongly to rising demand, this outcome is a little surprising. Even more noticeably, the same period witnessed a strong swing from lower density forms of housing, to higher density (flatted / apartment) developments. This can be seen in figure 4.

[Figure 4 goes here]

Thus, by around 2006 the evidence appeared to suggest that the substantial reforms of the planning system had led to a modest rise in housing completions overall, and a swing from low density developments with slower build rates, to higher density / higher build rate projects (see Adams et al, 2009). A number of commentators interpreted two further policy developments as evidence that housing policy makers remained dissatisfied with the response of the housing development industry to what government regarded as a substantially improved supply of housing development land. The Callcut Review and, at the time of its launch, the OFT housebuilding market study, appeared to move the focus of poor housing supply from the planning system to housing developers themselves. The Callcut Review was commissioned in December 2006, with a remit to examine, among other things:

> "…how the supply of new homes is influenced by the nature and structure of the housebuilding industry, its business models and its supply chain, including land, materials and skills…".

In June 2007, the UK's Office for Fair Trading (OFT) announced that they would undertake a market study focused on the housing development industry. The cited reasons for this launch included concern about:

> "…low supply response to sustained rising prices, low levels of quality and innovation."

The idea that housing developers have limited ability to substantially increase capacity found support from research carried out for the UK government's department of Communities and Local Government, later reported by Adams et al (2009). The study focused on the apparently high incidence of developer-to-developer land trading which, of course, represents a paradox in the context of very low land supply cited by developers as a reason for low supply response. The study presented qualitative evidence that housing developers, as individual firms, cannot easily respond to rising prices by boosting production output. Instead, they prefer to raise housing prices in response to rising demand, and to sell excess land that they consider ripe for development but for which they currently lack capacity to develop.

5.1 Study approach: proposition one

I test the first proposition set out in the previous by examining the nature of production technology, and the substitutability between land and non-land inputs to housing production, i.e. capital. In addition to being theoretically interesting, these questions are important with respect to housing policy – particularly in relation to the long debate over the importance of land supply to housing supply that played out between 2003 and the beginning of the global financial crisis. It is self-evident, for example, that if land is a poor substitute for non-land inputs then even a significant increase in land supply will lead to a relatively modest rise in new housing supply, and vice versa.

I first estimate a Constant Elasticity of Substitution (CES) production function:

$$H = A\left[\delta K^{\rho} + (1-\delta)L^{\rho}\right]^{1/\rho} \qquad (1)$$

where σ is defined as:

$$\sigma = \frac{1}{1-\rho}$$

The first order conditions for profit maximisation are:

$$H / L = A^{-\rho/\sigma}\delta^{-\sigma}(R/p)^{\sigma} \qquad (2)$$

$$H / K = A^{-\rho/\sigma}(1-\delta)^{-\sigma}(\eta/p)^{\sigma} \qquad (3)$$

where:

p	unit price of H
H	capacity to produce housing services (homogeneous of degree one)
L	lot size
K	quantity of non-land inputs
R	unit price of land

The empirical specification is derived from the solution for the two first-order profit maximisation conditions (see Thorsnes, 1997):

$$\ln\left(\frac{\eta K}{L}\right) = c + \sigma \ln R + (1-\sigma)\ln\eta + u \qquad (4)$$

We then estimate a Variable Elasticity of Substitution (VES) production function as follows:

$$\frac{\eta K}{L} = \frac{1-\rho}{1-\delta\rho}\eta + \frac{\delta\rho}{1-\delta\rho}R + u \qquad (5)$$

The estimate of the first term can be used to calculate the elasticity of substitution which, as shown in the specification, varies with the ratio of land to non-land production inputs:

$$\sigma = 1 + \left[(1-\rho)/(1-\delta\rho)\right](L/K) \qquad (6)$$

The hypothesis of variable elasticity of substitution is tested by estimating a Box-Cox transformation. The hypothesis under test, as noted above, is that the elasticity of substitution varies in relation to the ratio of land to non-land production inputs.

The empirical work draws on data from a number of sources. It is primarily derived from a database of residential planning consents provided by Emap-Glenigan but it is important to note that a sub-sample, representing developments described as either in progress or for which detailed approval has been granted, was drawn. This was narrowed down further to ensure that each observed development had a complete record comprising proposed number of housing units, site area and construction contract value. The resulting dataset was then matched with data on the mean transaction price of bulk residential development land at local authority level, provided by the Valuation Office Agency[1]. Both datasets span the period 2004 through 2008. Another set of company-specific variables was added.

In addition to the basic variables described above, the dataset includes a set of flags denoting whether each development is for housing, 'luxury housing', apartments or bungalows. Student housing and retirement projects were excluded from the database prior to the analysis. Descriptive statistics are set out in appendix 1.

5.2 Study approach: proposition two

[1] My thanks to Professor Craig Watkins, University of Sheffield, for facilitating access to this dataset

The second proposition introduced in the previous section is really an extension of an argument first put forward by Adams et al (2009) that the ability of housing developers to sell their output at the price they expect depends, in part, on the extent of local competition from other housing developers. In Adams et al (2009) it is argued that developers may voluntarily regulate their output level to ensure that the price achieved on completed units at least matches assumptions made at an earlier period – when development appraisal calculations informed their financial offers for site acquisition. We can take this argument a step further by hypothesising that, other factors held constant, developers defer development on sites with planning permission when these sites are in proximity to other competing new-build sites.

We test this by estimating a simple binomial logit model based on sites that receive planning permission and, in time, become active in the sense that a developer develops and sells housing in these locations. The modelling requires extensive analysis of two datasets merged using GIS methods. The first dataset contains information on residential planning consents in the UK between 1998 and 2008 and was supplied on license by Emap-Glenigan. This dataset makes it possible to identify the location of sites subject to detailed planning permission. A grid reference allows each site to be located in a GIS while a simple model of site area based on development design and size makes it possible, by assuming that every site is circular, to draw a radius around each of the developments identified in the planning permission database. The second dataset was supplied by Nationwide Building Society and includes information on 6,446 new-build housing transactions on which the Building Society provided a mortgage during the period 1998 through 2007. This dataset is used to identify approximately when each site in the planning database became active, if at all.

In order to avoid an unnecessarily convoluted explanation, it should be sufficient to note the following: the first temporal appearance of a new-build transaction within a site (in the GIS planning permission database) is taken to signify that a site has become active. An active site is being defined here in the sense that a developer is

building and selling homes in that location. A site is assumed to have become inactive once the completion date in the planning application database has passed. The truth of this was, of course, also checked in the hedonic dataset. This approach allows us to define a measure of competing local new-build alternatives as follows:

$$SI_i = \sum_j \frac{s_j}{d_{ij}} \qquad (7)$$

Where,

SI_i Spatial interaction term relevant to the *i*th site

s_j Number of housing units being constructed on the *j*th active site, where active is defined as being developed with housing being sold at the time of the *i*th hedonic transaction

d_{ij} Distance between the *j*th competing active site and the *i*th hedonic transaction

The spatial interaction variable defined above then feeds into a model of the probability of each site in the planning permission database becoming active as time elapses from the point that planning permission is granted. Formally, the model is as follows:

$$P(\pi) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_n X_n)}} \qquad (8)$$

Where,

$P(\pi)$ Probability that a site with planning permission will become active in a given year

X_1 Spatial interaction term (measure of competing nearby sites)

$X_{2...n}$ Other explanatory variables

Although not shown in full in the equation, the model includes other explanatory variables including indicators of planning stance and the cost of borrowing, with

more explanation and discussion of these variables and effects set out towards the end of the next section.

6. Empirical results

The first proposition is examined by estimating a series of equations beginning with equation (4). These estimates are shown in table 1 and refer to a constrained maximum likelihood estimation (the coefficients are constrained such that σ and (1-σ) sum to 1. This estimation is for the period 2004 through 2008.

[Table 1 goes here]

[Table 2 goes here]

What is notable about the estimation results are that, first, the elasticity of substitution is much lower than reported in previous (US based) studies. For example, Thorsnes (1997) reports a range of 0.80 to 1.08. Although both coefficients are statistically significant, the explanatory power of the model is poor (with an adjusted R square of 0.10). The Box-Cox transformation results, summarised in table 2, fail to reject the null hypothesis of variable elasticity of substitution, i.e. λ is significantly different from zero.

The poor explanatory power is not altogether surprising given that the estimation encompasses all local authority areas in England, and over a five year period. In addition, there are likely to be many unmeasured partial determinants of developers' production decisions including planning controls and infrastructure constraints. Most previous studies have attempted the estimation of a production function within a single metropolitan area, justifying the removal of the construction cost parameter (eta). Despite extensive work undertaken to create a construction cost index that varies at local authority level, the variable is not truly a comprehensive

representation of construction costs, as viewed by the firm, because no account is taken of the firm-specific cost of capital. In addition, while the equation includes mean residential development land prices at local authority level, there are inevitably variations within local authority areas. As discussed earlier in the paper, firms may interpret the opportunity cost of land differently depending on the extent of their land holdings and strategic holdings (land controlled through options).

Table 3 summarises a disaggregated set of estimation results (by calendar year). The most interesting insight that arises from this set of results is that the elasticity of substitution rises during the study period. It appears to be relatively stable, at between 0.35 and 0.38 in 2004 through 2006, rising to between 0.42 and 0.52 in 2007/2008. On the face of it, this is suggestive of changing production technology, and that land becomes more substitutable for capital later in the study period.

[Table 3 goes here]

The notion that developers may face more than one choice of production technology is supported by the results in table 4. This estimation adds a crude indicator of development type derived from the planning application data. Developments are assumed to be higher density (apartments) unless indicated otherwise by the 'housing', 'luxury housing' and 'bungalow' dummy variables. A second variant of this model, shown in the last two columns of table 4, adds a set of planning stance indicators to the specification[2].

[Table 4 goes here]

Adding three indicators of local authorities' planning stance has the effect of slightly improving the explanatory power of the model. By 'planning stance', I refer to the degree to which local authorities are inherently favourable towards accomodating residential development. Reducing such a notion to a set of quantitative indicators is

[2] I am grateful to my colleague Glen Bramley for facilitating access to these indicators

neither easy to do, nor defend. Clearly, planning stance is likely to depend in part on the size, urban/rural composition, density and broad location of a local authority, in addition to its political make-up – the aspect that has potential to help shape planning outcomes given the flexibility of the British planning system referred to earlier in the paper. A number of early model estimations, not reported here, experimented with a wider set of indicators including the length of time taken by planning authorities to reach development decisions, proportion of applications approved / rejected, proportion going to appeal, proportion being won on appeal, and so on. Either no statistical relationship, or else a very weak relationship, was found between the dependent variable and many of these indicators. The exceptions remain in the model summarised in the final two columns of table 4: the flow of planning consents per capita, the proportion of land area designated as green belt, and the proportion of new planning consents that relate to greenfield land. The first and last of these are both intended as indicators of positive planning stance, and the results suggest that land becomes more substitutable for capital as planning permissions become more abundant, and less so as the emphasis of planning permissions moves towards greenfield development. These observations, of course, make perfect sense.

I now introduce a final variant of this particular model – one that reflects the notion put forward by Ball et al (2010), and carried forward in this paper, that firm-specific factors may be important determinants of developers' decisions regarding how many housing units to supply to the market under different sets of economic conditions. The firm-specific indicators are derived from Wellings' (2000 through 2006) annual handbook of housebuilding statistics.

One consequence of including this additional set of predictors is that the time period covered by the analysis is reduced substantially[3]. The analysis is necessarily restricted to publicly listed companies. The resulting reduced dataset therefore covers the years 2004 and 2005, and encompasses 408 developments undertaken by 29 different

[3] The last Wellings handbook was published in 2006, containing data relevant to the preceding calendar year

firms. However, it is also worth noting that, taken together, these firms represent more than 50% of annual UK housing completions in the study period.

[Table 5 goes here]

The results shown in table 5 are for a parsimonious model, i.e. one that contains only statistically significant variables. In fact, only two of the new firm-specific variables were found to be statistically significant – annual completions and interest payments, expressed as a proportion of annual turnover. Some experimentation with other specifications considered a wider set of variables that also included firms' land holdings, debt to net asset ratio and annual turnover.

The results confirm the earlier finding that land is only weakly substitutable for capital. The addition of firm specific variables, and indicators of planning stance, increases the explanatory power of the model considerably (the adjusted R square rises to more than 0.40). Estimated parameters indicate that land is more readily substitutable for capital in local authorities with a higher rate of new planning consents, and less so in authorities with a higher proportion of greenfield sites and longer average planning decision times. Meanwhile, land is more substitutable for capital in relation to firms with higher volumes of annual completions, and significantly more so for those with relatively high exposure to debt (i.e. high annual interest payments as a proportion of turnover). This is particularly interesting given that, presumably, highly leveraged firms face higher costs of capital, but may nevertheless have significant land holdings.

The final set of statistical results examined in this paper is intended to test Proposition Two put forward in section 5. Although constructing the dataset was an enormous undertaking, the econometric estimation of equation 8 can itself be summarised very simply. The coefficients set out in table 6 indicate the effect of each variable shown on the probability of a given site with planning permission becoming active (i.e. development commencing) in a given year. The spatial interaction term is the main variable of interest (shown on the first line in the table, below the

constant). This variable is essentially an index of the quantity of nearby, competing development sites. As nearby sites become closer, or larger, the probability of a new development site becoming active then reduces. This is shown by the statistically significant, negatively signed coefficient. A contemporaneous version of this variable was not significant – neither were versions lagged 1 or 2 years – only the t-3 specification shown in the table was found to be significant.

Other results shown in table 6 indicate that high local authority level vacancy rates slow down development activity. To a lesser extent, stronger emphasis on apartment development also slows down activity. Another interesting finding is that high interest rates appear to accelerate the timing of sites with planning permission becoming active (development commencing). This is a plausible finding given that high interest rates imply a high holding cost for development land. Finally, there are statistically significant but very small effects of planning stance, private investment and deprivation variables. These variables are retained in the equation for econometric reasons but show such small effects that further discussion would be unwarranted.

[Table 6 goes here]

7. Discussion

I hope that the most substantial contribution of this paper to knowledge will be a contribution to a re-shaped policy relevant research agenda that is mindful of the many microeconomic assumptions that have been made about housing developers and the development industry. Stronger planning regulations in the UK, compared with the U.S., have been put forward in the past as a partial explanation for the weaker responsivness of supply. Without doubting this logic entirely, there can be little doubt that the rise in new housing completions following the policy reforms of the Barker Review was weaker than that sought be policy makers. In this paper I have reflected on that outcome while developing what I hope will be seen as some novel ideas about the behaviour of housing developers in terms of their interactions with

competititors, with the land market, and with housing consumers. The behaviour of developers in the land market has not been covered explicitly here, but I have commented on it elsewhere (see Adams et al, 2009), and it is clearly inadvisable to separate land market activities of developers from their interactions with competitors and with consumers.

In addition to the novelty of the ideas put forward here, I would argue that the empirical results are at least suggestive that the microeconomics of the housing development industry deserve more attention than hitherto received in the literature. The results suggest that the substitutability of land for capital partly depends on factors such as the size of development company, and firm-specific cost of borrowing. This might very well matter to policy makers given that the size of firms, their financial organisation, and market concentration, vary substantially within a country or region. Although the time period examined by the analysis is very short, there is at least a suggestion that the substitutability of inputs to construction is not constant over time. Perhaps the most interesting empirical finding is of a statistically significant link between the timing of development, or the length of time that elapses after grant of planning permission, and the amount / extent of nearby new supply. As the number and/or volume of nearby competing developments rises, the probability that a site with planning permission commences development declines. Not surprisingly, local housing market contextual factors such as vacancy rates and deprivation also affect this relationship. Meanwhile, macro-economic factors such as the cost of borrowing are also important. Together, these findings demonstrate that developers' decisions regarding which sites to purchase, when to apply for permission, when to commence development and how fast to supply completions to the market are very complex. The decisions involve interactions of macro factors, local housing market context, and micro-economics issues. The latter, in particular, have received insufficient attention by housing economists, and further work in this area may well be fruitful in developing our understanding of the interface between planning and local housing markets.

References

Adams, D., Leishman, C. and Moore, C. (2009) Why not build faster? Explaining the speed at which British house-builders develop new homes for owner occupation, *Town Planning Review*, Vol. 80, No. 3, 291-314

Ball, M., Meen, G. and Nygaard, C. (2010) Housing supply elasticities revisited: evidence from international, national, local and company data, *Journal of Housing Economics*, Vol. 19, 255-268

Barker, K. (2004) *Review of Housing Supply: Delivering Stability: Securing Our Future Needs*, London, HM Treasury

Bramley, G. (1993) The impact of land use planning and tax subsidies on the supply and price of housing in Britain, *Urban Studies*, Vol. 30, 5-30

Bramley, G. and Watkins, C. (1996) *Steering the housing market: new building and the changing planning system*, Bristol: Policy Press

Caldera, A. and Johansson, A. (2013) The price responsiveness of housing supply in OECD countries, *Journal of Housing Economics*, Vol. 22, 231-249

Callcutt, J. (2007) *The Callcutt Review of Housebuilding*, London, HMSO

Cheshire, P. and Sheppard, S. (1989) British planning policy and access to housing: some empirical estimates, *Urban Studies*, Vol. 26, 469-485

Cheshire, P. and Sheppard, S. (2004) Land markets and land regulation: progress towards understanding, *Regional Science and Urban Economics*, Vol. 34, No. 6, 619-637

Communities and Local Government (2007) *Planning for housing: market signals – summary of research*, London: Communities and Local Government

Epple, D., Gordon, B. and Sieg, H. (2010) A new approach to estimating the production function for housing, *American Economic Review*, Vol. 100, June, 905-924

Evans, A. (1991) 'Rabbit hutches on postage stamps': planning development and political economy, *Urban Studies*, Vol. 28, No. 6, 853-870

Evans, A. (1996) The impact of land use planning and tax subsidies on the supply and price of housing in Britain: a comment, *Urban Studies*, Vol. 33, No. 3, 581-5

Färe, R. and Yoon, B.J. (1981) Variable elasticity of substitution in urban housing production, *Journal of Urban Economics*, Vol. 10, 369-374

Leishman, C. and Bramley, G. (2005) A local housing market model with spatial interaction and land-use planning controls, *Environment and Planning A*, Vol. 37, No. 9, 1637-1649

Levin, E. and Pryce, G. (2009) What determines the price elasticity of house supply? Real interest rate effects and cyclical asymmetries, *Housing Studies*, Vol. 24, No. 6, 713-736

Malpezzi S, and MacLennan, D. (2001) The long-run price elasticity of supply of new residential construction in the United States and the United Kingdom, *Journal of Housing Economics*, Vol. 10, Issue 3, 278 - 306

McDonald, J.F. (1981) Capital-land substitution in urban housing: a survey of empirical estimates, *Journal of Urban Economics*, Vol. 9, 190-211

Meen, G. et al (2005) *Affordability targets: implications for housing supply*, London: Office of the Deputy Prime Minister

Meen, G. et al (2008) *Recent developments in the Communities and Local Government Affordability model*, London: Communities and Local Government

Meen, G. (2011) A long run model of housing affordability, *Housing Studies*, Vol. 26, Nos 7-8, 1081-1103

Office of Fair Trading (2008) *Homebuilding in the UK: A Market Study*, London, OFT

Pryce, G. (2003) Greening the market: distortions caused by fiscal incentives to build on brownfield land, *Housing Studies*, Vol. 18, No. 4, 563-585

Sirmans, C.F., Klau, J.B. and Lee, C.F. (1979) The elasticity of substitution in urban housing production: a VES approach, *Journal of Urban Economics*, Vol. 6, 407-415

Thorsnes, P. (1997) Consistent estimates of the elasticity of substitution between land and non-land inputs in the production of housing, *Journal of Urban Economics*, Vol. 42, 98-108

Wellings, F. (2000 through 2006) *Private housebuilding annual*, London: The Builder Group

Figures and tables

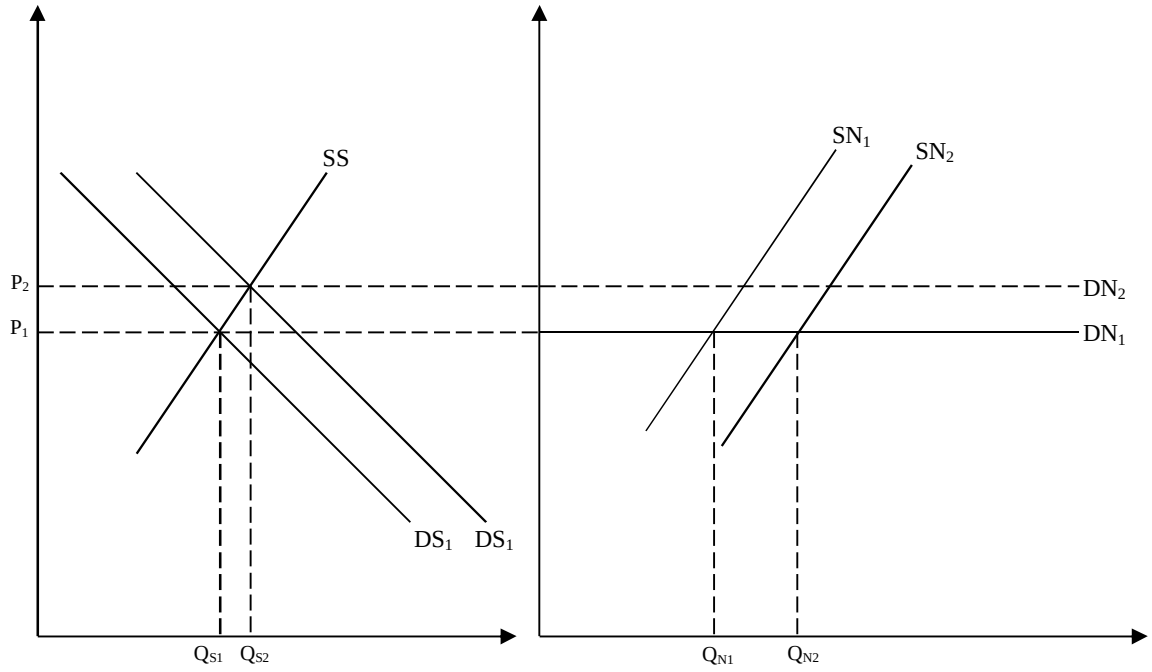

Figure 1 **Price determination in the second-hand and new-build sectors**

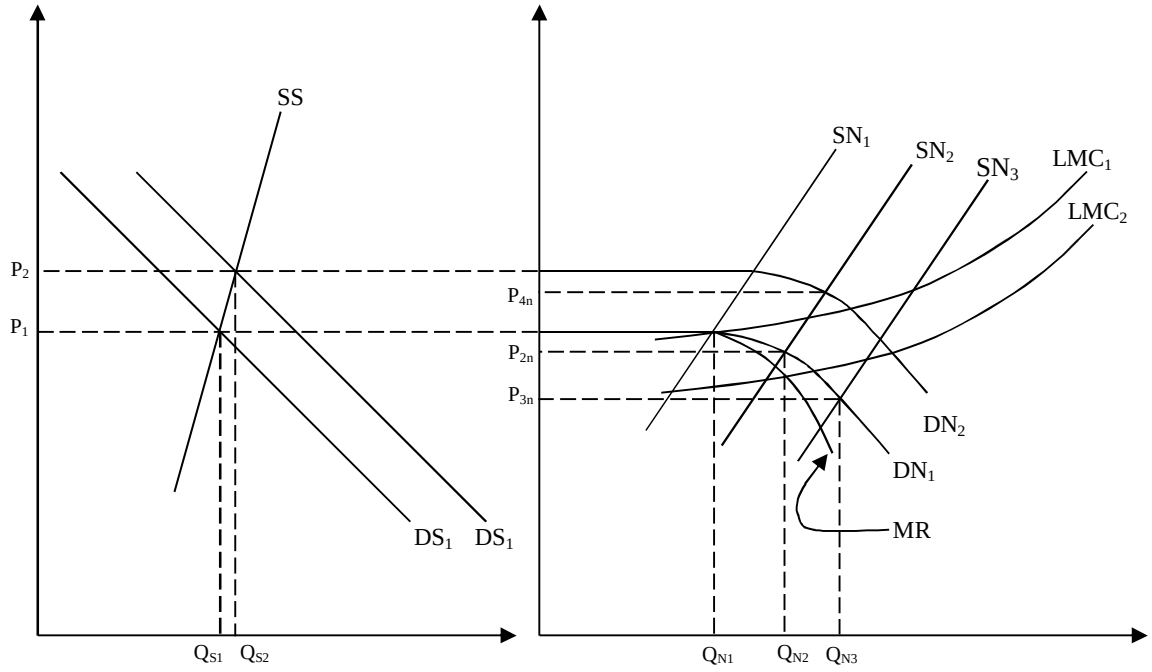

Figure 2 **Price determination with variable elasticity of new housing demand**

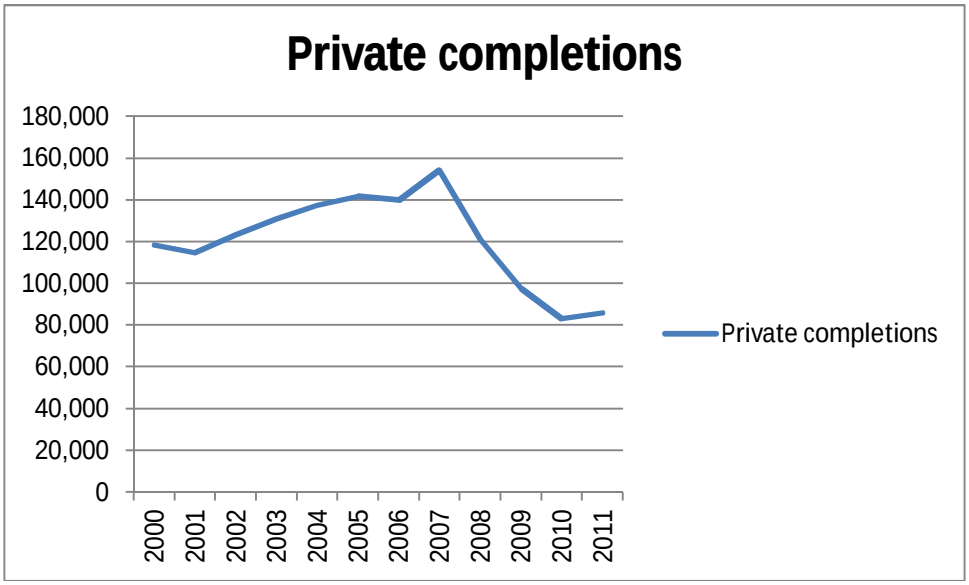

Figure 3 **Private housing completions in England 2000-2011**

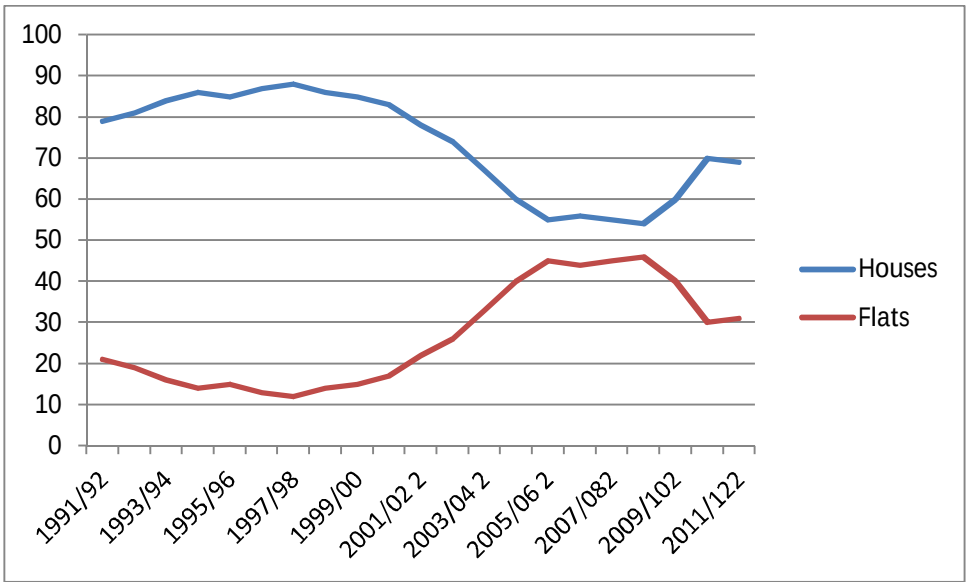

Figure 4 **Share of new completions that are houses or flats**

Table 1 **Elasticity of substitution**

	Coefficient	t	P
Constant	2.913	50.34	***
log unit land price	0.373	25.5	***
log unit construction cost	0.627	42.93	***
Adj R sq	0.101		
N	8574		

Table 2 **Pooled model Box-Cox transformation results**

	Estimate	Z / chi-sq	Significance
Lambda	-0.146	-10.59	***
Tests of null			
Lambda= -1	RLL	3631.14	***
Lambda= +1	RLL	7316.45	***

Table 3 **Elasticities of substitution within the study period**

	2004	2005	2006	2007	2008
Constant	1.493	2.541	3.119	3.657	0.499
log unit land price	0.382	0.338	0.340	0.416	0.515
log unit construction cost	0.961	0.796	0.638	0.342	0.911
Adj R sq	0.196	0.161	0.139	0.1291	0.2016
N	2346	2619	4627	1102	571

Table 4 **Elasticity of substitution with development type and planning proxies**

Variable	Model 3		Model 4	
Constant	4.223	***	5.42	***
log unit land price	0.102	***	0.055	***
log unit construction cost	0.870	***	0.769	***
2005 dummy	0.059	***	0.051	***
Housing development	-0.572	***	-0.506	***
Luxury housing development	-0.696	***	-0.611	***
Bungalow development	0.814	***	0.946	***
London dummy	0.424	***	0.286	***
Flow of planning consents			0.02	***
LA area designated green belt			-0.002	***
Proportion of consents greenfield			-0.008	***
R bar sq	0.225		0.249	

N	8574		8574	

Table 5 Elasticity of substitution with firm specific variables

Variable	Coefficient	t statistic	
constant	4.745	6.53	***
log unit land price	0.24	5.66	***
log unit construction cost	0.50	3.43	***
Flow of planning consents	0.094	2.19	**
Proportion of consents greenfield	-0.008	-5.64	***
Average planning decision time (weeks)	-0.023	-2.32	**
Housing development	-0.319	-6.94	***
Luxury housing development	-0.489	-6.88	***
log firm annual completions	0.034	2.09	**
firm interest payments % turnover (t-1)	0.972	5.37	***
R bar sq	0.407		
N	408		

Table 6 Spatial interaction model results

Variable	Coefficient	
Constant	-3.78326	***
Sum of t-3 units ÷ distance	-0.00207	***
Private housing vacancy rate	-0.21991	***
Proportion of developments that are apartments	-0.02055	***
Mortgage interest rates (t-1)	0.63228	***
Flow of land with planning permission (t-1)	-0.00075	***
Stock of outstanding planning permissions (t-1)	0.00033	***
Investment flow to private rental sector (t-1)	0.02014	***
Index of multiple deprivation (income) (t-1)	0.03131	**
N	1459	
Groups	267	
Wald chi2	182.43	***

Appendix – descriptive statistics

			Housing sites	Luxury housing sites	Flats / apartment developments	Bungalow developments
2004	site_area	Mean	2.01	1.13	0.4	0.46
		St. Dev.	(10.44)	(1.36)	(1.11)	(0.18)
	units	Mean	52.2	35.5	36.21	14.45
		St. Dev.	(77.64)	(45.39)	(56.55)	(3.36)
	k	Mean	4393.01	2388.1	2035.61	930
		St. Dev.	(19539.57)	(3061.57)	(4814.15)	(297.32)
2005	site_area	Mean	1.62	1.11	0.39	0.58
		St. Dev.	(3.9)	(1.55)	(0.75)	(0.48)
	units	Mean	51.88	33.48	37.95	24.3
		St. Dev.	(80.37)	(39.56)	(69.68)	(21.77)
	k	Mean	4107.57	2453.27	2232.59	1766
		St. Dev.	(10156.94)	(2619.07)	(6178.67)	(1556.66)
2006	site_area	Mean	2.46	1.98	0.47	0.54
		St. Dev.	(23.52)	(3.78)	(1.4)	(0.3)
	units	Mean	54.71	49.1	37.74	19.14
		St. Dev.	(84.89)	(88.99)	(67.86)	(10.4)
	k	Mean	5049.84	3481.75	2748.97	1442.86
		St. Dev.	(21601.18)	(5787.94)	(12342.85)	(769.43)
2007	site_area	Mean	1.92	1.04	0.5	.
		St. Dev.	(4.34)	(0.71)	(1.52)	.
	units	Mean	62.68	58.67	39.8	.
		St. Dev.	(100.66)	(65.8)	(78.09)	.
	k	Mean	4815.29	4085	3021.53	.
		St. Dev.	(11245.02)	(4396.02)	(10332.38)	.
2008	site_area	Mean	1.91	2.85	0.69	.
		St. Dev.	(4.25)	(3.14)	(1.71)	.
	units	Mean	56.16	80.5	47.1	.
		St. Dev.	(85.04)	(84.12)	(91.78)	.
	k	Mean	5278.33	5600	6544.53	.
		St. Dev.	(12346.78)	(5738.18)	(35943.28)	.