**THE UNIVERSITY OF READING**
**DEPARTMENT OF ECONOMICS**

# Regional Housing Supply Elasticities in England

By

**Geoffrey Meen**

**The University of Reading**

Centre for Spatial and Real Estate Economics, Department of Economics,
The University of Reading Business School,
PO Box 219, Whiteknights, Reading RG6 6AW, England.

Telephone: 0118 378 6029
Fax: 0118 378 6533

Prepared for the Barker Review of Housing Supply

October 2003

## 1. Introduction

In the decision, taken earlier this year, not to join the Economic and Monetary Union for the time being, the structure of the UK housing market was identified as a key difference from the rest of Euro area. Most of the remaining differences – particularly in the corporate sector – were found to be less severe and, indeed, in terms of labour market flexibility, the UK is probably more suited to monetary union than many of the countries that have already joined. However, housing market differences were the main reason why the convergence test was not met. The balance of the empirical evidence indicates that, as a result of housing, the UK economy is more sensitive to changes in interest rates than other major European economies. It is, therefore, unsurprising that many of the policy recommendations accompanying the Treasury's analysis of the Five Tests refer to the housing market. This paper relates to one aspect of the recommendations – the need to increase housing supply.

Although this paper has light to shed on the causes of weak supply responses, its main objectives are more modest and are concerned with estimating the price elasticity of housing supply for each of the standard regions of England. The estimates are based on an updating of the results presented in Meen (1996, 1996a), originally derived for the period 1973 to the middle of 1993. A number of explicit questions arise:

- (i) Do the elasticities vary regionally? Perhaps, the most common explanation for weak supply responsiveness concerns shortages of land for housing. If land supply constraints are particularly strong in the South East, we might expect the elasticity to be lower in that region.
- (ii) Is there evidence of a fall in the elasticities during the nineties? If so, this might (although not necessarily) be evidence of a tightening of land constraints. But might there be other reasons as well?
- (iii) Do the elasticities differ between cyclical upswings and downswings? Land constraints would be expected to bind when production is increasing, but not when it is falling. Therefore the elasticities might be greater in the downswing.
- (iv) Is there evidence of backward-bending supply curves? If so, this might provide evidence of speculative behaviour reducing the current levels of production.
- (v) Why in our earlier studies did behaviour in London appear to differ from elsewhere?
- (vi) Can estimates be made of the level of housing production that would keep real house prices constant over time? Over the last twenty years, real house prices have risen on average by more than 3% per annum.

Questions (i)-(v) are examined through new econometric work on the determinants of private sector housing starts. Question (vi) does not require new estimation, but estimates can be derived from previous work by Meen and Andrew (1998).

Section 2 reviews the EMU background and provides context for the study. In particular, why do low housing supply elasticities matter from a *macroeconomic* perspective. Section 3 sets out theoretical approaches, which have been used in the literature to model housing construction. Different approaches give rise to very different estimates. Section 4 discusses some important data issues. From a simple data analysis, we can immediately see that supply elasticities are likely to have fallen since the early nineties. Section 5 presents the empirical results and we throw some doubt on the view that land availability has been the *sole* cause of low housing supply in recent years. More complex forces appear to be at work. Section 6 briefly looks at why results for London are out-of-line with those for the rest of the country. Section 7 considers the level of construction needed to maintain constant real house prices, whereas Section 8 draws conclusions.

## 2. Background

Earlier this year the Chancellor presented the results of the Treasury's analysis of the Five Economic Tests, which underpin the government's recommendation on future membership of the Economic and Monetary Union (HM Treasury 2003). The Chancellor reported that three of the five tests had not yet been met. But the crucial difference between the UK and the rest of the Euro area concerns the structure of the housing market. Although housing is only a small part of national income directly, its influence on the wider economy is far more pervasive. In fact, if the housing market is taken out of the equation, the case for the UK staying outside the EMU on economic grounds becomes weaker. Indeed, it could be argued that the UK is more suited to membership than some countries that have already joined. But the housing market is particularly important to the *Convergence* test. In principle, differences in housing market structures can mean that common changes to interest rates from the European Central Bank may have varying effects across Europe. A particular question for the UK is whether our domestic economy is more sensitive to changes in interest rates than other countries.

For households, the centre of the debate concerns how changes in interest rates affect consumers' expenditure. As the Treasury identifies, there are a number of routes.

- Interest rate changes affect incentives to borrow and save
- Interest rate changes affect disposable incomes of borrowers and savers
- Changes in asset prices (resulting from interest rate changes) – both financial and physical – affect wealth and, therefore, consumption.

Within this overall framework, there are potentially four routes through which housing enters the picture:

(i) There is empirical evidence that consumers' expenditure is affected by households' wealth. But, since housing is the largest component of household wealth, trends and volatility in house prices have a significant impact.

(ii) Through the mortgage market: There are two important issues – first, the proportion of households who take out fixed as opposed to variable mortgage interest rates and, second, the level of mortgage debt.

(iii) Through housing tenure – countries that have high owner-occupation rates are more likely to be affected by variations in housing wealth.

(iv) Through housing equity withdrawal: when house prices are rising rapidly, households borrow against the increase in their house values in order to finance the purchase of other consumer goods. But the extent to which households can cash in depends on the extent of mortgage market liberalisation.

To expand on some of these points, first, if real house prices did not rise over time, then there would be little effect on consumers' expenditure – real household wealth would not rise. But as Figure 1 shows, this has not been the case. On average, since the early eighties, house prices have risen in excess of 3% a year more than the prices of other goods and services. Furthermore, there have clearly been periods in which prices have risen very rapidly indeed, increasing the scope for equity withdrawal.

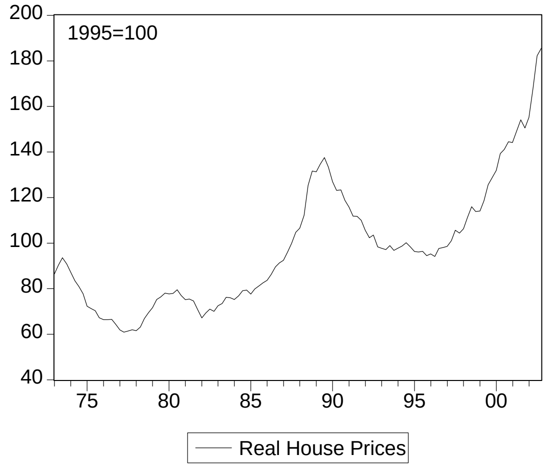


*Figure 1.* Real House Prices

By contrast, many European countries, for example Germany and France have shown little or no long run increase. But this is not universally true. Spain, the Netherlands and Ireland have shown increases and, although the trend is not as strong, relative house prices in the USA have increased over time (see Meen 2001). But a common argument why house prices have increased in the UK has been that the rise reflects the weakness of housing supply (due to planning and other constraints). Key worker affordability problems in the South East are one manifestation.

Second, mortgage debt as a percentage of GDP is higher in the UK than in any EU country apart from Netherlands and Denmark. In the UK, the mortgage debt percentage is approximately 60%, compared with an EU mean of 40% and a figure of only 10% in Italy. Other things equal, this means that a change in interest rates will have a bigger effect on household incomes in the UK than in most countries. Countries such as Italy, Spain and Greece have particularly low levels of indebtedness so that, if the ECB changes interest rates, they are relatively immune from effects on incomes and consumers' expenditure. But high levels of debt would not matter too much for households if most mortgages had fixed interest rates attached to them. But the UK has by far the lowest proportion of fixed interest rate mortgages in Europe. Therefore, given a situation in which the ECB raises interest rates, in the UK (were it to be a member), the increase would be passed onto mortgage rates with consequent negative effects on the housing market (pushing down house prices) and on consumers' expenditure. By contrast, in other countries, the increase is not passed onto mortgage interest rates for existing borrowers and the housing market and consumers' expenditure are isolated from the change.

Third, as Figure 1 shows, the UK has experienced several periods of rapid house price growth since the early seventies, but there is little evidence that equity withdrawal had a significant effect on consumers' expenditure until the late eighties. The difference was the mortgage market liberalisation that took place during the eighties. Whereas households had previously been constrained in their access to mortgage credit, from the eighties it became much easier to borrow to finance consumers' expenditure, using increased housing wealth as collateral. Although some Scandinavian countries have liberalised financial markets (and experience strong house price volatility), liberalisation started later and has progressed less far in Germany and France. Equity withdrawal has been negative in France, Germany and Italy.

To summarise, it is the combination of conditions in the housing market that singles out the UK and suggests that the UK is more likely to be sensitive to interest rate changes. In response, the Chancellor announced the setting up of two reviews. The Miles Review is concerned with ways in which fixed mortgage interest rates may be encouraged (and hence reducing the sensitivity of the housing market to changes in official interest rates). By contrast, the Barker Review is concerned with the ways in which housing supply may be increased. The concern arises from the view that the strong trend in real house prices and the cycle are, at least, partly due to the weakness of supply.

Some support for this view can be found in Meen (2000) and Meen (2002). The second of these studies finds that the main reason for differences in long-run real house price trends between the UK and the USA is differences in the price elasticity of housing supply. Using similar methodologies, in the USA, the elasticity appears to be approximately 3.0, but less than 1.0 in the UK. The first study argues that, because of the weakness of housing supply, the setting of interest rates, which is necessary for stability in the housing market, is not necessarily consistent with that required to meet wider inflation targets. Indeed the setting of interest rates adds to the volatility of housing markets. This problem could become even worse if the UK was subject to Europe-wide interest rates.

## 3. Theories of Housing Supply

In the UK, empirical models of housing supply have been constructed since the early seventies e.g. Whitehead (1971, 1974, 1975), Hadjimatheou (1976), Mayes (1979), Tompkinson (1979), Bramley (1993, 1993a, 1996) Tsoukis and Westaway (1994), Meen (1996) and Pryce (1999). The USA also gives rise to a large literature; here we point to just two studies – Topel and Rosen (1988), and Malpezzi (1996).

Over time, there has been a fairly high degree of agreement on the fundamental factors that affect housing supply in the long run. Indeed the long-run models remain fairly simple and can be summarised by equation (1).

$$st^*_t = \alpha_0 + \alpha_1 ph_t + \alpha_2 \cos t_t + \alpha_3 R_t + \varepsilon_t \qquad (1)$$

*st* is housing construction (starts) *ph* is an index of house prices; *cost* is an index of construction costs, $\varepsilon$ is an error term and *R* is the short-term (nominal) interest rate – the cost of borrowing. (*) represents the long-run desired or equilibrium level. Lower case variables are expressed in logarithms. Notice that if $\alpha_1$ and $\alpha_2$ are equal in absolute size, they can be combined into a single profitability variable as in Table 1 below. Meen (2000) provides support for this and the procedure is adopted in most of our estimates. It provides an estimate of the long-run price elasticity of supply.

However, at this stage, we need to distinguish between two approaches to estimating the price elasticity of supply. As already noted, equation (1) may be estimated directly and $\alpha_1$ provides an estimate. The alternative, adopted in Malpezzi (1996), is to augment the supply equation (1) with a housing demand equation. The model can then be solved for the implied reduced form house price equation, which is estimated. The supply elasticity is not formally identified in the price equation, but estimates can be obtained making reasonable assumptions (on the basis of theory) about the remaining coefficients. As we show below, this method has produced much higher estimates of the supply elasticities than those estimated directly from (1).

The theoretical specification of the model used in this paper is closer to the first approach, but, as it stands, the equation includes no dynamics. But houses cannot be constructed immediately in response to changes in economic conditions. Even if we concentrate on housing starts, dwellings take time to build. In Tsoukis and Westaway (1994) and Meen (1996), the lags are added through the solution to a dynamic cost minimisation problem. The final equation is given by (2).

$$\Delta st_t = \gamma_0 + \gamma_1(st^*_{t-1} - st_{t-1}) + \gamma_2 \Delta st^*_t + \mu_t \tag{2}$$

$\mu$ is a further error term. Therefore, the change in construction depends on disequilibrium in the previous time period, i.e. the difference between desired and actual levels of construction, and changes in the desired level of starts[1]. For estimation, equation (1) may be substituted into (2), although all the parameters of (1) can be recovered.

Extensions to (1) are possible. Although we cannot do this on time-series data, the equation might be extended to include direct measures of land availability. A series of studies by Glen Bramley does so and a recent study by Pryce (1999) incorporates Bramley’s data. But none of these are time-series analyses. It should be noted that in Bramley’s studies, perhaps surprisingly, the inclusion of land availability measures does not raise the directly estimated price elasticities of supply.

Three final points should be noted. First, equation (1) includes no scaling variable. To illustrate the issue; at the moment housing starts (measured in thousands of units) are related to price and cost indices and the short-term interest rate. None of the regressors are of the same scale or units as the dependent variable. Consequently any scaling effects will be picked up in the constant. At the regional level, because of variations in spatial scale, the constants will vary. This may be justified if the appropriate scalar is simply the size of the land mass – the constants are fixed effects – and this was the approach in our earlier work. But there are potentially alternative scalars. One possibility already mentioned is land with planning permission but the time-series data are unavailable in the required form. A second choice might be the size of the regional population[2]. But since our relationship is intended to capture housing *supply* and population influences *demand* (and, therefore, influences the price),

[1] In estimation, we concentrate on starts rather than on completions since the former are more directly under the control of builders and more closely represent their supply intentions.
[2] A possible justification is that population growth influences builders’ expectations.

problems of identification potentially arise. If we follow this approach, there is no reason why *all* the variables believed to enter the demand function, e.g. income, wealth, demographics, should not be included as regressors in the starts equation. In this case the demand and supply functions can no longer be separately identified. A final choice of scalar, which we explore in more detail later, is the volume of housing transactions (also measured in thousands of units). Although we know of no previous study that includes the variable in a starts equation, the idea is that builders are interested in housing turnover. In order to avoid financial constraints, they wish to avoid a build up of stocks of unsold dwellings and market turnover is a good indicator.

Second, although its relevance may not be evident at this stage, we need to point to one important structural feature of recent time-series models of the housing market. Models of both house prices and the volume of housing transactions "broke-down" at the end of 1990. Although there are hypotheses why this happened, our knowledge of the reasons is less than complete. It has been suggested, for example, that changes in behaviour by first-time buyers were influential (see Meen and Andrew 1998 and Andrew and Meen 2003). But, if the same phenomenon occurs in the starts equation, a simultaneous structural change in prices, transactions and construction activity would (i) be noteworthy (ii) provide a modelling strategy for housing starts.

Third, different approaches to modelling generate large differences in the estimated elasticities. Using direct approaches, such as equation (1), the estimates of the long-run elasticities for the UK are almost invariably less than one. Comparable estimates for the US by Topel and Rosen (1988) give elasticities of approximately 3.0. But indirect estimates, derived from reduced form house price equations are much larger. Malpezzi (1996) suggests that the long-run UK supply elasticity on post-war data is between 0.9 and 2.1, but pre-war (when controls were weaker) the elasticity was between 4 and 7. For the USA, his comparable findings are between 9 and 16 and 11 and 18 respectively. But, although the *level* of prices seems to have only a limited impact in the UK, using the direct approach, the *rate of change* has a strong effect (see Meen 2001, Table 6.5). This is consistent with findings by both DiPasquale and Wheaton (1996) and Stein (1995). The former concentrates on the role of vacancies, whereas the latter highlights credit market constraints. Whatever the explanation, since the rate of change of prices is highly volatile, this will mean that housing construction will also fluctuate strongly.

## 4. Data Issues

One crucial finding arose at the start of the study from simple analysis of the time series properties of the data. In Table 1 we present the results of Augmented Dickey-Fuller tests (ADF) for each of the regional housing starts variables and for the ratio of (national) house prices to construction costs – a simple measure of profitability.

Loosely ADF tests indicate whether a series has a trend upwards or downwards over time. If the estimates are below the critical value, we cannot reject the hypothesis that a trend exists (also known as non-stationarity). If the estimates are greater than the critical values, the series are stationary. The general idea is shown in Figure 2, which graphs (for England as a whole) housing starts and the profitability measure.

*Table 1.* ADF Tests (four lags) for Regional Housing Starts

| **Region** | **ADF(4) 1970Q2-1990Q4** | **ADF(4): 1970Q2-2002Q4** |
|---|---|---|
| North | -2.38 (-2.90) | -3.16 (-2.88) |
| North West | -2.59 | -3.31 |
| Yorks & Humber | -2.81 | -3.72 |
| E. Midlands | -3.37 | -3.96 |
| W. Midlands | -2.87 | -3.62 |
| E. Anglia | -2.88 | -3.42 |
| S. East | -3.30 | -3.54 |
| G. London | -1.72 | -1.72 |
| S.West | -2.86 | -3.32 |
| House prices/construction costs (UK) | -2.00 | -0.37 |

In brackets are the MacKinnon critical values at the 5% level for rejection of the hypothesis of a unit root. Variables are expressed in logarithms.


*Figure 2.* Housing Starts and Profitability (variables are in logarithms)

The graph indicates that the ratio of house prices to costs has a substantially stronger trend than housing starts. This is important and is demonstrated more formally in the Table 1 results. Up to 1990, we cannot reject the hypothesis that starts exhibited a trend (with the exception of the East Midlands and the South East). But in all regions, except London, the trend disappears when the sample is extended to 2002Q4. By contrast, the last row of the table suggests that the trend in profitability became *stronger* in the nineties.

Even before conducting any econometric estimation, we can draw some important conclusions:

(i) By itself, a non-stationary series cannot explain a stationary series.

(ii) Attempts to do so will mean that the estimated elasticity (here the price elasticity of supply) will be low.

(iii) This explains why the supply elasticity for all regions was quite low in our earlier studies, even on data to the end of 1990. The trend in real prices was greater than that in starts.

(iv) Since the trend in starts fell in the nineties, whereas that in real prices rose, the estimated price elasticity of supply is likely to fall in the nineties.

To emphasise the point, we will not be able to explain the course of housing starts by profitability alone and the supply elasticities are always likely to be lower than in the earlier period. Furthermore, it is likely to be the case that the *dynamics* of profitability, i.e. the rate of change, will be more important than the level[3].

Moreover, we are likely to need a further explanatory variable that has similar time-series properties to starts to include in the relationship. As we discussed above, this raises issues of the appropriate scaling variable.

One reason why the ratio of house prices to construction costs has a strong trend could be measurement error. If the trend is overestimated, then the supply elasticity estimates will be downward biased. Potentially, both the numerator and denominator could be mis-measured. In this study we have used the house price of *all* dwellings in each region (ODPM series), whereas our earlier work used *new* house prices. The change has been for two reasons:

(i) we are concerned about the smallness of sample sizes at the regional level for new dwellings
(ii) simultaneous equation bias in the elasticity estimates could potentially arise. This is less likely to be a problem with all prices since this is determined by activity in the second-hand as well as new market.

In practice, experiments suggested that the elasticity estimates are not very sensitive to the choice. The measurement of construction costs is more difficult since an official series does not exist over the whole estimation period. Consequently we retained the approach in Meen (1996) where an index of construction costs was calculated from equation (3).

$$COST = 0.67*(WC) + 0.33*(PMAT) \tag{3}$$

*PMAT* is the published index of the price of materials used in house building. *WC* is a constructed unit wage cost index, calculated from (4).

$$WC = ERCON * ETCON / QCON \tag{4}$$

*ERCON* is the published index of employee average earnings in the construction industry; *ETCON* is total employment in the industry and *QCON* is total output. The series, therefore, adjusts average earnings for estimated productivity. It is well known that the published average earnings series probably underestimates the volatility of earnings since it excludes the self-employed. Furthermore since *WC* is an artificially constructed series, we compared its movements with the Labour and Plant Indices underlying the published Resource Cost Index of House Building[4]. The published series is fairly smooth with periodic discrete jumps; our calculated series is noticeably more volatile. As a variant in estimation, therefore, we

[3] The technical reason is that the rate of change of real prices is a stationary series, formed by taking the first difference of the level.
[4] This is only available quarterly since 1990 and, therefore, cannot be used in estimation work.

calculated a moving average of our wage costs series[5]. But, again, the estimated elasticities were not very sensitive to the adjustment.

For the remaining variables in the study, regional housing starts numbers are taken from Housing Statistics and ($R$ ) is the three-month interest rate.

## 5. Estimation Results

We begin by estimating the simple static, or long-run equation given by (1), over two time periods, 1973Q3 - 1990Q4 and 1973Q3 – 2002Q4. The first period is very similar to that in Meen (1996a). The columns of the table give the most basic estimates of the price elasticity of supply (coefficient $\alpha_1$ in (1)). Over the first time period, the results are very similar to those reported in the earlier study. The patterns remain the same and the low elasticity in the South East and surprisingly high value in London stand out.

*Table 2.* Regional Housing Starts – Supply Elasticities From Static Models

| **Region** | **1973Q3-1990Q4** | **1973Q3-2002Q4** |
|---|---|---|
| North | 1.17 | 0.53 |
| North West | 0.74 | 0.28 |
| Yorks & Humber | 0.76 | 0.49 |
| E. Midlands | 0.81 | 0.56 |
| W. Midlands | 0.43 | 0.12 |
| E. Anglia | 0.57 | 0.40 |
| S. East | 0.28 | 0.15 |
| G. London | 0.86 | 0.68 |
| S.West | 0.55 | 0.33 |
| England | 0.57 | 0.31* |

*A fixed effects panel model across the regions gave an estimate of 0.45.

But extending the sample until the end of 2002 shows that the elasticities fall dramatically in all regions. On this simple test, regions have become less price sensitive during the nineties. This is in line with our analysis of the time-series properties of the data above. The results are unsurprising. Furthermore, in these (and later) tests, the elasticities are insignificantly different from zero over the nineties alone.

However, long-run estimates of elasticities derived from simple static relationships can be unreliable, i.e. biased. An alternative, and generally thought preferable, approach is to estimate the full dynamic model - combining (1) and (2) – and to derive the long-run elasticities from this model. We begin by estimating a panel model across the regions, allowing for potential spatial correlation in the errors (which improves efficiency) by using Seemingly Unrelated Regression (SUR). The results are shown in Table 3[6]. However, panel models generally assume that the coefficients are equal across each region. But this is

[5] This could be considered as a "normal" cost measure.
[6] Notice that, for the moment, London is dropped because its coefficients are so different from the other regions.

unlikely to be valid here and so the table allows the price elasticities and the interest rate coefficients to vary across the regions[7].

The implicit long-run supply elasticities are given in Table 4. Compared with Table 2, the elasticities are even lower and not significantly different from zero in the South East and South West. There is some evidence in Table 3 that the *dynamic* price responses (Δ(ph-cost)) are higher in the South East and East Anglia than in other parts of the country.

A final point to note (which becomes particularly important later) is the presence of four dummy variables, *DUM9193*, *DUM9496*, *DUM9799*, *DUM0002*. The first takes a value of one in each of the quarters of the years 1991 to 1993 with similar specifications for the other variables. Each of these dummies is highly significant and is a measure of the extent to which "traditional" equations failed to predict the course of housing starts in the nineties. For example, between 1991 and 1993, traditional equations would have over-predicted starts on average each quarter by 13.5%, *even with the much lower estimated supply elasticities*.

The panel estimates suggest that there is substantial coefficient variation across the regions. Although there is some efficiency loss from not using SUR, our judgement is that it is preferable to estimate separate equations for each area so that all the coefficients can vary.

Table 5, therefore, presents the results of dynamic equations for each region estimated independently. The specifications are very similar to those in Table 3, the differences arising from the fact that some regressors were found to be insignificant in some areas. Here we have reintroduced London into the estimates.

Across the regions, the strong message appears that the *dynamic* price terms and the interest variables (in levels) are consistently the most important in explaining housing starts. Indeed, in line with our earlier arguments, the levels of prices are small and frequently insignificant. It should also be noted that the fit of the London equation, measured in terms of $R^2$ and equation standard error, is noticeably worse than in the other regions.

If the low price elasticities (in levels) are due to land constraints, we might expect the elasticities to be greater in the downturn than in the upturn. This can be examined by testing for differential responses between the two phases. But this requires us first to identify the cycles. There are a number of possible approaches, but we allocated each period according to whether the ratio of house prices to construction costs, i.e. profitability, was rising or falling. On this definition, the following allocations were used:

| | |
|---|---|
| 1973Q3-1973Q4: | upswing |
| 1974Q1-1977Q3: | downswing |
| 1977Q4-1980Q1: | upswing |
| 1980Q2-1982Q3: | downswing |
| 1982Q4-1989Q3: | upswing |
| 1989Q4-1996Q2: | downswing |
| 1996Q3-2002Q4: | upswing |

[7] Note that now we assume equality of the house price and cost coefficients so that they are combined into a single variable.

*Table 3.* Fixed Effects Panel Estimation of Regional Starts (SUR)
Dependent Variable: Δst 1973Q3-2002Q4

| Variable | Coefficient | t-Statistic |
|---|---|---|
| Δst (-1) | -0.173907 | -5.755028 |
| DUM9193 | -0.134504 | -3.817040 |
| DUM9496 | -0.189194 | -4.449671 |
| DUM9799 | -0.150111 | -3.626508 |
| DUM0002 | -0.196194 | -4.019119 |
| N--Δ(ph-cost) | 0.436415 | 1.490485 |
| NW--Δ(ph-cost) | 0.282425 | 1.195805 |
| YH--Δ(ph-cost) | 0.259861 | 1.273923 |
| EM--Δ(ph-cost) | 0.259331 | 1.382981 |
| WM--Δ(ph-cost) | 0.430012 | 2.200468 |
| EA--Δ(ph-cost) | 0.749502 | 3.247320 |
| SE--Δ(ph-cost) | 0.643804 | 2.808259 |
| SW--Δ(ph-cost) | 0.177470 | 0.849798 |
| N--(ph-cost)(-1) | 0.268066 | 2.616874 |
| NW--(ph-cost)(-1) | 0.170116 | 2.650730 |
| YH--(ph-cost)(-1) | 0.104901 | 1.850605 |
| EM--(ph-cost)(-1) | 0.156441 | 2.796722 |
| WM--(ph-cost)(-1) | 0.126395 | 2.411199 |
| EA--(ph-cost)(-1) | 0.061116 | 1.097984 |
| SE--(ph-cost)(-1) | -0.034705 | -0.814476 |
| SW--(ph-cost)(-1) | -0.003239 | -0.064451 |
| N--st(-1) | -0.578263 | -10.12282 |
| NW--st(-1) | -0.472847 | -8.995162 |
| YH--st(-1) | -0.418299 | -8.951742 |
| EM--st(-1) | -0.450780 | -10.04475 |
| WM--st(-1) | -0.559040 | -11.93987 |
| EA--st(-1) | -0.415002 | -8.248453 |
| SE--st(-1) | -0.334781 | -8.958718 |
| SW--st(-1) | -0.291243 | -7.064854 |
| N--R(-1) | -0.023638 | -3.642597 |
| NW--R(-1) | -0.030628 | -5.903333 |
| YH--R(-1) | -0.029712 | -5.860680 |
| EM--R(-1) | -0.026576 | -5.438252 |
| WM--R(-1) | -0.019380 | -4.139827 |
| EA--R(-1) | -0.018727 | -3.484773 |
| SE--R(-1) | -0.020574 | -4.112508 |
| SW--R(-1) | -0.021733 | -4.400194 |
| R-squared | 0.664787 | -0.005771 |
| Adjusted R-squared | 0.646414 | 0.227978 |
| S.E. of regression | 0.135563 | 16.42927 |
| Durbin-Watson stat | 1.784186 | |

The equation also includes seasonal dummies and dummies for 1979Q1 and 1980Q1. The fixed effects (constants) are not shown in the table.

In fact, differential price elasticities (in either the dynamics or levels) were found to be significant only in the North West, West Midlands, East Anglia, South East and South West. The greater importance in the south of the country is consistent with the expectation that planning constraints are more binding. Note that, in Table 5, the price elasticities (in levels) are insignificant in all those regions. The results of introducing differential responses in the five regions are shown in Table 6. Separate rows are added representing effects that are present in all time periods and effects that only operate in the downswing. Therefore, for example, in the North West, there is no dynamic price effect in the upswing, but an elasticity of 1.53 that operates only in the downswing. In the West Midlands, there is a dynamic price elasticity of 0.45 in the upswing and 1.71 in the downswing (the sum of 0.45 and 1.26). In all cases there is a significant improvement in fit – differential responses between the upturn and downturn do occur in most areas. In most cases the insignificant (or negative) price responses in levels disappear.

From the combination of the results in Tables 5 and 6, Table 7 presents our best estimates of the long-run supply elasticities in each region, using conventional approaches. However, we have not been able to identify any significant effect in Yorkshire and Humberside.

*Table 4.* Regional Housing Starts – Long-Run Supply Elasticities From the Dynamic Panel Model

| **Region** | **1973Q3-2002Q4** |
|---|---|
| North | 0.49 |
| North West | 0.36 |
| Yorks & Humber | 0.25 |
| E. Midlands | 0.35 |
| W. Midlands | 0.23 |
| E. Anglia | 0.15 |
| S. East | -0.10* |
| S.West | -0.01* |

Note that London is excluded from estimation because of its distinctive characteristics (see below).
* denotes insignificantly different from zero.

*Table 5.* Dynamic Regional Starts Equations (OLS)
Dependent Variable: Δst 1973Q3-2002Q4

| Variable | N | NW | YH | EM | WM | EA | SE | SW | GL |
|---|---|---|---|---|---|---|---|---|---|
| Δst (-1) | - | - | -0.087 | - | - | -0.167 | 0.086 | - | -0.250 |
| | | | (1.1) | | | (2.0) | (1.0) | | (2.6) |
| Δst (-2) | 0.201 | 0.157 | - | 0.124 | - | - | 0.077 | - | - |
| | (3.1) | (2.2) | | (1.7) | | | (0.9) | | |
| Δ(ph-cost) | 0.324 | 0.381 | 0.921 | 0.796 | 1.017 | 1.260 | 0.705 | 0.608 | 0.286 |
| | (0.9) | (1.2) | (3.5) | (2.6) | (3.5) | (3.6) | (2.7) | (2.0) | (0.5) |
| Δ(R) | - | - | -0.014 | -0.012 | - | -0.012 | -0.016 | -0.013 | -0.034 |
| | | | (1.1) | (1.0) | | (0.9) | (1.4) | (1.1) | (1.6) |
| (ph-cost)(-1) | 0.436 | 0.183 | -0.020 | 0.250 | 0.096 | 0.153 | 0.038 | 0.057 | 0.336 |
| | (2.6) | (1.8) | (0.2) | (3.1) | (1.3) | (1.8) | (0.6) | (0.8) | (2.2) |
| st(-1) | -0.726 | -0.505 | -0.418 | -0.542 | -0.564 | -0.481 | -0.378 | -0.308 | -0.401 |
| | (9.0) | (7.1) | (5.1) | (7.0) | (7.8) | (5.1) | (4.8) | (4.2) | (3.7) |
| R(-1) | -0.021 | -0.026 | -0.021 | -0.027 | -0.012 | -0.023 | -0.021 | -0.019 | -0.028 |
| | (2.5) | (3.7) | (3.1) | (4.0) | (2.0) | (3.0) | (3.1) | (2.9) | (2.2) |
| Adjusted R-squared | 0.67 | 0.62 | 0.67 | 0.68 | 0.73 | 0.61 | 0.65 | 0.60 | 0.31 |
| S.E. of regression | 0.174 | 0.131 | 0.126 | 0.124 | 0.114 | 0.144 | 0.127 | 0.124 | 0.250 |
| Durbin-Watson stat | 1.92 | 2.02 | 1.95 | 1.86 | 1.83 | 1.89 | 1.95 | 2.02 | 2.02 |

The equation also includes a constant, seasonal dummies and dummies for 1979Q1 and 1980Q1.
t-statistics in brackets

*Table 6.* Dynamic Regional Starts Equations - Differential Responses Between the Upswing and Downswing
Dependent Variable: Δst 1973Q3-2002Q4

| Variable | NW | WM | EA | SE | SW |
|---|---|---|---|---|---|
| Δst (-1) | - | - | -0.183 | 0.085 | - |
| | | | (2.3) | (1.2) | |
| Δst (-2) | 0.152 | - | - | 0.085 | - |
| | (2.3) | | | (1.2) | |
| Δ(ph-cost) – all periods | - | 0.451 | 1.182 | 0.696 | 0.618 |
| | | (1.2) | (3.4) | (1.6) | (2.0) |
| Δ(ph-cost)- downswing only | 1.530 | 1.262 | - | 1.621 | - |
| | (3.1) | (2.2) | | (2.3) | |
| Δ(R) | - | - | -0.018 | - | -0.018 |
| | | | (1.4) | | (1.5) |
| (ph-cost)(-1) – all periods | 0.201 | - | - | 0.090 | - |
| | (2.1) | | | (1.3) | |
| (ph-cost)(-1) – downswing only | - | 0.165 | 0.220 | - | 0.180 |
| | | (2.4) | (2.2) | | (2.1) |
| st(-1) | -0.527 | -0.596 | -0.438 | -0.465 | -0.332 |
| | (7.7) | (8.5) | (5.7) | (5.8) | (5.0) |
| R(-1) | -0.025 | -0.010 | -0.022 | -0.019 | -0.021 |
| | (3.9) | (1.8) | (3.0) | (2.7) | (3.3) |
| Adjusted R-squared | 0.65 | 0.74 | 0.61 | 0.68 | 0.62 |
| S.E. of regression | 0.126 | 0.110 | 0.143 | 0.121 | 0.123 |
| Durbin-Watson stat | 2.02 | 1.81 | 1.90 | 2.03 | 2.04 |

The equation also includes a constant, seasonal dummies and dummies for 1979Q1 and 1980Q1.
t-statistics in brackets

*Table 7.* Regional Housing Starts – Long-Run Supply Elasticities

| **Region** | **1973Q3-2002Q4** |
|---|---|
| North | 0.60 |
| North West | 0.38 |
| Yorkshire & Humberside | 0.00 |
| E. Midlands | 0.46 |
| W. Midlands | 0.28 |
| E. Anglia | 0.50 |
| S. East | 0.19 |
| Greater London | 0.84 |
| S. West | 0.54 |

However, there is an important caveat to these results. In *all* cases, the equations would have over-predicted the level of housing starts in the nineties. We can see this from the coefficients on the dummy variables mentioned earlier. These coefficients and their associated t-values are set out in Table 8. The first cell in the table implies, for example, that on average between 1991 and 1993, the equation would have over-predicted the outturn level of housing starts in the North by 26.6% - clearly a large error given that the equation standard error is 17.4%.

The period coverage of the dummy variables was constructed so that the first two coincide approximately with the slump in the market, whereas the third and fourth dummies correspond to the upturn. If land shortages were the main explanation for the over-prediction, we would expect two findings:

(i) the coefficients on *DUM9799* and *DUM0002* would be bigger than those on the remaining dummies
(ii) the coefficients would be bigger in the southern regions, where the constraints are expected to be more binding.

Although the coefficients for the North are clearly large, broadly, the second condition appears to be met. East Anglia, the South East and the South West all have large errors. The London coefficients are, in fact, relatively small and insignificant, but as discussed below, London is a special case. The coefficients are also insignificant in Yorkshire and Humberside and, interestingly, this was the region in which we failed to find any significant supply elasticity.

However, there is no evidence that the first condition is met. The coefficients are fairly stable across time, over both the slump and the boom, including the southern regions. From these coefficients, there is little supporting evidence to indicate that the weakness of housing starts since 1997 has been due to planning.

*Table 8.*Overprediction of Housing Starts

| **Region** | **DUM9193** | **DUM9496** | **DUM9799** | **DUM0002** |
|---|---|---|---|---|
| North | -0.266 (3.2) | -0.242 (2.5) | -0.148 (1.6) | -0.237 (2.3) |
| North West | -0.147 (2.5) | -0.161 (2.3) | -0.143 (2.2) | -0.180 (2.3) |
| Yorkshire & Humberside | -0.071 (1.1) | -0.082 (1.2) | -0.014 (0.2) | -0.073 (1.0) |
| E. Midlands | -0.190 (3.4) | -0.239 (3.6) | -0.182 (2.8) | -0.269 (3.5) |
| W. Midlands | -0.113 (2.8) | -0.145 (2.8) | -0.106 (2.3) | -0.097 (2.0) |
| E. Anglia | -0.156 (2.7) | -0.207 (3.0) | -0.212 (3.4) | -0.258 (3.6) |
| S. East | -0.226 (3.7) | -0.245 (3.5) | -0.257 (3.8) | -0.310 (3.4) |
| Greater London | -0.114 (1.1) | -0.154 (1.3) | -0.182 (1.5) | -0.198 (1.2) |
| S. West | -0.198 (3.7) | -0.230 (3.6) | -0.189 (3.5) | -0.244 (4.0) |

t-values in brackets

This is, of course, a highly controversial conclusion and needs further support, ideally including an alternative explanation. One possibility would be the role of expectations, which can give rise to backward-bending supply curves. This hypothesis has been explored carefully by Pryce (1999). However, although using two time periods, Pryce's work is primarily based on cross-section data over the English local authorities. Although our data set cannot reproduce Pryce's specification exactly, in line with his work, we added the square of prices into the specification in Table 6 for the South East, where speculative pressures are likely to be more intense. The idea is that if builders expect the value of land held vacant to rise at a faster rate than current prices, there is an incentive not to build. Therefore, construction may fall even if current prices are rising. However, although the results are not shown here, we found no statistically significant evidence in support, although it has to be recognised that the tests are more simplistic than those conducted by Pryce and the findings are not conclusive.

What we appear to be observing in the results is a structural change taking place after 1990. But as noted above, similar results have been observed in two of the other main housing market indicators – house prices and the volume of property transactions. This suggests a further modelling approach in which transactions is used as the appropriate model scalar variable. Given that traditional relationships for both variables "broke down" in the early nineties and have failed to recover subsequently, transactions have the required time-series properties potentially to explain starts and are expressed in appropriate units. Low turnover of the existing housing stock implies that stocks of unsold new dwellings are likely to be increasing and builders will react by reducing new construction. Since sales provide finance for the next tranche of building, turnover of the stock is important in order to avoid financial constraints. Figure 3 graphs starts and property transactions (in England and Wales) and visually the two appear to be related. The fall in both series in the early nineties and their subsequent failure to rise, is evident. The simple correlation between the two series since the early seventies is 0.60.

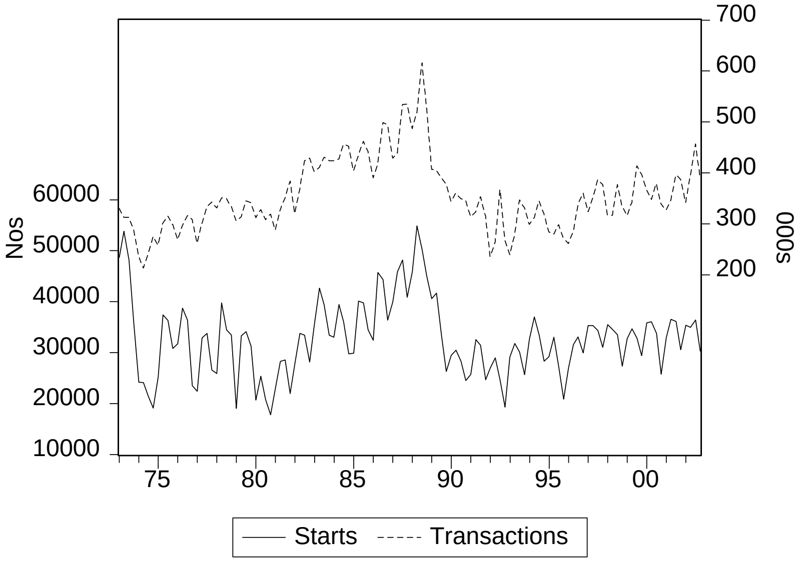


*Figure 3.* Housing Starts and Property Transactions

In testing this hypothesis, however, a problem arises in that data on housing transactions are not available at the regional level over the whole of our estimation period. We begin by estimating an equation, therefore, on data for England as a whole. The first column of Table 9 excludes transactions (*trans*), whereas the variable is added to the second. In terms of fit, the addition leads to an unambiguous improvement. Notice also that the dummy variables are now only on the borderline of significance and have smaller coefficients. But the result is that the remaining variables, with the exception of interest rates, become much less significant. The final column, therefore, removes the insignificant terms. Under this modelling approach the long-run price elasticity of supply is insignificantly different to zero[8].

We need to be clear what we are suggesting. The model indicates that, under this view of the world, the key drivers of construction activity are:

(i) housing transactions, as a measure of market turnover
(ii) the level of interest rates, representing the cost of borrowed finance
(iii) the rate of change of profitability, measured as the percentage change in house prices relative to construction costs. Parts of the literature suggest that this variable may capture availability of internal finance for future projects.

[8] Although full diagnostic statistics are not presented, there is no evidence of autocorrelation or heteroscedasticity. But evidence of misspecification occurs from Ramsey's Reset test.

By contrast, conventionally measured price responsiveness is much weaker. Although appropriate regional transactions data are not available, the national variable was tested in each of the regional equations. The variable was not significant in any of the northern regions, but was strongly significant in all the southern regions and in the West Midlands.

*Table 9.* National Starts Equations, Including Property Transactions
Dependent Variable: Δst 1973Q3-2002Q4

| Variable | Excluding Transactions | Including Transactions | Including Transactions |
|---|---|---|---|
| Δst (-1) | 0.107 (1.7) | 0.058 (0.9) | - |
| Δst (-2) | 0.107 (1.7) | 0.059 (0.9) | - |
| Δ(ph-cost) | 1.200 (3.7) | 0.720 (2.0) | 0.697 (2.0) |
| Δ(R) | -0.0126 (1.4) | -0.008 (0.9) | - |
| (ph-cost)(-1) | 0.149 (2.2) | 0.053 (0.7) | - |
| st(-1) | -0.473 (6.3) | -0.510 (6.9) | -0.492 (8.4) |
| R(-1) | -0.017 (3.0) | -0.016 (2.9) | -0.014 (2.9) |
| trans | - | 0.236 (3.0) | 0.272 (3.9) |
| DUM9193 | -0.167 (3.4) | -0.098 (1.9) | -0.062 (1.8) |
| DUM9496 | -0.183 (3.2) | -0.107 (1.8) | -0.074 (1.7) |
| DUM9799 | -0.173 (3.2( | -0.111 (2.0) | -0.079 (2.1) |
| DUM0002 | -0.223 (3.2) | -0.149 (2.0) | -0.104 (2.5) |
| Adjusted R-squared | 0.74 | 0.76 | 0.76 |
| S.E. of regression | 0.097 | 0.094 | 0.093 |
| Durbin-Watson stat | 1.92 | 1.89 | 1.87 |

The equation also includes a constant, seasonal dummies and dummies for 1979Q1 and 1980Q1.
t-statistics in brackets

## 6. Why Are the London Results Different?

In all our results here and in earlier work, the elasticities for London are out-of-line with the other areas and the equation fit is much poorer. One important reason is probably that the product mix is very different in London from the rest of the country. Although we cannot test formally what difference this will make, given the distributions shown in Table 10, it would be remarkable if the elasticities did not differ.

Table 10 uses NHBC data and shows, for 2002, the distribution of starts (in percentages) by dwelling type in the southern regions. The dominance of flats, maisonettes and terraced houses in London is clear. 89% of starts fall in to these categories compared with 56% in the South East, 49% in the South West and 47% in the East[9].

*Table10.* Distribution of Dwelling Types (2002, %)

| **Region** | **Detached Houses** | **Semi-detached Houses** | **Terraced Houses** | **Flats & Maisonettes** |
|---|---|---|---|---|
| London | 5 | 4 | 15 | 74 |
| South East | 26 | 15 | 22 | 34 |
| East | 32 | 16 | 24 | 23 |
| South West | 32 | 17 | 24 | 25 |

The rows do not sum to 100% because of the exclusion of the small percentage of bungalows.

[9] Note that these statistics are on a GOR basis.

## 7. What Level of Construction is Necessary to Maintain Constant Real House Prices?

In Meen (1998), we suggested that a supply elasticity of approximately 10 would be necessary to maintain constant real prices in the long run in the presence of permanent income changes that raise the demand for housing. Clearly this is much higher than we and other authors have found in the UK. A related question is what level of construction would be necessary to maintain constant real prices, if the economy was growing along a steady-state growth path? But, although the question may provide a benchmark, we should be aware of its limitations. At first sight, this may be viewed as the level of real house prices that would emerge in the absence of constraints on new construction. However, since productivity in construction is lower than the economy average, even in principle, rising real prices might be expected in the absence of controls. Furthermore, the international evidence does not universally support the view that constant real prices are the norm. Constancy occurs in some European countries, but not others. Figure 4 shows that the trend in real prices is weaker in the US than in the UK, but is still upwards. But controls are generally believed to be more relaxed in the US.

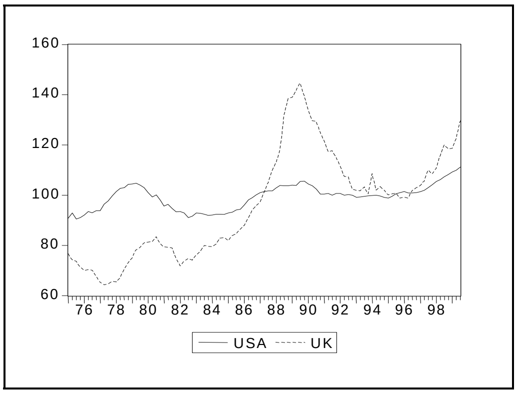


*Figure 4.*. Real House Prices - USA & UK (1995=100)

Source. Meen (2001)

With this caveat some estimates can be made using the model of house prices in Meen and Andrew (1998). The preferred long-run price equation is given by (5):

$$ph = -13.552 + 0.336*(rgw) - 1.744*(hs) + 2.401*(ry) - 0.037*(UCC) + 2.634*(WSH) \quad (5)$$

where, *ph* =house prices; *rgw*= real household wealth; *hs*= owner-occupier housing stock; *ry*= real household income; UCC= housing user cost of capital; *WSH*= share of wages in household incomes.

Using the trend growth rates of each of these variables, we can obtain an estimate of the long run expected growth rate of house prices. But it should be clear that the calculated value is highly dependent on the estimated parameters. Particularly important is the coefficient on the housing stock. But, in practice, this is one of the parameters subject to most uncertainty. Therefore, we construct our estimates of the required level of starts for different values of the coefficient. We assume the following long-run growth rates for each of the independent variables:

*ry* = 2.5% pa
*pc* = 2.5% pa
*hs* = 1.5% pa (the stock in 2001 was 17.1 million)
*rgw* = 2.5% pa
*UCC* = 0.0
*WSH* = -0.4 % points pa

The user cost is a stationary process and, therefore, has no trend. The assumed growth rate for real wealth is below that which occurred over the last twenty years, but the value ensures a constant long-run wealth to income ratio.

Under different values of the housing stock elasticity, Table 11 sets out the calculated trend growth rate for nominal house prices. Notice at the estimated elasticity of –1.744, trend growth is 5.5%. This would imply that real prices would grow by approximately 3% and the ratio of prices to incomes by approximately 0.5% pa. Neither of these are implausible, but the increasing price to income ratio might be considered marginally strong. But if the elasticity were to be slightly greater than –2.0, the ratio would be constant. This value is, by no means, outside the margins of error.

But, at the estimated elasticity, the required *additional* annual private sector housing starts would be 300,000 on top of the current level of approximately 160,000. But the table demonstrates how sensitive the results are to the elasticities. None of the values in the table could be ruled out.

These numbers are, of course, very large indeed. But the opening statements of this section should be remembered. There is no reason why constancy in real prices is a desirable objective.

*Table11.* Estimated Additional Starts to Maintain Constant Real House Prices, at Different Elasticities

| **Elasticities** | **-1.744** | **-2.0** | **-2.5** | **-3.0** |
|---|---|---|---|---|
| Growth in house prices | 5.5% | 5.3% | 4.5% | 3.8% |
| Required Additional Starts (000s) | 300 | 240 | 140 | 75 |

## 8. Conclusions

This paper presents the results of our investigations into regional housing supply elasticities. We draw the following conclusions:

(i) In line with our earlier work, price elasticities of supply vary across the regions but in all cases the elasticities are less than unity.

(ii) The elasticities have fallen sharply during the nineties, but this was not confined to the post-1996 upturn in the housing market. The changes began much earlier.

(iii) There is evidence in many regions that the elasticities are higher in the downswing than in the upswing.

(iv) Although land shortages may represent part of the reason for weak supply responses in the nineties, we are not convinced that it is the whole story. The low levels of starts may also have been affected by general changes in the housing market of which lower levels of property transactions was one facet. There is evidence that transactions, or turnover, is one of the key drivers along with interest rates and the rate of change of profitability. The *levels* of prices seem to be less important.

(v) Results for London are expected to differ from the rest of the country because of differences in the product mix.

(vi) In order to achieve constancy in real house prices, the required levels of additional construction may need to be very large.

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# Additional estimates

If real prices were to rise at 1.1%, nominal prices rise by approximately 3.6%. Therefore, the new version of Table 11 becomes:

*Table11*. Estimated Additional Starts to Maintain Real House Prices Growing at 1.1%, at Different Elasticities

| **Elasticities** | **-1.744** | **-2.0** | **-2.5** | **-3.0** |
|---|---|---|---|---|
| Growth in house prices | 5.5% | 5.3% | 4.5% | 3.8% |
| Required Additional Starts (000s) | 185 | 145 | 60 | 10 |