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THE DEVELOPMENT OF STANDARDISED INDICES FOR MEASURING HOUSE PRICE INFLATION INCORPORATING PHYSICAL AND LOCATIONAL CHARACTERISTICS

PROFESSOR MIKE FLEMING
University of Loughborough

and

DR JOE NELLIS
Cranfield School of Management
Cranfield Institute of Technology
Cranfield
Bedford MK43 OAL

(Tel: 0234 751122)

The Development of Standardised Indices For Measuring House Price Inflation Incorporating Physical And Locational Characteristics*

By M.C. FLEMING and J.G. NELLIS

Loughborough University *Cranfield School of Management*

SUMMARY

The development of index numbers to measure house price movements raises conventional index number problems in a particularly acute form partly because of the lack of a standard product but also because of the influence of locational factors on house prices. This paper reports on the development of indices of house prices in the UK, standardised to allow for the influence of a wide range of both physical house characteristics and locational attributes, using the 'hedonic' technique. A large data base is employed covering 60,000-90,000 house purchase transactions each year over the period from 1983 to 1989. Quarterly standardised indices are derived covering six categories of house type and buyer type for thirteen regions and countries of the UK as well as for the UK as a whole. Price movements based on the standardised indices are contrasted with those based on simple average prices.

Keywords: HOUSE PRICES; PRICE INDEX NUMBERS; HEDONIC TECHNIQUE; REGRESSION ANALYSIS

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1. INTRODUCTION

The measurement of house price movements over time raises a number of severe problems both in terms of data requirements and technical analysis. As with many other goods, the set of houses traded in any time period will possess a diverse range of both quantitative and qualitative characteristics. But, at the same time, house prices are affected by the nature of the immediate residential neighbourhoods in which the houses are located as well as by the characteristics of the wider surrounding areas. The derivation of standardised indices to measure price movements, therefore, demands that account should be taken of all of these types of influence. Needless to say, price indices play such an important part in the economy that it is important they should be constructed with as much accuracy and reliability as possible. In the UK the movement of house prices over recent years has assumed a special importance because of their impact on the measurement of the housing component of the 'cost of living' - the Retail Prices Index (RPI). For example, over the decade 1974-85 the housing component of the RPI increased from 10 per cent to 15 per cent of total expenditure and, because of its large weight and volatility, this has had a considerable effect on the level of the RPI, lowering it between 1974 and 1980 and raising it thereafter (Fry and Pashardes, 1986). House price movements, of course, are not the only price constituent of the housing component of the RPI but they are an important part.

This paper builds on previous research by the authors in this field (Fleming and Nellis, 1984, 1985b) and reports on the development of a new set of house price indices based on the so-called 'hedonic' approach to measurement. For many products, such as basic raw materials, their physical specifications are easy to define and remain unchanged over long periods of time and thus the construction of price indices in these cases presents no technical problem. In contrast, however, where heterogeneous products such as housing consist of a diverse variety of characteristics, the problem of price measurement over time is a significant one. The idea behind the hedonic approach is that goods with different characteristics may be regarded as different bundles of readily-defined attributes from which consumers gain satisfaction and hence will attract different prices. Thus, for example, in the case of a complex product such as a car the satisfaction it provides to consumers derives from factors such as its size, design and operating features (e.g. power, speed, safety features etc.), giving rise to a wide range of prices for various car models. Similarly, in the case of housing, each house may be considered as a bundle of both physical and locational characteristics such that the price of a house reflects the value to the buyer the various attributes embodied in it. The hedonic approach employs multiple regression analysis to isolate the influence of each measurable characteristic on price. It is then possible to 'repackage' the characteristics as the basis for constructing standardised (i.e. mix-adjusted) prices. In practice, the application of the technique is hindered by the large data-capturing demands that it imposes. The present study overcomes this problem by making use of a large data base consisting of all of the house purchase transactions on which one of the country's largest building societies (the Nationwide Anglia Building Society) made mortgage advances during the period from 1983 to 1989. The result is the development of a new house price analysis system which is now regularly used by the Society itself for the regular reporting of house price movements. A novel feature of this paper is the application of the hedonic technique to take account of the influence of *locational* factors, as well as a wide range of physical house characteristics, on house prices in the UK.

The hedonic technique has a long pedigree dating back for at least 60 years to the work of Waugh (1928) relating to the impact of quality change on prices in the agricultural sector. But its applications have been limited in practice because of the extensive data requirements that it demands, as noted above. In 1961 the United States Price Statistics Review Committee (usually referred to as the Stigler Committee) recommended that statistical agencies should explore the use of hedonic methods, arguing that this would provide a 'more objective' way of dealing with quality change than traditional methods (Price Statistics Review Committee, 1961). Hedonic-based price indexes are now used in the official US National Income and Product Accounts in the fields of housing construction (introduced in 1968) and computer equipment - introduced in 1985 (see Cartwright, 1986). Since 1988 they have also been incorporated in the valuation of housing components contained in the US official Consumer Price Index. In the UK, work on the development of hedonic-based price indices has been carried out, for example, on new farm tractor prices (Rayner, 1968), fertilizer prices (Rayner and Lingard, 1971) and car prices (Cowling and Cubbin, 1972; Deaton and Muellbauer, 1980) but the application in the case of house prices has been limited (see Wilkinson, 1976, who develops historical series for two towns from 1885 to 1970 and Fleming and Nellis, 1985a and 1985b). Unlike the USA, hedonic indexes have not been adopted officially, as yet, in the UK.

The arrangement of the paper is as follows. In Section 2 we consider briefly the purposes and problems associated with house price measurement, while Section 3 discusses the various methods of measurement which have been employed to date. Section 4 presents the results of the study we have conducted, using the unique and specially-developed data base, referred to above, designed to accommodate the various measurement problems associated with house prices. The outcome of the study is a set of standardised house price indices covering six house and buyer groupings for each of 13 regions and countries of the UK as well as for the UK as a whole. These standardised indices are reported in Section 5 and contrasted with indices based on simple average prices.

2. PURPOSES AND PROBLEMS OF HOUSE PRICE MEASUREMENT

2.1 The Purposes of House Price Measurement

The measurement of house prices is of interest to two main groups of users: first, direct participants in the housing market (buyers and sellers, housebuilders, providers of financial and professional services etc.) and secondly, other users such as the government and workers in academic and market research etc. Buyers and sellers, of course, will be mainly interested in current price levels at a particular point in time though, naturally, they may also be interested in making comparisons of movements over time as a basis for judging current prices. Other users, while interested in current price levels as well, will tend to have a greater interest in price movements over time. An index of price movements is of direct use to those, such as valuers, property insurers etc., who wish to estimate current market values on the basis of information about market prices in previous time periods. As noted above, an index of house prices is also used officially as a constituent in measuring changes in the cost of housing services, incorporated in the Retail Prices Index (RPI) for the UK.

Further, the fact that owner-occupation in Britain is now the major form of housing tenure (65 per cent) and that the ownership of housing constitutes the largest single component of personal sector wealth (approximately 40 per cent) means that changes in the reported values of properties over time, especially in boom or slump periods, provoke widespread interest. They are also an important determinant of people's expectations and economic behaviour, particularly with regard to expenditure decisions, labour mobility and wage demands (Bover *et al*, 1989).

2.2. Problems of House Price Measurement

The main problem of measurement has already been referred to above. This is that the houses traded in any time period will possess a diverse range of physical and locational characteristics and these vary from one time period to the next.

Consequently, the use of *simple* average prices as the basis for comparison is inherently misleading (we demonstrate that this is in fact the case in Section 5). Few houses are identical: they may differ according to a wide variety of physical characteristics such as size, type, age, garden, garage, quality of fixtures and fittings and general condition etc. Even where similar houses exist, each one is necessarily unique in having a fixed location, the regional and localised attributes of which mean that one such house is able to command a higher price than another.

Given that housing demand is satisfied, in the main, by the *existing* stock (rather than by *new* building), it may be thought that the mix of houses traded from one time period to the next may be subject to little change and thus failure to adjust explicitly for changes in the mix may have little significance. In fact, the mix of traded properties *does* change markedly over time. For example, the proportions of different types of dwellings on which building societies granted mortgage loans varied considerably during the 1970s and 1980s. The official surveys of building society transactions[1] show that in the case of *all* houses, the proportions of flats, maisonettes and terraced houses increased sharply between 1970 and 1988 at the expense of bungalows, detached and semi-detached houses (DOE, annually; BSA, 1988 and quarterly). Variations in the proportions of different types of dwelling illustrate only one source of mix variation in properties traded. Likewise, analyses of their age distribution also show considerable variation. For example, the surveys referred to above show that there has been a considerable decline in the proportion of houses traded which are new dwellings and a notable growth in the proportion of the oldest second-hand group (pre-1919). These illustrations, based on only two physical house characteristics, indicate the inherent dangers of relying on simple average prices as

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1 Building societies, of course, are not the only source of mortgage finance, but they are the major institutional provider. Their share of the total institutional mortgage finance market (as measured by the value of net mortgage advances) has fluctuated as follows: 1970 - 87 per cent; 1975 - 76 per cent; 1980 - 79 per cent; 1985 - 78 per cent; 1988 - 72 per cent (DOE, annually).

barometers of price movements and thus demonstrate the potential importance of standardisation. Furthermore, from the point of view of measuring prices at the national level, changes in the regional distribution of traded properties may be significant because of very marked disparities in regional house prices. Here too the official surveys show that there is some (though much less) variation over time in the regional distribution of transactions.

The problem of measurement in the context of mix variability is, of course, not unique to housing. The same problems arise in attempting to measure price movements generally, as in the RPI. The latter takes as a standard of comparison a standard 'basket' of goods which is repriced in successive time periods. To adopt the same principles for housing would require the existence of 'standard' houses which are regularly sold and resold. Unfortunately, the problem is not so readily solved in this context since there is no such thing as a 'standard' house and, as noted above, because locational factors play such a crucial role in house price determination.

In the UK, there are a large number of sources publishing house price information. Currently there are at least 15 such sources. A critical appraisal of the sources is provided in Fleming and Nellis (1981 and 1985a) and a complete collection of the available data is to be found, along with technical details, in Fleming and Nellis (1987). Among these sources only a few have made any attempt at standardisation (the main sources in this respect being the Department of the Environment, the Halifax Building Society and the then Nationwide Building Society). The methodologies employed are noted below before proceeding to present the results of the present study.

3. METHODOLOGICAL APPROACHES TO THE MEASUREMENT PROBLEM

Two main methodological approaches have been adopted in response to the standardisation problem: a weighted-average approach and a regression-based approach.

3.1 Weighted-Average Approach

The weighted-average approach takes average prices for sub-sets of houses defined so as to provide more homogeneous groupings (for example, by type, by size, by age etc.) and then combines these in fixed proportions into a grand or weighted average. This methodology was adopted in 1982 by the Department of the Environment (DOE) for compiling the official index of house prices, and applied retrospectively back to 1968 (DOE, 1982). However, the index adjusts for only three house characteristics: type, size (defined in terms of number of rooms) and age group, sub-classified according to the official standard regions of the UK, in arriving at an overall weighted average index. Consequently, the degree of adjustment is limited and there remains, therefore, an important element of non-comparability.[2] In addition, this approach, by definition, is unable to measure the degree of interaction between house and locational variables.

3.2 Regression-Based Approach

A second, and more sophisticated method of solving the problem of standardisation is to employ regression analysis to estimate the influence that each house characteristic has on price - for example, the contribution to price made by an extra bedroom, the availability of central heating, the existence of a garage or garage space, etc. These measurements may be referred to as 'characteristics-prices'. It is then possible to remove the influence of variation in the mix of characteristics (and

2 A similar approach was adopted by some individual building societies in publishing house price data, the major source being the Nationwide Building Society (now the Nationwide Anglia Building Society) until 1989 when the new methodology reported in this paper was adopted.

so to measure price changes for a standardised *set* of houses) by summing these characteristics-prices in fixed proportions according to the mix of characteristics possessed by a standard representative set of houses. This standard set can, of course, be changed from time to time in the light of any significant changes in the mix. This approach to price measurement, in both production and consumption, now has a long history and its description as the 'hedonic' approach is now common. It was pioneered by Waugh (1928) and Court (1939) and later revived by Griliches (1961) - see Griliches (1986) for discussion - but, as noted above, it has not been adopted widely in official price indices in practice mainly because the data requirements are quite severe. However, the method has been employed by the authors in earlier work to compile standardised indices for the Halifax Building Society in 1983 (Fleming and Nellis, 1984, 1985b). But, as discussed below, the construction of these indices was restricted to the incorporation of physical house characteristics only.

The development of the DOE weighted-index system in 1982 and the subsequent derivation of the Halifax regression-based series in 1983 are regarded as major advances in the measurement of house price trends in the United Kingdom. However, it is also important to stress that both systems focus on the physical characteristics of houses only with location treated merely as a classificatory variable at the broad regional level. They thus fail to allow for the influence of specific locational characteristics on house prices. In recognition of this shortcoming, the major contribution of the research reported here is to extend our earlier work in this area to include the impact of locational factors on house prices. At the same time, the research has permitted us to refine and extend the range of information incorporated about the physical attributes of the houses themselves.

C. PHYSICAL AND LOCATIONAL CHARACTERISTICS MODEL OF HOUSE PRICES

The application of the hedonic approach demands the collection of a large volume of cross-sectional data in each successive time period recording transactions prices and details of the characteristics of goods under investigation. The work reported here is based on a data set especially developed in conjunction with the Nationwide Anglia Building Society to meet this requirement. We describe the data base next before proceeding to present the technical details of the analysis and its application to derive standardised (i.e. hedonic) house price indices.

4.1 The Data Base

The data base covers all the house purchase transactions on which the Nationwide Anglia Building Society approved mortgage loans in each (quarterly) time period back to 1983. It has three particular merits from the point of view of this study. First, as the society is one of the largest societies in the UK, the number of transactions in the data base is exceptionally large (covering around 60,000-90,000 properties per year). As noted above, a large data base is essential in order to permit the reliable estimation of the influence of a large number of characteristics on price in each time period using the regression-based hedonic approach. A second merit of the data base is that the locality in which each property is situated is recorded in terms of post codes which define very small areas. This information is then used in conjunction with the ACORN[3] classification system to categorise the location of each property at two levels - first at the 'micro' level of the immediate residential neighbourhood and, secondly, at a broader 'macro' level relating to the wider

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3 ACORN stands for 'A Classification of Residential Neighbourhoods'. It was developed by CACI Market Analysis Ltd and applies census of population statistics to classify areas of about 150 households (census enumeration districts) into 38 different neighbourhood types. The ACORN classification takes into account 40 different variables encompassing demographic, housing and employment characteristics. The 38 neighbourhood types are aggregated up to 11 neighbourhood groups, as listed below.

surrounding area. For this latter purpose, classification is made in terms of parliamentary constituency boundaries, partly for convenience, but also because they provide a larger number of areas than alternatives such as counties or other administrative districts, and thus provide a better potential discriminatory variable. A third merit of the data base is that information on physical house characteristics is extensive and, unlike any other source, includes information on house size in terms of floor area - a variable which is a more precise indicator of size than simply number of rooms (which has to be relied upon in other sources). Subsequent analysis shows that size, measured by floor area, is in fact the most important determinant of house prices in terms of its contribution to overall explanatory power in the hedonic models.

We summarise the information about the house characteristics and locational variables incorporated in the data base below:

1. Purchase price (recorded at the mortgage approval stage).

2. House characteristics variables - classification according to:

   (a) House type:

      Detached house

      Semi-detached house

      Terraced house

      Detached bungalow

      Semi-detached bungalow

      Purpose-built flat or maisonette

      Converted flat or maisonette

   (b) Tenure:

      Freehold or feuhold with vacant possession

      Freehold or feuhold without vacant possession

      Leasehold

      Part freehold/part leasehold

(c) Garage:

Single garage

Double garage

Parking space

Neither garage nor parking space

(d) Central heating:

No central heating

Full central heating (gas, electric, oil, or solid fuel)

Partial central heating (gas, electric, oil, or solid fuel)

(e) House size (floor area)

(f) Number of bathrooms

(g) Age of dwelling (number of years)

3. Locational Variables - classification according to:

(a) *Regional location* based on 13 regions[4] (used only to classify the data base into 13 sets for subsequent generation of regional house price series);

(b) *Type of residential neighbourhood* based on 11 'ACORN' groupings:

Agricultural areas

Modern family housing, higher incomes

Older housing of intermediate status

Poor quality, older terraced housing

Better-off council estates

Less well-off council estates

Poorest council estates

Multi-racial areas

High status non-family areas

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4 These are equivalent to the 12 official Standard Regions with one region (South East) being divided into two: Outer Metropolitan Area and Outer South East.

Affluent suburban housing

Better-off retirement areas

(c) *Type of surrounding area* (as defined by Parliamentary Constituency boundaries), based on 7 groupings as follows:[5]

Inner metropolitan area

Scottish areas

Poorer, declining industrial areas

Traditional, stable industrial areas

Better-off industrial areas

High status and metropolitan suburbs

Rural areas, resort and market towns

Details of the classification of the variables for computation purposes is given in Appendix A.

For the purpose of this study, the data base is edited in order to exclude certain transactions which may be regarded as atypical. There are three main categories. First, there are houses which are sold at 'non-market' prices such as council houses sold at discounted prices to their tenants and other sales to sitting tenants in the private sector etc. Secondly, there are houses sold without vacant possession or which are unusual in being mixed freehold and leasehold. Thirdly, there are transactions which may be regarded as outliers either because they are genuinely atypical or because of an error in recording or coding at source. A procedure was therefore established in

5 The classification of Parliamentary Constituencies is similar to that employed by CACI Market Analysis Ltd in the development of ACORN. It applies a large number of socio-demographic characteristics, including age structure, household composition, housing, employment and socio-economic status, to categorise constituencies into 28 types and 7 broader groups as shown. This classification does not apply in Northern Ireland. In addition, it is not possible to assign locational variables to new houses because of the frequent absence of post-code information.

order to detect this kind of transaction. This procedure involved first the analysis of frequency distributions, breakdowns and cross-tabulations of related characteristics to identify outlying cases on individual variables (univariate outliers). On the basis of these investigations the range of values within which 99 per cent of cases fell was taken as the range to use in further analyses. At the same time, the data were examined for the presence of outlying cases based on the complete set of characteristics (multivariate outliers). Two tests for multivariate outliers were used, namely Mahalanobis' distance and Cook's distance - for further details see Norušis (1985). It was found that elimination of univariate outliers also removed the most significant multivariate outliers. We refer to this data set as the 'cleaned' data set.

4.2 The Methodology and Its Application

4.2.1 *The Hedonic Method*

The term 'hedonic method' encompasses any use in an economic measurement of an 'hedonic function' which is a relationship between prices of varieties or models of heterogeneous goods - or services - and the quantities of characteristics contained in them, i.e.:

$$P = h(c) \qquad (1)$$

where P is an n-element vector of prices of the varieties or models etc. and (c) is a k x n matrix of characteristics. The theory providing the economic interpretation of (1) in terms of price measurement rests on the 'hedonic hypothesis' explained above, namely the concept that the value placed on heterogeneous goods by consumers derives from the aggregation of their utility-bearing attributes rather than the provision of a single well-defined service in consumption (Lancaster, 1966, 1971; Griliches, 1971; Triplett, 1971, 1975; Rosen, 1974).

The application of the hedonic method uses multivariate regression analysis to isolate the variations in prices that are caused by differences in the qualitative and quantitative characteristics of goods (in this case housing), from those which reflect other market forces (that is, purely inflationary factors operating over time). Given cross-sectional data on house prices and the attributes of the houses sold in different time periods, we can thus estimate the change in average price, from one time period to another, on a standardised basis (that is, keeping the cross-sectional mix of attributes or characteristics constant). A particular attraction of the hedonic method is that it not only allows the inclusion of quantifiable characteristics in equation (1) above, but it also permits the inclusion of characteristics which are attached to goods through externalities such as, in the case of housing, the nature and quality of location.

4.2.2 *Technical Details*

We now turn to the application of the hedonic approach to the development of house price indices for the UK, using the data base described earlier. In relation to the present study, a cross-section of house prices, P_{it}, may be observed, where t represents the time period in which each house i is sold. Given the supply and demand conditions in the housing market, such houses may be priced differently due to differences in *qualitative* characteristics (such as the type of property, the availability of certain amenities, the location of the property etc.), and to differences in *quantitative* characteristics (such as the age of the property, the size of the property, garages, bathrooms etc.). Thus, for each house i we can write P_{it} as some function of these various characteristics, X_j, together with a group of unmeasured factors (assumed to be randomly distributed) which are specific to each house but for which data are not available, e_{it}; that is:

$$P_{it} = f(X_{1t}, X_{2t}, \ldots, X_{jt}, e_{it}) \qquad (2)$$

Given the nature of the data employed in this study, qualitative characteristics can only be represented by 'dummy variables' which take the value of 1 or 0 depending upon the presence or absence of a particular attribute. The technique of multivariate regression using ordinary least squares is used to estimate the coefficients pertaining to each of the explanatory variables in equation (2). The analyses are carried out for each quarter of the period 1983-1989 for six sub-sets of the data according to house and buyer type (defined below), for each of 13 regions and countries of the UK.

We consider next the usual technical issues that arise in multivariate regression analysis as applied to the development of the physical and locational characteristics model of house prices. We address the main technical issues in turn, concerning (a) choice of functional form, (b) optimal combinations of explanatory variables and (c) multicollinearity and heteroskedasticity.

(a) *Choice of functional form*

A potentially serious source of bias in hedonic-price and other regression-based studies may be associated with functional form mis-specification. In principle, many functional forms are possible but, unfortunately, there is no theoretical guidance as to which form is the most appropriate to a particular model. The solution to this problem, therefore, reduces to an empirical one. Box and Cox (1964) have developed a statistical procedure based on likelihood ratio tests to identify the functional form providing the 'best fit' and this is adopted here.

At the outset, it should be noted that various versions of the Box-Cox test procedure may be employed to test not only for the appropriate transformation of the dependent variable but also for the appropriate transformations of the explanatory variables to be included in the estimating regression equations. However, in relation to the present study a major limitation in applying this test is that many of the explanatory variables are dichotomous (that is, dummy variables taking the value of 1 or 0). This precludes higher transformations of these variables which must of necessity be linearly related to the dependent variable. The Box-Cox test cannot, therefore, be used to assess any of the qualitative characteristics, since these are coded as dummy variables. Thus the search for a functional form using the Box-Cox procedure can only be conducted with respect to the quantitative explanatory variables and the dependent variable, price. On the other hand, it should be appreciated that the use of dummy variables conveniently permits the incorporation of variables to which price may be related non-linearly without the necessity of specifying the nature of the non-linearity.

Our exploratory analysis clearly indicated that the regression results are substantially more sensitive to transformations of the dependent variable than of the explanatory variables. Therefore, the search for the most appropriate functional form focused on transformations of the dependent variable, price. The procedural steps involved in the Box-Cox test are conveniently summarised elsewhere - see, for example, Maddala (1977, 315-7) and Spitzer (1982). Application of the Box-Cox test procedure showed that the logarithmic transformation of P_{it} provides the most appropriate functional form for the hedonic regression model.

(b) *Optimal combinations of explanatory variables*

In conjunction with the Box-Cox test, analyses were also carried out to determine the optimal combinations and appropriate transformations of the explanatory variables in the regression equations. The conclusions of these investigations may be summarised as follows:

(i) floor area gave consistently better results (in terms of adjusted-R^2 and t-values) than the alternative size variable - number of rooms. In addition, there was very little to choose between transformations of the size variable (floor area) in terms of statistical fit, and hence, for simplicity, the untransformed variable was finally selected for inclusion;

(ii) as with floor area, transformations of age made very little difference to the overall explanatory power of the regression models. Hence we selected age in its 'raw' form (that is, number of years) as the candidate for inclusion;

(iii) while the use of the nine separate central heating categories gave slightly better results than the three broader groupings of 'full', 'non', and 'partial', some of these nine categories were frequently rejected from the equations for the different regions because they failed to meet the significance criteria for inclusion. To avoid this problem, therefore, and to maintain consistency across the regions, it was decided to include the broader, three-fold, classification rather than the nine-fold classification (these have been shown to provide broadly equivalent results);

(iv) the use of only two tenure categories (freehold or feuhold with vacant possession and leasehold with vacant possession) gave reasonably consistent results; use of the original categories included in the data base added little or nothing to the overall explanatory power of the models;

(v) our investigations indicated that the inclusion of *both* ACORN residential neighbourhood codes and Parliamentary Constituency (PC) codes as locational variables provided an improvement in the overall explanatory power of the regression models compared with those obtained using only one of these. This seems to confirm that the two locational variables do adequately measure different locational influences, the former at the 'micro' or neighbourhood level and the latter at a broader, 'macro', level as originally hypothesised.

(c) *Multicollinearity and heteroskedasticity*

Multicollinearity can cause problems with respect to the following aspects of regression analysis:

(i) estimated regression coefficients may not be uniquely determined,

(ii) estimates of the coefficients from sample to sample may fluctuate markedly, and

(iii) less reliability can be placed on the relative importance of variables as indicated by their partial regression coefficients.

Multicollinearity is inevitably present to some degree in most economic analyses and can rarely be eliminated completely. It has to be accepted in a study such as this that certain characteristics will, by their very nature, be closely associated with each other. The aim, therefore, must be to minimise the influence of multicollinearity as much as possible. Both logical and statistical criteria should be used.

There are a number of statistical approaches that may be employed in identifying the statistical relationship between explanatory variables and their relative importance based on adjusted-R^2 and t-values. For this purpose we employed 'forward selection', 'backward elimination' and 'stepwise selection' procedures, embodied in the SPSSX statistics package (for a detailed discussion of the computational procedures described above, see Norušis (1983), 159-65 and Norušis (1985), 42-55). In the present study, all three methods were employed and were found to give a broadly consistent picture of the relative importance of the variables.

The classic method of dealing with the problem of multicollinearity is to discard redundant variables. It will be appreciated, however, that even though some variables may be shown to offer little explanatory power, it is not sensible to exclude them if they are members of a *set* (e.g. type of house) which is, in general, very important in the analysis. Exclusion of a member of such a set would necessitate removal of the whole set from the equation as the integrity of a complete dummy-variable set must be maintained along with consistency in the model specification over time. In this study, the main candidates for redundancy were the alternative characteristics which measure size - number of rooms and floor area. Examination of the correlation matrix for these variables alone does show high correlations among these characteristics (see Table 1). Thus, a choice had to be made as to the best variable or variables to use as an indicator of size. Preliminary regression analysis showed that floor area consistently made a larger contribution to the overall explanatory power of the regression equations than other size variables and it was therefore chosen as the preferred measure for inclusion.

INSERT TABLE 1

It was expected that the two sets of ACORN and Parliamentary Constituency (PC) codes, incorporated to reflect the influence of locational attributes, would be highly multicollinear because of the similar nature of the characteristics on which the classifications were based. However, the correlation matrix and the variable selection procedures do not reveal any significant problem of multicollinearity with these classification codes. As noted earlier, it appears in general that the PC variables tend to reinforce the influence of the ACORN variables, rather than to detract from them. The effect of the PC variables is to augment the significance of some ACORN variables while diminishing the significance of others but in general there seemed to be adequate justification for retaining both on statistical as well as theoretical grounds.

Another potential problem is heteroskedasticity. In using microeconomic data of the kind used in the present study, the assumption of constant variance of the error term, e_{it}, may be violated. This issue was explored by plotting residuals using a sample of the data set. This showed that the constant variance assumption was not seriously violated. In any case, even if heteroskedasticity exists, it would only increase the confidence intervals of the indices; it would not affect their unbiasedness.

4.3 *Application of the Methodology*

The methodology described above is applied in two stages. First, it is employed to generate index numbers for each of 13 regions for four house groups and two buyer-type groups as follows:

- all houses
- new houses
- modern (post-1944) houses
- older (pre-1945) houses
- houses bought by first-time buyers
- houses bought by former owner-occupiers.

The second stage is the calculation of index numbers for the United Kingdom.

In the first stage, the methodology may be employed to generate index numbers in two basic ways. The usual way of devising an index, employing the hedonic approach, is to take a weighted average of the estimated regression coefficients, each coefficient being regarded as an implicit price of the corresponding characteristic. The other way is to incorporate an additional dummy variable for time into a regression model covering more than one time period, the estimated regression coefficient on such a dummy directly reflecting the change in price from one time period to another. However, this second approach has certain disadvantages. In particular, from the viewpoint of practicality, it makes greater computational demands in terms of computer processing time and space because it requires the chaining together of the data for many time periods and, secondly, it does not permit the adoption of alternative characteristics weights (that is, other than those which are internal to the particular data set). The approach of weighting the regression coefficients is therefore preferred.

4.3.1 *Generation of Regional Index Numbers*

The steps involved in generating regional index numbers are summarised below. They apply to the six house and buyer groups for each region.

(i) Weights, Q_{jt_0} for the *j* explanatory variables in a chosen reference time period t_0, are calculated. These constitute the proportions of the qualitative (categorical) variables and the means of the quantitative variables present in this time period.

(ii) With prices recorded in natural logarithms, the regression coefficients for the *j* explanatory variables are computed in both the chosen base reference period (that is, b_{jt_0}) and for every subsequent time period (such as b_{jt_n}) for the current time period

(iii) An index for the current period (I_{t_n}) is then calculated as the ratio between the sum of the weighted coefficients for the current period and the sum of the weighted coefficients for the chosen base reference period (both expressed in exponent form). That is:

$$I_{t_n} = \frac{\exp R b_{jt_n} Q_{jt_0}}{\exp R b_{jt_0} Q_{jt_0}} \times 100$$

In order to avoid reliance on any single time period for determining the pattern of weights to be adopted in this expression, we adopted instead a set of weights corresponding to the *average* value of Q_t for each variable j over a number of years. Initially, this was taken as the full period for which data were available, i.e. from 1983 to 1988. In future, it is intended that a 'rolling pattern' of weights will be employed by extending this time period, thus producing a chained Paasche-type index. The rationale of this procedure is to maintain an up-to-date pattern of weights and to avoid the need for periodic re-standardisation producing possible discontinuities in the price index series. Regressions have to be run, of course, for each house and buyer category in each of the 13 regions in each quarterly time period. Thus in the period covered by this study, this generates over 2,000 sets of regression results. It is not possible, of course, to report these in full. For the sake of illustration, we reproduce a set of specimen results for one region and for one (central) time period only, namely 1986 Q1, in Table 2 below. These results are reasonably representative, though, naturally, it will be appreciated that coefficients and significance levels are subject to variation over time and from one regression to another. Apart from sampling variation, the coefficients themselves are naturally subject to change over time in response to changing price levels and for this reason, of course, constitute the focus of this study.

INSERT TABLE 2

The statistical reliability of the results for each model is consistently high but, again, it is not possible to report the results in full. By way of summary, therefore, we comment on overall explanatory power and the statistical significance of the regression coefficients. First, the degree of explanatory power attained by each of the regional house price models for each category is very high (as measured by adjusted R^2 values). Generally, some 70-90 per cent of the variation in house prices is explained by the models. Secondly, the statistical significance levels for individual regression coefficients (on the basis of t-tests) is also very satisfactory: the vast majority are consistently significant at the 5 per cent, or very much higher, levels of significance. Those coefficients that fall below this threshold in one regression or another from time to time are generally individual members of dummy variable sets (such as type of house) and must be retained, as explained earlier, to maintain the integrity of such sets.

4.3.2 *UK Index Numbers*

UK index numbers could be computed in exactly the same way as those for each region described above i.e. running regressions covering the whole data set involving as many as 25,000 cases per quarter. However, from the point of view of devising nationally representative indices, this demands that the regional pattern of lending reflected in the data base should also be representative of *all* house purchase transactions nationally. This is not necessarily the case and for this reason, the UK index numbers are derived as weighted averages of the corresponding 13 regional series for each of the six house and buyer groups for each time period, using weights which *are* representative. For this purpose, a set of regional weights is employed based on the pattern of *all* building society mortgage transactions, as revealed in the official DOE Five Per Cent Sample Survey of building society mortgages, over the period 1983 to 1988. In the future, it is intended that this period will be rolled forward and extended in length.

5. RESULTS: REGIONAL AND UK INDICES

The results of the study are quarterly series of standardised indices from 1983 Q1 to 1989 Q4 for each of six house and buyer categories for thirteen regions and countries of the UK and for the UK as a whole. These are given in Appendix B - Tables B1-B6. A summary of the results, showing the percentage increase in house prices, on a standardised basis, for each series between 1983 Q1 and 1989 Q4 is given in Table 3. This shows that for all houses generally, prices increased on average for the UK as a whole by 133.8 per cent, varying across the regions and constituent countries from a low of 20.3 per cent in Northern Ireland to a high of 162.4 per cent in Greater London. With regard to the breakdown by house type, it will be seen that new houses generally increased less than non-new houses at the UK level but this difference was not consistent across the regions. In terms of buyer type, the prices of houses bought by first-time buyers increased by more than those bought by former owner-occupiers but the disparity varied greatly across the regions.

INSERT TABLE 3

Finally, it is of interest to compare the movement of the standardised indices with that based on simple average prices. Over the whole period from 1983 Q1 to 1989 Q4, the relative price increases for the UK as a whole for each of the six house and buyer types were as follows:

House and buyer type	*Standardised series*	*Simple average series*
All houses	133.8%	142.3%
New houses	111.2%	141.8%
Non-new houses		
Older (pre-1945)	146.3%	156.6%
Modern (post-1944)	130.4%	127.8%
First-time buyers	133.4%	138.3%
Former owner-occupiers	129.6%	121.9%

Comparisons of the trends in each of these series over the period are made in Figure 1 (for all houses and new houses), Figure 2 (for non-new houses) and Figure 3 (for first-time buyers and former owner-occupiers).

INSERT FIGURES 1 - 3

There are a number of notable features about the comparisons made in Figures 1 - 3. First, taking the period from 1983 Q1 to 1989 Q4 as a whole, prices for all houses on a standardised basis are shown to have risen somewhat less than simple average prices - 133.8 per cent as against 142.3 per cent - and this was a consistent tendency over the whole period except for two quarters (1988 Q4 and 1989 Q1). This is also true for most of the five sub-categories of house type and buyer type; only two out of the five (post-1944 houses and houses bought by former owner-occupiers) showed a greater rise on a standardised basis. But even for these two categories, the general tendency was for the standardised series to run below the simple average series over most of the period. A second notable feature is that the simple average price series is more volatile than the standardised series. Thirdly, the simple average series shows reversals of trend which are not mirrored in the standardised series. For example, taking the series for all houses at the UK level, the evidence for the following three periods is notable:

Period	*Simple average price change*	*Standardised price change*
1984Q2-1984Q4	-3.6%	+3.7%
1985Q2-1986Q1	-1.3%	+4.4%
1988Q3-1988Q4	-5.6%	+5.3%

The series for the sub-categories of house and buyer type show similar divergent movements between the standardised and non-standardised series (see Figures 1-3).

These comparisons bear witness to the influence of variations from one time period to the next in the underlying mix of traded properties and in their locations. The magnitude of the disparities is striking and demonstrates the importance of standardisation.

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TABLE 1

Correlation matrix of size variables

	SIZE (*floor area*)	*TOTRMS* (*total number of rooms*)	*RECEP* (*number of reception rooms*)	*BED* (*number of bedrooms*)
TOTRMS	.7826			
RECEP	.5814	.7895		
BED	.7346	.9067	.4571	
BATH	.3773	.2982	.2294	.2745

TABLE 2

Specimen regression results for 1986 Q1: all houses
Outer SE Region

Variable+	*Mean*	*Coefficient*	*Significance*
SDH	0.260	-0.22396	0.0000*
TH	0.348	-0.30888	0.0000*
DB	0.049	-0.03144	0.0662
SDB	0.019	-0.16148	0.0000*
FB	0.093	-0.27970	0.0000*
FC	0.038	-0.38036	0.0000*
LH	0.139	-0.09273	0.0001*
SGAR	0.496	-0.16340	0.0000*
SPACE	0.110	-0.23626	0.0000*
NOPARK	0.340	-0.24695	0.0000*
AGE	37.928	0.00034	0.0003*
NOCH	0.234	-0.10182	0.0000*
CHP	0.105	-0.06112	0.0000*
SIZE	901.336	0.00037	0.0000*
BATH	1.049	0.10231	0.0000*
A	0.009	0.08550	0.0163*
C	0.193	-0.05677	0.0000*
D	0.026	-0.14195	0.0000*
E	0.085	-0.01998	0.1097
F	0.018	-0.06375	0.0118
G	0.002	0.06628	0.3607
H	0.004	-0.30238	0.0000*
I	0.037	0.00853	0.6592
J	0.132	0.05700	0.0000*
K	0.071	0.00051	0.9728
P1	0.001	0.31732	0.0005*
P2	-	-	-
P3	0.001	0.18780	0.0362*
P4	0.011	-0.18104	0.0000*
P5	0.368	-0.03498	0.0000*
P7	0.216	-0.08603	0.0000*
Constant	1.000	10.62045	0.0000*
	Sample Size		2942
	Adjusted-R^2		0.7546
	F-Statistic		302.5130

* Significant at the 5%, or higher level, of significance.

\+ Variable labels are defined in Appendix A.

TABLE 3

Percentage Increase in Standardised House Prices:
1983 Q1-1989 Q4

Regions	*All Houses*	*House Type*			*Buyer Type*	
		New	*Older (Pre-1945)*	*Modern (Post-1944)*	*First-time Buyers*	*Former Owner-Occupiers*
Northern	117.3	168.3	121.0	124.3	91.9	112.2
Yorks & Humberside	136.8	99.0	152.3	141.8	140.8	125.6
North West	120.2	92.7	125.4	124.4	118.0	117.7
East Midlands	160.5	120.6	174.9	143.3	147.8	149.3
West Midlands	144.3	98.7	172.4	137.3	147.4	135.6
East Anglia	146.5	141.3	142.5	160.1	208.4	139.2
Outer South East	144.3	135.1	165.3	134.4	141.6	142.9
Outer Metropolitan	146.0	151.8	161.0	134.7	155.7	140.8
Greater London	162.4	133.9	168.7	147.9	161.4	158.3
South West	139.1	121.5	159.8	133.9	143.3	136.0
Wales	124.2	136.5	122.6	128.2	117.2	123.0
Scotland	76.6	70.1	87.1	77.4	77.8	69.5
Northern Ireland	20.3	25.9	16.5	26.1	10.7	27.9
UK	133.8	111.2	146.3	130.4	133.4	129.6

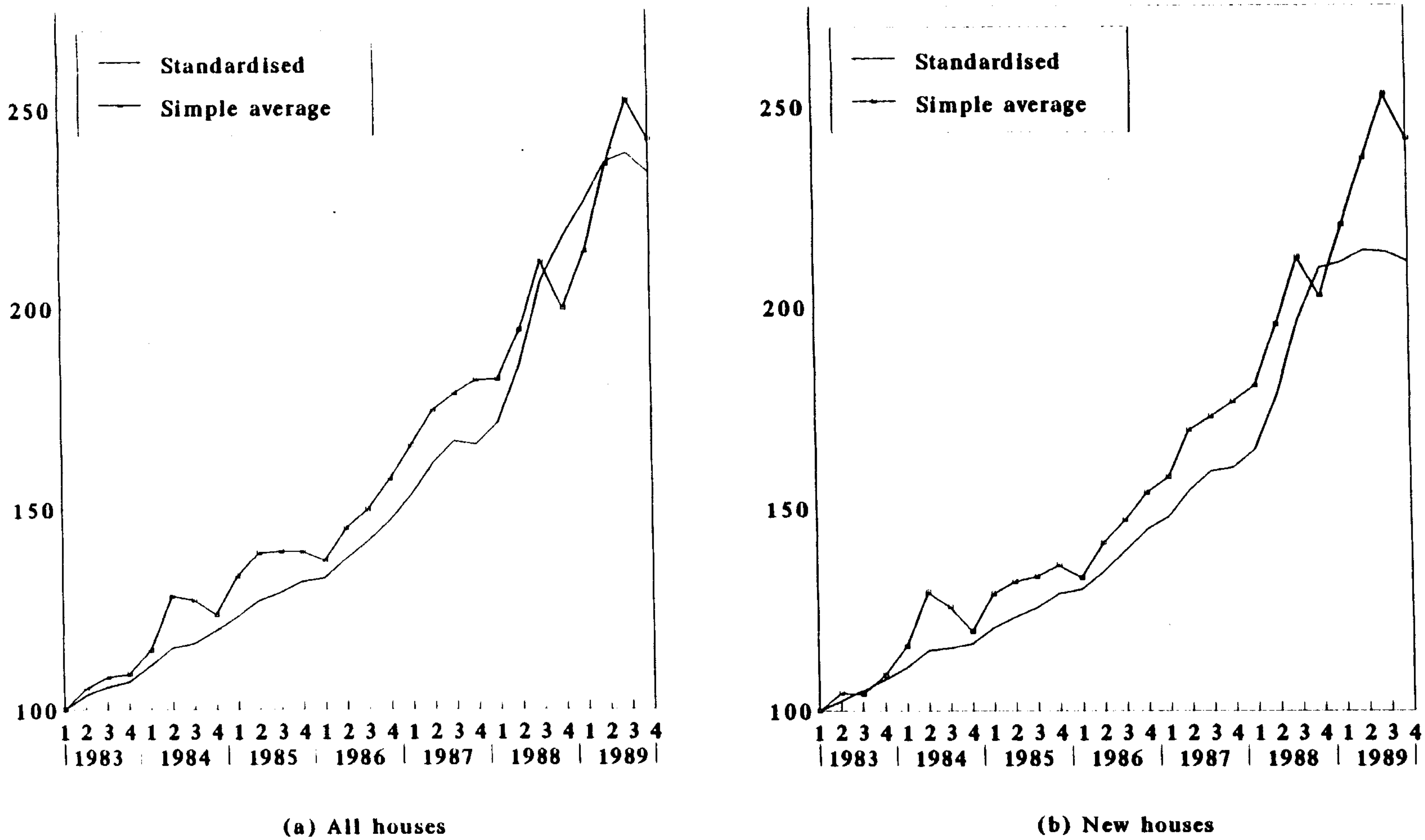


Fig 1. Price indices for all houses and new houses, UK (1983 Q1 = 100)

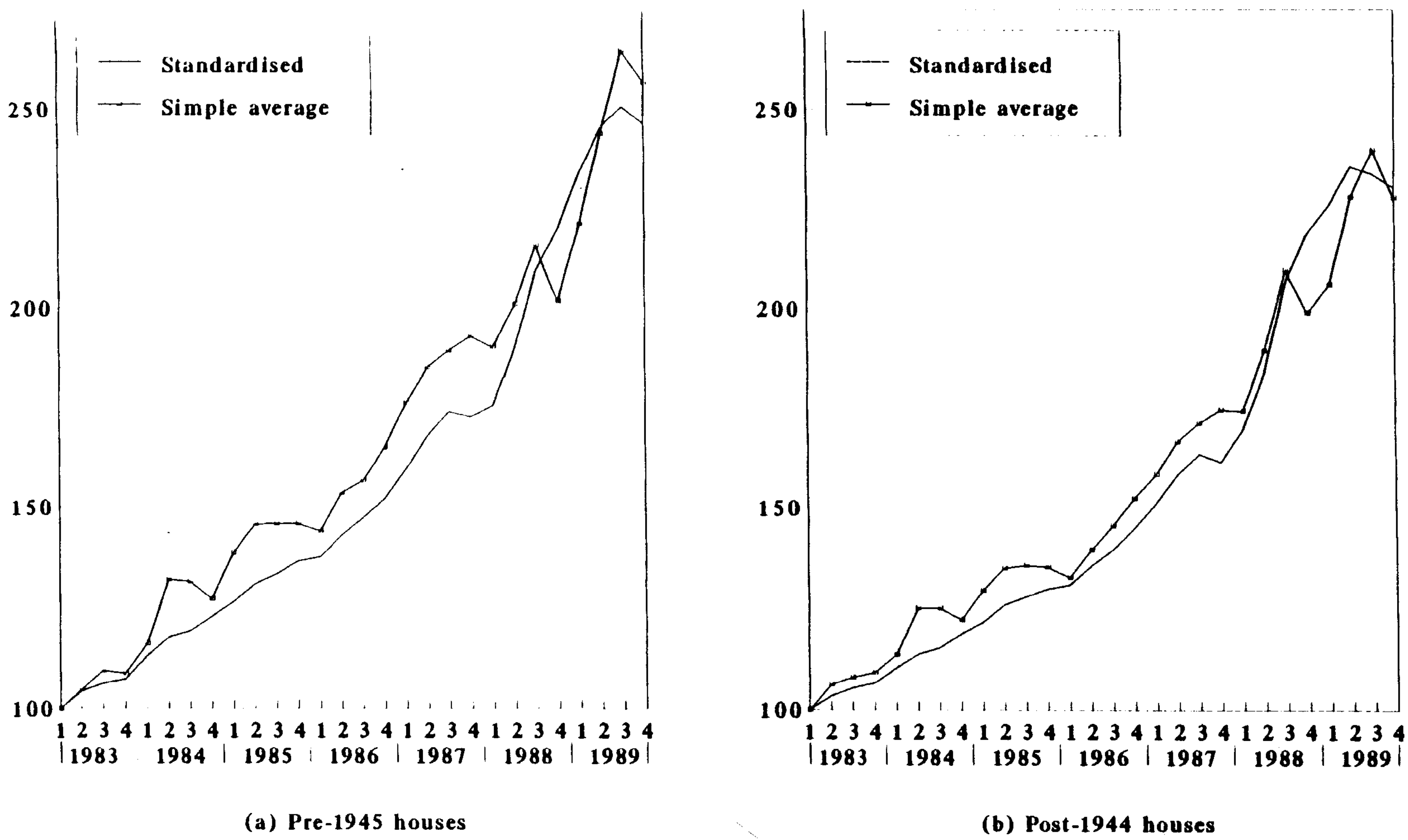
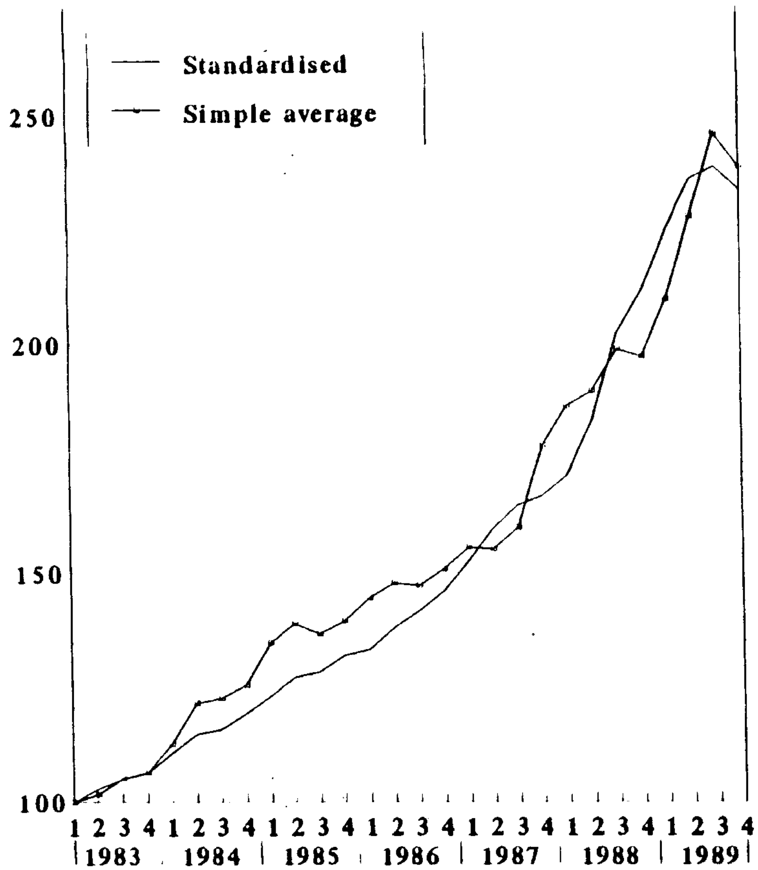
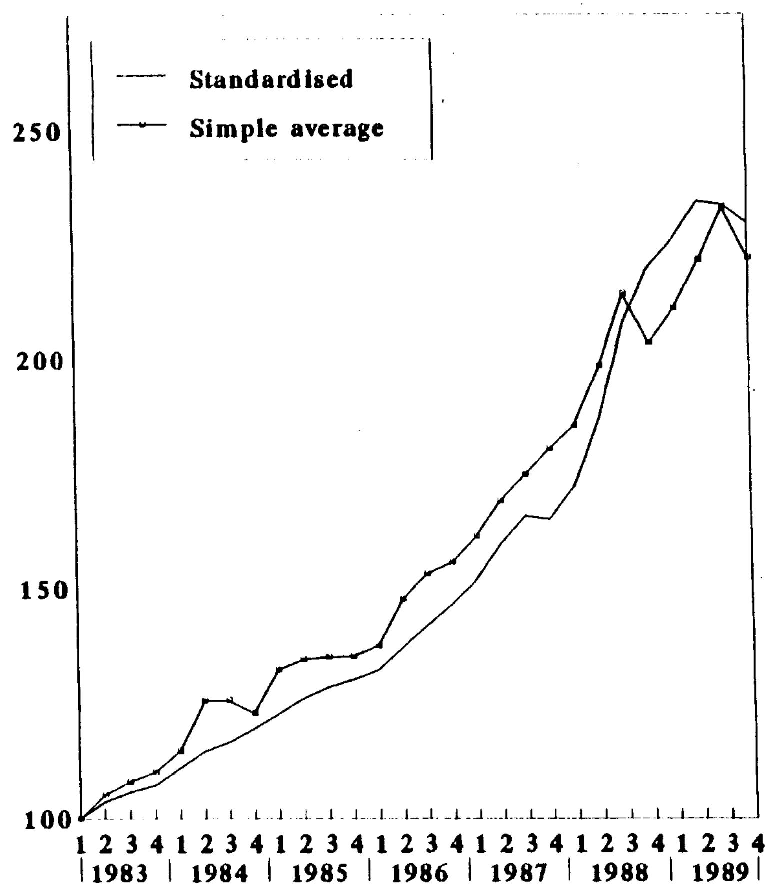


Fig 2. Price indices for secondhand houses, UK (1983 Q1 = 100)



(a) First-time buyers



(b) Former owner-occupiers

Fig 3. Price indices for houses bought by FTBs and FOOs, UK (1983 Q1 =100)

APPENDIX A

Definitions and Code Names of Variables

We list below those variables that have been included in the final model specifications. In the final regression specifications and results (see specimen in Table 2), it will be noted that one constituent of each dummy variable set is excluded. This is necessary in order to avoid 'over-specification' of the ordinary least squares regression equations. The dummy variable elements chosen for exclusion were: DH, FFVP, DGAR, CHF, B and P6.

Variable Name	*Code*	*Variable Type*
HOUSE TYPE:		
Detached house	DH	A set of dummy variables coded as 1 for the house type to which the property corresponds, otherwise 0.
Semi-detached house	SDH	
Terraced house	TH	
Detached bungalow	DB	
Semi-detached bungalow	SDB	
Purpose-built flat or maisonette	FB	
Converted flat or maisonette	FC	
TENURE:		
Freehold or feuhold with vacant possession	FFVP	A set of two dummy variables, coded as 1 when tenure type corresponds, otherwise 0.
Leasehold	LH	
GARAGE:		
Double garage	DGAR	A set of four dummy variables coded as 1 for the corresponding category, 0 for the others.
Single garage	SGAR	
Parking space	SPACE	
Neither garage nor parking space	NOPARK	
AGE OF DWELLING:		
This is calculated from the construction date such that AGE = [(analysis year+1)-date]. The addition of 1 is necessary to avoid a zero age for houses built in the analysis year, which would then exclude such cases from the regression.	AGE	Number of years.
CENTRAL HEATING:		
Full central heating	CHF	A set of three dummy variables coded as 1 when heating type corresponds and 0 when it does not.
No central heating	NOCH	
Partial central heating	CHP	
SIZE of DWELLING:	SIZE	Floor area in sq. ft.
BATHROOMS:	BATH	Actual number of bathrooms.

APPENDIX A (Continued)

ACORN GROUPS:		
Agricultural areas	A	A set of eleven dummy variables coded as 1 for the corresponding group and 0 otherwise. Not included in specification for 'New Houses' due to the absence of the corresponding post codes.
Modern family housing, higher incomes	B	
Older housing of intermediate status	C	
Poor quality older terraced housing	D	
Better-off council estates	E	
Less well-off council estates	F	
Poorest council estates	G	
Multi-racial areas	H	
High status non-family areas	I	
Affluent suburban housing	J	
Better-off retirement areas	K	
PARLIAMENTARY CONSTITUENCY GROUPS:		
Inner metropolitan	P1	A set of seven dummy variables coded as 1 for the corresponding group and 0 otherwise. Not present in specification for 'New Houses' due to the absence of the corresponding post codes.
Scottish areas	P2	
Poorer, declining industrial areas	P3	
Traditional, stable industrial areas	P4	
Better-off industrial areas	P5	
High status and metropolitan suburbs	P6	
Rural areas, resort and market towns	P7	
HOUSE PRICE	LP	Natural log of house price (P) measured at the mortgage approval stage.

APPENDIX B

Results: Regional and UK Index Numbers 1983Q1-1989Q4

B1: ALL HOUSES - STANDARDISED INDEX NUMBERS

	REGIONS													UK
	Northern	Yorks & Humber-side	North West	East Midlands	West Midlands	East Anglia	Outer South East	Outer Metro-politan	Greater London	South West	Wales	Scotland	Northern Ireland	
Q1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Q2	104.7	104.2	103.1	104.5	101.7	102.0	103.5	104.3	104.4	103.5	104.2	104.7	100.2	103.7
Q3	107.5	105.9	103.3	105.1	103.0	105.6	105.3	107.1	107.9	106.7	107.2	106.8	102.5	105.8
Q4	107.6	106.4	103.7	106.4	102.9	106.6	108.2	110.7	110.9	107.7	105.8	107.1	101.2	107.0
Q1	110.5	110.3	108.1	108.2	107.1	109.2	112.8	114.9	116.9	112.1	109.4	111.1	104.1	111.0
Q2	115.3	113.8	111.5	114.8	109.1	115.6	117.8	119.8	122.7	114.4	114.7	115.0	105.3	115.3
Q3	116.1	111.7	110.5	114.2	109.9	119.3	119.8	122.9	125.4	116.2	116.8	117.6	107.3	116.5
Q4	118.5	118.4	112.2	119.0	111.9	121.0	122.8	125.4	130.1	120.5	116.3	119.4	110.2	119.6
Q1	121.1	118.8	115.6	121.6	115.9	124.7	127.3	130.7	135.7	123.5	117.6	122.4	112.7	123.1
Q2	124.4	123.9	119.0	124.3	118.1	130.3	131.6	135.6	141.8	127.0	121.5	125.4	111.9	127.0
Q3	125.3	123.6	120.0	125.7	119.3	131.4	134.7	140.4	147.0	130.1	121.4	124.8	115.8	129.0
Q4	128.0	127.5	120.3	127.7	120.8	135.0	137.6	145.0	152.6	132.0	125.5	125.3	115.8	131.7
Q1	125.7	124.9	120.3	130.1	119.8	135.1	141.3	146.3	158.9	135.4	123.8	123.8	114.5	132.6
Q2	131.7	128.1	122.5	134.8	122.6	142.0	147.3	153.3	166.7	140.7	127.0	127.7	117.6	137.5
Q3	126.9	129.6	124.5	137.1	124.8	146.2	153.7	162.9	179.5	147.0	128.0	128.3	120.1	141.8
Q4	133.1	131.0	125.7	141.9	128.9	154.4	161.6	173.0	191.3	150.9	132.9	129.0	118.2	147.0
Q1	134.1	136.4	129.2	147.6	134.7	160.6	169.8	186.8	203.9	156.7	133.5	130.4	115.1	153.4
Q2	136.2	143.2	132.0	153.9	142.3	176.8	182.0	198.1	219.1	165.5	139.0	131.1	123.0	161.4
Q3	137.2	142.3	134.0	154.2	148.8	186.5	192.7	209.5	231.3	173.7	139.0	131.6	121.0	166.8
Q4	131.1	140.1	131.5	156.4	149.4	192.2	194.4	209.3	228.3	175.2	134.9	128.6	114.8	166.0
Q1	131.1	138.5	134.1	161.1	156.1	209.0	207.1	217.9	232.5	186.9	140.8	125.2	115.4	171.4
Q2	135.2	151.1	140.9	181.9	177.8	238.6	227.2	230.6	246.2	212.3	147.8	129.2	117.3	186.0
Q3	143.3	169.1	151.5	212.4	209.8	274.2	253.2	250.5	262.8	246.7	167.0	134.8	113.9	206.6
Q4	154.7	192.7	165.6	235.2	222.6	267.7	261.9	256.1	265.3	253.2	192.7	139.9	117.3	217.6
Q1	171.1	211.4	181.3	248.8	231.3	272.6	264.8	262.3	268.7	250.8	210.5	146.3	116.7	226.3
Q2	194.0	227.6	202.0	255.4	240.8	275.9	269.2	266.4	274.0	257.9	224.5	160.4	121.5	236.6
Q3	199.7	242.3	223.4	248.9	249.1	260.2	259.5	259.3	269.5	255.7	225.0	171.9	119.2	238.7
Q4	217.3	236.8	220.2	260.5	244.3	246.5	244.3	246.0	262.4	239.1	224.2	176.6	120.3	233.8

2: NEW HOUSES - STANDARDISED INDEX NUMBERS

	REGIONS													UK
	Northern	Yorks & Humber-side	North West	East Midlands	West Midlands	East Anglia	Outer South East	Outer Metro-politan	Greater London	South West	Wales	Scotland	Northern Ireland	
Q1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Q2	101.6	95.9	100.3	102.7	100.6	104.6	104.7	103.7	105.1	104.8	112.9	100.7	96.2	102.4
Q3	99.6	101.1	102.0	105.1	104.5	103.4	106.8	106.8	111.6	108.5	105.1	103.0	104.2	105.0
Q4	104.7	101.4	102.5	106.3	112.7	111.9	107.5	111.5	108.7	108.8	113.9	105.2	105.3	107.7
Q1	112.5	103.6	108.5	106.9	107.8	114.1	114.9	113.6	119.2	113.6	114.5	106.7	105.3	110.7
Q2	112.4	107.6	112.9	113.7	111.5	118.1	117.2	120.5	123.6	114.8	119.5	113.8	108.3	114.9
Q3	110.7	109.4	110.9	113.2	111.3	124.3	119.3	121.7	119.4	118.4	117.5	113.0	107.0	115.4
Q4	109.7	109.3	111.3	115.2	115.2	123.3	120.5	124.5	124.2	116.8	120.3	111.7	111.2	116.6
Q1	111.8	110.5	119.3	119.5	119.5	126.8	125.1	129.7	124.6	121.1	119.7	114.6	113.6	120.4
Q2	109.5	115.0	118.1	117.6	120.2	132.8	131.9	132.5	133.5	125.6	122.8	115.5	113.1	123.0
Q3	120.4	118.6	113.9	123.2	116.9	134.6	133.9	136.0	138.6	128.4	131.0	114.2	115.1	125.2
Q4	127.4	115.0	119.8	126.1	126.5	136.2	138.6	144.5	141.5	127.8	123.4	118.7	116.6	128.7
Q1	116.1	120.8	114.7	128.4	123.6	140.9	139.6	145.6	150.8	133.1	130.0	117.5	113.2	129.7
Q2	126.8	120.5	117.5	132.8	122.3	145.0	145.5	153.8	154.8	140.0	133.5	120.7	117.2	134.0
Q3	126.0	120.3	124.3	135.8	130.0	148.5	155.0	164.6	163.0	145.4	139.0	120.8	119.6	139.4
Q4	124.7	121.6	130.3	143.5	131.4	161.6	160.6	174.1	167.1	153.4	135.9	127.5	117.2	144.6
Q1	128.2	124.1	131.2	148.8	133.8	164.9	168.6	181.8	183.0	149.8	136.7	120.3	121.0	147.8
Q2	127.8	129.9	128.2	151.0	141.1	176.1	177.3	192.7	193.3	162.2	153.0	122.8	122.7	154.5
Q3	135.8	127.7	126.0	152.4	139.3	186.4	192.7	202.8	210.0	167.5	149.1	127.8	118.8	159.3
Q4	129.7	128.5	128.1	157.4	147.9	190.6	190.4	203.3	210.3	169.0	144.5	123.8	118.0	160.2
Q1	124.8	126.0	125.8	158.7	150.8	210.0	198.4	213.0	206.1	179.3	156.6	124.1	116.7	164.5
Q2	125.5	133.3	131.9	170.1	171.5	233.6	222.2	228.5	220.2	205.8	156.1	123.7	122.5	178.1
Q3	136.1	156.6	138.6	196.0	202.6	265.4	247.8	243.9	235.5	230.9	176.9	130.8	116.9	197.1
Q4	147.4	177.9	153.7	235.5	198.9	297.8	245.0	252.3	243.4	245.8	207.5	131.7	122.1	209.7
Q1	166.9	181.0	159.2	217.0	208.4	262.0	266.8	254.5	249.3	241.2	199.6	139.3	118.1	211.1
Q2	177.4	199.8	177.6	237.3	217.3	255.0	252.2	246.2	224.7	235.9	225.7	155.0	120.8	214.7
Q3	196.2	176.7	185.9	209.2	221.5	243.6	242.6	266.6	227.8	238.7	225.1	155.7	122.8	213.7
Q4	168.3	199.0	192.7	220.6	198.7	241.3	235.1	251.8	233.9	221.5	236.5	170.1	125.9	211.2

B 3: OLDER (PRE-1945) HOUSES - STANDARDISED INDEX NUMBERS

	REGIONS													UK
	Northern	Yorks & Humber-side	North West	East Midlands	West Midlands	East Anglia	Outer South East	Outer Metro-politan	Greater London	South West	Wales	Scotland	Northern Ireland	
Q1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Q2	103.4	104.4	103.3	107.1	103.5	97.4	102.6	105.4	104.7	104.5	103.7	107.2	104.4	104.3
Q3	109.4	107.5	103.5	104.1	105.4	104.6	103.8	107.7	107.9	107.2	106.4	110.1	103.6	106.4
Q4	108.8	107.8	103.3	108.9	108.2	97.8	105.6	110.8	110.5	108.1	102.6	109.1	101.7	107.3
Q1	111.6	113.5	109.9	111.4	112.5	104.5	112.8	117.0	117.4	115.8	111.6	113.9	104.4	113.2
Q2	116.9	116.5	113.0	117.4	116.3	110.0	119.8	121.7	123.5	120.0	116.0	115.4	108.1	117.7
Q3	122.4	113.3	112.4	118.4	115.8	117.0	122.3	125.6	127.1	120.7	117.2	118.7	111.3	119.3
Q4	122.8	123.6	115.2	123.7	116.7	116.7	124.2	128.3	131.6	126.4	114.6	121.3	113.1	122.8
Q1	123.1	121.3	117.1	125.1	124.0	122.2	129.8	134.2	138.1	129.6	117.2	125.4	114.1	126.3
Q2	128.1	128.0	120.9	128.8	125.0	130.3	134.1	138.9	143.9	134.1	121.6	129.7	112.1	130.8
Q3	127.5	128.5	122.1	129.1	127.3	128.8	138.4	144.4	149.6	137.1	120.9	129.8	118.7	133.1
Q4	132.8	134.0	122.2	132.9	127.0	132.5	140.9	150.5	155.7	139.6	126.5	129.9	119.6	136.4
Q1	128.1	130.3	123.1	136.5	127.9	128.0	145.5	151.4	162.4	141.4	122.9	128.9	120.2	137.4
Q2	137.6	136.3	124.4	141.1	131.0	137.2	150.5	159.9	170.7	148.1	129.0	131.4	121.0	142.9
Q3	130.5	135.8	126.9	144.4	131.9	141.8	157.1	169.4	183.1	155.0	128.2	133.9	125.0	147.2
Q4	140.1	137.9	126.4	146.0	135.4	147.2	166.3	180.0	196.1	158.7	132.3	131.9	117.1	152.1
Q1	143.6	146.2	132.4	154.4	141.5	156.5	171.3	194.5	209.3	166.2	132.9	135.9	109.7	159.7
Q2	143.2	150.2	132.7	160.0	151.6	173.4	184.7	206.0	223.4	176.1	143.2	138.2	133.2	168.0
Q3	144.7	150.3	136.0	162.2	161.3	186.1	195.1	218.8	237.5	182.9	138.1	138.4	130.5	174.1
Q4	136.6	145.8	133.5	161.3	158.8	192.4	198.3	222.2	234.0	185.8	134.2	135.3	124.6	172.8
Q1	135.7	143.3	138.7	160.7	158.7	197.8	208.8	226.4	239.4	192.9	138.3	129.8	121.8	175.6
Q2	137.7	159.9	142.8	183.4	181.1	226.5	229.3	240.3	251.8	217.3	146.3	136.7	120.0	190.1
Q3	146.8	171.0	153.1	213.2	205.4	267.6	259.9	263.8	271.2	247.7	159.9	141.1	113.7	209.4
Q4	159.0	189.8	163.6	248.4	227.2	243.1	267.2	262.3	272.3	256.1	185.7	148.2	123.8	219.9
Q1	173.5	224.8	181.8	260.6	237.3	277.9	278.6	278.2	271.7	259.8	211.5	153.9	121.6	233.7
Q2	204.9	241.0	202.5	273.6	261.3	256.2	274.5	282.3	280.7	270.5	224.1	165.9	131.5	245.3
Q3	202.7	263.1	230.6	270.0	275.8	256.5	271.5	272.1	274.3	268.8	213.6	190.6	120.7	250.6
Q4	221.0	252.3	225.4	274.9	272.4	242.5	265.3	261.0	268.7	259.8	222.6	187.1	116.5	246.3

8.4: MODERN (POST-1944) HOUSES - STANDARDISED INDEX NUMBERS

	REGIONS													UK
	Northern	Yorks & Humber-side	North West	East Midlands	West Midlands	East Anglia	Outer South East	Outer Metro-politan	Greater London	South West	Wales	Scotland	Northern Ireland	
Q1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Q2	105.6	102.8	102.5	102.8	100.9	103.0	103.5	103.6	105.1	103.5	105.8	106.2	102.4	103.5
Q3	108.4	103.2	104.1	104.1	101.6	103.9	105.7	106.5	108.6	107.5	108.9	107.4	103.8	105.5
Q4	104.1	104.6	103.7	105.1	101.0	106.9	109.1	110.4	113.2	107.7	108.4	109.6	105.0	106.8
Q1	111.5	107.4	107.4	106.8	104.9	109.2	113.3	114.7	116.6	112.1	109.5	111.5	107.4	110.4
Q2	113.8	111.8	110.9	111.4	105.3	111.1	117.4	119.1	122.7	113.0	114.6	118.2	106.3	113.9
Q3	116.0	111.1	109.7	110.1	106.8	116.1	119.3	121.9	123.6	116.1	117.3	120.6	110.3	115.4
Q4	114.9	116.5	112.5	116.0	110.3	120.9	123.0	124.9	127.5	120.0	116.7	124.1	111.6	118.8
Q1	118.7	117.6	113.5	118.4	112.7	121.4	127.1	129.7	133.7	122.8	119.1	126.5	115.1	121.7
Q2	122.3	120.4	118.6	123.6	115.3	127.0	131.2	135.3	139.1	124.9	122.7	128.1	119.6	125.7
Q3	125.5	118.9	120.2	125.3	117.0	131.8	133.3	139.8	141.5	129.3	123.7	129.1	120.4	127.9
Q4	125.3	122.2	119.6	124.1	118.2	132.1	138.2	143.1	147.3	130.5	126.6	128.7	117.4	129.7
Q1	126.9	121.6	119.4	125.6	116.2	134.3	140.1	145.3	152.2	135.7	125.5	125.7	117.7	130.7
Q2	131.3	124.2	123.5	130.8	120.1	141.2	146.4	151.3	159.8	139.1	125.8	131.0	120.3	135.4
Q3	126.7	125.9	124.4	133.1	122.6	144.9	153.1	161.1	174.2	145.6	127.8	131.1	122.3	139.5
Q4	130.7	128.6	125.9	139.6	127.7	151.2	160.6	170.6	185.4	149.7	132.4	133.1	122.1	144.9
Q1	130.8	129.7	128.2	143.5	134.6	157.5	170.6	185.0	196.9	154.3	136.5	133.5	118.6	151.0
Q2	131.1	137.5	134.0	149.3	139.4	172.6	182.2	196.5	214.3	162.9	136.0	133.6	122.9	158.5
Q3	133.6	137.3	134.9	148.8	147.1	182.3	192.7	207.1	216.8	171.9	139.2	132.5	121.8	163.6
Q4	126.7	135.6	130.4	146.8	145.6	188.1	193.4	204.4	217.6	171.4	132.9	129.7	112.3	161.6
Q1	128.3	134.6	132.0	161.0	156.5	205.6	207.7	214.8	220.6	185.0	140.5	128.2	114.8	169.5
Q2	134.7	144.7	140.2	181.4	178.0	237.5	225.3	226.5	236.1	212.5	148.6	131.0	117.7	184.3
Q3	140.8	170.5	150.8	213.9	216.7	269.6	249.1	244.8	248.5	248.2	174.2	136.5	117.1	206.8
Q4	151.8	198.6	173.4	231.8	221.5	268.2	258.1	255.4	254.1	249.9	206.5	142.7	119.8	219.0
Q1	169.0	200.7	187.4	242.9	231.8	268.8	262.9	257.4	258.5	253.2	218.1	150.0	118.1	225.8
Q2	193.7	214.9	209.7	243.2	236.4	302.1	268.4	261.8	263.7	257.2	228.2	161.6	120.4	235.7
Q3	204.7	227.6	220.4	242.4	239.3	258.4	252.4	251.4	254.7	253.7	230.0	171.0	118.0	233.8
Q4	224.3	241.8	224.4	243.3	237.3	260.1	234.4	234.7	247.9	233.9	228.2	177.4	126.1	230.4

5: FIRST-TIME BUYERS - STANDARDISED INDEX NUMBERS

	REGIONS													UK
	Northern	Yorks & Humberside	North West	East Midlands	West Midlands	East Anglia	Outer South East	Outer Metropolitan	Greater London	South West	Wales	Scotland	Northern Ireland	
Q1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Q2	104.4	102.4	103.0	105.3	101.2	102.6	102.3	103.1	102.7	102.0	105.2	103.8	97.6	102.9
Q3	108.7	105.6	103.0	104.7	102.4	108.2	103.5	106.1	105.4	103.6	108.4	105.8	102.1	105.0
Q4	109.6	104.4	103.1	106.6	102.7	105.3	105.8	110.4	109.1	105.7	108.3	108.2	99.3	106.3
Q1	111.3	108.3	108.5	109.7	106.5	108.8	111.4	113.3	114.7	112.6	115.2	112.7	102.8	110.8
Q2	117.6	113.0	111.4	115.3	109.2	118.8	116.1	119.1	120.3	113.6	115.4	114.1	105.5	114.9
Q3	118.0	109.9	109.1	114.4	109.7	122.3	117.8	122.2	123.2	116.5	116.7	116.8	106.3	115.8
Q4	119.5	117.7	109.5	117.9	111.8	121.6	122.5	124.8	128.3	120.7	118.7	121.4	109.9	119.3
Q1	125.5	116.7	114.0	124.4	115.9	126.9	127.2	130.6	134.3	124.2	119.0	122.7	111.0	123.1
Q2	125.7	123.6	117.8	126.8	119.1	136.1	129.9	133.9	140.0	128.5	120.7	126.9	109.9	127.0
Q3	124.4	121.2	119.4	127.9	118.2	131.8	133.4	139.6	144.5	127.7	121.1	127.6	114.1	128.2
Q4	127.7	129.0	119.8	128.4	120.9	132.8	137.5	143.8	151.1	132.8	128.9	126.4	113.9	131.7
Q1	130.5	122.8	118.9	131.7	119.0	135.3	142.6	147.2	156.7	136.9	126.2	127.1	113.7	133.0
Q2	132.5	130.8	121.5	138.6	122.4	145.4	148.5	151.8	163.8	142.2	127.5	130.6	115.9	137.9
Q3	133.3	130.2	122.7	138.8	124.7	148.5	153.6	159.5	176.8	147.3	131.3	129.6	117.4	141.5
Q4	135.5	134.4	122.0	145.4	126.2	156.5	158.7	170.5	186.5	149.2	131.6	131.2	115.3	145.9
Q1	136.5	138.8	126.6	148.0	135.6	163.7	167.8	186.6	196.2	156.0	136.5	132.8	112.1	152.5
Q2	144.0	141.7	129.8	156.9	139.0	183.6	178.0	192.9	211.5	163.4	140.4	133.2	120.2	159.5
Q3	141.6	142.1	132.1	153.7	145.8	189.4	185.9	206.8	226.5	172.2	140.6	132.7	121.3	164.7
Q4	135.5	141.7	130.5	159.7	149.5	200.6	195.4	213.2	225.6	175.7	139.6	131.2	114.3	166.7
Q1	135.0	140.9	131.5	163.9	156.3	208.2	207.2	220.4	230.3	184.0	146.5	129.0	114.3	171.0
Q2	140.2	150.7	138.0	184.3	175.2	239.6	229.0	230.5	242.3	202.5	148.9	132.4	115.7	183.5
Q3	151.4	167.8	142.9	209.7	201.4	274.8	254.8	251.5	259.4	236.8	169.4	136.4	114.1	202.2
Q4	158.8	185.2	157.6	232.9	213.3	250.3	259.7	256.8	263.3	247.0	185.1	140.7	116.0	211.1
Q1	172.4	222.6	170.0	250.7	227.0	304.8	267.4	264.0	265.8	245.4	205.3	144.3	118.6	224.3
Q2	197.4	226.7	192.8	263.8	257.5	269.0	264.3	275.0	273.9	254.4	217.9	163.6	118.9	235.7
Q3	195.5	248.3	208.1	265.4	252.1	273.5	265.3	268.7	266.8	245.7	228.6	173.1	120.8	238.4
Q4	191.9	240.8	218.0	247.8	247.4	308.4	241.6	255.7	261.4	243.3	217.2	177.8	110.7	233.4

6: FORMER OWNER-OCCUPIERS - STANDARDISED INDEX NUMBERS

	REGIONS													UK
	Northern	Yorks & Humber-side	North West	East Midlands	West Midlands	East Anglia	Outer South East	Outer Metro-politan	Greater London	South West	Wales	Scotland	Northern Ireland	
1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2	106.3	101.4	102.2	103.1	101.6	102.2	103.7	104.5	106.1	103.8	104.6	104.9	104.3	103.6
3	107.6	102.8	103.3	104.9	103.1	105.4	106.2	107.6	109.5	107.4	107.2	106.4	102.9	105.8
4	108.6	104.0	104.5	106.8	103.0	109.0	109.3	110.8	112.4	108.7	105.6	106.4	104.7	107.4
1	111.9	108.4	107.2	107.7	107.9	109.8	113.6	115.7	118.7	111.5	106.7	109.3	105.2	111.0
2	115.0	110.3	111.2	113.1	108.2	114.5	118.2	119.5	124.4	114.1	116.1	114.1	104.8	114.7
3	115.4	110.2	110.7	113.8	109.9	118.2	120.6	123.2	127.2	116.3	117.8	117.0	112.0	116.6
4	118.7	115.8	113.0	118.8	111.6	121.4	122.8	125.7	131.6	120.2	116.1	117.5	111.2	119.5
1	121.4	115.3	116.2	119.3	116.1	124.8	126.9	130.8	137.1	123.0	117.8	121.5	116.2	122.7
2	123.4	119.2	118.8	121.5	117.1	128.5	131.7	135.9	142.7	125.4	122.6	122.5	114.0	125.9
3	124.8	121.8	119.7	123.0	118.9	133.2	134.6	139.6	147.1	130.0	121.6	121.2	117.7	128.4
4	125.7	122.1	119.2	125.4	119.7	135.0	136.5	144.4	152.0	130.3	123.3	123.1	117.5	130.1
1	123.9	120.1	120.8	127.9	120.9	136.7	140.5	146.3	161.2	134.3	123.9	120.7	117.1	132.0
2	131.1	123.0	123.2	131.6	123.3	141.6	146.5	154.6	169.0	139.7	126.9	125.1	121.7	137.0
3	125.1	125.8	126.0	135.4	126.3	147.2	153.1	163.7	180.8	146.5	128.0	127.2	127.0	141.8
4	131.2	125.4	128.1	137.3	130.5	151.6	161.7	172.0	192.1	150.9	133.9	127.3	124.4	146.5
1	135.2	128.8	129.6	144.6	133.9	158.3	168.5	183.9	203.0	155.2	131.8	127.1	118.6	151.7
2	133.1	137.1	132.2	148.9	143.1	172.9	180.1	195.8	216.9	164.1	139.0	128.2	126.6	159.7
3	135.3	137.0	134.3	152.0	148.3	184.5	193.2	206.6	228.4	171.7	137.0	130.3	122.2	165.7
4	130.5	134.7	131.3	153.8	149.2	189.8	192.9	205.8	227.7	173.6	135.4	125.7	116.0	164.9
1	131.6	134.6	137.0	159.5	157.1	207.7	205.8	215.9	233.7	188.6	140.0	122.9	118.9	172.2
2	135.7	147.3	144.1	179.1	179.6	236.2	223.6	229.0	247.4	215.0	151.0	127.0	120.7	187.2
3	138.4	166.4	158.1	210.5	214.6	269.0	249.1	247.0	261.8	244.7	166.6	134.0	117.3	207.9
4	153.0	191.9	171.8	233.9	227.4	265.2	259.0	253.5	265.0	252.2	197.6	138.8	120.9	220.1
1	170.9	197.3	187.2	241.3	233.4	262.4	261.2	260.5	269.6	248.6	213.1	145.4	116.7	226.2
2	192.0	217.1	204.9	242.2	232.1	272.5	265.7	261.4	270.5	256.5	222.1	154.1	123.3	234.1
3	201.0	223.5	223.5	232.9	241.6	252.0	253.4	250.8	266.4	252.9	219.9	163.8	120.5	233.4
4	212.2	225.6	217.7	249.3	235.6	239.2	242.9	240.8	258.3	236.0	223.0	169.5	127.9	229.6