The Dynamics of Spatial Inequality in UK Housing Wealth

Discussion Paper

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Abstract

This paper investigates the dynamics of spatial inequality in gross housing wealth in the UK. Our results challenge recent research findings in the UK that suggest inexorable rises in housing wealth inequality. We argue that such findings are illusory, arising in part from the use of final period price levels to categorise areas into low and high house price locations. We use Monte Carlo simulations to illustrate the bias that final period categorisation introduces and we then estimate how gross housing wealth inequality changes over time using a battery of measures. All our results indicate that there is evidence of cycles in housing wealth inequality but no evidence of an upward trend. Most surprisingly, the cycles in inequality are found to be of very large amplitude and this may have important effects on consumption, work incentives and business formation. We also find that the entire distribution of house values has shifted which is likely to imply a growing gulf in housing wealth between owners and renters over the period considered.

Keywords: Housing wealth; inequality

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Introduction

Housing wealth inequality has been investigated in a variety of countries as a potentially major source of economic and social inequality. There has been concern in the US, for example, about inequalities in returns to homeownership between different racial and social groups (e.g. Flippen 2004 and Quercia et al 2000) and the effects on life chances (Boehm and Schlottmann 2001). Examination of UK housing data by Thomas Dorling (2004) has revealed the huge variation across neighbourhoods in house price appreciation, with some households accumulating levels of housing equity that dwarf all other sources of personal wealth. Similar phenomena have been debated and researched in other countries that have large owner occupation sectors (e.g. see Burbidge 2000 on

Australia, and Skaburskis and Moos 2008 on Canada). The ability of owners to pass on this wealth to their children has led to questions about the role of housing wealth as a driver of class reproduction, and how this relates to Marxist perspectives which tend to see the variation in returns as subservient to labour market inequalities (Burbidge 2000). These issues have a potentially crucial role to play in the wider debate about the efficacy of homeownership (Ronald 2008) which has gained renewed pertinence in the aftermath of the US subprime crisis and the subsequent world recession.

At the heart of these interconnected issues is the relatively unexplored question of whether the inequality in housing wealth accumulation can, and does, increase inexorably, or whether it is part of a cyclical process. If the latter, then spatial variation in house price appreciation will have an ambiguous role as a driver of wider socio-economic inequality and class reproduction (though there may nevertheless be important questions to be asked about the amplitude of cycles in housing wealth). There are also methodological questions about the appropriate measurement of housing wealth and how relative changes in price are calculated. How one computes the dynamics of spatial inequality in housing wealth can have a critical effect on the results, as we discover in the research presented here. While the focus of the current paper is on the UK, the methodological and socio-economic issues raised are relevant to all countries where there is a substantial homeownership sector or where the optimum share of houses in owner occupation (and the taxation and regulation of this sector) is under consideration.

The purpose of the research presented here is to investigate the dynamics of spatial inequality in gross housing wealth in the UK. Housing wealth is defined in the literature in one of two ways: (i) as *gross housing wealth* = cumulative house price change over a given period; or (ii) as *net housing wealth* = gross housing wealth less outstanding mortgage debt (Henley 1998). Studies that consider *net housing wealth* face the challenge of approximating amortisation. Because outstanding mortgage debt is not typically recorded in datasets that have precise information on the location of dwellings, researchers in the UK attempting to measure net housing wealth either use survey data that typically precludes fine grained spatial analysis (Henley 1998) or attempt to estimate net housing wealth from gross housing wealth by adjusting for household age (Thomas and Dorling 2004). Unfortunately, adjusting for age can introduce significant distortion. This is because the age of head of household is not evenly distributed across space (i.e. households may cluster by age). Adjusting gross housing wealth for amortisation in this way will confuse life cycle effects (older people have smaller mortgages because they have had longer to amortise – areas with a high proportion of old people will have relatively high net housing wealth, *cet par*) with spatial inequality effects that arise from genuine differences across areas in the opportunities to accumulate wealth from housing capital gains. Since it is the latter we are interested in here, adjusting for amortisation should be avoided. The only major distortion that could arise from not adjusting for amortisation is if there are significant differences across space in mortgage interest rates. Given that this does not appear to be the case in our study area (see section 5 below), gross housing wealth is the most appropriate definition for considering the dynamics of spatial inequality.

The focus of this paper is on the relative gains to gross housing wealth across space. Suppose someone purchased dwelling in a low house price area in 1996. Would they have fared any better or worse over the subsequent decade in terms of the percentage increase in value of their house than someone who purchased a house in a high house price area in 1996? Of greatest interest is whether inequalities in rates of increase persist over time, creating ever increasing inequality. Temporary fluctuations over the course of a year are of less interest because they may simply cancel each other out over a longer period.[1]

[1] i.e. if annual fluctuations do not cancel each other out, they will lead to cumulative increases (or decreases) over a longer period, which is what we are most interested in.

Note that our focus is on relative changes in housing wealth. Absolute changes in housing wealth are not considered because they would give potentially distorted picture. For example, other things being equal, areas with small houses would yield lower absolute capital gains even if all prices rise at the same rate. Absolute changes in house price would also yield massively different rates of volatility in housing wealth inequality even if all houses appreciated at the same rate. For example, if all houses rise in value by 10% over the course of a year, owners of £1m houses will make a capital gain of £100,000, whereas owners of £50,000 houses will accumulate a gain of £5,000. If all house prices fall the following year by 10% then the owner of the £1m house will lose £100,000, whereas owners of £50,000 houses will lose just £5,000. To avoid these complications, our focus in this paper is on whether there is a systematic and persistent difference in the *rate* of house price increase between areas with cheap houses and those with expensive houses. Absolute changes are nevertheless important, particularly at the macro level (notably, via the impact of equity withdrawal[2] on aggregate demand – see Goodhart and Hofmann 2008).

Note also that our focus is explicitly spatial. Our goal is to understand the systematic patterns across neighbourhoods, rather than tell the story of the aggregate for the entire country, or of any one neighbourhood or household. While there is no denying that particular individuals have made huge capital gains by selling a single expensive house at the right time, this in itself does not represent growing inequality unless those same individuals could not have achieved proportionally equivalent gains by selling several cheaper houses. One of the inefficiencies associated with housing as an investment vehicle is that it is a lumpy asset – one cannot easily purchase a share in a house. If expensive houses tended to increase in value at a faster rate than cheaper ones, this lumpiness would imply an inequality of opportunity among homeowners because lower income homeowners would be excluded from the most profitable share of the market.

The remainder of the paper is structured as follows. First we summarise why housing wealth inequality is important. We then, in section 2, offer a brief survey of the housing wealth literature. Section 3 expands further on the rationale for choosing gross, rather than net, housing wealth. Section 4 focuses on a number of methodological issues and our proposed solutions. We summarise our data in section 5 and present our results in section 6, first those from simple comparisons of house price distributions ("simple" in the sense that they do not consider the implications for *spatial* inequality), and then findings from the various spatial measures of housing wealth inequality, including BIP (the slope coefficients from a series of regressions of house price inflation on house price levels), DRIP (the ratio of average house price inflation in the tenth house price decile to the first house price decile), SG (the spatial Gini coefficient), and SA (the spatial Atkinson coefficient). We conclude with a summary of findings, our thoughts on policy implications, and avenues for future research.

1. Why is Housing Wealth Inequality Important?

Housing wealth inequality is of importance for at least five reasons. Firstly, it connects to the wider debate about the pros and cons of inequality (Johnson, 1973; Lambert 1993; Shaw *et al*, 2007; Dorling *et al.* 2007) and the role of homeownership in reinforcing class reproduction (Rex and Moore, 1967; Haddon, 1970; Harvey, 1973; Kemeny, 1981; Saunders 1990; Hamnett *et al.*, 1991; Burbidge 2000; Ronald 2008). Housing has become such an important asset, so the argument goes, that changes in the distribution of house prices have the potential to affect profoundly the distribution of personal wealth. Thomas and Dorling (2004), for example, find that the size of

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[2] Mortgage equity withdrawal, sometimes also called *equity extraction*, is the process of accessing the net housing wealth (current value of the house less the outstanding debt) by taking out a second mortgage or by increasing the value of an existing mortgage. It is a way of accessing the increased wealth that arises when house prices increase and has become an important driver of aggregate consumption (Goodhart and Hofmann 2008).

housing wealth inequality in the UK is large enough to swamp both individual achievement and the redistributive impact of income taxation and welfare:

> "… the major underlying trend in the data … shows ever growing inequalities in wealth being generated through the operation of the housing markets in Great Britain. These levels of housing wealth inequality are unprecedented and, we argue, almost insurmountable by individuals, whatever efforts they might make to improve their relative situation through, for instance, employment." (Thomas and Dorling 2004 p. 9)
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> "… we are moving towards a situation in which this country's children will be divided more by wealth than has been the case since at least Victorian times. For children, wealth and in particular housing wealth is a national lottery of their accident of birth. Increases in direct income taxation, in inheritance tax, in benefits paid to the poor would have little influence on the results of this lottery given the sums of money involved and the abilities of the wealthiest families through trusts and other means to avoid such redistribution." (Thomas and Dorling 2004 p. 6)

Secondly, housing wealth inequality has implications for the long-term attractiveness of low-price areas to investors and movers. A finding that low house price areas tend to perform poorly (in terms of the return on every £1 invested in residential property) is itself likely to make those areas less attractive to both owner occupiers and landlords. Lower rates of price appreciation in low price areas (Thomas and Dorling 2004) could become a self-fulfilling prophecy – the vicious circle of net out-migration and falling property values would only deepen the blight of deprived areas and push the goal of mixed communities further beyond reach (Galster *et al.* 2000, 2007). If, on the other hand, such processes are merely cyclical and low house price areas tend to perform just as well in the long-term as more expensive areas, then property investors can be reassured that their money will be as equally well-placed in Wales (where house prices are traditionally low) as in Knightsbridge (one of the most expensive areas of the UK). Such a finding will reduce the stigma associated low house price areas and attract long-term property investors. Note that we do not investigate differences housing wealth accumulation by house type. While differences in house price appreciation across dwelling types is interesting, it is not as important to the debate on inequality as the geography of housing wealth accumulation. One of the contributions of Thomas and Dorling (2004) and Dorling *et al*. (2007) has been to emphasise the importance of geography – housing wealth inequalities across space are important because they have the potential to significantly exacerbate social segmentation. Note also that dwelling type tends to be spatially clustered. If detached dwellings have risen in value relative to other types, for example, this would be of particular interest if such properties were spatially concentrated and if this had led to spatial segmentation emerging in wealth inequality. Since we address directly the issue of whether there has been growing spatial segmentation in housing wealth, the issue of house type becomes a secondary issue and is not considered here.

Thirdly, polarisation of housing wealth has implications for the shortage of key workers in high-house price areas. Cameron and Muellbauer (1998) found that "expected house price appreciation is a crucial counterweight to high house price to earnings ratios, which otherwise discourage net migration to a high priced region." (p. C110, Muellbauer 2005). Their estimates help explain why economic activity continues to be attracted to high priced but prosperous locations – one would otherwise expect firms to locate where housing costs are low attracting workers priced out of expensive areas, but it seems that the expectation of rising prices is itself a reason why people move to an area (see also Roback 1982). This can have further perverse effects if private sector wage rates adjust to regional house price imbalances, exacerbating the public-private sector wage gap in high house price regions, leading to acute shortages of key workers (particularly teachers and nurses) in those areas (i.e. if wages rise in areas with rising house prices in order to be able to attract workers – see Roback 1982 – then those on national wage scales, such as public sector workers, will be priced out of those markets, something that has been raised as a particular problem in London and the South East – Barker 2003).

Fourthly, shifts in housing wealth affects the relative position of renters. If the rise and decline in the relative position of low and high house price areas is intrinsically temporary – part of a perpetual process of adjustment – the most pressing question would then be whether house prices overall tend to ratchet-up over time. If the entire house price terrain has been elevated, the implication would be an *increase* in the gap between the housing wealth of renters (who have no housing wealth) and those at the bottom end of the market for owner-occupancy. While we do not enter into the broader renting vs ownership debate (see Dietz and Haurin 2003; Hulchanski 2001), our results may have some bearing on that debate. For example, if the returns to homeownership were much greater for those living in affluent areas, this might imply that, while homeownership is advantageous for the most wealthy, it may not be so for those living in poorer areas. Shifts of the house price distribution also has implications for "affordability" – the ability of renters to enter homeownership. This has been considered at length in the tenure choice literature (see reviews by Dietz and Haurin 2003 and Gyourko 2003) and the spatial affordability literature (Wilcox 2003; Meen *et al*. 2005; and Fingleton 2008).

Fifthly, irrespective of the secular trend in housing wealth inequality, there is the issue of volatility. If there exist cycles in housing wealth inequality, and these cycles are of large amplitude, there are questions as to whether there may be distortions and social ills that emerge or are exacerbated as a result. For example, if large swings in housing equity arise because of arbitrary market processes that bear no relationship to work effort, entrepreneurship, or explicit democratic choice of society, there may be negative implications not only for economic efficiency but also for the role of government and the capacity of policy to affect peoples' lives. One particular concern is that large swings in housing wealth may distort labour supply decisions. Textbook labour supply theory suggests that capital gains will "reduce the incentive to supply labour as they reduce an agent's marginal utility of wealth…" (Henley; 2004, 439-40; Henley's estimation of the impact of windfall gains arising from increases in housing equity finds significant reductions in hours worked follow real housing gains). Moreover, if housing capital gains are an important source of funds to finance business start-ups (Cressy 1996), volatility in housing equity may be a crucial driver of cycles in the number and success of new businesses.

2. Review of the Literature

The empirical literature on spatial inequalities in housing wealth is surprisingly sparse in the UK. While there is a large body of work on housing wealth *per se*, few studies look at the *inequality* of housing wealth across space at a local level, and fewer studies still look at how this inequality has changed over time. No study that we are aware of has applied standard measures of inequality (such as the Gini and Atkinson coefficients) on an annual basis to housing wealth and traced how these indicators have changed over a prolonged period, and no study has successfully completed a fine-grained spatial decomposition of changes in housing wealth inequality. (Gruber and Martin 2003 apply Gini coefficients to housing wealth distributions, but these are not based on real data – i.e. they simulate a range of plausible scenarios in a hypothetical economic model).

The lack of spatial analysis is partly explained by the fact that empirical interest in housing wealth has been driven by macro economic modelling. Prior to the 1990s, macro studies "implicitly ignored the mobility features of housing markets and emphasised how changes in aggregate demand drive housing system outcomes" (Maclennan and Tu 1998). Failure of macro models in the late 1980s to explain consumption behaviour led to renewed interest in the role of housing wealth as a possible explanation (Dicks 1990**;** Carruth and Henley 1993**;** Muellbauer and Lattimore 1995; Muellbauer and Murphy 2008; Greenspan and Kennedy 2008).

Rapid house price inflation during the 1980s led to concern about the tendency for homeowners to pass on capital gains to their children, and so another branch of the literature considered the class reproduction implications of homeownership. Holmans (1997), however, went some way to allay those concerns in the UK (at least until the research by Thomas and Dorling 2004 was published) by arguing that, "The forecasts made in the later 1980s … severely underestimated the length of the time scale and did not take any account of the payments for care" (Holmans (1997) p.*x*). A related debate examined the sociological and ideological implications of homeownership (see review by Ronald 2008). According to Burbidge (2000, p.260), the Weberians (Haddon, 1970; Rex and Moore, 1967; Saunders 1990) argued that "homeownership leads to the formation of social or economic groups–variously named housing classes, housing status groups, property classes or consumptions sector cleavages"; while the Marxists (Hamnett *et al.*, 1991; Harvey, 1973; Kemeny, 1981) claimed that "the economic inequalities constructed through housing tenure largely reflect inequalities generated in the job market". However, as Saunders (1990, p. 125), Duncan (1990, p. 205) and Burbidge (2000, p.263) point out, many of the early studies on rates of capital gains were based on aggregate data (giving the impression that "that all homeowners benefited from the rises in house values", Burbidge 2000, p.263), or were based on relatively small, idiosyncratic samples. For example, Badcock's (1994a, b) studies are based on a sample of 206 households that sold in 1988-1989 in Australia; and his earlier work (1992) was based on house price averages for 30 local government areas. (This compares with a variety of measures and data sources used in the present study which include multiple time periods and cover most of England and Wales, with sample sizes of up to 12 million observations.)

In the US literature on housing wealth, the focus has been on the implications for accessing homeownership and on inequalities in returns to homeownership between different racial and social groups. Boehm and Schlottmann (2001), for example, find that children of homeowners are more likely to enter owner occupancy sooner than are children of renters, and likely to achieve higher levels of education and income (see also Englehardt and Mayer 1994, and Gale and Schlotz 1994). This ties in with a larger literature on the efficacy of homeownership, and the literature on the differential rates of house appreciation for different social and ethnic groups (see Quercia *et al.* 2000, Denton 2001, Kim 2000, 2003, Flippen 2004, Krivo and Kaufman 2004; Archer *et al.* 1996, and Brasington, 2002, Woldoff 2008; see Dietz and Haurin 2003 for a review of the wider literature on the social and private consequences of homeownership).

The first explicit, detailed study of UK housing wealth inequality using large datasets seems to have been that of Henley (1998) who employed General Household Survey (GHS) and British Household Panel Survey (BHPS) data to examine movements of the housing wealth distribution and changes in the determinants of household housing wealth. He presents a decomposition of housing wealth inequality by both region and age of head of household, and considers a variety of wealth measures including gross housing wealth (cumulative house price change), net housing wealth (gross housing wealth less outstanding mortgage debt), both within owner occupancy and across all tenures. Henley finds that the "level of inequality is much higher for all households than for owner-occupiers alone." (Henley, 1998, p.336). There is evidence of a small growth in housing wealth inequality over the period 1985-91, and this is more pronounced for gross (rather than *net*) housing wealth. Despite regional differences in house price change, "nearly all of the growth in inequality is explained by the growth of *within-region* inequality" (*ibid*, p.374). Similarly, the age-group decomposition finds that most of the increase in inequality is *within-group* (*ibid*, p.375).

While Maclennan and Tu (1998) do not apply traditional inequality analysis to housing wealth, their study is of interest because it attempts to consider how housing equity (i.e. net housing wealth: the difference between current house value and outstanding mortgage debt) varies across household types. They considered patterns in housing equity using a variety of survey-data sources (including the BHPS) and found that "current household income was not significantly related to housing equity, largely because elderly households with low incomes had large asset stocks, nor was ethnicity and purchase via Right-to-Buy patterns" (Maclennan and Tu, 1998, p.456).

3. Why use gross housing wealth?

While survey data such as the BHPS allows one to approximate the net housing wealth of each household by deducting estimated outstanding mortgage debt from the house price, there are four significant disadvantages with this type of data: (1) there is typically a lack of spatial information (usually omitted to preserve the anonymity of respondents); (2) the sample is rarely evenly distributed across the country so true geographical analysis is precluded; and (3) the lack of transactions-based price data means that estimates of the value of the house in each year – crucial to the computation of housing wealth – is only very approximate in most cases;[3] (4) the mortgage variables are typically limited – current mortgage balances usually have to be approximated using amortisation equations (as in Maclennan and Tu 1998) with other simplifying assumptions.

These limitations would make it impossible to use the BHPS, for example, to conduct a fine-grain spatial analysis of housing wealth accumulation, or to achieve complete geographical coverage. House transactions data, on the other hand, while lacking mortgage information, have the potential to provide price and attribute information with a high degree of spatial precision and extensive geographical coverage. The lack of mortgage information is not necessarily critical, however, because it is questionable whether net housing wealth is the variable of most interest, particularly if one is concerned with the implications for social inequality. Suppose households in more expensive areas have had greater rates of house price increase, and have also had greater rates of equity withdrawal. As a consequence, the net proportionate increase in housing equity is no greater than for home owners in low price areas. But the apparent uniformity in housing equity growth in this example masks the growing inequality that has occurred over time in the benefits of living in high house price area relative to living in a low house price area. Relative house price growth across different geographical or social classifications is, in many respects, the most important variable.

If one is interested in spatial inequalities in housing wealth accumulation (the primary motivation behind Thomas and Dorling 2004 and the current paper) a distortion that might arise from using gross rather than net housing wealth measures is the possibility that homeowners in some areas pay higher rates of mortgage interest than in others. Spatial patterns in interest rates might be due to geographical differentials in risk premia, reflecting the concentration of higher risks (e.g. higher loan-to-value ratios or unemployment risks) in certain locations. It is unlikely, though, that geographical differences in interest rates will have a major impact on the spatial pattern of housing wealth because UK lenders have tended not to use credit scoring to increase the interest rates offered to high risk borrowers. Instead, lenders have tended to use credit scoring to screen out (i.e. ration credit) to high risk borrowers (see Pryce 2003). For example, for new mortgages 2003, the average variation *between* English regions in the mean regional interest rate was just 0.04 percentage points, whereas the average deviation[4] *within* these regions was almost 0.7 percentage points (note how similar the interest rate distributions are for these two regions in Figure 1, even though they

[3] Only around 5-7% of properties transact in a given year (see Pryce and Mason 2006). Consequently, only a very small proportion of the sample has recent price information; valuation of other properties can be approximated but with questionable levels of precision.
[4] That is, the standard deviation.

represent the two extremes of regional interest rates in the UK).[5] It would be interesting and important, but beyond the scope of the present study, to explore whether the variation of interest rates within each region has a stronger spatial component, but it seems unlikely.[6]

Figure 1. **Differences in Mortgage Interest Rates in 2003 between London and Yorkshire & Humberside**

Gross housing wealth differentials, measured using relative rates of change between high house price areas and low house price areas, are therefore of particular importance, and the best way to examine this effect is to use transactions data, such as that provided by HM Land Registry or building societies.

This is the basis of the approach taken by Thomas and Dorling (2004). Note, though, that while Thomas and Dorling use transactions data, their findings are not based on *gross* housing wealth – they attempt to calculate *net* housing wealth based on "the simple ratio of outright owners to buyers," where information on outright owners is gleaned from Census data (Thomas and Dorling, 2004, p.20). However, in addition to the problems noted above of attempting to estimate net housing wealth as the basis of inequality measurement (a person may, for example, have high mortgage debt because they have benefited from equity withdrawal) there may be further drawbacks when using Census data in this way and when computing area averages. First, there is the problem that many homeowners over the past twenty years have taken out endowment and other interest-only mortgages.[7] The implication here is that, at a given point in time, many borrowers will have very large *gross* debt (nothing repaid on their mortgage), but insignificant *net* debt (because their endowment policy is close to maturity). In other words, rates of outright ownership are a crude measure of indebtedness, and therefore lead to potentially biased measures of net housing wealth.

A second, and more acute, problem arises when outright ownership rates are used to examine geographical variation in wealth. Older, lower-debt/higher-wealth, households tend to concentrate in particular areas, so this can give the impression that there is spatial inequality in net housing wealth, an impression that is somewhat misleading because it may be the natural outcome of the life-cycle and housing-careers process. Young homeowners tend to purchase their first property in entry-level housing (which is typically clustered in particular areas) and do so with high debt-gearing (loan to value ratios close to 100%). As time passes, they progress up the income scale, and pay-off more of their mortgage debt (or their endowment policy matures), until they own outright. Over the course of these income and debt lifecycles, housing needs change. In particular, older homeowners tend to

[5] Note also that a regression of interest rates on regional dummies explains just 5% of the variation of interest rates on new mortgages. This suggests that the almost all the variation in interest rates is non-spatial. The average interest rate in London was 4.16 (standard deviation of 0.67), whereas the average interest rate in Yorkshire and Humberside was 4.28 (standard deviation of 0.68).

[6] Even if there were a degree of risk pricing, the spatial pattern of mortgage interest rates at a given point in time is likely to be highly random due to a range of complicating factors. For example, some mortgages have fixed interest rates while others vary with the base rate, and there are variations in the number of new mortgages and re-mortgages, which will have interest rates affected by the range of mortgage products that happen to be on the market at a given time, many of which will have complex and idiosyncratic interest rate structures.

[7] An "endowment mortgage" is one where the borrower meets interest payments but does not pay down the mortgage until the duration of the loan is complete. Instead, the borrower takes out an "endowment policy", usually with an insurance company, which is an investment vehicle structured to reach maturity in the same year as the mortgage reaches maturity. The borrower then uses the proceeds of the investment to pay off the mortgage. Endowment mortgages became common in the UK during the 1980s but have since dwindled in popularity due to poor performance of endowment policies.

relocate to "mature areas" – quieter neighbourhoods inhabited by owners at a similar stage in their lifecycle. Note that this process would imply spatial inequality in net housing wealth *even if all homeowners had exactly the same life-cycle earnings*. Using *net* housing wealth only leads to confusion because we do not know whether changes in net housing wealth inequality across space are due to changes in life-cycle and housing careers behaviour (which may be innocuous – e.g. older homeowners increasingly wanting to live near neighbours at a similar life-stage) or whether the changes are due to systematic changes in the spatial pattern of housing wealth accumulation. While the former is not problematic, the latter may well be (if, for example, flows into "mature areas" were determined by a growing gulf between low-and high-price areas in the rate of increase of value housing over the course of a lifetime). Therefore, the simplest and most appropriate way to measure changes in housing wealth inequality across space is to use a measure of *gross* (rather than net) housing wealth.

4. Methods

There are three further problems with existing approaches: (i) the focus on the extremes of the distribution; (ii) the use of final period price levels to decide on whether houses were in a low or high house price area; and (iii) results reported on inequality growth are often based on two points in time (to coincide with Census dates, for example, in Thomas and Dorling 2004), rather than at every point. These are common (see Friedman 1992) but serious methodological weaknesses that need addressing. We discuss in this section the nature of these problems and our proposed solutions.

(i) Not Just the Extremes: Using BIP (Regression coefficient based on Initial Prices) to Measure Inequality in Price Change Comparing the rate of price accumulation in the highest price decile with the rate of price change in the lowest price decile (as in Thomas and Dorling 2004), or counting the number of households with housing wealth above a certain threshold (as in Dorling *et al*. 2007), are both simple ways of measuring whether price increases tend to be greater in more expensive areas. However, such methods ignore the distribution of housing wealth in the bulk of the sample. We propose an alternative, which we denote *BIP* = β coefficient from a regression of average postcode sector[8] house price inflation on *Initial Period* average postcode sector price levels:

$$Inflation_i = \alpha + \beta P_{i,t=1},$$

where P_{it} is the average house price for postcode sector i in period t. The advantage of this approach is that it uses the entire price distribution (rather than looking only at postcode sectors with very low or very high house prices). If *BIP* is positive, as in the hypothetical case in Figure 2 below, it indicates growing inequality over the time period in question.

Figure 2. **Hypothetical Scatter Plot: The Case of Growing Inequality**

(ii) The Problem with Base Period Prices

An important question is whether one should use the initial period (such as 1996) to measure a postcode sector's house price level, or whether one should use the final period (such as 2006). The question of interest is whether the estimate of β, which captures the relationship between price *change* and price *levels*, is materially affected by whether one measures price levels at the first or

[8] UK Royal Mail allocates each dwelling to groups of around 15 properties, to which it ascribes a unique "postcode unit" (e.g. G12 8RS). Higher level groupings can then be made from these units. For example, a common basis for empirical analysis is the "postcode sector" (e.g. G12 8). We select all postcode sectors where there are at least 30 sales in a given year and calculate the average selling price. There are 8,001 postcode sectors that meet this criterion in our data (which covers England and Wales but not Scotland). Note that the Thomas and Dorling data was supplied to us in average form and so, to maintain consistency, we use averages, rather than medians, when using the Land Registry data.

final period. Let $\boldsymbol{t}$ be the set of time periods over which data are available on house price *levels*, *P*, across areas *i*:

$$\boldsymbol{t} = \{t: t = 1, 2, 3, \ldots, \tau\}$$

where τ is the final period in the data. Price *inflation* for area $i \in I$ between the first and last time periods where $\tau > 1$, is calculated as:

$$Inflation_i = \%\Delta \mathrm{P}_i = (\mathrm{P}_{i,t=\tau} - \mathrm{P}_{i,t=1})/\mathrm{P}_{i,t=1}$$

Suppose one calculates the average house price, P, for eleven areas in period 1 and then for period 2. Then calculate the rate of inflation = proportionate change in prices in each area. Suppose that all areas have had zero inflation except area *a*, the lowest priced area in period 1, which enjoys a 200% price rise (see table below).

Table 1. **Hypothetical Example of Final Period Bias**

Intuitively, one would understand inequality to have fallen overall because the lowest price area in the first period has become the most expensive by period two. Indeed, if one runs a scatter plot of house price inflation on $\mathrm{P}_{t=1}$, one obtains a downward sloping line, indicating that the slope is less than zero, which confirms the anticipated fall in inequality. However, if one runs a scatter plot of inflation on $\mathrm{P}_{t=2}$, one gets he opposite effect – an upward sloping line, indicating that the slope is greater than zero, which suggests, incorrectly, that inequality has been rising. The problem is that the different levels of inflation across areas has changed the ordering of areas (as shown in Figure 3 below) and those areas that have had the largest price increase, even if they started off as among the lowest priced areas (as in this example), will become ranked among the highest house price areas in the second period, provided that price increase has been large enough. It becomes tautological then to say that areas with the highest house prices in period 2 have had the highest rates of inflation: it is *because* of the higher rates of inflation that those areas have high house prices in period 2.

Figure 3. **Tautological Nature of Final Period Spatial Inequality Measures**

This does not mean that, if a measure based on final period price levels suggests growing inequality, then a measure based on base period prices will show falling inequality. It simply means that a final period measure will overestimate any growth in inequality (or underestimate any fall in inequality). And the greater the variability in inflation relative to initial price levels, the greater the distortion caused.

To understand better the relationship between the bias caused by final period inequality estimation, we run a series of Monte Carlo simulations.[9] The goal of the simulations is to estimate the relationship between the variability of inflation across areas (measured using the coefficient of variation = standard deviation of inflation divided by mean inflation) and the bias introduced by

[9] Monte Carlo methods refer to a range of statistical techniques for deriving hypothetical samples that incorporate the kind of random variation one might observe in real life but in a controlled way. This confers a distinct advantage over using real data – using hypothetical samples allows one to control the data environment and hence better understand how a particular procedure behaves. Monte Carlo simulation has become a standard tool for statisticians (see Robert and Casella 2004 for an over view of different methods and related techniques). In our case, we want to gauge the bias introduced by categorising areas using final period house price levels (as in Thomas and Dorling 2004). We do so by setting up a Monte Carlo simulation where the true value of the slope coefficient of interest is zero. If final period categorisation when applied to this simulated data leads to a slope significantly greater or less than zero then we know that it has introduced bias.

using final period (rather than initial period) price levels to gauge whether an area has high or low prices. Our simulation is constructed in such a way that, if there were no bias introduced by final period categorisation, then a purely random distribution of house price inflation rates across areas (i.e. no systematic tendency for high or low house price areas to perform any better or worse) would result in a slope coefficient of zero when regressing price change against price levels.

We start off with a normally distributed sample of 30,000 hypothetical average house prices (representing 30,000 areas[10]) in period $t = 1$. We then generate a random house price inflation value for each of these 30,000 areas over the period t=*1* to t=*T*, and calculate the new average house price in each area in period *t*=*T*. This inflation rate is random normally distributed with mean = 0 and sd = 0.1. We use this sample to run a regression of inflation against period *T* house prices. Of course, because the inflation variable has been created to be purely random, the slope coefficient should be zero, but will nevertheless vary from sample to sample due to sampling variation. To deal with the issue of random sampling variation (the spurious result that the slope coefficient is estimated as being different to zero simply by chance) the whole procedure is repeated 100 times to yield 100 random house price inflation values for each of 30,000 areas the using the same random process.

To see what happens if the mean and standard deviation of the random inflation variable change, both were incremented and the entire process repeated. The scatter plot in Figure 4 shows the values of the slope coefficient b_tT estimated using final period (t = T) price levels to categorize areas. The graph plots 100,000 slope estimate values from 100,000 regressions (of inflation on final period prices) against the incremented coefficient of variation. The graph clearly shows a systematic tendency for the slope coefficient to increase non-linearly with the coefficient of variation, rising steeply at first and then reaching a plateau.

Figure 4. **Monte Carlo Simulation Results: The Case of Zero Mean House Price Inflation Scatter Plot of *Final* Period (*t*=*T*) Slope Coefficients on the Coefficient of Variation**

If there were no bias implied in using final period price levels to categorise areas as low or high price localities, this scatter plot would have no particular trend – the estimates of the slope coefficient would be scattered around $\beta = 0$. To confirm this, consider the scatter plot in Figure 5 of the slope coefficient obtained from a random subset of the same simulated samples but using the *initial* period (t = 1) price levels to categorise areas. As one might expect, there is positive heteroscedasticity – increasing variation in the estimated values of β – as the coefficient of variation increases, but the mean is approximately zero, and a line of best fit through these repeated estimates of β would have zero slope.

Figure 5. **Scatter Plot of Initial Period (*t* = 1) Slope Coefficients on the Coefficient of Variation of Inflation**

The difference between the average value of *b_tT* and *b_t1*, the slope coefficient based on initial period (t = 1) prices, gives us the bias associated with final period estimation. Since, in this experiment, the average of *b_t1* equals zero, the bias associated with final period based inequality growth measures is simply equal to *b_tT* – 0 which equals *b_tT*. All this leads us to conclude that all inequality measures should be calculated using initial period prices to categorise areas.

(iii) Frequency of Inequality Measurement

[10] Note that the “areas” in the context of the Monte Carlo simulation are hypothetical. They could refer to postcode sectors or to any partition of our geographical area into a large number of contiguous regions.

Measuring the change in inequality, whatever the indicator used, between two points can be misleading. Suppose, unbeknown to the researcher, inequality moves in cycles. If the first point is taken at a peak in inequality and the second point is taken at a trough, the researcher will conclude that inequality has been falling. On the other hand, if the first point is taken at a trough in inequality and the second point is taken at a peak, the researcher will come away with the opposite conclusion. To allow for the possibility of cyclical fluctuation, one therefore needs to compute one's measure of the change in inequality at sufficiently frequent intervals (e.g. every year) to capture this effect.

A further issue arises when using the initial period to measure whether a postcode sector has low or high house price levels. Galton's fallacy may give the appearance of house price convergence over time if regression towards the mean increases subsequent house price growth for low house price areas and reduces subsequent house price growth for high house price areas. The fallacy is that this apparent house price convergence over time provides no information about change in the degree of spatial house price inequality over time (see Cook 2003; Friedman 1992; Hart 1995; Quah 1993). Nevertheless, such apparent convergence is relevant in the sense that owners of low price area houses would tend to gain proportionately at the expense of owners of high price area houses. We adopt a number of different methods in order to check for evidence of both effects.

Summary of Proposed Methods

Our main measure, therefore, is *BIP:* β estimated on frequent intervals, and using base period prices to categorise areas. However, to complement this approach, and to triangulate our results, we also compute a number of other measures. The list of the measures estimated is presented below in order of the sequence of results:

1. *BIP* = *Regression coefficient based on Initial Prices* – as described above. We estimate *BIP* for England and Wales using a variety of spatial units, time periods, and different definitions of housing.
2. *DRIP* = *Decile Ratio using Initial Period Prices.* An alternative to using the slope coefficient from a regression of price *changes* on price *levels* to measure relative growth rates, is to monitor how the differences in average prices between first and last deciles change over time. *DRIP* has the disadvantage of ignoring most of the sample. It is included in our analysis below because it is a common measure – for example, it is used by Thomas and Dorling 2004, albeit incorrectly since they use final period categorisation (again, it matters profoundly whether one measures price levels at the first or final period; that is at t = 1 or $t = \tau$). *DRIP* is calculated here as the ratio of average house price inflation in the tenth decile, D10, to the first decile, D1, where the deciles are not from the distribution of inflation, but from the distribution of house price *levels* in the first period:

$$DRIP = (1/n_j)(\Sigma_j \,\%\Delta P_{\boldsymbol{j},t=1}) \,/\, (1/n_k)(\Sigma_k \,\%\Delta P_{\boldsymbol{k},t=1}),$$

= ratio of average inflation in areas in the tenth decile of house prices to average inflation in areas in the first decile, where deciles are derived from *initial* period prices.

j = $\{i\text{: } i \in \text{D10}(P_{t=1})\}$ = areas that belong in the tenth decile of house prices in period t=1

k = $\{i\text{: } i \in \text{D1}(P_{t=1})\}$ = areas that belong in the first decile of house prices in period t=1

n_j = number of areas in the tenth decile = $N/10$, where N is the total number of areas.

n_k = number of areas in the first decile = $N/10$, where N is the total number of areas.

If *DRIP* = 1, then the percentage change in house prices in high house price areas was no more and no less than price changes in low house price areas. One might then conclude that house price inequality had remained stable – neither risen nor fallen – over the intervening period. On the other hand, suppose the inflation multiple was greater than one, say 5, then this would imply that house prices in high house price areas had risen in value at five times the rate of price increase in low house price areas. However, an inflation multiple less than unity would not necessarily indicate decreasing housing wealth equality over time because of the Galton fallacy. However, it would indicate that house price growth in low house price areas subsequently exceeds house price growth in high house price areas, suggestive of increased *housing wealth accumulation* equality over time.

3. *SG* = *Spatial Gini coefficient*. The Gini coefficient, the most popular indicator of inequality, takes on a value between zero and one, and can be represented as a percentage (Johnson, 1973; Lambert 1993; De Maio 2007). If wealth is perfectly equally distributed, the Gini coefficient will equal zero. In a perfectly unequal society, where all wealth is owned by one person, the coefficient will equal one. The standard Gini measure of inequality is applied to postcode sector average prices.
4. *SA* = *Spatial Atkinson coefficients* allow the user to specify a sensitivity value, *e*, to capture how concerned the researcher is about those in the sample with lowest wealth. *e* can be specified to lie at any point range zero to infinity, the higher the value, the greater the sensitivity of the index to inequalities at the bottom of the wealth distribution. Atkinson coefficients are conventionally computed for a variety of values of *e*, typically *e* = 0.5, 1, 1.5 and 2 (De Maio, 2007, p. 850). We apply the standard Atkinson measures of inequality to postcode sector average prices.

5. Data

Our data are from 3 sources:

1. We use house price data is from Land Registry sales which record all transactions in England and Wales over the period 1996 to 2006. We were able to access this rich dataset of over 12 million geocoded dwelling transactions (see descriptive statistics in Table A1 of the Appendix) because the research was funded by Communities and Local Government, a UK central government department. Unfortunately, when that project came to an end, so did our access to Land Registry data so we have been unable to update our results in the light of the recent downturn.
2. However, we also apply our analysis to a dataset from a longer time period kindly made available by Bethan Thomas and Danny Dorling of the University of Sheffield which includes marked downturns in the housing market in the 1980s and 1990s (see Table A2 in the Appendix). This data is based on mortgage transactions from 1980 to 2003, described in detail in Thomas and Dorling (2004) which allowed them to produce “the most detailed reliable mapping of house prices and housing wealth produced for Great Britain to date for a 24 year period.” Thomas and Dorling allowed us access to the average house prices they had

computed for each of the 1,282 Census Tracts for each year using a unique confidential dataset provided by a UK mortgage lender.

3. Interest rate data is from the Council for Mortgage Lenders Regulated Mortgage Database of 142,430 sales between June and December 2003 (see Figure 1).

6. Results

The Distribution of House Prices

Before proceeding with our six measures of changing housing wealth and inequality, it is worth familiarising ourselves with the shape of the house price distribution and how it has changed over time. This exercise will not answer the core research question posed in the introduction because it will not reveal which areas have done well relative to others — it is a non-spatial analysis and it will merely show whether the UK distribution has *shifted*, and whether it has *changed shape* (become flatter or more peaked).

Summary Statistics on Individual Land Registry House Prices from 1996 to 2006

The two line graphs in panel (a) of Figure 6 show that the gap between the 75th centile (P75) and the 25th centile (P25)[11] has increased as one might expect, but the question is whether there has been a *relative* increase, not just an *absolute* increase. Similarly, the 10th and 90th centile have clearly drifted apart (panel (b)), but this would be true even if all house prices increased at the same rate. In other words, if all dwellings increased in value at 20% a year (fixed proportionate scalling of all house prices), the 10^{th} (P10) and 90^{th} centile (P90) would drift apart in absolute terms, but would be constant as a proportion of each other.

Figure 6. **House Price Trends in England and Wales**

(a) First and Second Quartiles (b) Tenth and Ninetieth Centiles

Both sets of ratios in Figure 7 tell a similar tale: the top end of price distribution pulled away from the bottom end of the distribution in relative terms at the turn of the millennium, but in the last three years, prices at the bottom end of the distribution have enjoyed an equally noticeable catch-up. These results suggest that house price inequality is lower now than it was a decade ago. They also raise the question of whether it matters that gross housing wealth inequality increased temporarily during 1996-2002. Transitory increases in inequality of this kind may simply imply a lag in the house price adjustment process.

Figure 7. **Ratio of Upper to Lower House Centiles**

(a) Second Quartile : First Quartile (b) Ninetieth Centile : Tenth Centile

Of course, this tells us nothing about how the distribution of prices has changed *across space* – one does not know if low price areas in 1996 have remained low price areas or whether some have swapped places with localities previously considered to have higher house prices. Nevertheless, the results indicate that something fairly dramatic has occurred in the housing market, and that one cannot assume that housing wealth inequality has been rising inexorably.

[11] A quartile is one of three values that divide a sorted set of observations on a variable into four equal parts. The first quartile is the value of the variable which 25% of the data fall at or below – that is, it is the 25^{th} centile (or “percentile”). The second quartile is the value of the variable which 50% of the data fall at or below – the 50^{th} centile, also known as the median. The third quartile is the value which 75% of the data fall at or below – the 75^{th} centile (see an introductory statistics text, such as Moore and McCabe 2003, p. 42).

Changes in the Distribution of House Prices

Consider now two particular questions about the distribution[12] of house prices: (i) whether the distribution has shifted to the right (all homes become more expensive), and (ii) whether it has become more stretched-out – less "peaked" (expensive homes increased in value by a proportionately larger amount).

The first of these questions has already been answered by the simple descriptive statistics above – shifts in the mean price over time are likely to represent shifts in the distribution – the only other explanation is that values at the top end have become more extreme and have, as a result, pulled up the average. So the two questions are linked – if the distribution has become more extreme, then the mean price will have increased, and the allocation of housing wealth is likely to have become less equal. If, on the other hand, the distribution has retained its shape but simply shifted to the right over time, then all owners would have benefited by similar proportionate amounts. Under this scenario, the gap between the wealth of renters who have no housing wealth and those at the low end of the market for owner-occupancy is also likely to have increased.

Figure 8, panel (a), plots the estimated relative density curve for house prices in 1996 against the density curves for 2000 and 2006.[13] To control for the effect of proportionate scaling (i.e. even if all houses increase in value by the same amount, the distribution will appear to change shape), Figure 8 (b) rescales the prices in 2000 so that they have the same mean price as 1996 prices (i.e. all prices in 2000 are divided by $1 + \pi_{1996–2000}$, where $\pi_{1996–2000}$ = cumulative proportionate change in the mean house price between 1996 and 2000). Prices in 2006 are similarly rescaled by a constant factor (i.e. all prices in 2006 are divided by $1 + \pi_{1996–2006}$ where $\pi_{1996–2000}$ = cumulative proportionate change in the mean house price between 1996 and 2006). Interestingly, when the distribution is rescaled so that the mean of 2006 is to equal the 1996 mean (as in Figure 8(b)), the distribution has an almost identical shape to the 1996 distribution. The same is not true of the rescaled 2000 distribution, which is slightly more skewed than the 1996 distribution. So, in relation to questions (i) and (ii) above, it seems that: (i) the distribution of prices has shifted but the shift is almost entirely proportional – i.e. prices have risen by a similar % across the board. With respect to question (ii), there is no evidence from these distributions (which are based on very large samples: 0.8 million observations in 1996, 1.1 million observations in 2000, and 1.3 million observations in 2006) that the distribution has become more stretched-out, other than through a common proportionate increase – i.e. there is no evidence from these graphs that high price houses have increased in value at a faster rate than low house price houses.

Figure 8. **Changes in the House Price Distribution**

(a) House Prices without Rescaling (b) House Prices with Proportionate Rescaling

Results for BIP

BIP is the slope coefficient obtained from running an ordinary least squares regression of house price change on initial period house price levels. As noted earlier, the advantage of this approach,

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[12] By "distribution" we mean the number of dwellings with a given price. This is usually plotted as a histogram or density function, the latter being a more precise way of representing the spectrum of house prices for a given year.

[13] A density curve is a way of showing the distribution of a variable. It is similar to a histogram except that the vertical axis is standardised to ensure that the area under the distribution equals one. Also, the density curve is more precise than a histogram in the sense that it shows the shape of the distribution as a continuous line rather than as a series of discrete columns. We estimate the shape of the distribution using kernel density methods which are non-parametric and so do not assume a particular shape to the distribution (such as a *normal* distribution). See an introductory statistics text, such as Moore and McCabe (2003 pp. 66-68, 82-83, 310-312) for further explanation.

over say the inflation multiple methods considered below (*DRIP*), is that it uses the entire price distribution (rather than just the first and last decile). If the slope coefficient were to come out as zero, one would conclude that proportional capital gains in low house price areas in 1996 pretty much kept pace with the proportional capital gains in areas categorised as high house price localities in 1996. As such, other things being equal, housing wealth inequality would neither have increased nor decreased in proportionate terms. This scenario is represented by the horizontal line in Figure 9. Conversely, an upward sloping line relating price *change* and price *levels* would mean that *BIP* is positive, as in the line *BIP* > 0 in Figure 9. A slope coefficient greater than zero would imply that proportional capital gains in areas categorised as low house price areas in 1996 subsequently lagged behind the gains made in areas categorised as high house price localities. Housing wealth inequality would have increased.

Figure 9. **Schematic Diagram Depicting the Three Categories of *BIP* Values**

In the event, the estimate of the slope coefficient came out as negative (-2.1), which suggests that over the period 1996 to 2006 house price inflation was greater for those areas that started with low average house prices. The regression (based on 6,201 post code sectors with greater than 30 observations in both 1996 and 2006) revealed a high t-ratio on the price levels coefficient, ensuring that the 99% confidence interval did not span zero, which allows us to say that the slope estimate is significantly less than zero. However, the R^2 was only 5% suggesting that spatial variation in house price *levels* explained only a tiny proportion of the spatial variation in subsequent house price *change*. This suggests that variations across space in the rate of change in house prices is largely determined by factors other than whether those areas are, on average, low price areas or high price areas. Put another way, inequality in the rate of housing wealth accumulation is *not* adequately explained by inequality local price levels. This can be seen from the rather random scatter plot of inflation on price levels presented in Figure 10, along with the line of best fit modelled by the regression. These findings chime with those of Skaburskis and Moos (2008) who find that “shifts and cycles of investment across broad city sectors predicted by neoclassical and Marxist theory are overwhelmed by local factors” (p.905). They found that areas that gain value relative to other properties in one period tend to lose relative value the next, which negates the idea of ever increasing inequalities in housing wealth accumulation.

Figure 10. **Scatter Plot of BIP for the Period 1996 to 2006**

Note that house prices used in the regression were measured in £m. One can use the model (albeit tentatively, given its poor explanatory power) to calculate the cumulative inflation associated with an area with a particular average house price. Simply multiply the average price (measured in £m) by the slope coefficient (in this case -2.1) and add the intercept term (2.3). For example, if you purchased a house in an area where the average price in 1996 was £50,000, to work out how much the property would have risen in value by 2006, you would make the following calculation to arrive at a figure of **219%**:

% change since 1996 in a **£50k area** = $100 \times (2.3 - (2.1 \times £0.05m))$
$= 100 \times (2.3 - 0.104)$
$= 219.1\%$

On the other hand, if you purchased a house in an area where the average price in 1996 was £200,000, the property would have risen in value by a rather less impressive **188%**, a difference in growth rates of **31 percentage points**:

% change since 1996 in a **£200k area** $= 100 \times (2.3 - (2.1 \times £0.2m))$
$= 187.81\%$

Shifts Over Time in BIP

A marked difference in the slope coefficient for an alternative period, 1996/2004 (chosen arbitrarily), compared with that estimated from the 1996/2006 regression, led us to investigate how this slope coefficient had changed incrementally as the period for cumulative capital gains extends from one year (1996 to 1997) to two years (1996 to 1998) to three years (1996 to 1999) and so on. The results of repeating for each individual year the process of calculating average prices in each postcode sector in England and Wales, computing the cumulative percentage increase since 1996 in each sector, and running regression of this percentage increase on 1996 prices, are presented in the line graph shown in Figure 11. The vertical axis measures the value of the slope coefficient estimated for each year. The hump-like shape suggests that housing wealth accumulation inequality rose significantly in the late nineties, but peaked in 2001 and then fell in every successive year until 2005 where it bottomed out.

In other words, if you had bought a house in a low house price area in 1996, things were looking rather bleak by 2001, since although the cumulative proportionate increase in value in your property had been positive, it was a lot lower than the cumulative proportionate increase you would have received if you had purchased a property in a high house price area in 1996. However, if you had the courage to hold on to your property, by 2004 the cumulative proportionate increase would have caught up with that in high house price areas, and by 2006 would have significantly exceeded it.

Figure 11. ***BIP*** **for Successive Intervals**

Results for DRIP

Consider now the results for *DRIP*, the ratio of house price inflation in the tenth decile of base period (t=1) price *levels* to that of the first decile. Figure 12 plots these results using the Thomas and Dorling (2004)[14] building society data, combined with results from the last four years of the Land Registry data in an attempt to create a graph from 1981 through to 2006. The graph measures inequality in gross housing wealth accumulation. A value of one indicates that house price inflation in more expensive areas is no greater than house price inflation in low-price areas. A value greater than one, on the other hand, indicates that there is a greater rate of house price growth in more expensive areas. Conversely, a value less than one occurs when houses in low-price areas are rising in value at a faster rate.

It is clear from the graph that *DRFP* (Decile Ratio calculated using Final Period prices), the approach used by Thomas and Dorling (2004), significantly over-estimates the level of inequality in housing wealth accumulation during peak years. This overshoot arises because of the bias caused by using final period prices to compute the deciles. Is there an upward trend in the values of *DRIP* that exceed unity? It is not obvious that there is. There appear to be two clear peaks in *DRIP*: one in

[14] Note that Thomas and Dorling (2004) also attempt to control for outstanding mortgage debt by adjusting their measure to estimate the housing wealth of mortgage-free households. We argue that this approach is problematic – see Section 3 above. Nevertheless, our finding that housing wealth inequality is cyclical should remain fairly robust to whether or not one attempts to control for outstanding debt, particularly given the amplitude of the cycle. Thomas and Dorling find that "both absolute housing wealth and the change in housing wealth have been mainly driven by the increase in house prices and, not surprisingly, wealth has increased most where prices have risen the most" (p.20).

1987 (*DRIP* = 1.99) and one in 2000 (*DRIP* = 1.98). Note that it is not really possible to tell whether the troughs have risen because the current trough (2006) is estimated using a different dataset.

Figure 12. **Combining Thomas & Dorling and Land Registry Data**

Results for SG and SA: Spatial Gini and Atkinson Coefficients

How do standard inequality measures (Gini and Atkinson coefficients) applied to the postcode averages compare with our *BIP* and *DRIP* results? One can see from Figure 13 that the spatial inequality measures point to house prices being slightly less unequal in 2006 than a decade ago, and suggest a peak in inequality in the year 2000. *SG* and *SA* were also computed for the Thomas and Dorling (2004) data (Figure 14) allowing us to consider a longer timeframe, one that includes both pronounced slumps and pronounced booms (see Appendix). The results confirmed the cyclical nature of housing wealth inequality, but unlike the other measures, there appears to be a possible hint of an upward trend in inequality, albeit one that is dominated by the amplitude of the cycles.

Figure 13. ***SG* and *SA* Applied to Land Registry Selling Price (Area Averages)**

Figure 14. ***SG* and *SA* Applied to T&D Data**

7. Discussion and Conclusion

Our results are summarised as follows:

- Inequality of gross housing wealth accumulation appears to have fallen in recent years (2000-2006).
- This seems to be part of a regular cycle in housing wealth accumulation inequality – house prices in expensive areas pull away for a while, only for prices in less expensive areas to catch up.
- There is no unambiguous evidence of an upward trend in this cycle. For some measures (DRIP), the latest peak in housing wealth inequality accumulation (around 2000) was actually slightly lower than the peak thirteen years earlier, whereas other measures (SG and SA) suggest the opposite.
- The shift in the price distribution is likely to have widened the gulf between the housing wealth of renters (zero) and the housing wealth of owners.

That inequality in housing wealth accumulation is cyclical is perhaps not surprising. Theories of economic convergence would predict that lower priced areas will experience more rapid price growth in relative terms and, at the regional level, at least, there is substantial evidence of spatial lags, ripple effects and convergence (albeit of a rather uneven nature) in house price adjustment (Meen, 1999; Cook 2003, 2009; Holmes and Grimes, 2008). As prices become prohibitively high in one area, increasing numbers of house-buyers consider adjacent, less-expensive areas. Note, though, that our data are sub-regional and that we do not find a downward trend in inequality (which true convergence would produce), but *cycles* in inequality. It is puzzling why the cycles are so pronounced and why the duration of the cycle is so great – why does the catch-up process take a decade to complete? Does it matter? Certainly, if housing wealth accumulation inequality growth is cyclical rather than secular the implications for class reproduction and wealth polarisation are far more ambiguous than previously suggested. Our results (and those of Skaburskis and Moos (2008)) do much to allay the fears raised by Thomas and Dorling (2004) about inexorable polarisation of housing wealth between expensive and inexpensive areas. However, we do not observe unambiguous evidence of convergence. The reality appears to be more complicated and transitory than either theory would suggest.

Much has changed at a fundamental level in the housing market over the period under consideration, and future trajectories of housing wealth inequality may not correspond to historical patterns. For example, there are reasons to expect high-density entry-level housing to face more acute downward pressures on price in the medium term due to the severity of the current downturn (Pryce and Sprigings 2009). A possible implication is that the recent fall in housing wealth inequality is actually illusory – a symptom of over-priced housing at the low-end of the market. Buy-to-Let mortgage products have led to large numbers of purchases by landlords in areas where demand is otherwise limited may have given an inflated picture of house price growth in poor areas. Moreover, the impact of high-density new-build (much of it poor quality – see "*The CABE Report*", Harvey *et al.* 2007)[15] will have implications beyond the current cycle. Such developments may have affected the structure of the housing market at the local level and may have a permanent affect on the trajectory of prices in those areas.

There may also be a negative ratchet effects for low income owners (Pryce and Sprigings 2009) that make the returns to homeownership uneven, even if relative housing wealth gains are accrued evenly across all house types and locations. The ability of owners to hold on to and exploit those gains may not be equal if the ability of borrowers to exit and enter the housing market at the most opportune phases of the cycle is not equal. Boehm and Schlottmann (2004), for example, find that lower income and minority households are more likely to slip out of homeownership back into renting. The timing of this process is crucial and, in principle at least, we might expect such households to leave owner occupancy at the worst time: when house prices (and employment opportunities) are falling. Moreover, there may be tipping points in the rates of neighbourhood decline and recovery that make it very difficult for the poorest areas to experience persistent equity gains (Meen 2009).

Perhaps the most important aspect of our findings, however, is not the trend (or lack of it) in housing wealth inequality, nor its cyclical nature, but the enormous *amplitude* of the cycle. How concerned should we be about the massive variation in relative wealth due to the swings and arrows of market fortunes? Housing has become such an important asset that changes in the distribution of house prices can have profound effects on the distribution of overall household wealth. In section 1 we raised the issue of volatility of wealth as a cause for concern. Large swings in housing equity may be as important as equality of wealth because of its deleterious consequences for consumption and worker incentives (Henley; 2004), particularly if such volatility is the result of arbitrary market processes rather than deliberate decisions on the part of the electorate regarding the distribution of wealth in society. It may also have important consequences (both positive and negative) for the availability of credit for business startups – with significant wider economic implications (Cressy 1996) it is a topic worthy of further research.

What should the policy response be? A prerequisite for answering this question is a clear understanding of what causes the cyclical variation in housing wealth inequality to have such amplitude. Is it a function of market failure, such as information failures causing bottlenecks in the

[15] "Fewer than one in five developments we audited could be classed as good or very good. The quality of a substantial minority of developments is so low that they simply should not have been given planning consent" (Harvey et al 2007, p.4).

arbitrage process? Does supply unresponsiveness and the non-neutrality of housing taxation catalyze the cyclical process, or does the phenomenon arise largely from the interface between housing and labour markets? These are deep and complex questions, beyond the scope of this paper.

Perhaps the clearest implication for policy at this point is that the case for radical intervention in the residential property sector to prevent inexorable escalation of housing wealth inequality (as suggested in Thomas and Dorling, 2004) is fundamentally undermined by our findings. There is no long-term, unambiguous upward trend in housing wealth inequality and government should hold fire until a clearer picture emerges. A second implication is that the relative position of renters has almost certainly deteriorated (assuming rents have not fallen). The entire distribution of house prices has shifted to the right: home-owners in both low-priced and high-priced areas have benefited from significant housing wealth gains. The gulf in housing wealth between renting and owning will most probably have widened in most areas. There will be a cyclical component to this divide – during slumps, housing wealth for some owners will actually be negative – but also a strong upward trend as the proportionate secular shifts in the entire distribution dominate the temporary swings of cyclical variation. More work is needed to verify these anticipated effects and to gauge housing wealth inequality across all tenures (not just owner occupancy).

Our work has identified a number of areas of further research:

- There is a need to understand what *causes* cycles of such amplitude in housing wealth inequality, and its implications for economic efficiency and social well-being.[16] Further research into both these questions should be a prerequisite to policy response.
- There is a need to investigate whether the methods used here in the context of homeownership can be applied across all tenures as a means of incorporating the inequality effect of the widening gap between owners and renters.
- This paper has included only a rudimentary analysis of regional differences in mortgage interest rates (and found little spatial variation), but there may be a case for exploring whether there is spatial variation of interest rates *within* regions as this could affect the inequality of *net* housing wealth.
- Spatial variation in house price *levels* were found to explain only a tiny proportion (5%) of the spatial variation in subsequent house price *change*. This suggests that variations across space in the rate of change in house prices is largely determined by factors other than whether those areas are, at the start of the period, low price areas or high price areas. Further research is needed into what determines the remaining 95% of the variation in local house price inflation.

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[16] Note that we have not attempted to model the determinants of house price movements which are determined by a complex set of interconnected processes that affect demand and supply. There have been many policy and economic changes in the UK over the period of our data including cycles in consumer and housing demand (Goodhart & Hoffman 2008), deregulation of the mortgage market (Stephens 2007) and removal of mortgage interest deduction (Hendershott and Pryce 2006). We have not endeavoured to estimate the impact of individual drivers, merely measure the net outcome of the entire process for the dynamics of spatial inequality in UK housing wealth.

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Appendix

Table A1 **Descriptive Statistics on Individual House Prices for the Land Registry Dataset of Dwelling Transactions in England and Wales**

Table A2 **Descriptive Statistics for Area Average House Prices using Thomas and Dorling Data**

Although our geocoded data on individual Land Registry transactions stops in 2006, and therefore do not include properties sold in the recent downturn, the period covered by the data from Thomas and Dorling (which we also use in our analysis), does include years with annual price falls comparable to those that have occurred since 2008 in England and Wales. This can be seen from the comparison of Figures A1 and A2 below – note the price fall between 1992 and 1993 (12%) recorded in the Thomas and Dorling data was comparable to the price fall between 2008 and 2009 (11%) recorded in the most recent Land Registry data. As such, we have no reason to believe that the most recent downturn will significantly affect our most important result: that housing wealth inequality appears to move in cycles, with no evidence of either an upward or downward trend.

Figure A1 **Annual House Price Inflation in England and Wales**
(1996 to 2009 Land Registry Sales, smoothed)

Figure A2 **Annual House Price Inflation in Great Britain**
(1980-2003, Thomas & Dorling Data, smoothed)

Table 1. **Hypothetical Example of Final Period Bias**

Area		$P_{t=1}$		$P_{t=2}$	Inflation
a	£	50,000	£	150,000	200%
b	£	60,000	£	60,000	0%
c	£	70,000	£	70,000	0%
d	£	80,000	£	80,000	0%
e	£	90,000	£	90,000	0%
f	£	100,000	£	100,000	0%
g	£	110,000	£	110,000	0%
h	£	120,000	£	120,000	0%
i	£	130,000	£	130,000	0%
j	£	140,000	£	140,000	0%

Table A1 **Descriptive Statistics on Individual House Prices for the Land Registry Dataset of Dwelling Transactions in England and Wales**

	Average Sale Price £	Standard Deviation £	Number of Observations
1996	£ 67,916	£ 62,072	776,520
1997	£ 75,618	£ 87,982	908,529
1998	£ 85,085	£ 334,605	987,997
1999	£ 95,362	£ 128,077	1,143,387
2000	£ 107,284	£ 122,539	1,091,967
2001	£ 118,559	£ 129,827	1,142,549
2002	£ 138,113	£ 135,446	1,275,722
2003	£ 156,105	£ 134,600	1,179,684
2004	£ 178,818	£ 144,249	1,216,280
2005	£ 190,103	£ 155,430	1,013,244
2006	£ 204,269	£ 175,017	1,281,746
Total			12,017,625

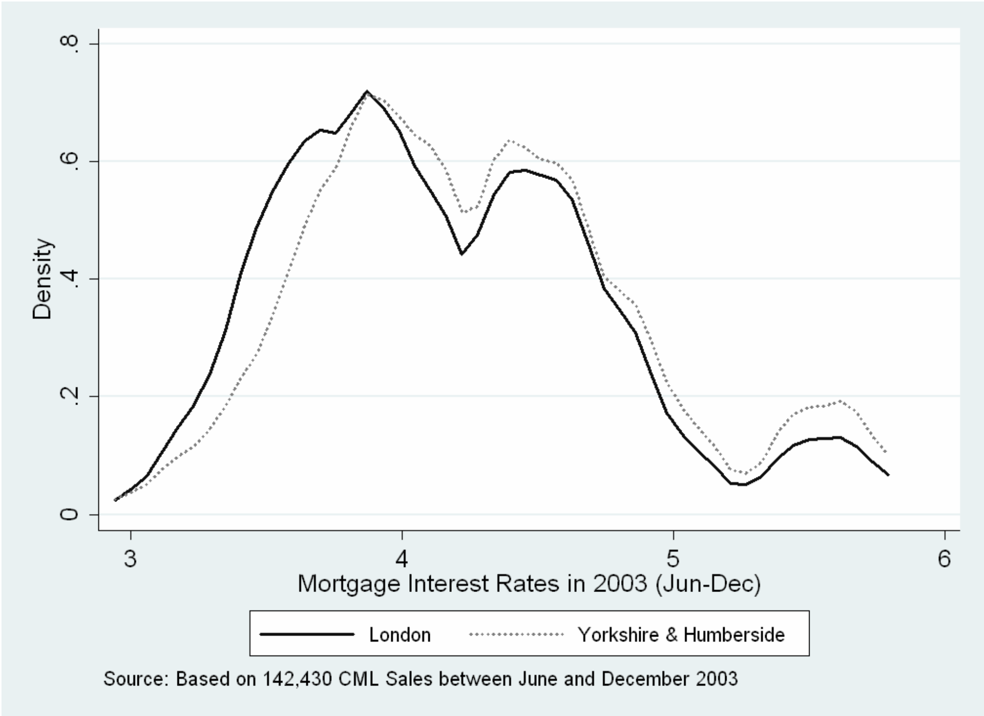
Source: Geocoded Land Registry data on individual transactions provided by the Department of Communites and Local Government as part of the project: Measuring Changes in Housing Wealth (see Levin and Pryce 2008).

Table A2 **Descriptive Statistics for Area Average House Prices using Thomas and Dorling Data**

	Average Sale Price £ Across Census Tracts	Standard Deviation £ Across Census Tracts	Number of Census Tract Averages in each year
1980	£ 22,844	£ 7,243	1282
1981	£ 23,358	£ 7,178	1282
1982	£ 24,307	£ 7,646	1282
1983	£ 26,729	£ 9,065	1282
1984	£ 30,349	£ 10,856	1282
1985	£ 33,492	£ 13,097	1282
1986	£ 37,030	£ 15,890	1282
1987	£ 45,695	£ 22,724	1282
1988	£ 55,406	£ 27,575	1282
1989	£ 66,101	£ 29,508	1282
1990	£ 69,630	£ 27,020	1282
1991	£ 66,842	£ 22,724	1282
1992	£ 63,646	£ 19,711	1282
1993	£ 55,658	£ 10,779	1282
1994	£ 55,428	£ 10,809	1282
1995	£ 65,429	£ 27,572	1282
1996	£ 66,733	£ 29,527	1282
1997	£ 75,509	£ 37,632	1138
1998	£ 85,044	£ 46,246	1138
1999	£ 93,876	£ 53,165	1138
2000	£ 110,322	£ 68,395	1138
2001	£ 122,456	£ 74,081	1138
2002	£ 136,427	£ 81,877	1282
2003	£ 159,797	£ 86,516	1282

Source: Thomas and Dorling (2004, 2007) Great Britain Census Tract Averages based on mortgage lending data.

Figure 15. **Differences in Mortgage Interest Rates in 2003 between London and Yorkshire & Humberside**



Note: “Yorkshire and Humberside” is a single region.

Figure 16. **Hypothetical Scatter Plot: The Case of Growing Inequality**

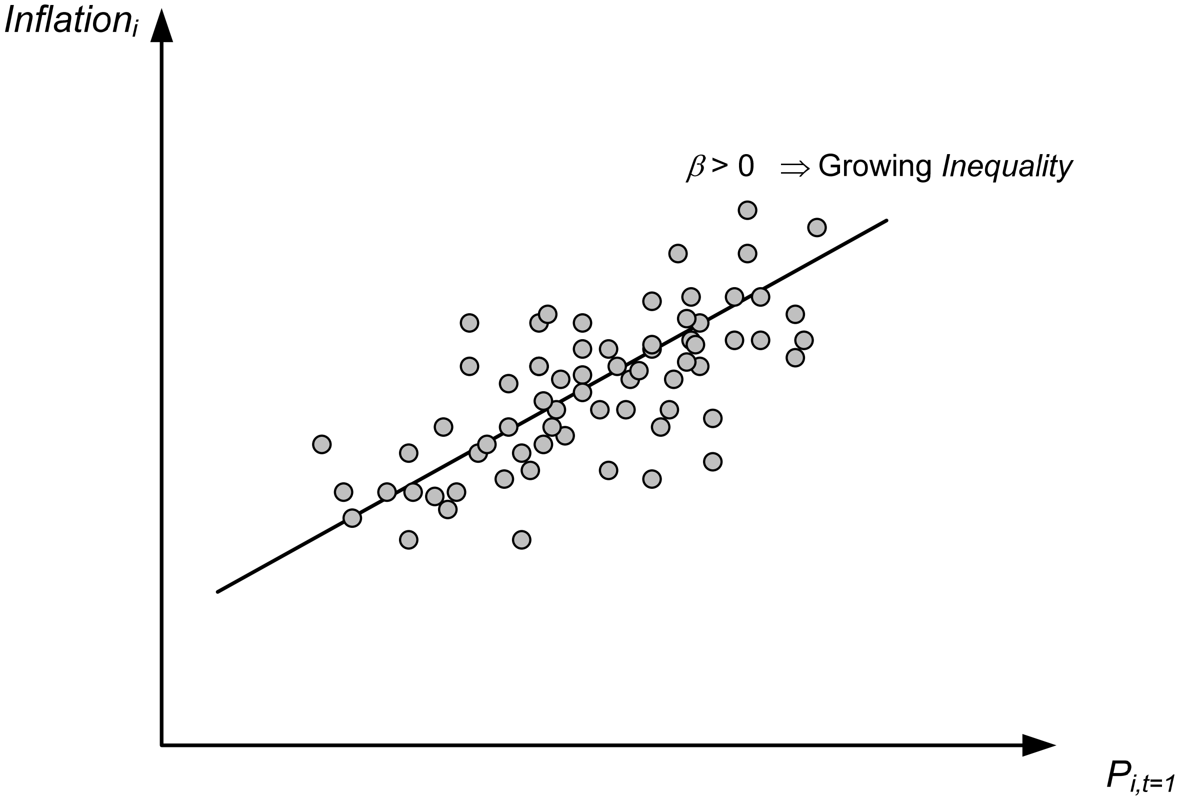


Figure 17. **Tautological Nature of Final Period Spatial Inequality Measures**

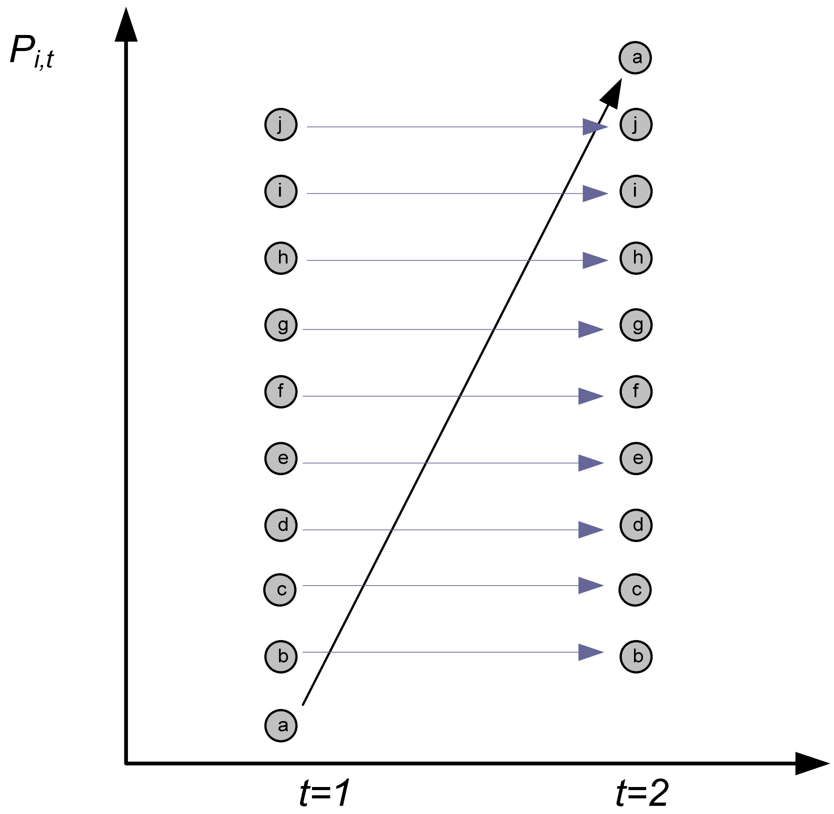


Figure 18. **Monte Carlo Simulation Results: The Case of Zero Mean House Price Inflation Scatter Plot of *Final* Period (*t*=*T*) Slope Coefficients on the Coefficient of Variation**

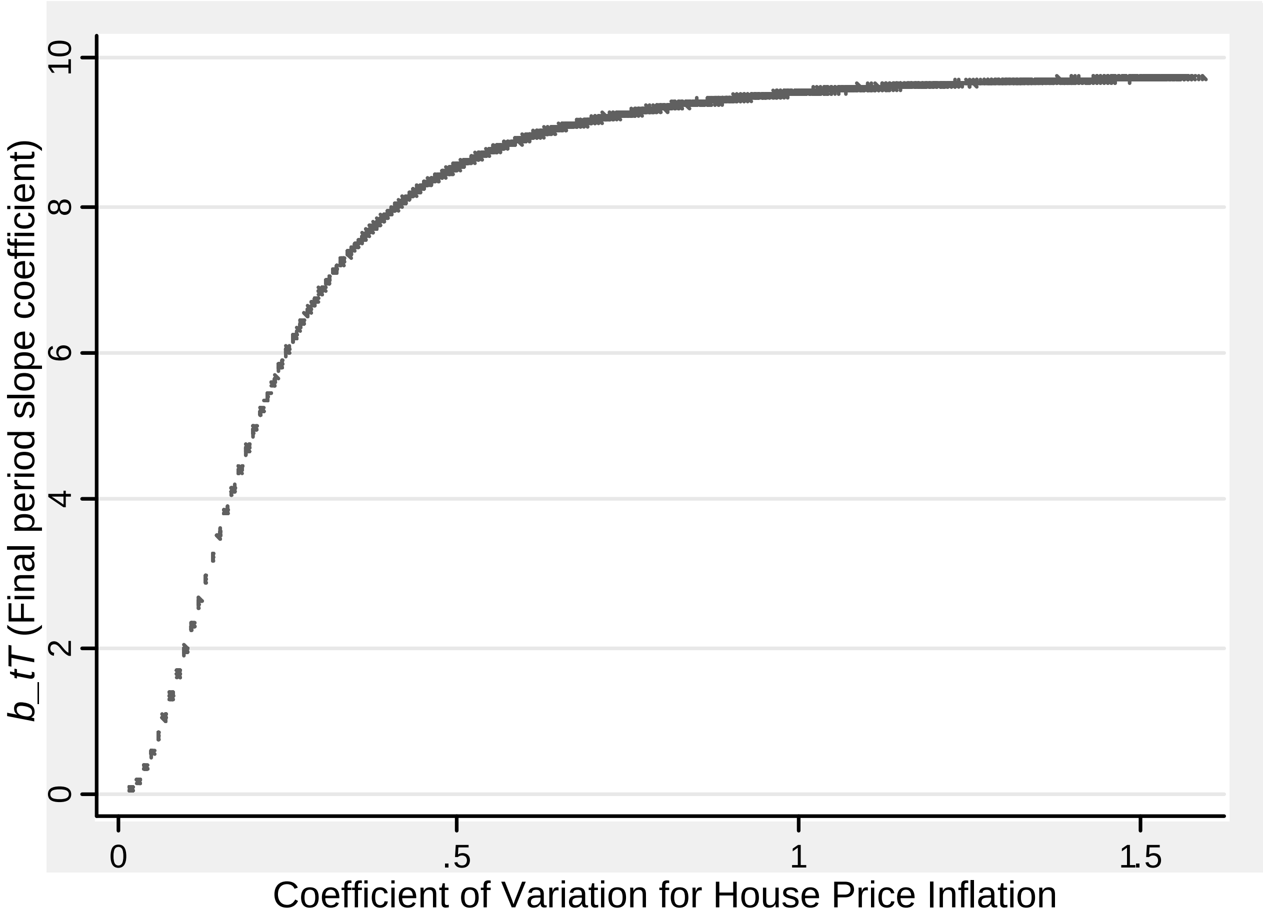


Figure 19. **Scatter Plot of Initial Period (*t* = 1) Slope Coefficients on the Coefficient of Variation of Inflation**

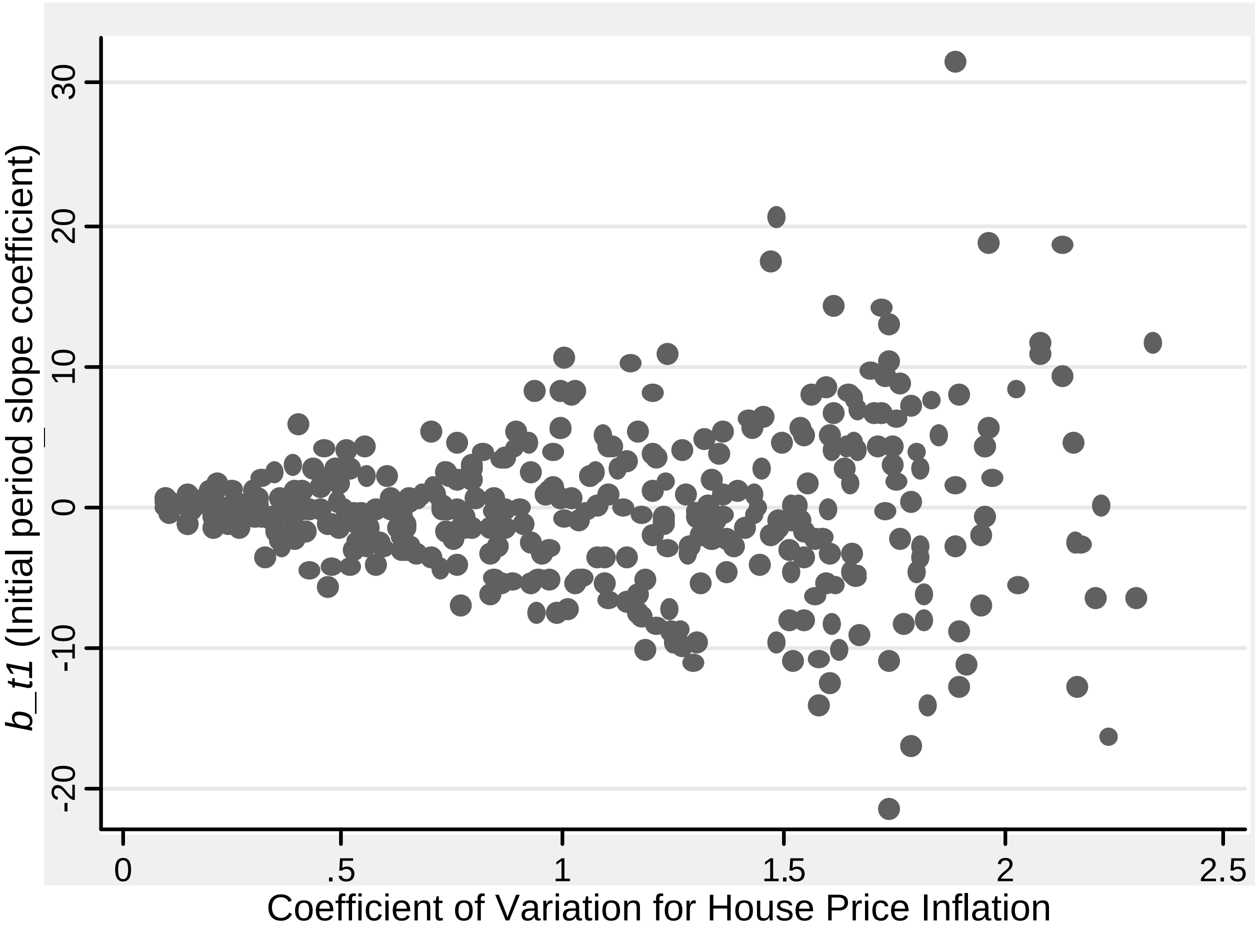
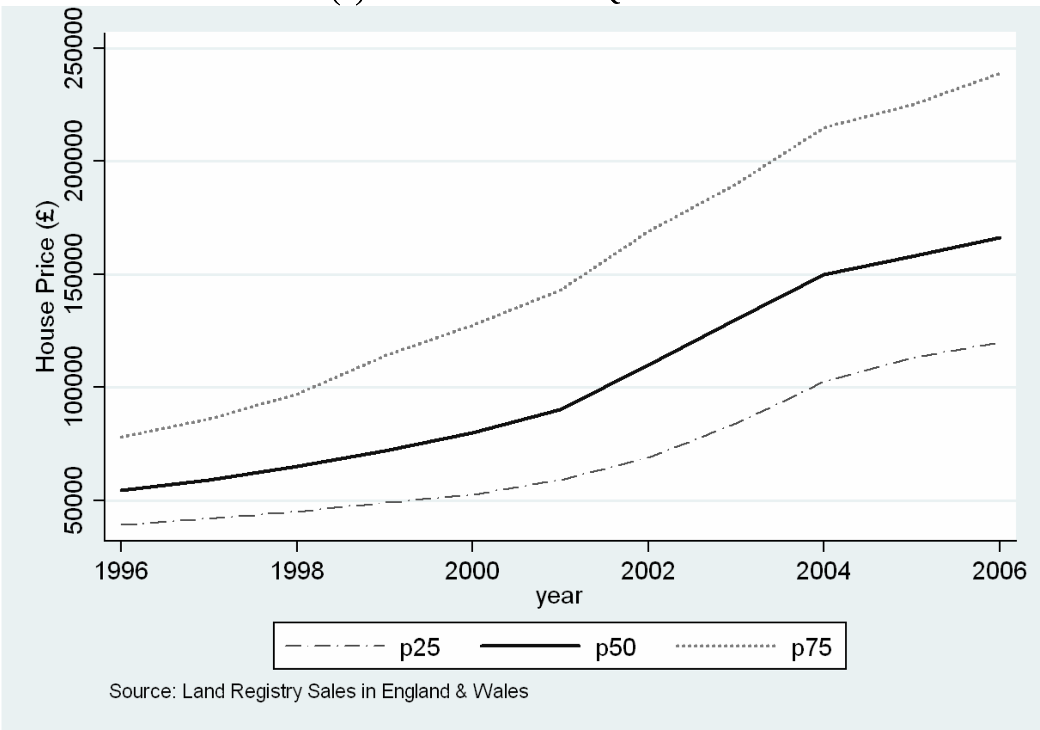


Figure 20. **House Price Trends in England and Wales**

(a) First and Second Quartiles



(b) Tenth and Ninetieth Centiles

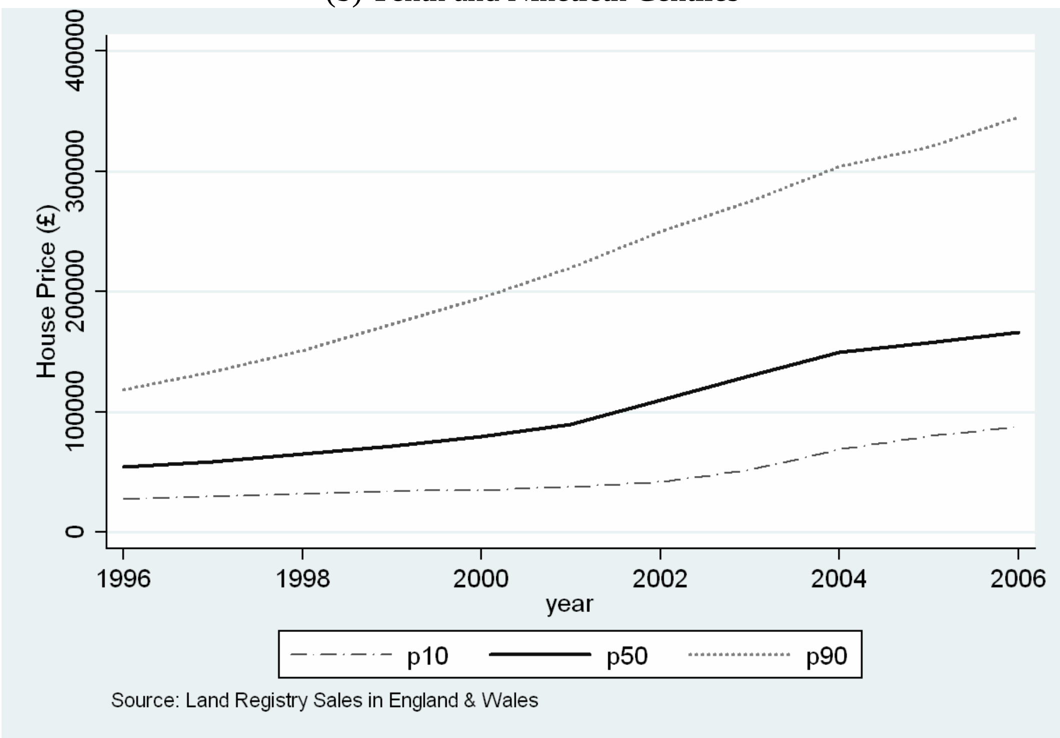
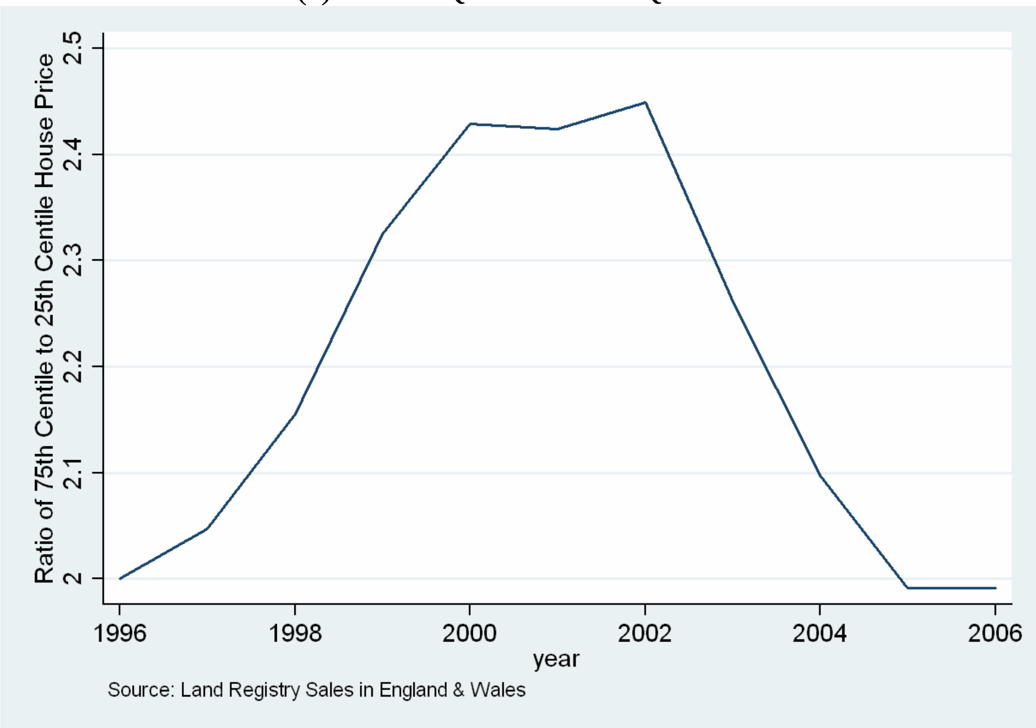


Figure 21. **Ratio of Upper to Lower House Centiles**

(a) Second Quartile : First Quartile



(b) Ninetieth Centile : Tenth Centile

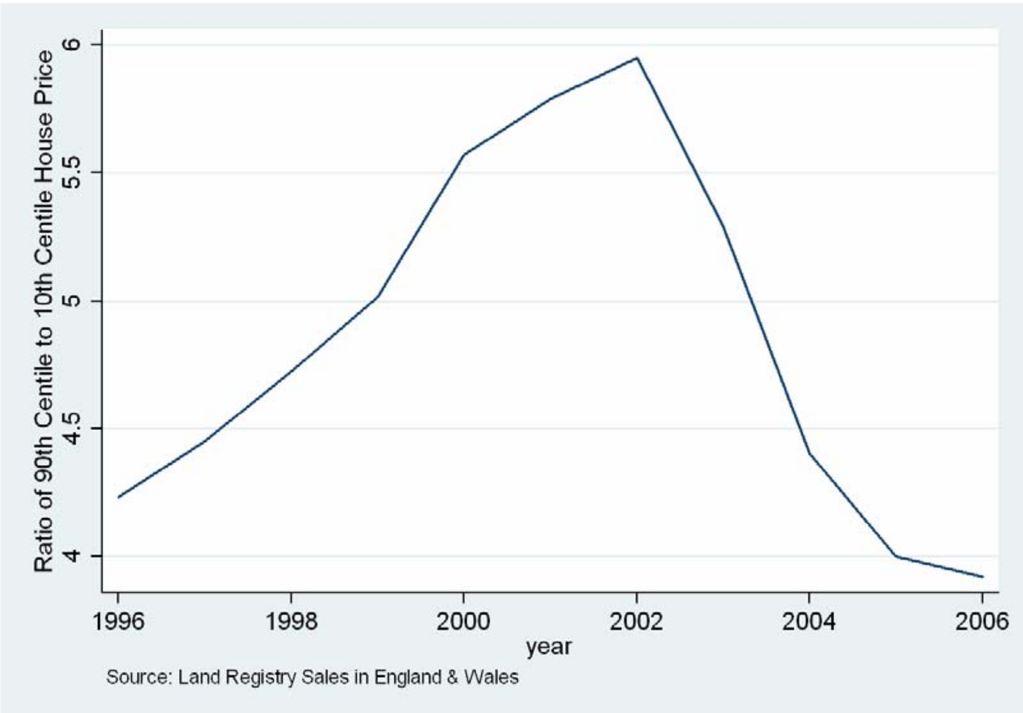
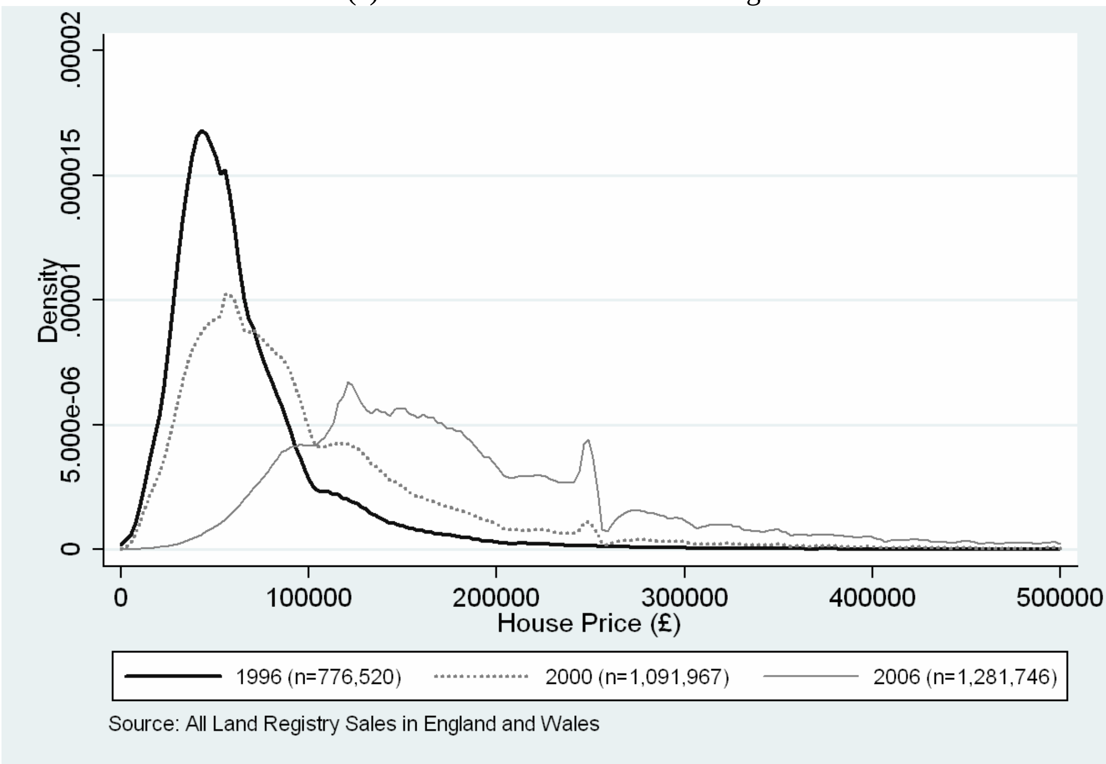


Figure 22. **Changes in the House Price Distribution**

(a) House Prices without Rescaling



(b) House Prices with Proportionate Rescaling

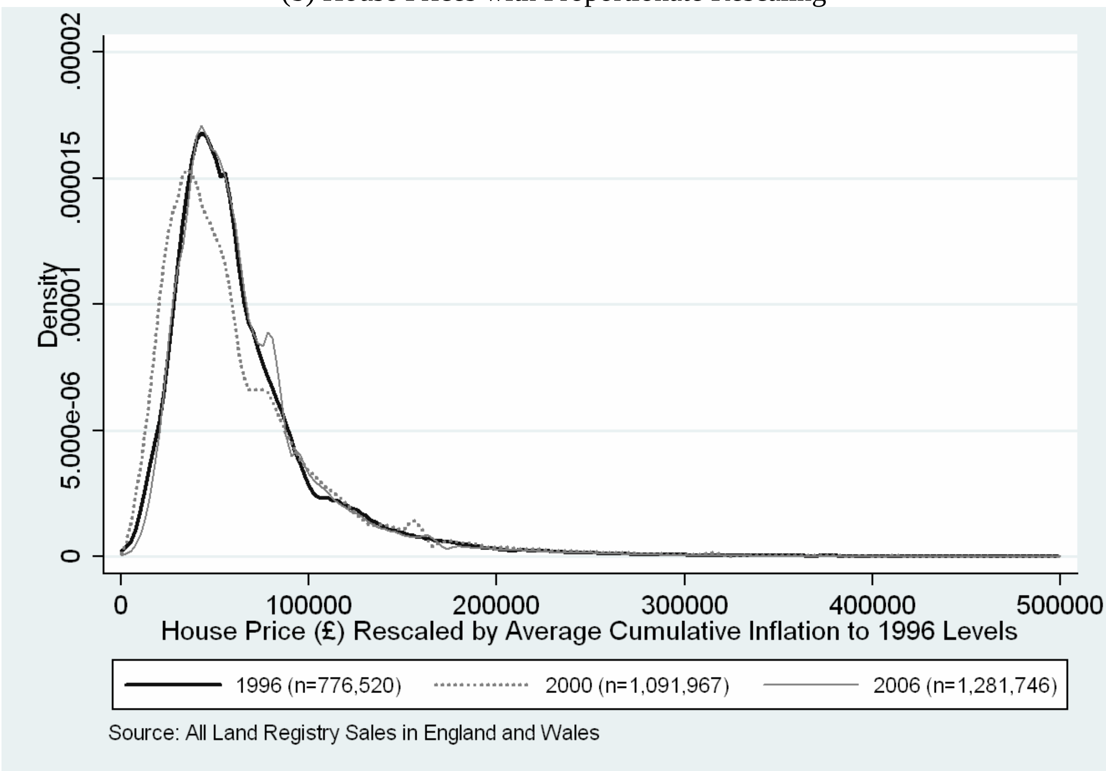


Figure 23. **Schematic Diagram Depicting the Three Categories of *BIP* Values**

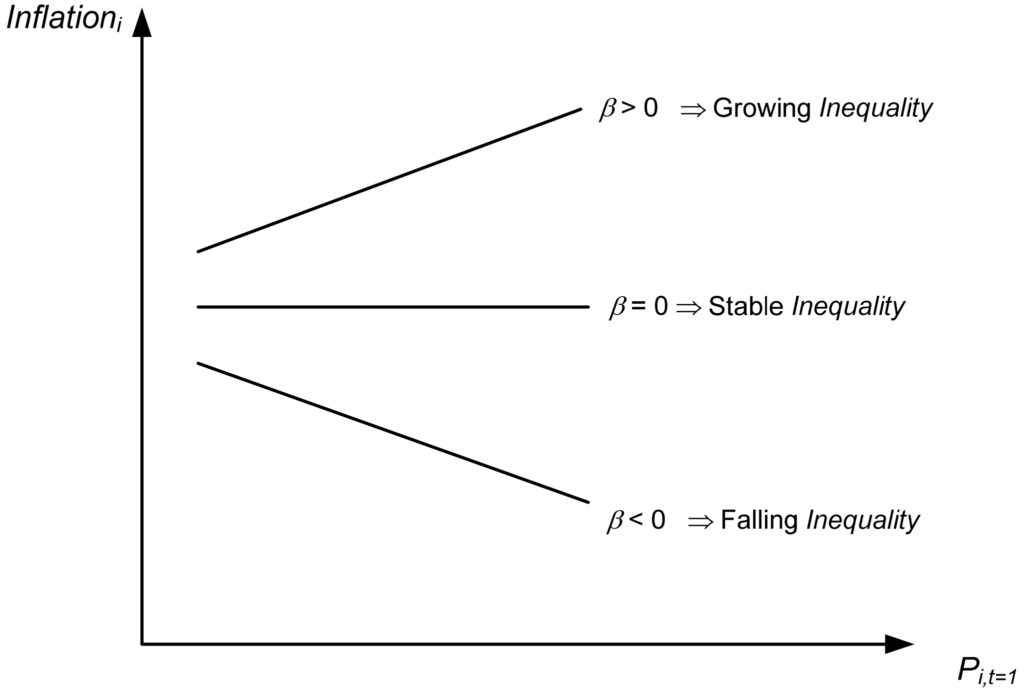


Figure 24. **Scatter Plot of *BIP* for the Period 1996 to 2006**

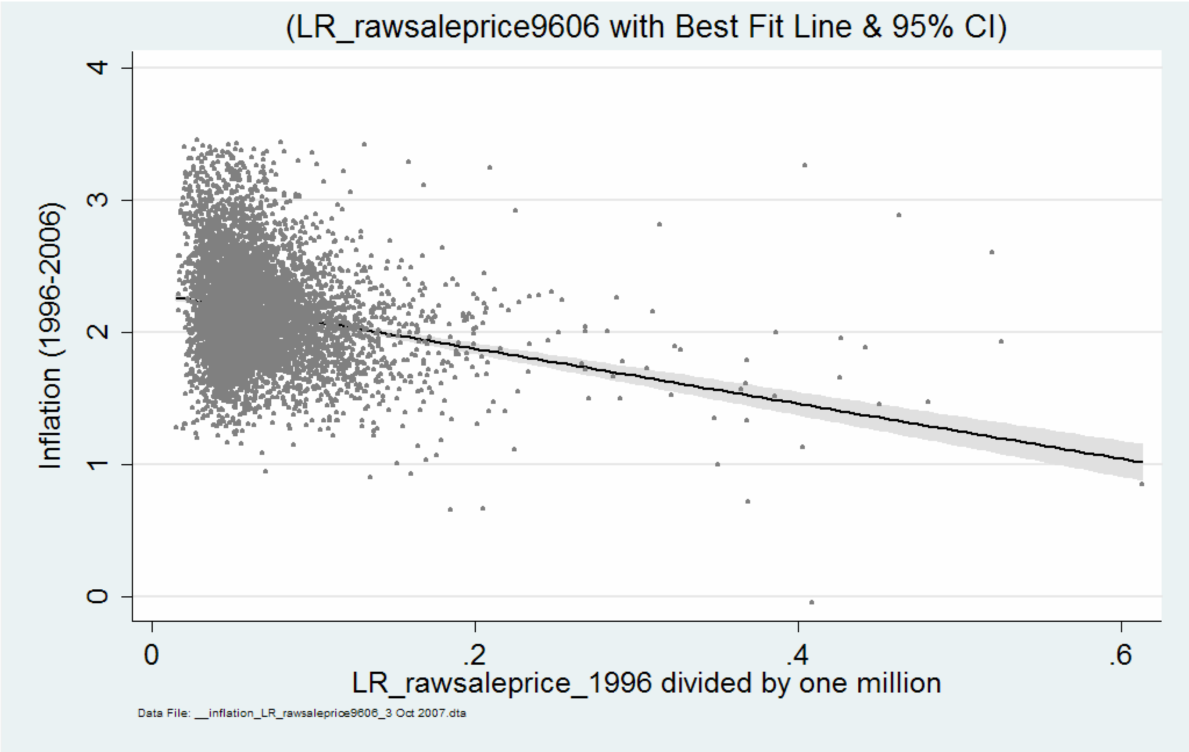


Figure 25. ***BIP* for Successive Intervals**

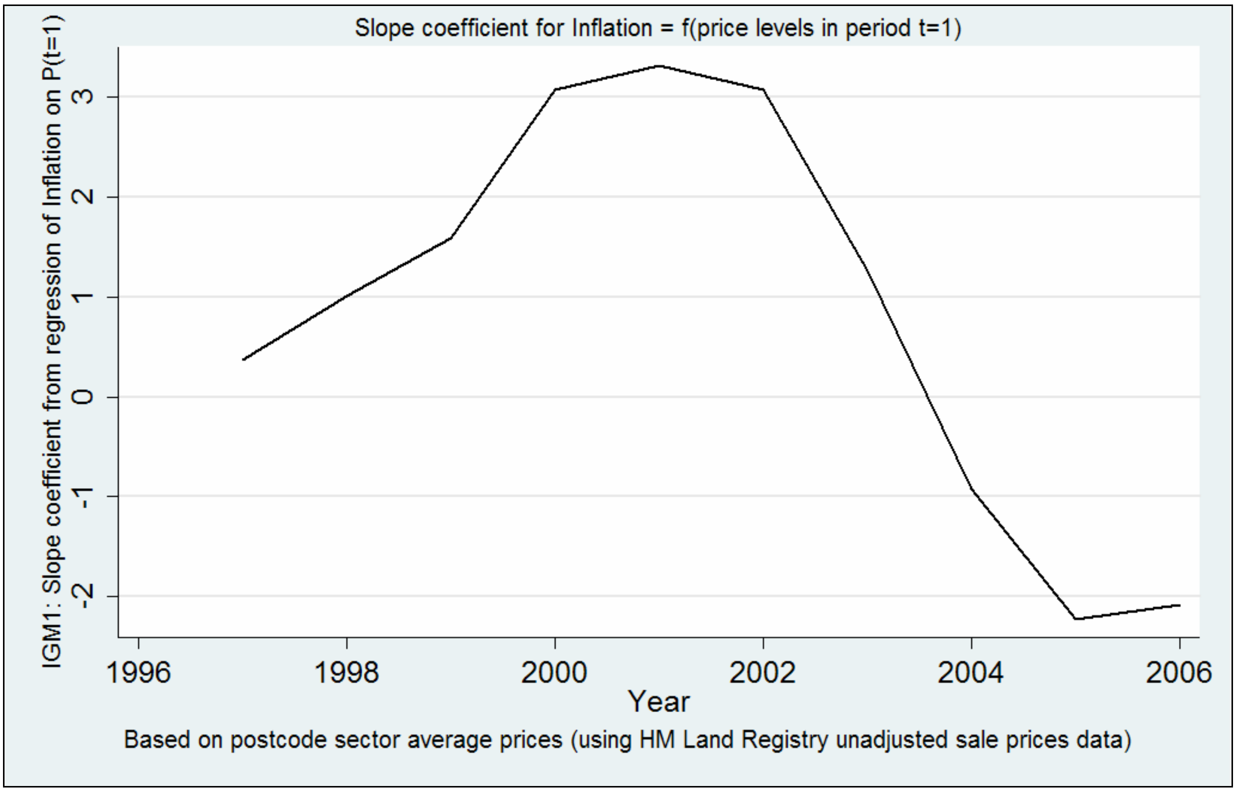
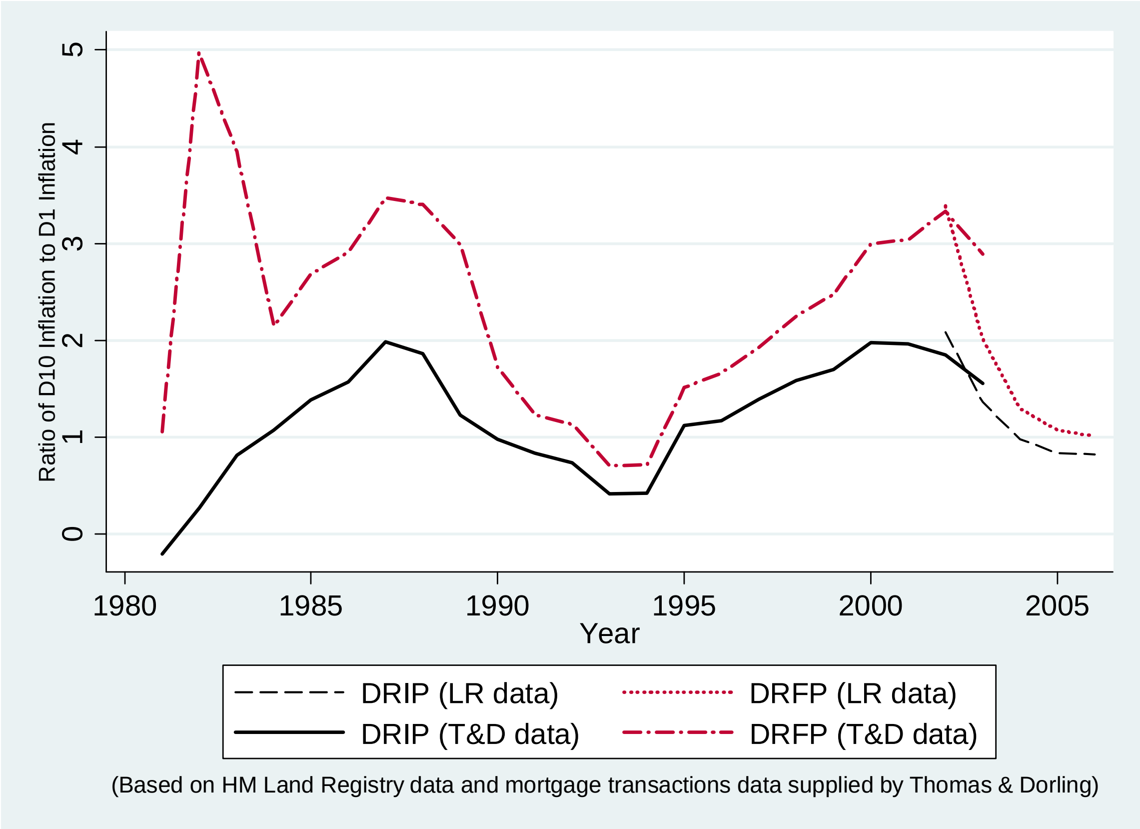


Figure 26. **Combining Thomas & Dorling and Land Registry Data**



DRIP = Decile ratios calculated assuming *initial* period (t = 1) categorisation of price levels;
DRFP = Decile ratios calculated assuming *final* period (t = T) categorisation of price levels.

Figure 27. ***SG* and *SA* Applied to Land Registry Selling Price (Area Averages)**

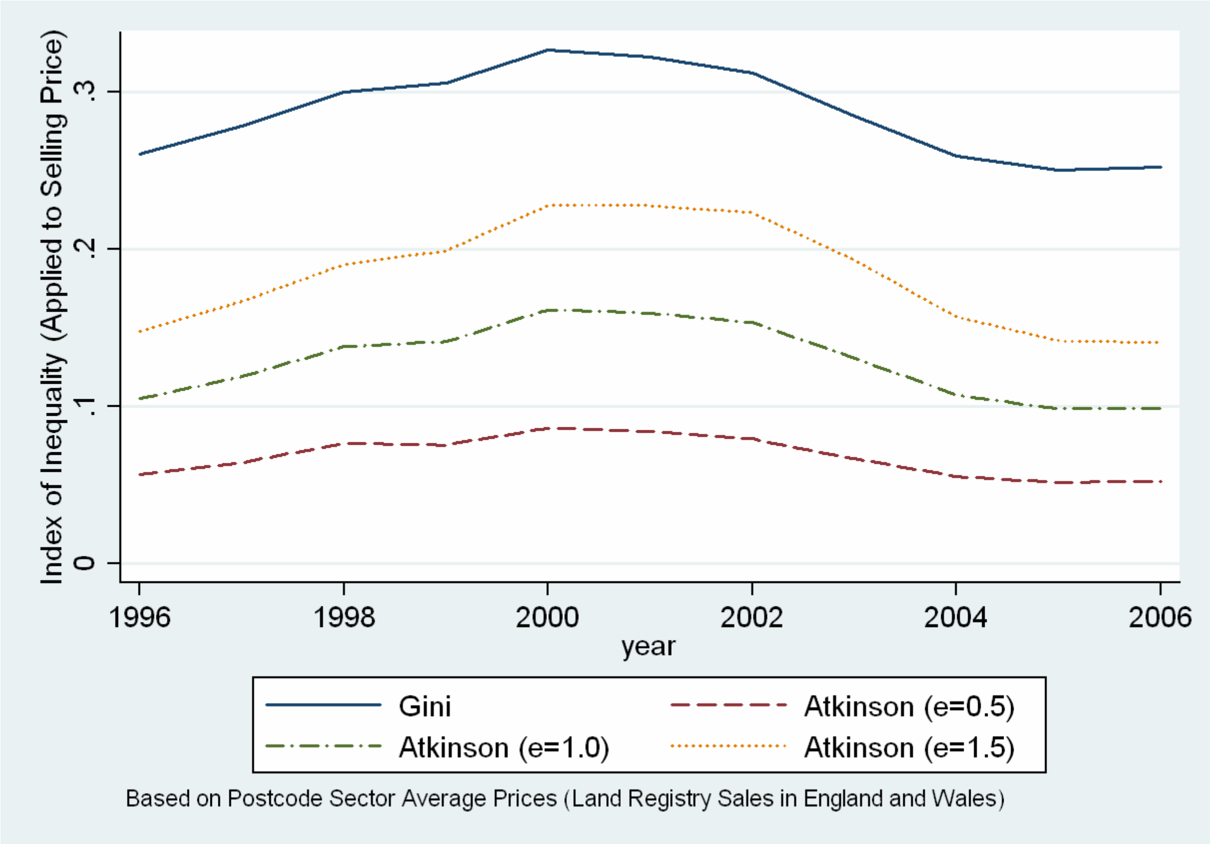


Figure 28. ***SG* and *SA* Applied to T&D Data**

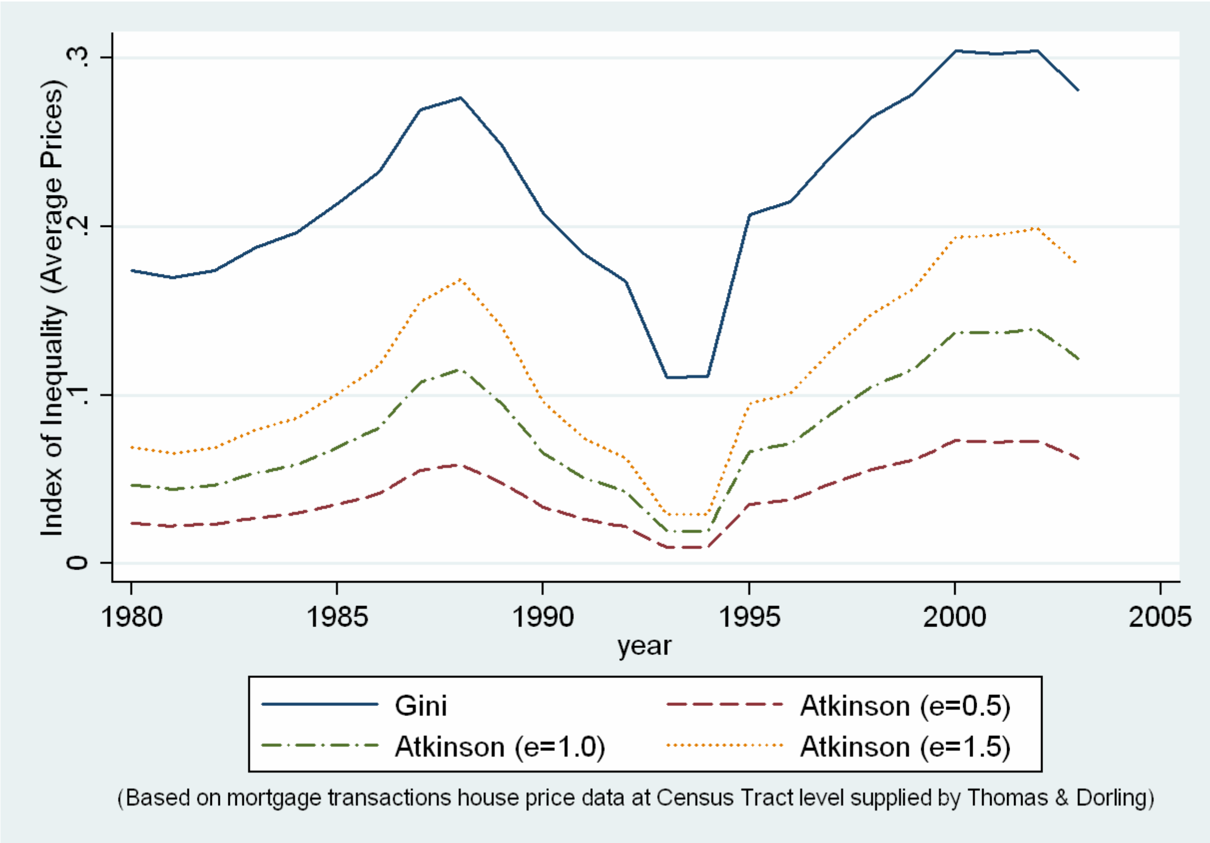
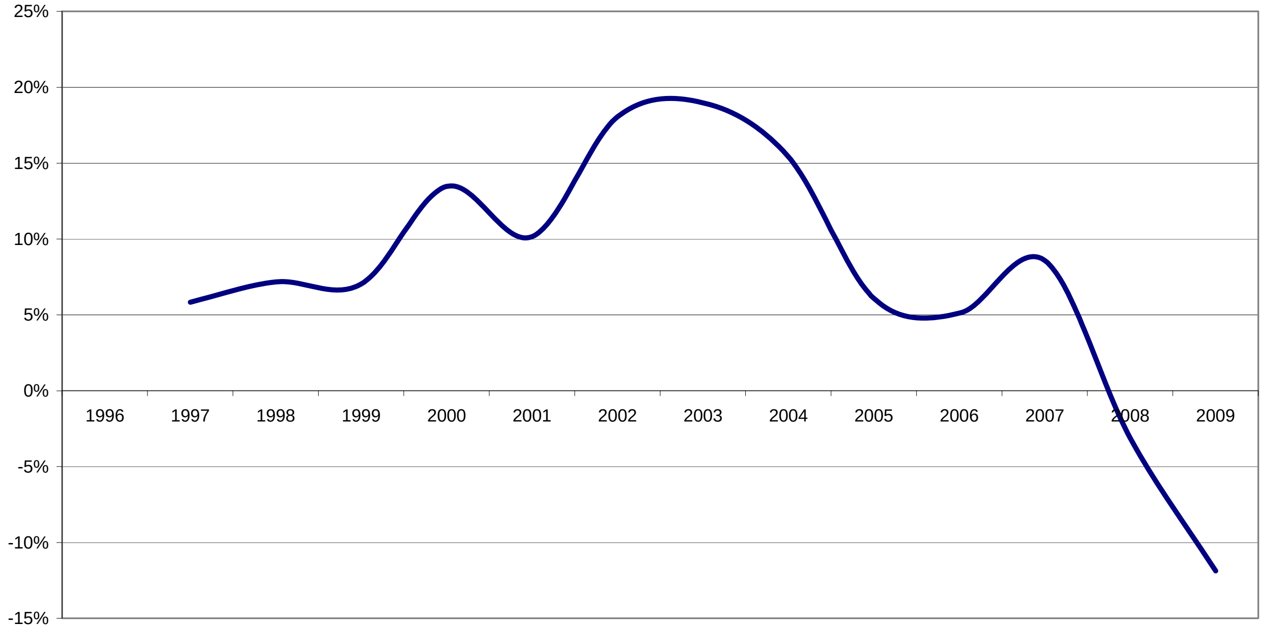
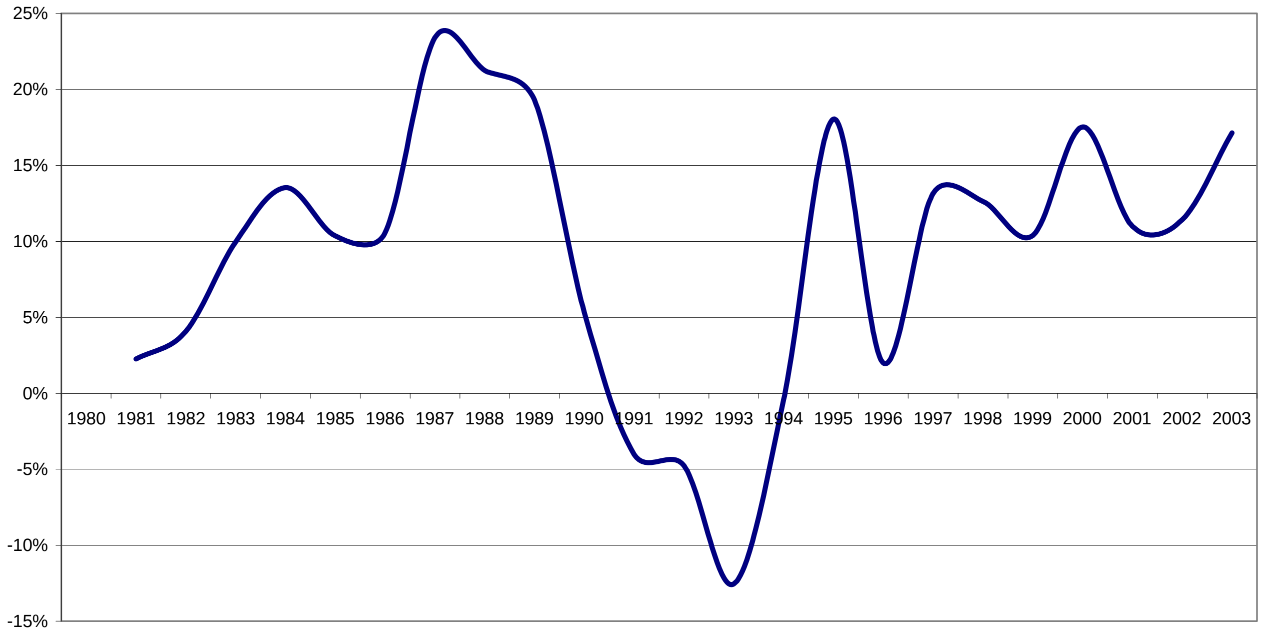


Figure A1 **Annual House Price Inflation in England and Wales**
(1996 to 2009 Land Registry Sales, smoothed)



Source: Land Registry website: www.landregistry.gov.uk
Note: data for 2009 were based on sales from January to June 2009

Figure A2 **Annual House Price Inflation in Great Britain**
(1980-2003, Thomas & Dorling Data, smoothed)



Source: Thomas and Dorling (2004) Census Tract Averages based on mortgage lending data.