ISSN 1471-0498

DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

HOUSING MARKET DYNAMICS AND REGIONAL MIGRATION IN BRITAIN

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Number 275

August 2006

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Housing Market Dynamics and Regional Migration in Britain*

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Revised: 22 August 2006

Abstract:

Economic conditions exert a strong influence on regional migration. On the one hand, strong labour market conditions, as exemplified by low unemployment rates and high earnings, draw migrants into regions. On the other hand, strong housing market conditions can prevent movement since expensive housing can deter migrants and commuting may often be an alternative. This can be thought of as giving rise to a migration equilibrium, where high house prices choke off migration caused by strong labour market conditions. Expected capital gains in housing and expected earnings growth however, can offset high levels of house prices, effects ignored in previous literature. Migration can also be influenced more directly by the availability of housing relative to population without this being mediated through prices. This paper presents evidence from a 28 year panel on net and gross migration for the regions of Britain that is broadly in accord with these expectations.

Keywords: Regional migration, house prices, expected capital gains, contiguity, Great Britain, regional panel.

JEL Codes: C33, J19, R3.

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* This paper builds on a wider project funded by the Office of the Deputy Prime Minister (ODPM), now Department for Communities and Local Government on 'Affordability Targets: Implications for Housing Supply' (*www.dclg.gov.uk*). We would like to thank Paul Chamberlain, David Hendry, Michael Kell, Geoff Meen, and participants at seminars in Oxford, Reading and the 2006 Royal Economic Society Annual Conference at Nottingham for helpful comments. All errors and omissions remain our own.

1. Introduction

Migration between regions plays a central role in the workings of regional housing and labour markets. As such, it has often been said that the relatively low level of labour mobility in the UK is intimately connected with the poor performance of some regional labour markets and the relatively unusual structure of housing tenure in the UK, with its small private rental sector and declining social rented sector (see Hughes and McCormick (1987, 2000), and McCormick (1997) inter alia). The high degree of persistence in regional unemployment rates compared with the US is perhaps one symptom of this inefficiency (Cameron and Muellbauer (2001), Elhorst (2003)).

Bover et al. (1989) and Muellbauer and Murphy (1991) suggested a number of ways that a large owner-occupied sector could exacerbate regional mismatch over and above the fact that owners face higher transactions costs in moving. A body of econometric evidence has now built up to suggest that high relative earnings and employment opportunities encourage migration to a region, while high relative house prices discourage it. The most obvious mechanism for this negative effect of house prices on migration arises through cost of living differentials between regions. If earnings are not deflated by a regional cost of living index which appropriately incorporates housing costs, relative house prices will, in part, measure this omitted cost of living effect. However, there are likely to be further effects connected with constraints on credit availability and the risks associated with a high level of indebtedness both relative to income and to housing equity.

Standard household choice models with an intertemporal dimension emphasise the relevance of expected earnings growth and expected returns in housing (or user cost). Given the importance of the latter, demonstrated in the literature on the determination of house prices, the demand for living space by employees can be crowded out by higher portfolio demand. In this paper we show that the expected relative appreciation of house prices and of relative earnings growth has an important effect on migration. This helps explain the peak of net out-migration from the South East in 1988-89 when South East labour demand was so buoyant: at this time, high relative house prices coincided with high appreciation and relative earnings growth expected in other regions, all three factors encouraging net out-migration. Of course, migration is only part of the wider interaction of labour and housing markets, in which wages, employment, unemployment, house prices, household formation and tenure choice, as well as migration, are jointly determined.[1]

This paper models regional migration choices as a system of nine regional equations for England, Wales and Scotland with cross-equation restrictions. Data are taken from the National Health Service Central Register for 1975 to 2003 and we examine both net and gross migration rates, normalizing by the overall rate of regional migration within Great Britain.

The paper improves on previous work by Cameron and Muellbauer (1998) in several respects. These are the inclusion of Greater London as a separate region; the modelling of gross as well as net migration; the incorporation of a better specification of equilibrium-correction through the housing stock per head; the inclusion of expected earnings growth; the examination of migration for different age groups; and the extension of the sample by eight years.

The outline of the paper is as follows. We review the empirical literature on the links between the housing and labour markets and regional migration in Section 2. We set out a simple theoretical model of migration in Section 3 and use it to examine the migraion commuting trade-off. We show how the model may be implemented econometrically. Section 4 provides details of the econometric specification of our model, which includes a number of features omitted from the simple theoretical model of Section 3. We present and discuss the empirical results for both gross and net migration as well as net migration by broad age group. Some conclusions are set out in Section 5. Details of our one year ahead earnings and house price forecasting equations and the data are set out in the Appendix.

[1] A systems approach is therefore necessary when trying to answer a question such as what effect an increase in South East housing supply will have on house prices there or elswhere. Such a system was developed for the ODPM project, see previous footnote.

2. A Review of the Literature

In this section we provide a selective review of recent empirical research on the relationship between the housing market and regional migration in Britain, the United States and continental Europe.[2]

(a) UK Studies Using Pooled Cross-Section Individual Level Data

Studies based on single year cross-sections have little scope for estimating robust housing market effects, other than of tenure characteristics, since controlling for wider amenities associated with locations is almost impossible. Relative house prices are likely to be highly correlated with unobserved amenity values and so hard to interpret. Unobserved heterogeneity is also likely to limit the interpretability of other regional effects such as from unemployment or earnings.

Thomas (1993) used Labour Force Survey data for 1984-86 to examine the influence of wages and house prices on the destinations of inter-regional migrants. The survey distinguishes those moving for job reasons from those moving for other reasons. He finds that job movers are attracted to areas with high wages but are not significantly affected by high house prices in such areas. In contrast, active non-job movers are deterred from areas of high house prices, and the coefficient on log house prices is about one third of that on log wages. However, with only three years in the data set, there is limited scope for obtaining significant results.[3]

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[2] Greenwood (1997) and Stillwell (2005) are useful surveys of literature on internal / regional migration but their discussion of how the labour and housing markets interact with regional migration is limited. Champion *et al.* (1998) review the existing data and evidence on the determinants of migration flows in England, and pay more attention to housing market effects. Unfortunately, their review of the literature is somewhat incomplete. We do not survey the literatures on migration and relative living standards or Oswald's hypothesis that higher homeownership rates lead to more unemployment (e.g. Oswald (1997), Dohmen (2004)).

[3] The author found regional fixed effects insignificant, and the cited results exclude them.

Hughes and McCormick (1994) use LFS data for 1983 to 1986 to examine the influence of owner occupied house prices upon the level and pattern of inter-regional migration in Britain. They include variables capturing actual or potential housing capital gains and more interaction terms. They find relatively small house price effects mainly for older workers. They do not find significant capital gains effects but with a small amount of time-series variation in the data, such effects are hard to estimate robustly and regional fixed effects are excluded. As in their previous cross-section work (Hughes and McCormick 1989), they find that high regional unemployment deters regional migration.

Hughes and McCormick (2000) analyse a variety of micro data from the General Household Survey, Labour Force Survey and Survey of English Housing, encompassing much of their earlier work. They compare estimates for five years between 1973 and 1991 with estimates on annual data between 1993 and 1998. Their models typically include year and region dummies. Like Pissarides and Wadsworth (1989), they find that regional relative wages but not regional unemployment rates significantly influence migration between regions, though being unemployed makes an individual more likely to migrate out of a region. They find some influence on regional migration for relative house prices, most significant for those approaching retirement age. There seems, however, to have been some weakening of the relationship in the 1990s.

Their results confirm their previous findings on the link between housing tenure and mobility.[4] However, while they find a fall in mobility rates for owner-occupiers, they find some rise in mobility rates for social tenants, narrowing the gap between these two tenures. Higher rates of Stamp Duty appear to reduce mobility rates. The high mobility rates of private tenants are confirmed.

(b) Other UK Studies Using Pooled Cross Section Data

In a series of papers Gordon and Molho and their co-authors estimate two (or three) stream models of place to place migration flows in Great Britain using Census and other

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[4] See Hughes and McCormick (1981, 1987, 1991 and 1994) *inter alia*.

data.[5] They emphasize the migration commuting trade-off. Gordon (1975) pointed out the need to distinguish between two kinds of inter-regional migrants: those who are merely changing address ("housing streams") and those who are changing employment as well ("employment streams"). This distinction shows up as consistent differences in estimated migration models for contiguous and non-contiguous regions (Gordon (1975, 1982) and Molho (1982)).

Since housing and employment migration streams are not directly observed in the data, Gordon and Molho proceed to estimate the two streams using generalized push and pull gravity models with distance effects. They identify the two streams using either a contiguity or distance cut-off, since housing streams are likely to involve shorter moves than employment streams. They then relate the estimated push, pull and distance coefficients to a range of economic and other variables, including unemployment rates, employment growth rates, incomes, new house construction rates, house prices and housing tenure.

The commuting-migration trade-off is clearly important but it does not follow that Gordon and Molho's two step estimation procedure – first, estimating the housing and employment streams, and then regressing the estimated push and pull coefficients on a range of economic and other variables – is the best way of modelling inter-regional migration. The procedure is not very parsimonious. Moreover, the stage two regression results are often rather mixed and do not always make economic sense. We suggest that our formulation of the housing and labour market explanatory variables captures the commuting-migration trade-off in a relatively simple and intuitive fashion, so a two step modelling procedure is not required.

(c) UK Panel Data Studies

Both Henley (1998) and Böheim and Taylor (2002) use British Household Panel

[5] For example, Molho (1982, 1988) uses Census data for 1971 and 1981 respectively, Molho (1984) uses quarterly National Health Service central patient register (NHSCR) data from 1975 to 1979 and Gordon and Molho (1998) uses a combination of Census and NHSCR data for seven selected years between 1960 and 1991.

Survey (BHPS) data to look at housing and residential mobility in the 1990's.[6] Although they do not focus on regional migration, their findings are interesting. Henley (1998) examines the impact of negative housing equity on residential moves. He finds strong evidence that negative equity had an adverse impact on mobility, along with results suggesting that home owners did not move (sufficiently) in response to changing labour market conditions, thereby exacerbating housing related rigidities in the job matching process.

Böheim and Taylor (2002) investigate the relationship between housing tenure, employment status and residential mobility. They find that mortgage holders did not display high levels of residential mobility, and to a lesser extent regional mobility, relative to other tenures, although this may just reflect the depressed state of the housing market in the early 1990's. Böheim and Taylor point out that migrating home owners incur large transactions costs and therefore large changes in the expected benefits of moving are required to induce them to migrate. They also find that the unemployed are more likely than employees to move house. A desire to move house motivated by employment related reasons has the single largest impact on the probability of moving between regions.[7]

(d) UK Time Series Studies

Recent time series studies have generally used migration data derived from the National Health Service Central Register (NHSCR) of patients. The net migration data for most regions start in 1971. Data on gross flows by origin and destination region and by broad age group are available from 1975.

Pissarides and McMaster (1990) estimate pooled OLS regressions for net regional migration and relative regional wages over the period 1963 to 1982. Their migration data are a combination of NHSCR data from 1971 on and their own estimates before then. They find that net migration responds to relative unemployment rates and short run relative wages

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[6] Gregg, Machin and Manning (2000) also use BHPS as well as Labour Force Survey (LFS) data to look at the relationships between unemployment, housing tenure and residential mobility.

[7] Dixon (2003) presents some recent evidence from the BHPS and LFS on migration within Britain for job reasons.

while relative wages respond to relative unemployment rates. Their equations have long lags so, although net migration and relative wages adjust to offset regional unemployment differentials, equilibrium is only achieved in the very long run. They do not examine housing market issues.

Muellbauer and Murphy (1990) use NHSCR data from 1971 to 1989 to model gross and net migration flows to and from the South East (including London) partly as a direct check on the implicit story regarding segmented regional labour markets and the mobility trap in Bover *et al.* (1989). They find a highly significant negative effect for the relative house price to earnings ratio, which they interpret as short-term mobility trap and cost-of-1iving effects. They also find significant relative employment and unemployment effects and check for spill-over effects from international migration.[8]

Jackman and Savouri (1992a) use NHSCR data for 1974 to 1989 and a job hiring framework to model gross bilateral inter-regional migration flows including regional fixed effects. In their model, migration flows respond to unemployment rates, the share of the long term unemployed, relative vacancies, relative house prices and non-housing costs and the structure of housing tenure in the origin and destination regions.[9] The house price effects are significant and plausibly signed. However, unlike many other time series studies, they find a perverse wage effect, except with respect to migration to the South East. Here, high relative wages are associated with employment growth and so may also be associated with high in-migration. The authors suggest that job migration away from relatively high wage regions may be accounting for these results.

Jackman and Savouri (1992b) extend their model to incorporate an implication of the commuting/migrating trade-off on the determinants of migration, see Gordon (1975), Molho

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[8] Muellbauer and Murphy (1991) discuss the role of housing in contributing to regional economic disparities, more generally.

[9] Regional vacancy data for Britain are not collected any longer. The series used by Jackman and Savouri (1992a, 199b, 1996) *inter alia*, which were based on Job Centre administrative records, became unreliable and were discontinued in 1999.

(1982). This results from the fact that fixed costs are much greater for migrating, while commuting costs strongly increase with distance. Thus the trade-off operates more powerfully for contiguous region migration than non-contiguous region migration. If relatively cheap commuting is an alternative, the location decision will be more strongly influenced by relative housing market variables. It will be less strongly influenced by relative labour market variables, since if commuting is relatively cheap, the decision of where to live can be made more independently from the decision of where to work. They present evidence in favour of this hypothesis by interacting relative house price effects and relative labour market effects with a measure of contiguity between regions. This is the length of boundary shared by contiguous regions in a model of bilateral migration flows between all bilateral regional alternatives. They show that relative house prices operate somewhat more powerfully and relative vacancies operate more weakly on migration to contiguous regions. In their 1996 paper, they update the sample to 1992 and examine the implications of the model for the 1990-92 recession.[10]

Johnes and Hyclak (1994) examine net migration, house prices, unemployment and wages for the South East region (including Greater London) for 1973 to 1992. However, the model makes little economic sense.[11]

Cameron and Muellbauer (1998) model net migration rates for 1975-1995 between British regions where London is incorporated into the South East. They include relative unemployment, log relative earnings and house prices as explanatory variables. However, they also find a significant influence from measures of expected relative house price appreciation and for downside risk in the housing market. These five economic variables are all significant and with expected signs. They also find evidence in favour of the migration/commuting trade-off: for contiguous regions housing market differentials operate

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[10] They also show that bilateral region fixed effects can be well proxied by region fixed effects, distance and the length of common boundaries.

[11] House prices, wages and unemployment in the South East (SE) are treated as uninfluenced by the corresponding UK variables. Moreover, net migration to the SE is driven entirely by the difference between SE and UK house price inflation.

more strongly, and labour market differentials less strongly. Their estimated commuting equations are consistent with these findings.

Fotheringham *et al.* (2004) study out migration from the 98 Family Health Service Areas in England and Wales between 1983-84 and 1997-98. Unfortunately they do not include area fixed effects in their model or compare their results with one that does. So despite a large array of proxies, unobserved heterogeneity is likely to contaminate the estimates of area or region income, unemployment rate, employment rate, and housing effects. Variables such as real income and real house prices appear in levels form when the previous economics literature[12] typically includes them in log form. Step-wise regression is used to select parsimonious models from very general formulations. Few economic variables such as income, employment rates and unemployment rates have the signs anticipated by economic reasoning. The chief exception is the effect of high relative house prices outside the region. For all groups except young males, these discourage out migration from within the region.

Wall (2001) estimates a model of regional migration in order to estimate compensating differentials as measures of regional quality of life. He uses annual data from 1982 to 1992 to model net region to region migration rates in Britain. His model, which is static, has both time and region fixed effects. Wall's dependent variable is unusual – it is the ratio of net migration to the product, not the square root of the product, of the origin and destination populations. The economic variables in his model are the log ratios of real per capita incomes and vacancy rates in the two regions, the national down-payment ratio times the difference in real house prices in the two regions as well as a measure of contiguity.[13] The estimated coefficients on all of these variables are correctly signed and significant.

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[12] The authors do not reference the earlier literature by Gordon (1975), Molho (1982, 1984), Pissarides and Wadswoth (1989), Pissarides and McMaster (1990), Jackman and Savouri (1992a, 1992b, 1996), Gordon and Molho (1998) and Cameron and Muellbauer (1998).

[13] Wall (2001) measures real income using income data from Regional Trends and Reward Group regional cost of living data. The income data are problematic (Cameron and Muellbauer, 2000) and the main regional varying component in the cost of living data is large mortgage repayment component.

As noted by Hatton and Tani (2005), international migration into the UK has increased considerably in the past decade or so, with around 110,000 migrants arriving each year in the second half of the 1990s compared with around 37,000 in the second half of the 1970s. This is their starting point for an analysis of the effect of international migration on net inter-regional migration rates in Britain from 1982 to 2000. They model both net and gross bilateral migration rates between the regions including regional fixed effects and national time effects, relative log unemployment, relative log vacancy inflow rates, relative log earnings and relative levels and changes in log house prices. They also include the net international immigration rate.[14]

Although their estimates are not very precise, they typically find that the arrival of an additional 100 immigrants to a region results in the displacement to another region of between one-third and two-thirds of that number. This therefore provides a mechanism by which the labour market effect can be attenuated in the region in which international migrants arrive - although given the notorious lack of supply response in the British housing market (see Barker, 2004), it is perhaps not surprising to find a displacement effect of this magnitude. The economic variables, especially earnings, house prices and the vacancy inflow rates, are significant and plausibly signed. There is some evidence that their estimated coefficients for Southern and Midlands regions are somewhat larger than for the the rest of Great Britain.

(e) US Studies

Greenwood (1969, 1975 and 1997) surveys the empirical literature on inter-regional migration in the US. Housing markets do not play a big role in much of this literature, possibly because there is a large market rental sector in the US and it is believed that house prices adjust quickly to labour market shocks.

Gabriel *et al.* (1992) estimate a logistic model for bilateral flows from IRS data for

[14] Hatton and Tani's (2005) measure of international migration is based on International Passenger Survey data. The Total International Migration data, available from 1990, are more comprehensive and display a somewhat different aggregate trend.

nine broad US regions for the 1986-7 tax year. They find significant wage and unemployment rate effects with plausible signs. High house prices in destination regions appear to deter out-migration, but low house prices in regions of origin seemingly not. However, the results for a single cross-section are likely to suffer from the unobserved heterogeneity bias discussed above. Gabriel *et al.* (1993) also examine another cross-section with broadly similar findings but they do not pool the data.

Treyz *et al.* (1993) estimate net migration rate equations for 1971-1988 for 51 US states. The data come from tax records analysed by the Internal Revenue Service (IRS). They use a fixed effects model with log relative employment rates, log relative wage rates and log relative wage mix as the drivers. The wages rates are deflated by relative production costs and relative house prices. The wage mix weights national industry specific wage rates by the industrial mix of each state. All relativities are taken with the national average, so that contiguity with other regions plays no role. The regressors are generally significant with lags from t to t-2.

Davies *et al.* (2001) also study aggregate binary US state to state migration flows using IRS data from 1986/7 to 1996/7 and a conditional logit model with state fixed effects. The drivers are log relative population, relative unemployment rates, log relative per capita state income, distance, distance squared and a non-migration dummy. The parameters are highly significant, even for the unemployment rate, where previous studies had not always found clear effects. No housing market variables were investigated.

(f) Some European Studies

There is considerable interest in the housing - regional migration topic in European countries including Finland, Spain and Sweden. Hämäläinen and Böckerman (2004) analyse net and gross flows between 85 regions of Finland for 1988-1997. Their model includes region fixed effects and national time effects. The net and in-migration equations suggest generally plausibly signed effects for region income, region unemployment rates and region house prices, but the out equations less so. Implicitly, the national time effects pick up any national time varying effects, so the region effects could be reparameterised as deviations from national means. However, contiguity effects are not modelled. The authors emphasise the sensitivity of the results to methods of estimation.

Bentolila and Dolado (1992) analyse internal net migration rates for Spain divided into 17 regions for 1962 to 1986. They generally find plausibly signed unemployment, log real wage and house price effects, measured relative to the national average, in specifications including regional fixed effects. However, the speed of adjustment is slow. 'House prices' are proxied by market rents and imputed rents for owner-occupiers, and these are significant despite the fact they also play a role in the regional cost of living indices used to deflate regional wage rates. Log real wages and log real house price deviations are both scaled by the national unemployment rate, suggesting that these economic influences have less effect when national unemployment is high. A feature of the paper is the use of equations for wage and unemployment differentials to simulate system dynamics.

Antolin and Bover (1997) analyse data from the LFS for Spain in 1987 to 1991 to explain regional out migration probabilities for men. They examine the effects of regional deviations from the national average for wages, unemployment rates and house price. They check both for asymmetries between above and below average regions, and for interactions between the regional unemployment deviation and the men's employment and other characteristics. Log real wage and house price differentials are significant, and for higher than average house price regions, the out migration effect of high house prices is enhanced. The interactions of personal characteristics with regional unemployment differences are important, and generally, they conclude that these data throw doubt on the effectiveness of migration for alleviating regional unemployment differences. Comparisons of specifications with and without regional fixed effects and other specification tests are a feature of the paper.

Eliasson, Lindgren and Westerlund (2003) estimate a bivariate probit model of inter-regional employment change and migration using Swedish data for 290,000 individuals in 1994-95. The empirical results include a powerful commuting-migration trade-off. The unemployed were more likely to both commute and migrate. They also find a weak house price effect for out-migration – individuals were more likely to migrate from areas with higher house prices. However, with cross section data and all destination regions aggregated and no relative house price terms, it is surprising that they found any house price effect at all.

Summary

The main conclusion of our survey of the literature is that empirical studies of inter-regional migration that have reasonable time variation in the data, and include fixed effects and relevant housing market variables, generally find significant and plausibly signed coefficients on the latter. Contiguity effects and the commuting migration trade-off are important.

3. A Simple Model of Migration

In the first half of this Section we outline a simple, theoretical, discrete choice model of migration with an explicit commuting-migration trade-off. We use our simple permanent income model to provide micro foundations for our models and, more specifically, to analyse commuting and migration choices. In the second half of this Section, we briefly show how an econometric model may be derived from the theoretical model.

(a) Migration and Commuting

Let h be the housing stock and hp be the price of housing relative to non-housing consumption c. Housing services are proportional to the stock of housing, h. To keep things simple, assume the real interest rate r is fixed and that the current relative price of houses to non-housing consumption is expected to continue. Then we can write the user cost of housing as $uc_h.hp$, where the user cost rate uc_h is constant. This reduces a two good, multi-period optimization problem to a two good optimization problem with the budget constraint $c + uc_h.hp.h = r.W = r.(y + A + hp.h)$, where W is life-cycle wealth. In general W consists of the discounted expected flow of real non-property income y, non-housing assets minus debt A, and housing assets $hp.h$. When the household maximises utility $U(c,h)$ subject to the budget constraint, the resulting indirect utility function is $V(uc_h.hp,W)$.

We consider five types of households in turn – (i) households that live and work in region i; (ii) households that live in region i and commute to work in adjoining region j; (iii) households that migrate to live and work in adjoining region j; (iv) households that migrate to live in adjoining region j but continue to work in region i; and (v) households that migrate to live in another, more distant, region s.

(i) Stayers. For a household in region i that neither commutes or migrates, maximizing utility $U(c,h)$ subject to the budget constraint results in solved out utility given by the indirect utility function $V(uc_{hi}.hp_i, r\,(y_i + A + hp_i.h_i))$, where the subscripts denote region i. When preferences are homothetic, so the income elasticity of demand for c and h is unity, the indirect utility function is:

$$(1) \qquad v(uc_{hi.}hp_i)\, r\,(y_i + A + hp_i.h_i)$$

(ii) Commuters. Now consider the possibility of commuting to region j with commuting costs c_{ij}.[15] The budget constraint is then $c + uc_{hi}.hp_i.h_i = r\,(y_j - c_{ij} + A + hp_i.h_i)$. Assuming homotheticity, the indirect utility function is:

$$(2) \qquad v(uc_{hi}.hp_i)\, r\,(y_j - c_{ij} + A + hp_i.h_i)$$

so, *ceteris paribus*, commuting occurs when $y_j - c_{ij} > y_i$. In the non-homothetic case, this condition is likely to dominate.

(iii) Short Distance Movers. Next, consider the decision to migrate to live and work in an adjoining region j. Migration involves facing a different relative price of housing and the budget constraint $c + hp_j.h_j = r\,(y_j - m_{ij} + A + hp_{i.}h_i)$, where m_{ij} is the cost of migrating. Solved out utility is:

$$(3) \qquad v(uc_{hj}.hp_j)\, r\,(y_j - m_{ij} + A + hp_i.h_i)$$

[15] For simplicity we assume c_{ij} incorporates the leisure as well as the money cost of commuting and that it reflects the discounted present value of these costs.

(iv) Reverse Commuters. There is also the possibility of continuing to work in region i but moving to region j, and therefore commuting from j to i. In this case, solved out utility is:

(4) $$v(uc_{hj}.hp_j)\, r\, (y_i - m_{ij} - c_{ji} + A + hp_i.h_i)$$

(v) Other Movers. Finally, there is the possibility of living in some other disparate region s and working in region j, with utility:

(5) $$v(uc_{hs}.hp_s)\, r\, (y_j - m_{is} - c_{sj} + A + hp_i.h_i)$$

where region j could be the same as region s, in which case $c_{sj} = 0$.

Households can then be conceived as choosing the maximum among the alternatives given by equations (1) to (5). This discrete choice model can be turned into a model for proportions of households in each region making the various commuting and migration choices by including unobserved stochastic components. Generally speaking, one expects relatively few households to face stochastic elements large enough to overpower the double cost of commuting and migrating in (4) and (5), except for near distance moves.

The Choice of the Commuting and Migration Options

Two conditions hold for households who live in region i and commute elsewhere. The first condition is:

(6) $$\max_{j \neq i}\ v\left(uc_{hi}.hp_i\right) r\left(y_j - c_{ij} + A + hp_i h_i\right) > v\left(uc_{hi}.hp_i\right) r\left(y_i + A + hp_i h_i\right)$$

which simply states that higher utility is obtained by commuting to work in region j than by working in region i. As noted above, this inequality simplifies to $\max_{j \neq i}\left(y_j - c_{ij}\right) > y_i$, which does not depend on house prices in region i. The second condition is:

(7)
$$\max_{j\neq i} v\left(uc_{hi}.hp_i\right) r\left(y_j - c_{ij} + A + hp_i.h_i\right)$$
$$> \max_{s\neq i} v\left(uc_{hj}.hp_j\right) r\left(y_s - m_{ij} - c_{js} + A + hp_i.h_i\right)$$

which states that higher utility is obtained by commuting from region i than by migrating from i, where the latter option could include living and working in region j (with $c_{jj} = 0$) or living in region j and commuting to region s. This condition brings in relative house prices and relative earnings in region i versus region j.

A household migrates from region i to region j when the utility of migrating to j exceeds the utility of living in i:

(8)
$$\max_{s\neq i} v\left(uc_{hj}.p_{hj}\right) r\left(y_s - m_{ij} - c_{js} + A + p_{hi}.h_i\right)$$
$$> \max_{j\neq i} v\left(uc_{hi}.p_{hi}\right) r\left(y_j - c_{ij} + A + p_{hi}.h_i\right)$$

where $c_{jj} = 0$. The utility of migrating to region j includes the possibility of commuting to region s, or indeed back to i. The commuting option will be small for regions with high commuting costs, and vice versa for low commuting cost regions. For most households, the dominant term on the right hand side of inequality (8) will be the own-region term, not involving commuting, although moving to the South East region in order to commute to London could be common.

Consideration of (8) supports the points made by Gordon (1975), Molho (1982) and Jackman and Savori (1992a, 1996) *inter alia*, concerning the different response of migration to adjoining or contiguous region differences in labour and housing markets. This implies that high earnings in adjoining regions, to which commuting is possible, may help persuade households not to migrate from region i but commute instead. This offsets the opposite effect that arises from the contiguous regions also being potential migration destinations. High housing costs in potential destination regions have a deterrent effect on migration from a region. For adjoining regions this deterrent effect is enlarged by the fact that commuting offers an alternative way to take advantage of high earnings in these regions.

Other Considerations

To derive population proportions from these inequalities, stochastic variations need to be introduced representing unobserved taste variations for households and deviations of user costs, house prices, discounted earnings from the observable region means. We look at this issue in the following sub-section.

Even the simplest assumptions suggest several complications which tend to be omitted in regional migration models. In particular, the probability of an individual migrating (or the proportion of individuals migrating) will, in general, not depend just on the ratio of region i user costs $uc_{hi}.hp_i$ and discounted earnings y_i relative to the national averages. The distributions of the $uc_h.hp$'s and the y's are likely to be relevant also.

Also important for the explanation of migration are the expectations effects and risk factors (discussed in the next Section) which have been omitted from our simple model. The user cost of housing depends not only on house prices but on interest rates and expected house price appreciation. If interest rates are the same across regions, it may be thought that interest rate effects should cancel out in comparing user costs between regions. However, this ignores the potential non-linearity of $v(\mathrm{uc_h,hp})$ and various risks, including the risk of negative rates of return.

(b) An Econometric Specification

We now show how to derive an econometric model using the economic model of the migration – commuting decision set out above. For ease of exposition, we assume that the percentage user cost of housing uc_h is the same in the two regions and that initial wealth $A + ph.h$ is zero.

The Basic Migration Equation

We initially consider a two region (r = 1, 2) model and suppose that commuting is not an option. An individual or household in region 1 will migrate to region 2 if his/her indirect utility is higher in region 2 than in region 1:

$$(9) \qquad v(y_2 - c_{12}, uc_h.hp_2, z_2, \varepsilon_2) > v(y_1, uc_h.hp_1, z_1, \varepsilon_1)$$

where y_r = real income in region r, hp_r = real house price in region r, c_{12} = cost of migrating from region 1 to 2, z_r = observed attributes of r, ε_r = unobserved attributes of r and $v(\ )$ is the indirect utility function. Using a random utility model (RUM) formulation:

$$(10) \qquad v(y_1, uc_h.hp_1, z_1, \varepsilon_1) = v(y_1, uc_h.hp_1, z_1) + \varepsilon_1 = v_1 + \varepsilon_1$$
$$v(y_2 - c_{12}, uc_h.hp_2, z_2, \varepsilon_2) = v(y_2 - c_{12}, uc_h.hp_2, z_2) + \varepsilon_2 = v_{12} + \varepsilon_2$$

When the unobserved ε's are distributed as iid type I extreme value (Gumbel) random variables, the probability of migrating from region 1 to region 2, pr_{12}, equals $\exp(v_{12}) / [\exp(v_1) + \exp(v_{12})] = \exp(v_{12} - v_1) / [1 + \exp(v_{12} - v_1)]$, which is approximately equal to $\exp(v_{12} - v_1)$ since pr_{12} is small. A similar expression for pr_{21}, the probability of moving from region 2 to region 1, may be derived.

Net migration (inflow minus outflow) into region 1 equals $Pop_2.pr_{21} - Pop_1.pr_{12}$ so the net inflow per head of population in region 1 is approximately:

$$(11) \qquad m_1 \approx (Pop_2/Pop_1).\exp(v_{21} - v_2) - \exp(v_{12} - v_1)$$

where Pop_r is the population of region r. Population shares and observed attributes are generally relatively fixed (or slowly changing). The principal variable cost of migration is the tax (Stamp Duty) on purchasing a house in the destination region so we assume $m_{12} = \tau.hp_2$, where τ is the tax rate.[16] Under these circumstances, the net migration rate may be approximated by:

[16] Recall that distance between the two regions is fixed.

(12) $$m_1 \approx \beta_0 + \beta_1 \ln (y_1/y_2) - \beta_2 \ln(hp_1/hp_2) - \beta_3\tau$$

where the β's are all positive. Time trends will capture slowly changing regional population shares and attributes.

This simple model may be readily extended to the case where there are three or more regions. In this case

(13) $$m_1 \approx \beta_0 + \beta_1 \ln (w_1/w_2) + \beta_2 \ln (w_1/w_3) - \beta_3 \ln (hp_1/hp_2) - \beta_4 \ln (hp_1/hp_3) - \beta_5\tau$$

Unfortunately, the number of terms in (13) tends to increases as we introduce more regions, so our formulation is not very parsimonious. Of course, the rise in commuting costs with distance will mean that many of the relative earnings and house price terms will be small and so can be omitted.

Migration and Commuting

Now assume that there are only two regions and that commuting is an alternative to migration. The RUM formulation for region 1 is now:

(14) $$\begin{aligned} \mathrm{v}(w_1, hp_1, z_1, \varepsilon_1) &= v(w_1, hp_1, z_1, \varepsilon_1) = v_1 + \varepsilon_1 \\ \mathrm{v}(w_2 - m_{12}, hp_2, z_2, \varepsilon_2) &= v(w_2 - m_{12}, hp_2, z_2) + \varepsilon_2 = v_{12} + \varepsilon_2 \\ \mathrm{v}(w_2 - c_{12}, hp_1, z_3, \varepsilon_1) &= v(w_2 - c_{13}, hp_1, z_1) + \varepsilon_3 = v^c_{12} + \varepsilon_3 \end{aligned}$$

where the second and third options are the migration and commuting options respectively. The migration option is chosen when $v_{12} + \varepsilon_2$ exceeds both $v_1 + \varepsilon_1$ and $v^c_{12} + \varepsilon_3$.

When the ε's are iid extreme value (McFadden, 1974), the probability of migrating from region 1 now equals $\exp(v_{12}) / [\exp(v_1) + \exp(v_{12}) + \exp(v^c_{12})]$ or $1 / [1 + \exp(v_1 - v_{12}) + \exp(v^c_{12} - v_{12})]$. It is clear that, *ceteris paribus*, the commuting option reduces the probability of out migration to an adjoining region with, for example, relatively good labour market prospects.[17] To a first approximation, house prices will drop out of the second term in the denominator involving v^c_{12} - v_{12}. Thus, the out migration rate should be a good deal more responsive to relative earnings than to relative house prices, quite apart from any cost of living effects.

An analogous expression for the probability of moving into region 1 can be derived and per capita net migration into region 1 is:

(15)
$$m_1 \approx (Pop_2/Pop_1) / [1 + \exp(v_2 - v_{21}) + \exp(v^c_{21} - v_{21})] \\ - 1 / [1 + \exp(v_1 - v_{12}) + \exp(v^c_{12} - v_{12})]$$

As before, this may be approximated by a log linear function of relative wages and house prices in the two regions (assuming commuting costs are relatively fixed in relation to wages) and the rate of Stamp Duty.

Contiguity Effects

When there are more regions, the commuting option reduces the incidence of both gross and net migrating to adjoining / contiguous regions with relatively good labour market prospects so our migration models focuses on relative housing and labour markets prospects. We measure these prospects relative to Great Britain as a whole and relative to contiguous regions (as opposed to relative to every other region).

Our parsimonious formulation can be rationalized by the omission / aggregation of alternatives involving high commuting costs and /or the replacement of the independence of irrelevant alternatives (IIA) assumption.[18] For example, an ordered nested logit models with overlapping nests, along the lines of Small (1987), may be used to justify our approach. In these sorts of model, the alternatives have a natural ordering based on contiguity and / or

[17] When there are more regions, increased out migration may occur to a distant region which adjoins a region with dear house prices and high wages.

[18] The IIA assumption, which follows form the assumption that the ε‘s are iid may be relaxed in a number of different ways. For example, see Chapter 6 in Train (2003).

distance, so that (loosely speaking) closer alternatives matter more. As we show in the next Section, our explanatory variables are specifically formulated so that they capture this effect.

4. Empirical Results

(a) Data Issues

Regional net migration data are available back to 1971 from the Office of National Statistics. Gross bilateral data are available from 1975. The data are based on National Health Service records of patients registering with local doctors and are adjusted for small lags between moving and registering.[19] Migration data for the Greater London region are not available before 1975, so we use annual gross and net regional migration data from 1975 to 2003.

--- Figure 1 About Here---

Since the definition of regions changed from Standard Statistical Regions (SSR's) to Government Office Regions (GOR's) in the mid 1990s, in our econometric work we have to merge the North East and North West regions into a total North (NT) region, and the East and the South East regions into the South (ST) region. Greater London is a separate region surrounded by our South region (see Figure 1).

--- Table 1 About Here ---

Table 1 shows the average total number of people moving between various Government Office Regions of Britain over the four years 2000 to 2003. The migration flows decrease with distance and the gross flows are much larger than the net flows. In addition,

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[19] The NHSCR data are discussed in Devis and Mills (1986), Boden *et al.* (1992), Hornsey (1993), Champion et al. (1998), Scott and Kilbey (1999) and Chapell *et al.* (2000), *inter alia*. Although there is some evidence that migration rates amongst young males are underestimated, Scott and Kilbey (1999) conclude that the NHSCR provides high quality estimates of migration, as compared to other sources.

the large gross and net flows to and from Greater London and nearby regions are very noticeable.

--- Table 2 About Here ---

Means and standard deviations of the gross and net migration rates are set out in Table 2, which covers the whole sample period 1975 to 2003. The age breakdown of the gross flows suggests that about 10% of the gross flows migrants are aged 65 years or more, while about 16½% are aged 15 years or less.[20] Thus, migrants consist largely of working age adults and their dependents.

(b) Model Specification

As the theory presented in Section 3 implies, high relative earnings and employment, along with other local amenities will tend to attract households to a region, while high relative house prices will tend to deter them both because of cost-of living effects and because of credit-constraints operating through the mortgage lending system. In addition, a more plentiful housing provision per unit of population is likely to attract migrants. This is because, outside the owner-occupied sector, quantity constraints are likely to matter, given controlled rents in the social housing sector and sticky rents in the market sector.

Molho (1984) points out that uncertainty, risk aversion, expectations formation and adjustment costs are likely to play an important role within this theoretical framework. Thus a recent history of negative returns in housing will deter a risk-averse household, given the short-to medium-run persistence of housing returns. Furthermore, expectations of earnings growth and of house price appreciation may overcome high house prices (Cameron and Muellbauer, 1998).[21] We also permit the speed of response of migration to the basic labour

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[20] Over the period 1975 to 2003, the age breakdown of the gross regional flows is 15.5% aged 0 to 15 years; 29.5% aged 16 to 24 years; 33.8% aged 25 to 44 years and 10.1% aged 65 or more years.

[21] Kiel (1994) emphasizes the role of expected house price appreciations in explaining residential mobility in the US, albeit not in the regional migration context.

and housing market forces to be time varying.

Since the transaction and other costs of moving, including disruption costs, increase with the distance to be moved, one would also expect contiguity to be important in regional location decisions. Consequently, relative house prices in contiguous regions should matter more. However, in the labour market, the commuting-migration trade-off can weaken or reverse the role of near versus far alternatives as we saw in Section 3.

The specification below also incorporates the related issue of connectivity. This is the idea that, for example, Scotland or the South West are less integrated into the national economy given their spatial separation. So, one might expect regional interactions to be affected by how connected a region is with its neighbours. It turns out that the basic results are not much affected by introducing this effect.

We analyse the net and gross migration rates to and from a region. For modelling purposes, all the rates are scaled by gross migration between all British regions and by the regional working age population. Thus,

$$(16) \qquad migr_r = \left(\frac{mig_r}{wpop_r}\right) \Bigg/ \left(\frac{\left(\sum_s mig_s\right) / \left(\sum_s mig_{s,1990}\right)}{wpop_{GB} / wpop_{GB,1990}}\right)$$

where mig_r is migration (respectively net or gross) for region r, $wpop_r$ is working-age population and $\sum mig_s$ is the sum of all regional migration flows within Britain. Essentially this provides a measure of migration per working-age individual in region r, relative to Britain. The scaling by normalised national gross regional migration is intended to control for economic, institutional or policy changes which might influence overall movement between regions.[22]

Turning now to the formulation of the independent variables, we have measures of

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[22] Cameron and Muellbauer (1998) use this measure of migration. Jackman and Savouri (1992a, 1992b and 1996) also scale regional migration flows by the national migration flow.

relative log full-time earnings (ln *earn)*, relative unemployment rates (*ur)*, relative log house prices (ln *hp)* and so on which capture an "own region" effect relative to Great Britain as a whole and a separate effect relative to contiguous regions (weighted by working age populations). The way the "own region" and "contiguous region" effects are combined varies depending on whether the variable in question is a labour market or housing market variable, since the migration and commuting implications of these two types of variables differs, as we saw in Section 3.

To re-iterate, relatively good labour market propects (high earnings and low unemployment etc.) in a region tend to increase both migration and commuting into that region. However, in the case of housing, relatively good prospects (low house prices, high expected capital gains etc.) tend to raise migration and reduce commuting into the region. Our formulation of the labour market and housing expanatory variables captures these effects Consider our relative log earnings variable:

(17) $$F_1\left(\ln earn_r\right) = \left(1-\lambda_1\right)\left(\ln earn_r - \ln earn_{GB}\right) + \lambda_1\left(\ln earn_r - contig \ln earn_r\right)$$

The first term in $F_1(\ln earn_r)$ is the own region effect relative to all other regions, and the second term, which most migration models ignore, is the effect relative to contiguous regions. A priori, λ_1 should be negative since higher earnings in the contiguous regions should attract migrants to region r. This point may be more obvious when (17) is re-written as $F_1\left(\ln earn_r\right) = \left(\ln earn_r - \ln earn_{GB}\right) - \lambda_1\left(contig \ln earn_r - \ln earn_{GB}\right)$. We use the same λ_1 for all of our labour market variables, including unemployment rates and expected earnings growth.

Now consider our relative log house price variable:

(18) $$F_2\left(\ln hp_r\right) = \left(1-\lambda_2\right)\left(\ln hp_r - \ln hp_{GB}\right) + \lambda_2\left(\ln hp_r - contig \ln hp_r\right)$$

We expect λ_2 to be positive since own and contiguous region house price effects work in the same direction. To put it another way, high house prices in contiguous regions act as an attractor for in-migration to region r in addition to high house prices in all other regions. We use the same λ_2 in all of our housing market variables, including downside risk, expected appreciation and housing per head.

There is one further detail. As mentioned above, our analysis also examines an issue related to 'contiguity', that of 'connectedness'. A priori it seems likely that regions such as the West Midlands and Greater London, entirely surrounded by other regions, would experience stronger contiguity effects than regions, such as the South West, which only share a realtively small border with other regions. A simple measure of 'connectivity' is the ratio of connected boundary to total boundary in ech region.[23] For example, the total South region has approximately half of its boundary with other regions, which is scaled up to 0.6 due to the high density of the boundary with Greater London. Overall, we used the following connectivity weights to scale the λ's - North (NT) 0.56, Yorkshire and Humberside (YH) 0.73, West Midlands (WM) 1.00, East Midlands (EM) 0.85, South (ST) 0.60, Greater London (GL) 1.00, South West (SW) 0.33, Wales (WW) 0.36 and Scotland (SC) 0.12. Thus, for example, our relative earnings and house price variables are formulated as:

(19)
$$\begin{aligned} F_1\left(\ln earn_r\right) &= \left(1 - \lambda_1 conn_r\right)\left(\ln earn_r - \ln earn_{GB}\right) + \lambda_1 conn_r\left(\ln earn_r - contig \ln earn_r\right) \\ F_2\left(\ln hp_r\right) &= \left(1 - \lambda_2 conn_r\right)\left(\ln hp_r - \ln hp_{GB}\right) + \lambda_2 conn_r\left(\ln hp_r - contig \ln hp_r\right) \end{aligned}$$

where $conn_r$ is our measure of connectivity. It turns out that estimates of the basic economic responses in our model appear to be quite robust to whether we assume connectedness is uniform or varies across regions.

The gross and net migration equations simplify to partial adjustment equations with a variable speed of adjustment. The speed varies with the rate of residential property transactions, *ptran*. Thus:

(20)
$$\Delta migr_r = m_{0r} + m_1\left(1 + m_2 \ln ptran\right)\left(x_r{}'\beta_r - migr_{r,-1}\right)$$

where x_r is our set of explanatory variables. We include region-specific double fixed effects

[23] Jackman and Savouri (1992b, 1996) also employ a measure of connectivity.

and time trends. We also allow some parameter heterogeneity in the Greater London equations. The typical regional net or gross migration equation is as follows:

$$
\begin{aligned}
\Delta migr_r = {} & m_{0r} + m_1(1 + m_2 \ln ptran).[\beta_{0r} + \beta_{tr}(year - 1990) \\
& + \beta_1 F_1(\Delta ur_r) + \beta_2 F_1(ur_{r,-1}) \\
& + \beta_3 F_1(\widehat{\Delta \ln earn}_{r,+1}) + \beta_4 F_1(\ln earn_r) \\
& + \beta_5 F_2(\widehat{\Delta \ln hp}_{r,+1}) + \beta_6 F_2(\ln hp_{r,-1}) + \beta_7 F_2(rrhneg_{r,-1}) \\
& + \beta_8 F_2(\ln(hs / wpop)_{r,-1}) - migr_{r,-1}]
\end{aligned}
\tag{21}
$$

where the subscript r denotes region r, Δ denotes a first difference, the subscript −1 a one-year lag and hats refer to the one year ahead forecast (or fitted) values of Δln *earn* or Δln *hp* using the equations set out in Appendix A.[24]

Consider the individual terms in this equation. The first term m_{0r} is a region fixed effect. If the speed of adjustment were zero, m_{0r} would pick up the mean change in migration. The second term $m_1(1 + m_2 \ln ptran)$ is the variable speed of adjustment term. The coefficient on the speed of adjustment varies with ln *ptran*, the log rate of property transactions (scaled by owner-occupied housing in Great Britain) relative to its value in 1990.[25] Since ln *ptran* is zero in 1990, m_1 is the speed of adjustment in that year. The role of the variable speed of adjustment on top of the scaling of the dependent variable by the overall regional migration rate in (16) deserves comment.

One interpretation is that overall migration concerns all tenures. Shifts in the British tenure structure, income distribution, labour market flexibility and turnover rates,

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[24] We also checked a specification including forecast change in relative unemployment rate, but found them insignificant.

[25] Inter alia, increases in Stamp Duty rates (the major transactions cost in the UK) and negative equity reduced the rate of property transactions since the mid 1990's. In their model of regional house prices, Cameron, Muellbauer and Murphy (2006) allow the speed of adjustment to the long run equilibrium to depend on the rate of Stamp Duty. Van Ommeren and van Leuvensteijn (2005) show that rises in transaction costs have a large negative effect on residential mobility in the Netherlands. Hughes and McCormick (2000) find similar effects for the UK.

demography and social structure, the divergence beween social rents and market rents, as well as changes in the operation of Housing Benefit could therefore influence the overall rate of regional migration. Scaling the dependent variable controls for these complex, evolving shifts. The variable speed of adjustment applies to drivers of migration for current and would-be owner-occupiers, implying a faster impact of labour and housing market influences when property market turnover is high and transacting is easy for this tenure category.

The first term in square brackets β_{0r} is a second region fixed effect. This is also needed since the means of some of the regressors in the expression in the square bracket could be far from zero. The second term $\beta_{tr}(year - 1990)$ is a region specific trend and the last term, the lagged level of migration $migr_{r,-1}$, is a partial adjustment / equilibrium correction term.

The next four terms involve labour market variables. The two terms $\beta_1 F_1(\Delta ur_r)$ + $\beta_2 F_1(ur_{r,-1})$ are relative unemployment rate effects in change and level form. Unemployment rates seem to capture quantity type labour market effects better than employment rates. The next two terms $\beta_3 F_1(\widehat{\Delta \ln earn_{r,+1}}) + \beta_4 F_1(\ln earn_r)$ are relative earnings effects. We find that forecast growth in earnings in region r as well as the higher levels of earnings, relative to elsewhere, increase net migration to region r.[26]

We now consider our housing market variables. The first two of these, $\beta_5 F_2(\widehat{\Delta \ln hp}_{r,+1}) + \beta_6 F_2(\ln hp_{r,-1})$ are relative house price effects. The first term captures the effects on inflows of expected appreciation in relative house prices next year. As expected, high relative house prices reduce inflows, other things being equal, so β_6 is negative. The current change in log relative house prices, $\Delta \ln hp_r$, was insignificant.

Downside house price risk is captured by the $\beta_7 F_2(rrhneg_r)$ term. Note that $rrhneg_r$ is

[26] The relative earnings growth forecasting equation is set out in Appendix A.

either zero or negative so β_7 should be positive.[27] A negative rate of return on housing reduces in migration, consistent with the findings in Henley (1998) and Böheim and Taylor (2002). The final housing market explanatory variable $F_2(\ln(hs/wpop)_{r,-1})$ is a quantity variable. It is the lagged log housing stock to working age population ratio. The more houses there are relative to population, the higher the net inflow, other things being equal. As noted above, quantity constraints are likely to matter, given controlled rents in the social housing sector and sticky rents in the market sector.

Hughes and McCormick (1981, 2000) have long argued that the rationing system for provision of social housing creates serious mobility barriers. Having controlled for population relative to the housing stock, regional fixed effects and region-specific trends, we could find no significant relationships between migration rates and the social housing tenure proportions.

The Greater London equation has exactly the same structure except that the β_1, β_2 and β_8 parameters are allowed to take on values different from those in other regions. The expected signs of the β's in the in-mgration equations are the same as those in the net migration equations. The out-migration equations have exactly the same structure with reverse signs for the economic effects.

(c) Net Migration Results

As noted above, our modelling focussed on a system of nine regional equations for Britain, imposing cross-equation restrictions in a two-step manner. First, the Seemingly Unrelated Regressors (SUR) estimator was used to form an estimate of the covariance matrix of the regression. Second, Generalised Least Squares (GLS) with robust standard errors was used with the fixed covariance matrix from step one.

--- Table 3 About Here---

[27] The rate of return on housing *rrh* is defined as the rate of capital appreciation plus 3 percentage points (for imputed rent) minus the mortgage interest rate, so *rrhneg* = *rrh* if *rrh* is negative and zero otherwise.

Results for net migration are presented in Table 3, where column 1 refers to the general model of equation (21) and the other columns to successive omission of various effects. In the general model the speed of adjustment $m_1(1+m_2 \ln ptran)$ is 0.67 in 1990 when ln *ptran* is (normalized to be) zero. On average, the speed is 0.70 with a high of 0.82 in 1988 and a low of 0.57 in 1995, at the low point of the rate of property transactions. This rests on the estimate of m_2 of 0.47.

The unemployment rate effects are allowed to differ between Greater London and the rest of the economy, the most pronounced difference showing up in the change in the regional unemployment rate to which GL is much more sensitive, possibly connected to the youthfulness of its labour force. The forecast relative rate of growth of earnings one year ahead is highly significant and has a coefficient, β_3, over twice as large as for the relative level of earnings, β_4, though this is also very significant.

The forecast growth in relative house prices (relative capital gains) effect is positive with a coefficient, β_5, about one quarter of the earnings growth coefficient. Analogously, the coefficient on relative log house prices, is between one half and one third of the coefficient on log relative earnings, β_6, which is a little larger than the pure cost of living interpretion would suggest. We found that the coefficient on current relative house price growth was very small and not significantly different from zero, implying the level effect enters at a lag of one year.

The estimated downside risk coefficient, β_7, is quite large and highly significant in line with our prior that recent relative house price losses deter net migration . The relative housing stock per head of working age population is highly significant and has a positive effect on in migration, this effect being somewhat larger in Greater London, where the owner-occupation rate is lower than in other regions. This is consistent with the above interpretation of the effect as reflecting migration of those outside the owner-occupied sector.

The λ_1 parameter, measuring the labour market contiguity effect, is not very well determined when freely estimated so we have imposed the more accurately estimated value of -0.25 obtained from the gross migration equations. However, the housing market contiguity effect λ_2 is reasonably accurately estimated at 0.37, which is consistent with theoretical priors and the value estimated from the gross flow equation.

Most previous research either ignored house prices altogether, or only included level effects, so we explored the consequences of omitting our housing market exaplanatory variables. In column 2 we omit expectations of relative earnings and house price growth, current house price dynamics and the downside risk measure as such measures are excluded in those studies which do contain a house price effect.[28] The result is to increase the estimated level effects of house prices and of housing per head but to weaken the long run influence of relative earnings. The trace statistic indicates a substantial worsening of fit.

In column 3, the model is restricted further by omitting housing per head, leading to a marginal increase in the relative house price effect, as prices pick up the 'explanatory slack'. The fit again deteriorates substantially and the housing market contiguity effect vanishes. In the last column, house price effects are omitted altogether. The relative earnings effect now changes sign, implying quite perversely that higher relative earnings repel in-migrants! The unemployment effects, however, at least retain their economic interpretation.

--- Table 4 About Here ---

Table 4 presents some basic diagnostics for the general model corresponding to column 1. Most diagnostics are satisfactory, though there are some traces of heteroscedasticity, which is why we use heteroscedastic consistent standard errors. We checked the stability of the model over time and across regions using overlapping sub-samples and a two way split of the regions. There is some evidence, as in Hatton and Tani (2005), that the house price and earnings effects matter more in Southern and Midlands regions. These are regions with above average house prices. Antolin and Bover (1997) found that in Spain too the effect of house prices on migration was larger in such regions.

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[28] Although Hatton and Tani (2005) include the log change of house prices, interpreting it as a proxy for expected appreciation.

As Table 7 below shows, net migration equations for the Southern and Midlands regions show greater sensitivity to housing market turnover and downside risk, as well as to relative house prices and earnings compared with estimates for Great Britain as a whole. Unemployment effects other than for Greater London, are zero. The labour market contiguity effect is stronger than for estimates on all British regions, suggesting that the commuting trade-off operates more powerfully in these regions which share a border with the South East and have population centres with under two hours commuting time to London.

(d) Relative Magnitude of Effects

Table 5 shows the estimated long run responses of net migration per 1000 to key changes at 2003 levels of migration for Greater London and the other regions, first for estimates based on all regions and then based on the Southern and Midlands subset. For example, suppose house prices in Greater London were 1% premanently higher relative to the average for Great Britain and the surrounding South region, and other factors including relative earnings, expected relative house price appreciation and downside risk were unchanged, then net out migration relative to the working-age population would rise by 0.09 per thousand (compared with an average net annual outflow for 2000-2003 of -10.73 per thousand). The estimates for the Southern and Midlands regions suggest a rather larger effect of 0.19 per thousand.

A fall of 1% in London's housing stock relative to working age population, holding house prices, earnings and unemployment rates constant (e.g. because of changes in international migration), would decrease net regional migration rates into London by 0.67 per thousand.[29] More people in London would raise relative house prices, but if expected relative house price appreciation also rose, the two effects could easily cancel out, at least in the short run.

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[29] Estimates on national data and on the subset of Southern and Midlands regions give virtually the same results here. Note that a 1% fall in the ratio is equivalent to around 31,000 dwellings, so that with a London working age population of about 5 million, about 3,300 net regional migrants would be discouraged via this channel, and additional numbers via the house price channel.

--- Table 5 About Here ---

To get a visual feel for the magnitude of the most important housing related and labour market effects, we show graphs for three regions based on national estimates. These plot the scaled net migration rate against (i) the composite of the fitted relative earnings and the three types of relative house price effects (capital gains, cost of living and downside risk); (ii) the fitted effect of houses per head, and, (iii) the fitted effect of unemployment effects.

--- Figures 2 to 4 About Here ---

Figure 2 shows that for the North, much of the variation in the net migration rate is explained by the relative earnings and house price effects, while variations in the log of houses per head only have a relatively small effect, as do variations in the unemployment rate.

Figure 3, for Greater London, shows exactly the opposite: variations in the relative number of houses per head, which in recent years has been strongly influenced by international migration, have visibly had a major influence on regional net migration rates. The influence of relative earnings and house prices on net migration is far less obvious, though it helps account for some of the smaller fluctuations. The influence of variations in the relative unemployment rate is also visibly greater than in the North.

Figure 4 for the South region, the sum of the South East and East GOR's, shows an intermediate case, where both relative earnings and house prices, and the number of houses per head, play a clearly visible role in explaining variations in net migration rates. Estimates based on the subset of Southern and Midlands regions would show around twice as much variation in the fitted contributions of relative earnings and house prices.

--- Figure 5 About Here ---

Figure 5 shows the gross migration between all GB regions and ln *ptran*, the log of housing transactions in England and Wales scaled by the owner-occupied housing stock. Recall that we divide the regional migration rates by overall GB migration and that the speed of adjustment varies with the transactions rate. The decline of ln *ptran* implies that the speed of adjustment of migration to housing and labour market effects has fallen since the late 1980s.

(e) Gross Migration Equations for All Ages

The gross equation results in Table 6 for general specifications are broadly consistent with the net migration results, repeated for ease of comparison in column 1.[30] However, the differences between the parameters for Greater London and the other regions tend to be somewhat more pronounced.

--- Table 6 About Here ---

Forecast relative earnings growth, and the relative levels of earnings and house prices appear to have somewhat larger effects for gross in-migration than (with the opposite signs) for out-migration. In this specification, we have constrained the ratio of earnings to house price effects to be the same in the inflow and outflow equations, an acceptable restriction. Forecast relative house price appreciation and downside risk have broadly similar impacts on in- and out-migration.

Though every regional in-migrant is an out-migrant from another UK region, one should not expect the two equations to be exact mirror images of each other. One reason is because both are weighted by the working age population of the region rather than as some average of the origin and destination region populations. Another reason is that contiguity effects are not handled exactly symmetrically. The special role of London – more than twice as popular as a destination per head of working age population than any other region - and

[30] The inflow and outflow equations were jointly estimated as a system, so the same λ_1, λ_2 and m_2 are used everywhere. We allowed m_1 to differ between the inflow and outflow equations.

parameter differences between London and the other regions are then likely to account for asymmetries.

For example, the gross in-migration equation contains a very large housing stock per head effect for London, but a much smaller one for other regions. The gross out-migration equation reveals the opposite, on the face of it displaying serious asymmetry for London and non-London regions, respectively. However, it is likely that the large housing stock per head effect for the non-London gross out-migration equation is the result of London being a popular destination for out migrants, so that variations in housing per head there matter for other regions.

The relative changes and levels in the unemployment rate matter more in the out-migration equation than for in-migration, while London is more sensitive to changes in the unemployment rate than other regions.

The speed of adjustment m_1 is estimated to be significantly lower (0.53) for the gross out-migration equations than for the in-migration equation (0.80), which could possibly be a symptom that the specification of the out-migration equations is missing some heterogeneity better captured in the in-migration equations. The estimated speed of adjustment of the net migration equations, not surprisingly, is between those of the two gross flow equations.

--- Table 7 About Here ---

Table 7 reports results for the Southern and Midlands regions. The net migration columns were discussed above. For gross migration too, the influences of property market turnover, relative earnings, relative house prices and downside risk are somewhat greater than for estimates based on all regions, while expected house price appreciation and the housing stock per head have somewhat weaker effects. Other than for Greater London, and a trace of a change effect in the out-migration equation, unemployment effects vanish. Generally, the inflow and outflow estimates are closer to being symmetric and the labour market contiguity effect is larger, than for estimates based on all regions. As noted above, the latter finding is consistent with commuting playing a more important role than on average for all regions.

(e) Net Migration by Age

We now consider some net migration results by age group as a further check on the specification of our model. Table 8 presents all-region results for the three broad age groups - ages 16 to 24, 25 to 44 and 45 to 64 – for which we had data. The restriction $\lambda_2 = 0.35$ is imposed since the freely estimated parameter is badly determined. For the youngest age group $\lambda_1 = -0.25$ is also imposed.

--- Table 8 About Here ---

The results generally make very good economic sense. The unemployment level effects are largest for the youngest age group and smallest for the oldest, consistent with new entrants being more affected than incumbents, and differences between London and other regions now look insignificant. The change in the unemployment rate has no effect for the oldest age group, but similar ones for the two younger ones, with the London effect continuing to be larger. The forecast relative earnings growth effect declines with age, as does that of the relative earnings level, in line with life-cycle considerations. Choice of region in this respect matters most for those with the most working years to look ahead to.

The speed of adjustment is most sensitive to the rate of property market turnover for the oldest and least sensitive for the youngest, consistent with the ranking of the three groups in terms of the rate of owner-occupation and net housing equity. The relative level of house prices and expected relative house price appreciation matters least for the youngest, and most for the middle group, though both effects are very significant for the oldest group. One explanation for why the appreciation effect is smaller for the 45-64 age group than for the 25-44 age group, is a lower level of gearing in terms of debt. The higher gearing of the latter group raises the effective rate of return. While capital appreciation has the smallest coefficient for the youngest group, it is still a significant driver of their migration rate.

Downside risk matters least for the oldest group since with low gearing, experiencing negative equity will, on average, be unlikely. It matters most for the youngest group. This is likely to be connected to the risks imposed by high debt gearing so that a relatively negative recent returns experience is a serious deterrent to moves to that region, even for those who are not yet owner-occupiers.

The housing per head effect is now much more similar between Greater London and other regions for each age group, suggesting that the differences for all age groups, discussed above, are explained by differences in the age composition of migrants to and from London. The housing per head effect is smallest for those aged 45-64 years, probably because fewer of this group are in the social or market rented tenure group. For the other two age groups the effects are fairly similar, only marginally smaller for 16-24 years olds, who are likely to have the lowest space requirements. It is also possible that for those in full time education, institutional housing is not fully reflected in the housing stock figures.

(f) Some Limitations

Finally, some of the limitations of this kind of exercise must be pointed out. Historical annual data for standard regional classifications on government interventions (the allocation of rate support grants, infrastructure investment, expenditure under urban renewal schemes, spending by regional development agencies and EU structure fund spending), have not, to our knowledge, been assembled in a systematic form. Such spending could well have implications for regional migration not mediated through unemployment rates, earnings and house prices.

Micro-evidence suggests a link between education and mobility. While we have some data on the age composition of migrants, and data on the age composition of regional populations, we do not have historically comparable data on the educational qualifications of either. We were also unable to construct consistent regional series for student places in higher education to help explain migration patterns of the young. Further, the composition of housing is not controlled for when we investigate the direct effect of housing availability on migration. Regional fixed effects and trends, while helpful, will not be ideal proxies for such omitted effects. The presence of illegal immigrants and other measurement errors are another limitation. The evidence for some parameter heterogeneity between the subset of Southern and Midlands regions and all regions suggests that our current treatment of connectivity based on lengths of shared boundaries may not capture the economically relevant concept well enough. Future research would do well to address these issues.

5. Some Conclusions

Our econometric models of regional migration within Great Britain show how migration responds to a range of housing market effects – house price levels, expected house price apprecaition, downside house price risk and housing scarcity (houses per per head of population). Most previous research either ignored house prices altogether, or only included level effects. Leaving out housing market effects typically results in mis-specified models in which labour market effects are estimated as being weak or even perverse in direction. We find much more plausible earnings effects on migration, for example, when controlling for the full range of housing market influences.

We modelled gross in and out migration as well as net migration and found strong housing and labour market effects broadly consistent between the inflow and outflow equations. We also examined migration patterns for three broad age groups - those aged 15 to 24, 25 to 44 and 45 to 64 years old. The differences across age groups are fully consistent with economic logic.

The evidence is that the unemployment rate appears to be more relevant for migration than the employment rate. In the 1990s, regional differentials in the unemployment rate narrowed much more than differentials in the employment rate, reflecting the higher levels of disability benefits claimants and other non-participation in the poorer regions. The finding suggests that such claimants and early retirees are less likely be migrants or to respond to economic signals.

In the case of contiguity, we find that, as economic incentives suggest, housing market comparisons with contiguous regions are more important than with the average of all regions. Given the commuting option, people may choose to live in regions with somewhat lower housing costs and commute to the contiguous region with higher house prices for work. Indeed, we find that good labour market opportunities in contiguous regions have a considerable influence on migration to and from a region. The housing and labour market explanatory variables in our models are formulated so that we can capture this migration–commuting tradeoff.

There is clear evidence of some heterogeneity in behaviour, although it is far lower when migrants are split by broad age group: migration to and from Greater London has somewhat different responses to unemployment, than from other regions. Greater London's migration also responds between two and three times as strongly as other regions to the level of housing per head of population. As we saw, this explains much of the variation in net regional migration into Greater London, and suggests an important crowding out effect on this migration from international migration

While the micro-econometric literature has emphasised the role of tenure on mobility, we could identify no significant and plausibly signed effects, for example from regional social housing tenure rates on migration rates. This is probably because such effects are captured by the region fixed effects and the region time trends, and also because our migration rates are scaled by the sum of gross regional migration rates, which will capture aggregate variations in mobility due to tenure changes at the national level.[31]

Our findings confirm the importance of housing, both mediated through prices and direct availability, for regional migration in Britain, as well as the central and different way in which regional migration to London operates. Both have interesting implications for analysing the effects of increased house building in different regions on the affordability of housing in different regions. The important role played by relative expected house price appreciation and earnings growth, as well as down-side risk, helps to explain phenomena many have found puzzling. For example, why the greater South East continued to attract net migrants in 1988-89 when house prices were rising very strongly relative to other regions

[31] It is also possible that shifts over time in tenure-specific mobility rates, found by Hughes and McCormick (2000), may have made it hard to find stable coefficients.

and had become very expensive relative to earnings. In turn, this helps a little in explaining why relative regional house prices in Britain have such sustained periods of appreciation.

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Table 1
Average Regional Migration Flows in Britain 2000-2003

Origin				**Destination**								
Region	Population Total	Population Working Age	Net Migration	NT	YH	WM	EM	GL	ST	SW	WW	SC
	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)	(000's)
NT North	9324	5818	-2	-	27	15	13	18	30	10	10	12
YH Yorkshire & Humberside	4984	3110	+3	28	-	8	16	11	21	6	3	5
WM West Midlands	5294	3292	-6	15	7	-	14	12	23	13	8	3
EM East Midlands	4208	2642	+20	13	18	16	-	14	39	8	3	3
GL Greater London	7330	4922	-94	17	10	11	10	-	79	15	5	7
ST South	13449	8399	+29	27	17	21	27	156	-	42	11	12
SW South West	4957	3021	+33	11	6	16	9	24	62	-	9	4
WW Wales	2920	1787	+11	12	3	10	3	6	14	11	-	2
SC Scotland	5060	3214	+5	12	5	3	4	8	14	4	2	-

Source: Office for National Statistics NHS central patient register data.
Notes: Net migration = inflow – outflow. The North and South regions are the sums of the North East and North West, and South East and Eastern Government Official Regions (GOR's) respectively.

Table 2
Gross and Net Regional Migration Rates 1975-2003

Region	Net Migration Rate		Gross In Migration Rate		Gross Out Migration Rate	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
	%	%	%	%	%	%
NT North	-0.23	0.13	1.62	0.21	1.85	0.14
YH Yorkshire & Humberside	-0.06	0.12	2.17	0.28	2.23	0.24
WM West Midlands	-0.26	0.68	1.95	0.26	2.22	0.22
EM East Midlands	0.25	0.13	2.89	0.35	2.63	0.26
ST South	0.33	0.18	2.86	0.21	2.53	0.20
GL Greater London	-0.56	0.33	3.05	0.22	3.61	0.29
SW South West	0.66	0.18	3.40	0.27	2.75	0.21
WW Wales	0.18	0.16	2.32	0.27	2.14	0.19
SC Scotland	-0.07	0.22	1.16	0.16	1.23	0.12

Note: The regional population of working age is used as the denominator for all of the migration rates.

Table 3
Regional Net Migration Equations for Great Britain
Two Step Parameter Estimates 1976 to 2003

Parameter		I General Model		II Levels House Price & Housing Stock Effects		III Levels House Price Effect Only		IV No Housing Market Effects	
		Coeff	t Stat	Coeff	t Stat	Coeff	t Stat	Coeff	t Stat
m_1 Adjustment Speed		0.672	16.0	0.628	13.1	0.545	8.0	0.440	6.2
m_2 Variation in Adj. Speed with Property Transactions		0.473	1.9	0.427	1.6	0.833	3.2	-	-
β_1 Δ Rel Unemp Rate	(Ex. GL)	-0.023	-2.2	-0.047	-2.8	-0.042	-1.9	-0.110	-1.7
	(GL)	-0.338	-7.6	-0.306	-7.0	-0.217	-3.9	-0.335	-4.3
β_2 Rel. Unemp Rate Lagged	(Ex. GL)	-0.013	-2.5	-0.011	-1.6	-0.014	-2.1	-0.018	-1.1
	(GL)	-0.023	-1.2	-0.027	-1.4	-0.104	-2.9	-0.039	-1.0
β_3 Forecast Δ Rel. Log Earnings Next Year		4.800	4.4	-	-	-	-		
β_4 Rel. Log Earnings		1.913	3.0	0.295	0.3	0.460	0.4	-3.955	-2.3
β_5 Forecast Δ Rel. Log House Prices Next Year		1.238	5.7	-	-	-	-	-	-
β_6 Rel. Log House Prices Lagged		-0.764	-6.4	-1.044	-7.5	-1.132	-5.7	-	-
β_7 Rel. Downside Risk Lagged		0.647	3.3	-	-	-	-	-	-
β_8 Rel Lagged Log (Housing Stock /	(Ex. GL)	6.059	5.4	6.370	4.7	-	-	-	-
Working Age Population)	(GL)	7.688	9.0	8.117	7.8	-	-	-	-
λ_1 Weighting - Labour Market Contiguity Effects		-0.250	-	-0.250	-	-0.250	-	-0.250	-
λ_2 Weighting - Housing Market Contiguity Effects		0.373	3.2	0.300	1.6	-0.132	-0.3	-	-
Trace		248.6		309.2		376.8		608.2	

Notes: The dependent variables are the changes in the scaled net migration rates. Heteroscedastic consistent standard errors are used to calculate the t statistics. The sample size is 252 i.e. 28 observations for 9 regions. Region specific intercepts (18) and time trends (9) are not reported. One restriction, $\lambda_1 = -0.25$, has been imposed. In column IV, $m_2 = 0$, so the model is linear and there are only nine region specific intercepts.

Table 4
Some Single Equation Summary Statistics and Regression Diagnostics for the Net Migration Equations

Region	Dependent Variable		Equation	R^2	LM Tests P Values	
	Mean	Std Dev	Std Error		Hetero	Auto
NT North	0.007	0.082	0.050	0.62	0.16	0.45
YH Yorkshire & Humberside	0.008	0.080	0.063	0.38	0.53	0.35
WM West Midlands	0.004	0.062	0.046	0.44	0.48	0.40
EM East Midlands	0.011	0.089	0.068	0.39	0.04	0.34
ST South	-0.009	0.080	0.046	0.69	0.01	0.55
GL Greater London	-0.017	0.194	0.110	0.67	0.55	0.12
SW South West	-0.0001	0.102	0.073	0.47	0.46	0.44
WW Wales	0.011	0.105	0.068	0.57	0.89	0.88
SC Scotland	0.003	0.177	0.102	0.67	0.93	0.16

Notes: The dependent variable in each equation is $\Delta migr_r$, the change in the scaled net migration rate per head of the working-age population in that region. The equation standard errors, R^2's and LM test P values all refer to the model set in column 1 of Table 3. The LM autocorrelation test are for AR(1)/MA(1) errors.

Table 5
The Estimated Responsiveness of Net Migration

Estimated Long Run Change in 2003 Net Migration Per 1000 Working Age Population	All Regions Table 3 Results		Midlands and South of England Table 7 Results	
	Greater London	Other Regions	Greater London	Other Regions
1% Rise in relative house prices	-0.08	-0.08	-0.18	-0.18
1% Point rise in relative unemployment rates	-0.27	-0.15	-0.36	-
1% Rise in relative earnings	+0.22	+0.22	+0.28	+0.28
1% Rise in relative housing stock to working-age population ratio	+0.88	+0.70	+0.84	+0.50

Notes: The estimated long-run effects are derived using the net migration parameter estimates in column I of Table 3 (all regions) and Table 7 (Midlands and South of England). Feedback effects from migration to house prices etc. have been ignored and the rises in relative house prices etc. are assumed to be permanent. The 2000 to 2003 average net migration (per 1000 of the working age population) were -0.49 in the North, 0.78 in Yorkshire and Humberside, 4.66 in the East Midlands, -1.96 in the West Midlands, -10.73 in Greater London, 1.92 in the South, 7.06 in the South West, 4.09 in Wales and 0.91 in Scotland.

Table 6
Gross and Net Migration Equation Parameter Estimates

Parameter		Net Migration		Gross In Migration		Gross Out Migration	
		Coeff	t Stat	Coeff	t Stat	Coeff	t Stat
m_1 Adjustment Speed		0.672	16.0	0.804	32.4	0.525	18.9
m_2 Variation in Adj. Speed with Property Transactions		0.473	1.9	0.855	5.5		
β_1 Δ Rel Unemp Rate	(Ex. GL)	-0.023	-2.2	-0.010	-1.7	0.029	6.9
	(GL)	-0.338	-7.6	-0.133	-6.3	0.192	9.1
β_2 Rel. Unemp Rate Lagged	(Ex. GL)	-0.013	-2.5	0	-	0.019	6.8
	(GL)	-0.023	-1.2	-0.069	-7.1	0	-
β_3 Forecast Δ Rel. Log Earnings Next Year		4.800	4.4	2.634	4.8	0	-
β_4 Rel. Log Earnings		1.913	3.0	1.3333 [r]	5.5	-0.215 [r]	-1.7
β_5 Forecast Δ Rel. Log House Prices Next Year		1.238	5.7	0.484	5.8	-0.525	-9.8
β_6 Rel. Log House Prices Lagged		-0.764	-6.4	-0.506 [r]	-9.4	0.082 [r]	1.7
β_7 Rel. Downside Risk Lagged		0.647	3.3	0.212	1.8	-0.338	-4.5
β_8 Rel Lagged Log (Housing Stock / Working Age Population)	(Ex. GL)	6.059	5.4	1.010	2.5	-4.959	-8.3
	(GL)	7.688	9.0	6.335	14.0	-2.212	-5.5
λ_1 Weighting – Labour Market Contiguity Effects		-0.250	-	-0.248	-1.7		
λ_2 Weighting – Housing Market Contiguity Effects		0.373	3.2	0.342	4.4		
Trace		248.6		482.8			

Notes: Regional fixed effects and time trends are not reported. The net migration results are the same as in Column I of Table 3. The two gross migration equations were jointly estimated. The λ_1, λ_2 and m_2 parameters are the same in the two equations. In addition, the ratio of the long run earnings to house price effects ($\beta_4 \div \beta_6$) is restricted to be the same in the two equations.

Table 7
The Midlands and South of England
Gross and Net Migration Equation Parameter Estimates

Parameter		Net Migration		Gross In Migration		Gross Out Migration	
		Coeff	t Stat	Coeff	t Stat	Coeff	t Stat
m_1 Adjustment Speed		0.606	9.4	0.771	19.9	0.574	12.3
m_2 Variation in Adj. Speed with Property Transactions		1.118	4.6	1.359	6.2		
β_1 Δ Rel Unemp Rate	(Ex. GL)	0	-	0	-	0.016	1.3
	(GL)	-0.197	-4.6	-0.108	-5.0	0.096	3.0
β_2 Rel. Unemp Rate Lagged	(Ex. GL)	0	-	0	-	0	-
	(GL)	-0.031	-1.5	-0.054	-5.0	0	-
β_3 Forecast Δ Rel. Log Earnings Next Year		4.014	2.6	2.664	4.8	0	-
β_4 Rel. Log Earnings		2.467	3.1	1.816 [r]	4.5	-1.206 [r]	-4.7
β_5 Forecast Δ Rel. Log House Prices Next Year		0.577	1.2	0.246	1.4	-0.570	-4.1
β_6 Rel. Log House Prices Lagged		-1.606	-4.5	-0.828 [r]	-6.0	0.550 [r]	5.0
β_7 Rel. Downside Risk Lagged		1.602	4.7	0.484	2.9	-0.696	-3.5
β_8 Rel Lagged Log (Housing Stock / Working Age Population)	(Ex. GL)	4.355	1.6	0.999	0.8	-2.595	-2.6
	(GL)	7.390	4.5	4.671	7.4	-1.235	-1.8
λ_1 Weighting – Labour Market Contiguity Effects		-1.350	-	-1.360	-2.5		
λ_2 Weighting – Housing Market Contiguity Effects		0.205	2.0	0.186	2.1		
Trace		138.5		272.3			

Notes: The Midlands and South of England consists of the East and the West Midlands, Greater London, the South and the South West. Regional fixed effects and time trends are not reported. The two gross migration equations were jointly estimated. The λ_1, λ_2 and m_2 parameters are the same in the two equations. In addition, the ratio of the long run earnings to house price effects ($\beta_4 \div \beta_6$) is restricted to be the same in the two equations.

Table 8
Regional Net Migration Equations by Broad Age Group
Two Step Parameter Estimates 1976 to 2003

Parameter		Ages 16-24		Ages 25-44		Ages 45-64	
		Coeff	t Stat	Coeff	t Stat	Coeff	t Stat
m_1 Adjustment Speed		0.793	13.1	0.734	13.2	0.674	12.4
m_2 Variation in Adj. Speed with Property Transactions		0.168	0.6	0.370	1.7	0.672	2.7
β_1 Δ Rel Unemp Rate	(Ex. GL)	-0.010	-1.8	-0.018	-2.6	0.002	0.6
	(GL)	-0.136	-10.5	-0.130	-5.6	-0.020	-2.0
β_2 Rel. Unemp Rate Lagged	(Ex. GL)	-0.015	-5.2	-0.006	-1.6	-0.002	-0.7
	(GL)	-0.020	-3.6	-0.004	-0.3	0	-
β_3 Forecast Δ Rel. Log Earnings Next Year		1.427	3.2	1.038	1.8	0.287	1.3
β_4 Rel. Log Earnings		0.601	2.7	0.496	1.6	0.100	0.6
β_5 Forecast Δ Rel. Log House Prices Next Year		0.256	2.8	0.665	6.4	0.179	2.8
β_6 Rel. Log House Prices Lagged		-0.032	-0.7	-0.318	-6.9	-0.161	-5.0
β_7 Rel. Downside Risk Lagged		0.429	5.3	0.315	3.9	0.076	1.3
β_8 Rel Lagged log (Housing Stock /	(Ex. GL)	1.544	3.4	3.355	5.1	1.210	7.1
Working Age Population)	(GL)	3.253	9.2	3.232	5.8	0.841	5.6
λ_1 Weighting – Labour Market Contiguity Effects		-0.250	-	-0.250	-	-0.250	-
λ_2 Weighting - Housing Market Contiguity Effects		0.350	-	0.398	4.3	0.898	5.1
Trace		242.7		249.1		245.3	

Notes: See the Notes to Table 3. The dependent variable is the change in the scaled net migration rate for the age group.

Figure 1: Map of Government Office Regions (GORs)

Figure 2: North Region Net Migration - Estimated Pop/Housing Stock, Unemployment and Combined House Price & Earnings Effects

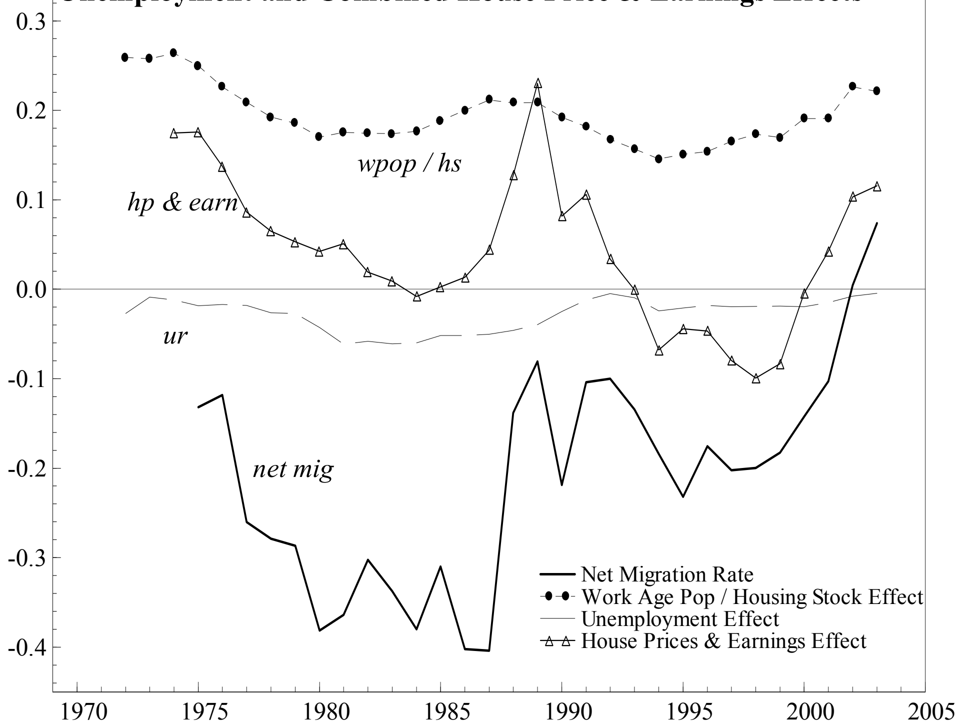


Figure 3: Greater London Net Migration - Estm'd Pop/Housing Stock, Unemployment and Combined House Price & Earnings Effects

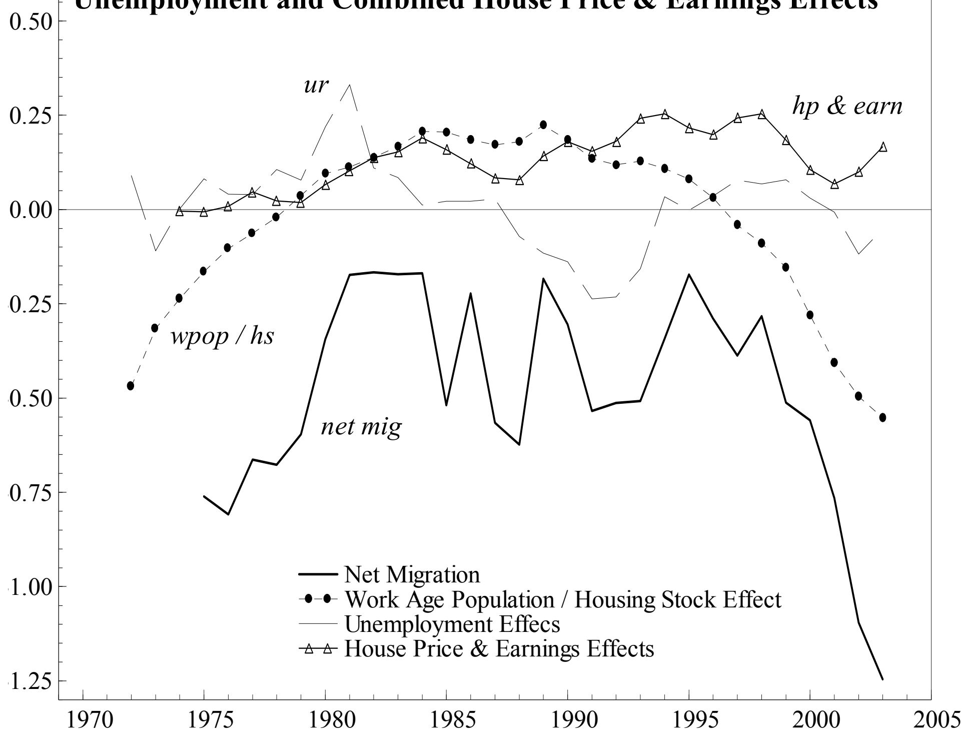


Figure 4: South Region Net Migration - Estimated Pop/Housing Stock Unemployment and Combined House Price & Earnings Effects

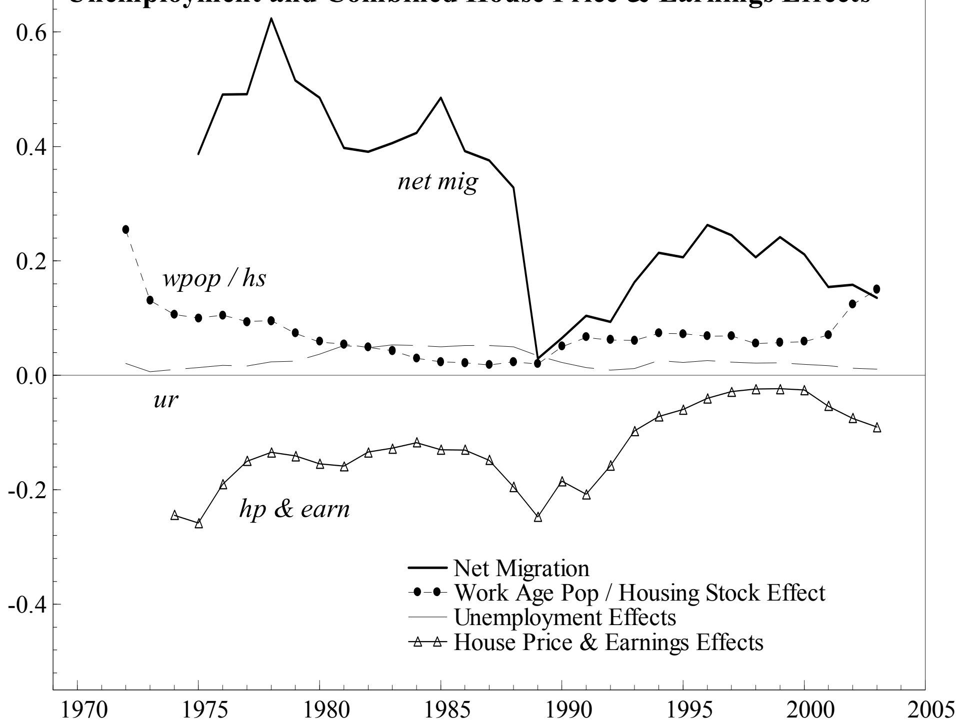
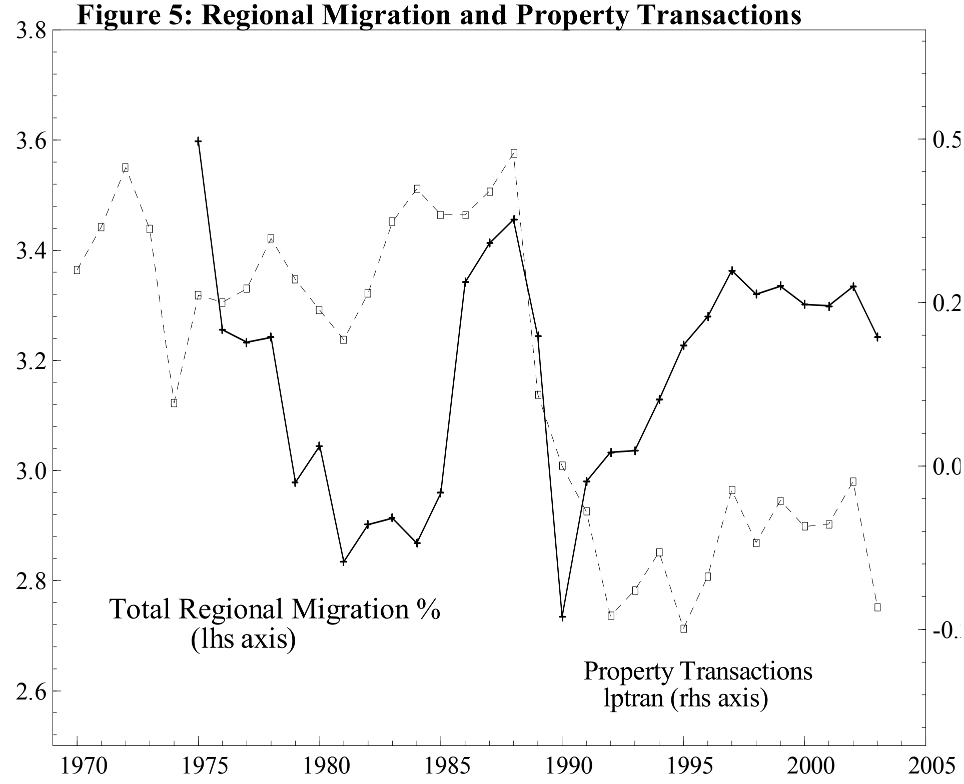


Figure 5: Regional Migration and Property Transactions



Appendix A – Equations Used to Forecast Relative House Prices and Earnings

(a) Semi-Rational One Year Ahead Relative House Price Forecasting Equations

$$
\begin{aligned}
\Delta rel\ \ln\ hp_r \ =\ & \pi_{0r} + \pi_{tr}(year\ -\ 1990) \\
& + \pi_1((1\ -\ w_{1r}\ -\ w_{2r})\Delta rel\ \ln\ hp_{r,-1} + w_{1r}\,\Delta rel\ contig\ \ln\ hp_{r,-1} + w_{2r}\,\Delta rel\ \ln\ hp_{GL,-1}) \\
& -\pi_2 rel\ \ln\ hp_{r,-1} + \pi_3 rel\ contig\ \ln\ hp_{r,-1} + \pi_4 M_4 rel\ rrhneg_{r,-1} \\
& + \pi_5\left(\Delta_2 \ln\ abmr_{-1}\right) rel\ poo_{r,-2} + \pi_6\left(\ln\ abmr_{-1}\right) rel\ poo_{r,-2} \\
& + \pi_7 \Delta \ln\ real\ FTSEneg_{-1}\ +\ \pi_8 \Delta \ln\ (FTSE/pdi)_{-1}\ +\ \pi_9 rel\ \ln\ ft\ earn_{r,-1}
\end{aligned}
$$

Apart from region specific fixed effects and trends, the explanatory variables are: lagged relative house price changes (a weighted average of own region, contiguous region and Greater London effects), lagged houses prices (own region and contiguous regions effects), downside risk (a 4 year average of lagged *rrhneg*), the lagged tax adjusted mortgage rate (second difference and level of *abmr* weighted by the relative proportion of owner occupiers, *poo*, in the region), the change in downside stock market risk (real *FTSEneg* defined in the same way as *rrhneg*), the change in the FTSE relative to personal disposable income (*pdi*) and lagged relative full-time earnings (*ft earn*).

We allowed some coefficient heterogeneity in the Greater London and South equations. Note that the house price forecasting equations are only semi-rational since, inter alia, they do not include demographic, supply side or credit conditions variables. The equations are based on the information set of households as opposed to the information set used in, for example, our house price paper (Cameron, Muellbauer and Murphy (2006)).

(b) One Year Ahead Relative Earnings Forecasting Equations

$$
\begin{aligned}
\Delta rel\ \ln\ ft\ earn_r \ =\ & \alpha_{0r}\ +\ \alpha_{tr}(year\ -\ 1990)\ +\ \alpha_1 \widehat{\Delta rel\ \ln\ hp_r} \\
& + \alpha_2(\Delta rel\ \ln\ emp_{r,-1} + \Delta rel\ contig\ \ln\ emp_{r,-1})/2 \\
& + \alpha_3 \Delta \ln\ real\ FTSE_{-1} + \alpha_4 \Delta \ln\ real\ FTSEneg_{-1} \\
& + \beta[\gamma_1\left(rel\ \ln\ hp_{r,-1}\right) rel\ \ln\ poo_{r,-1}\ +\ \gamma_2\left(\ln\ abmr_{-1}\right) rel\ \ln\ poo_{r,-1} \\
& + \gamma_3 pop\ 5054\ share_{r,-1} + \gamma_4 pop\ 5559\ share_{r,-1}\ +\ \gamma_5 pop\ 6064\ share_{r,-1} \\
& + \gamma_6 ave\ fin\ emp\ share_{r,-1} + \gamma_7 ave\ prod\ emp\ share_{r,-1} \\
& + \gamma_8\left(ave\ prod\ emp\ share_{r,-1}\right) ave\ \ln comp_{-1}\ +\ \gamma_9 ave\ gov\ emp\ share_{r,-1} \\
& -\ rel\ \ln\ ft\ earn_{r,-1}]
\end{aligned}
$$

Apart from region specific fixed effects and trends and a lagged dependent variable, the explanatory variables include forecast relative house price changes $\widehat{\Delta rel \ln hp_r}$, relative own and contiguous region employment changes as well as the lagged relative structure of employment i.e. employment shares in production industries, financial and other business services and government services. The share of production industry employment is interacted with a measure of competitiveness.

We allowed some coefficient heterogeneity in the Greater London and South equations. The earnings forecasting equations are somewhat more elaborate then the house price forecasting equations since relative earnings are more predictable than relative house prices and have a larger individual component.

(c) Measures of Fit

The fit of the forecasting equations is shown in Table A1. The fit is reasonable given that the dependent variable is the change in relative log house prices or earnings in a region. Further details of the forecasting equations are available on request.

Table A1
Fit of One Year Ahead Forecasting Equations for Relative Earnings and House Price Log Changes

Region	House Prices			Earnings		
	Std. Dev. %	Std. Error %	R^2	Std. Dev. %	Std. Error %	R^2
NT North	5.17	2.72	0.72	0.57	0.32	0.65
YH Yorkshire & Humberside	5.26	3.27	0.60	0.80	0.65	0.39
WM West Midlands	3.23	1.96	0.62	1.11	0.89	0.35
EM East Midlands	2.85	1.99	0.55	0.97	0.66	0.54
ST South	2.90	1.43	0.75	0.42	0.25	0.65
GL Greater London	4.46	2.62	0.65	0.81	0.59	0.48
SW South West	2.78	1.92	0.51	1.00	0.70	0.53
WW Wales	4.61	2.32	0.74	0.98	0.68	0.50
SC Scotland	6.60	2.82	0.81	0.89	0.63	0.49

Notes: Std dev = standard deviation of the dependent variable, $\Delta rel \ln hp_r$ or $\Delta rel \ln earn_r$; std. error. = equation standard error.

Appendix B - Data Descriptions

(a) Regional Migration Flows -Data supplied by Office for National Statistics (ONS) based on National Health Service (NHS) central patient register.
(b) House Prices - hp_r = house prices in region r. All regional and national log house price indices, which are derived by linking published Office of the Deputy Prime Minister (ODPM), now Department of Community and Local Government (DCLG), mixed adjusted second hand house price indices, are adjusted by adding an adjustment factor which corrects for composition changes as banks etc. entered the mortgage market (Muellbauer and Murphy, 1997). All indices have been rebased to 1985 using average second hand house price values.
(c) Full Time Earnings - $earn_r$ = total full earnings in April in region r. New Earnings Survey (NES) data linked to Annual Survey of Hours and Earnings (ASHE) data from 2002. We used ⅔ of current earnings and ⅓ of next years earnings value because the data are for April.
(d) Population (pop_r), Working Age Population ($wpop_r$) and Population in Various Age Groups ($pop5054_r$, $pop5559_r$ and $pop6064_r$) – ONS regional population estimates.
(e) Employment and Unemployment Data – emp_r = employment in region r; ur_r = claimant count unemployment rate in region r. Data from Oxford Economic Forecasting (OEF) regional model databank.
(f) Employment in Production, Financial Services and the Government Sector - Data from Oxford Economic Forecasting (OEF) regional model databank.
(g) Housing Stock (hs_r) and Proportion of Owner Occupiers (poo_r) – Linked ODPM / DCLG data.
(h) Return on Housing (rrh_r) and Downside Risk / Negative Return on Housing ($rrhneg_r$) - $rrh_r = \Delta\ln hp_{r,-1} + 0.03 - abmr$ and $rrhneg_r = rrh_r * 1(rrh_r<0)$. where Δlhp_r = first difference of log house price index in region r (source: linked ODPM / DCLG data); $abmr$ = tax adjusted building society mortgage

rate (*bmr*) with the adjustment based on Inland Revenue estimates of the cost of tax relief and $1(rrh_r < 0) = 1$ if rrh_r is negative and 0 otherwise.

(i) Other Variables - *comp* = BIS trade weighted index of competitiveness (real effective exchange rate); *pc* = Consumer expenditure deflator (ONS National Accounts / Blue Book); *pdi* = Personal disposable income (ONS Blue Book); *ptran* = Rate of property transactions in England and Wales, adjusted for right to buy council house sales (ONS Economic Trends and ODPM Housing Statistics); $rabmr = abmr - \Delta \ln pc$ = Real mortgage rate; *FTSE* = FTSE index; real *FTSE* = *FTSE* / *pc*; Δln real *FTSEneg* = Δln (*FTSE* / *pc*) if negative and zero otherwise. It is a proxy for downside risk in the stock market.

(j) Contiguous Variables – A weighted average of the same variables in regions contiguous to region r using full time wage bills to contiguity weights.