MODELLING OUT-MIGRATION RATES IN ENGLAND AND WALES: GLOBAL AND LOCAL MODELS OF MALES AGED 30-44.

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ABSTRACT

In this paper the spatial and temporal patterns of the local parameter estimates of out-migration models in England and Wales for males aged 30 - 44 years old are examined. The data are available from the National Health Service Central Register and relate to the 98 Family Health Service Areas in England and Wales. Using 12 migration determinants, models of out-migration rates were calibrated for 14 annual time periods (1984 to 1997). Both global and local models were calibrated. The latter allow the spatial distribution of the local parameter estimates to be mapped so that both spatial and temporal variations in the determinants of out-migration rates can be examined. The global models were calibrated using standard linear regression techniques; the local models were calibrated by Geographically Weighted Regression using the GWR 2.0 software.

KEYWORDS: Internal Migration, Geographically Weighted Regression, Spatiotemporal Analysis, Local Trends in Migration.

INTRODUCTION

This paper is meant to pilot the undertaking of an extensive exercise looking at internal migration using time series data and new methodologies. It is the first time that such a rich dataset has been made available for the study of migration determinants. The data set includes 15 years of out- migration data and 7 years of migration flows available from the National Health Service Central Register (NHSCR) and relate to the 98 Family Health Service Areas (FHSAs) in England and Wales. The data are aggregated into 14 sex/age groups. There are 7 age groups based on people's life stage and these are broken down into males and females. In this paper we examine only the behaviour of the largest of these 14 migration groups; males aged 30-44.

The aim of this work is to examine trends in UK internal migration. To accomplish this, we investigate the temporal and spatial stability of migration rates. The dataset available includes 140 variables for modelling out-migration rates (push factors) and 60 variables to explain the attraction of destinations to migrants (pull factors). Apart from the traditional modelling using ordinary regression techniques, we analyse the data by Geographically Weighted Regression (Brunsdon et al., 1996; Fotheringham et al., 2000). The latter technique allows spatial variations in the determinants of migration rates to be examined. Here, we are looking only at local and global models of out-migration rates of males aged 30-44 using 14 migration determinants for 14 years of data (1984 to 1997).

In the sections that follow we describe the migration determinants used in detail and we briefly present the methodology used. Due to space constraints here, we only present and interpret the important variables and trends of our analysis. In the final section we report some conclusions and suggestions for future work in this area.

BACKGROUND

Over the last 50 years there has been a great deal of work attempting to explain internal migration in many countries. However, many of these studies

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have been severely limited in terms of data on explanatory variables and, as a consequence, suffer sever potential misspecification biases.

An interesting area of debate that may be related to misspecification bias concerns the significance of economic variables acting as push factors in the production of migrants. This is part of the Lowry Hypothesis about what affects net migration in an area. A group of authors (such as Alonso, 1972, 1973; Feder, 1982; Lansing and Mueller, 1967; Lowry, 1966; Morrison, 1975; and Morrison and Relles, 1975) argue that there is no significant relationship between economic conditions and out-migration. They base their work on Lowry's observation that labour market conditions at the origin zone are irrelevant to the determination of migratory outflow (Lowry, 1966). However, other authors provide empirical evidence against this hypothesis. For example Miller (1973) found employment growth to be the primary economic determinant of out-migration. Greenwood (1975) suggests the income coefficient is usually smaller at the origin than at the destination of a migration trip. The origin income coefficient is sometimes not significantly different from zero and in some cases it is significantly positive (Greenwood, 1971; Greenwood and Ladman, 1978).

The literature suggests that high employment growth, household income and employment rates are more likely to deter out-migration whereas high unemployment rate and house prices increase the number of out-migrants. It is interesting to test the above findings both over time and space. It is likely that some variations will occur over time. This will be demonstrated in the Analysis and Results section.

MIGRATION DETERMINANTS

Table 1. List of variables included in the model and their description.

Variable	Description
AIR_UNLG	Index derived from variables Annual mean of NO_2 and Ozone (unlogged)
CLIMATE_UNLG	Index derived from variables Sunny days, Rainfall, Mean July temperature and Frosty days (unlogged)
CRIME_UNLG	Index derived from Rate of Offences, Household Insurance Premium Index, and Crime a serious problem index (unlogged)
NONWH	Non white persons (% total)
TER	Terraced (% total dwellings)
ASUNEM_L	Age specific unemployment rate lagged (by 1 year)
EMPGRO_L	Employment growth lagged (by 1 year)
EMPR_L	Employment rate lagged (by 1 year)
GCSE_L	5(+) GCSEs at grade C or above (% 16 year olds obtaining) lagged (by 1 year)
HHINC_L	Household income lagged (by 1 year)
HPRICE_L	House price (average) lagged (by 1 year)
PVAC_L	Vacant all sectors (% all dwellings) lagged (by 1 year)
TPOPN_Y_L	Regional Variable of total population lagged (by 1 year)
LONDONDUMMY	London Dummy (1 for London Boroughs, 0 elsewhere)

In the work reported here, the dependent variable is the out-migration rate per thousand population and the independent variables include representatives from several types of variables used in migration modelling. These include environmental determinants (AIR_UNLG, CLIMATE_UNLG), housing determinants (TER, HPRICE_L, PVAC_L), employment determinants (ASUNEM_L, EMPGRO_L, EMPR_L), economic determinants (HHINC_L), social determinants (GCSE_L, CRIME_UNLG), demographic determinants (NONWH), and spatial structure determinants (TPOPN_Y_L, LONDONDUMMY). The variable TPOPN_Y_L is calculated as an index that compares the total population in a zone with the total population of the surrounding zones weighted by a second power of distance. It is used to capture a pull effect produced when an origin is surrounded by very populous zones that draw migrants from the origin. The London Dummy is used to capture unique effects of the capital city that are not captured in any other way. A description of the variables is shown in Table 1.

METHODOLOGY

In this section a very brief description of methodological issues are discussed. The data preparation exercise includes two tasks. One is the adjustment of out-migration data of males so that the male to female ratios of the NHCSR data equal those of the 1991 Census Special Migration Statistics. This is necessary to remove the undercount of young males in the NHSCR data caused by moving adult males delaying registering with a GP before they face a health problem (Rees, 1996; Boden et. al., 1992). The second task is to lag by one year those variables for which annual data are available (ASUNEM_L, EMPGRO_L, EMPR_L, GCSE_L, HHINC_L, HPRICE_L, PVAC_L, TPOPN_Y_L) so that migration in one year is explained by the economic and housing conditions of the previous year.

The indexes AIR_UNLG, CLIMATE_UNLG and CRIME_UNLG are each the first principal component of a principal component analysis on corresponding sets of explanatory variables. The global models have been calibrated using Ordinary Linear Regression within SPSS. The dependent and most of the independent variables have been logged (natural logarithm). Only the London dummy and the principal components have not been logged since their values are negative or zero for some areas. The selection of the significant variables in global models has been made using stepwise regression within SPSS.

There are 28 global models and 1372 local models calibrated; each of the latter containing 14 parameter estimates. The global models have been calibrated for 14 years; one set with all the 14 variables in the model and a second set with only the significant variables in the model (obtained from a prior stepwise regression). The local models include all variables and have been calibrated using data for each of the FHSAs for each of 14 time periods.

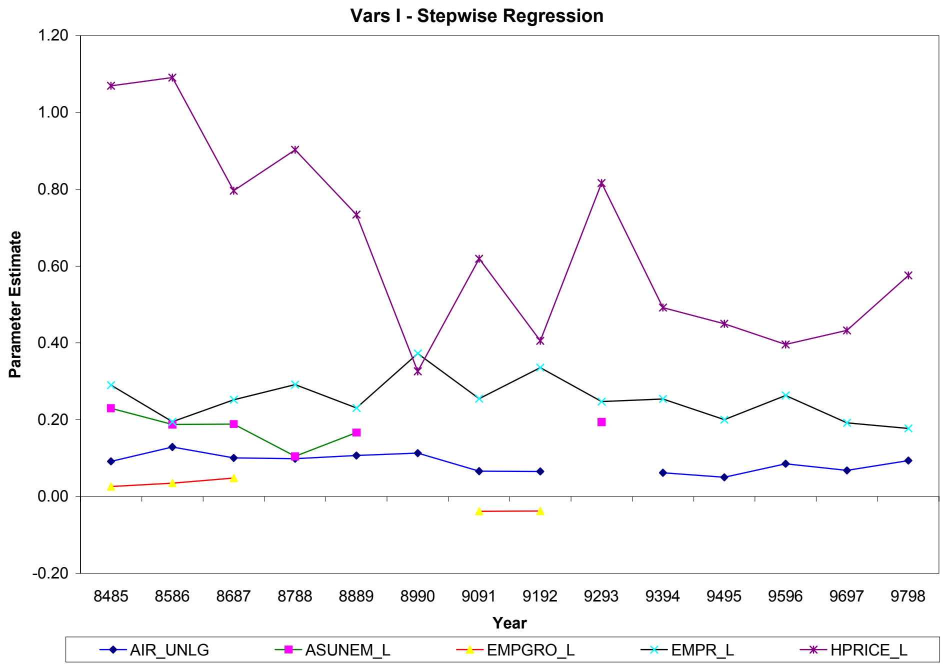
The local models have been calibrated using the GWR 2.0 software. In Geographically Weighted Regression there are two tasks involved: the selection of the kernel and the selection of the bandwidth (Fotheringham et. al., 2000). Here a fixed kernel type has been used. The bandwidth selection has been made by an Akaike Information Criterion (AIC) minimisation function, implemented within the software. The models are fit at the data points, the centroids of the polygons representing the 98 FHSAs in England and Wales.

ANALYSIS AND RESULTS

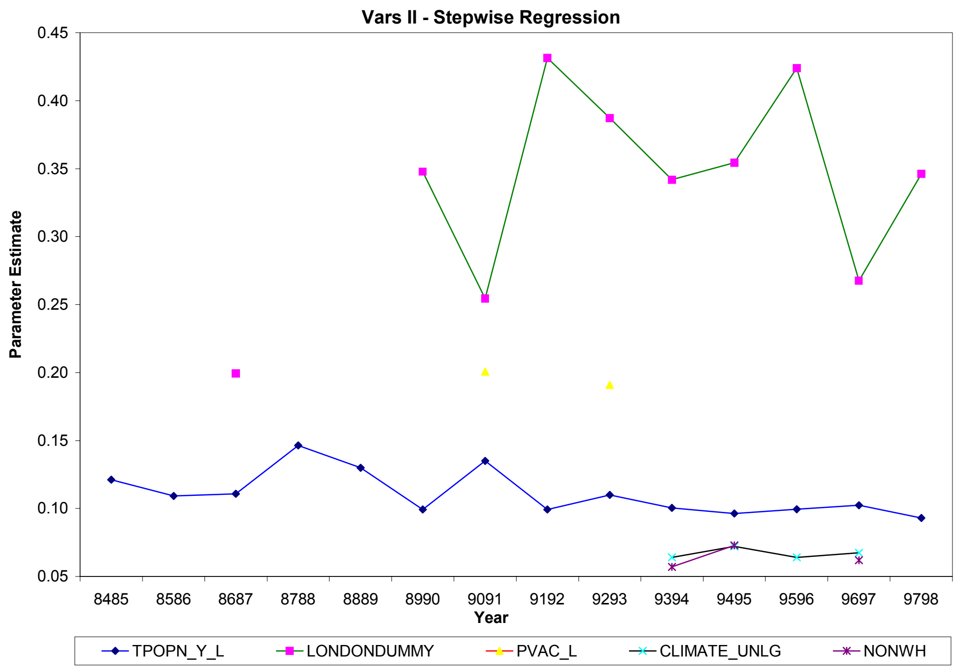
In this section only some of the results are presented. We demonstrate the temporal variation in the parameter estimates. For example, employment growth parameter estimates (Figure 1.a and Figure 3) are positive in the mid 1980s and negative in the early 1990s. The spatial variation of the local parameter estimates, not previously examined in a migration context, suggests that findings in a global model can be misleading. The significant spatial variation of employment rate (Figure 5) would have never been observed since the parameter estimates in the global model (Figure 1.a) are stable over time.

1. Global Results

First, the parameter estimates of the global models for 14 years are presented in two charts (Figures 1a and 1b). The models for which the parameters are estimated contain only the statistically significant variables. Out of the 14 variables (Table 1) only five appear to be significant in most of the time periods under investigation: house prices; employment rate; total population in surrounding areas; air; and the London dummy.



a.



b.

Figure 1. Parameter estimates of global models using stepwise regression

House prices and London Dummy parameter estimates are not stable over time, whereas most of the rest are. Employment growth appears to induce out-migration during the mid-1980s whereas it becomes negative in early 1990s. Almost every parameter estimate is positive over time.

2. Local Results

Some summary statistics of the results of calibrating local models are now presented. Three out of 14 sets of boxplots shown in Figures 2 - 4 provide an indication of the spatial variation and temporal trends of parameter estimates in local models. In those figures it is easy to extract the mean (bold black line in the middle of each box), the range and the outliers of the parameter estimates. The wider a box is, the more likely the local parameter estimates exhibit a significant spatial variation.

The relationship between out-migration rates and sex/age unemployment rates appear to have an increased spatial variation in early and mid 1990s. The mean of this variable declines during 1980’s with a peak in 1986-87 mid year. It experiences a low in 1991-92 and increases in mid 1990s with a second decline phase in late 1990s. In contrast, employment growth parameter estimates appear to have relatively little spatial variation. The parameter estimates for household income exhibit relatively large spatial variation in late 1980s and early 1990s. Interestingly, while the mean is negative from 1984 to 1989 it becomes positive from 1990 to 1998. It is important to note that this variable has not been found significant in any year in the global models. The latter is evidence for the importance of this work to identify trends that traditional global empirical work missed.

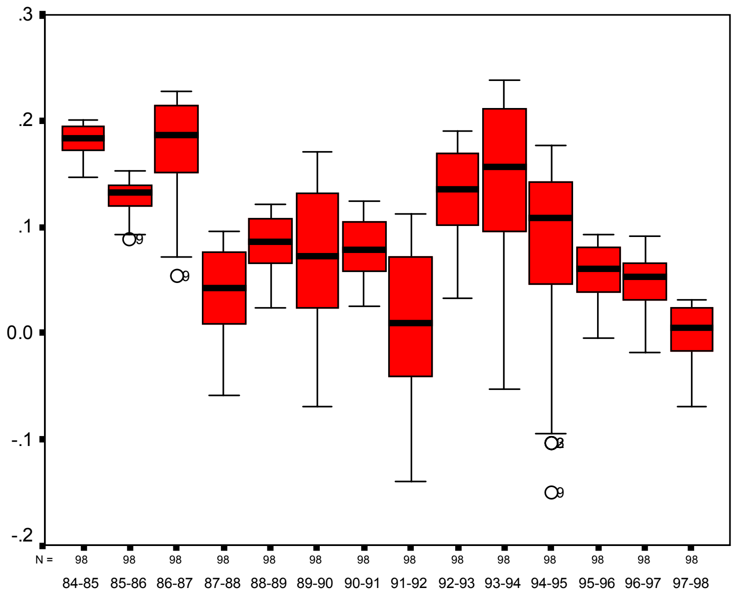


Figure 2. Parameter Estimates of Age/Sex Unemployment (Unlogged).

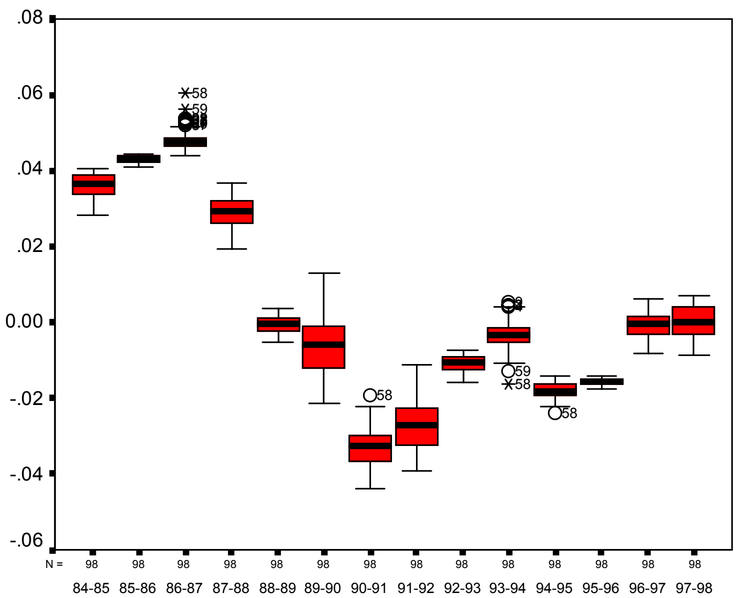


Figure 3. Parameter Estimates of Employment Growth.

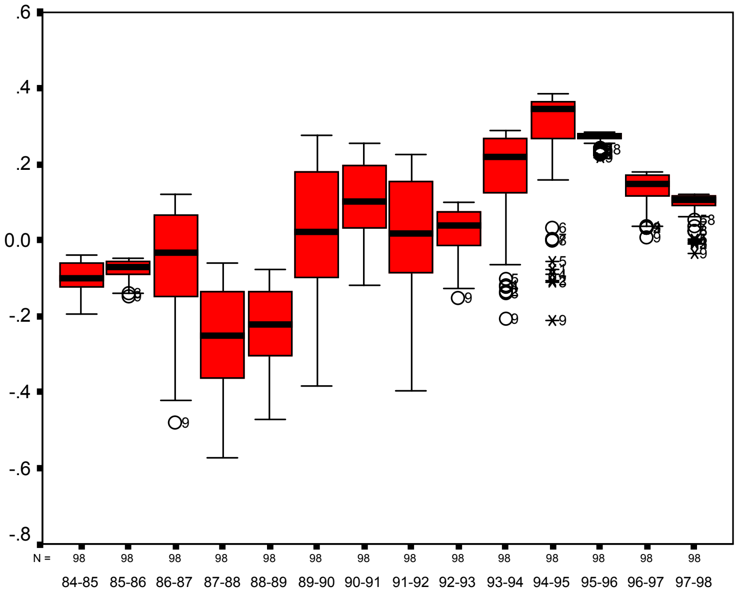


Figure 4. Parameter Estimates of Household Income.

The significance of the spatial variation of the variables under examination is presented in Table 2. The tests are based on the Monte Carlo significance test procedure due to Hope (1968). A variable has as significant spatial variation when the test value is equal or less than 0.05. In Table 2, the variables that satisfy this criterion are presented in bold fonts and those that the test value is above 0.05 and below 0.1 in italics. Only half of the variables appear to significantly vary over space at least one year of the examination period. The local parameter estimates associated with the variables EMPR, HHINC and HPRICE appear to exhibit a fair degree of spatial nonstationarity in various time periods. The local parameter estimates associated with the other variables are more stable.

Table 2. Tests based on the Monte Carlo significance test; males aged 30-44.

	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98
Intercept	0.14	0.16	**0.05**	0.19	0.13	0.12	0.18	**0.04**	*0.06*	**0.01**	0.14	0.51	0.80	0.64
AIR_UNLG	0.57	0.60	0.71	0.80	0.83	0.81	0.73	0.41	0.49	0.81	0.64	0.87	0.74	0.85
CLIMATE_UNLG	0.29	0.51	0.44	0.62	0.86	0.32	0.38	0.75	0.57	0.32	0.60	0.62	0.72	0.43
CRIME_UNLG	0.38	0.28	0.73	0.23	0.18	**0.02**	0.59	0.91	0.53	0.82	0.48	0.43	0.69	0.55
NONWH	0.73	0.80	0.67	0.56	0.18	0.22	0.50	0.56	0.59	0.78	0.45	0.47	0.28	0.49
TER	0.37	0.32	0.52	0.30	0.80	0.88	0.80	0.42	0.69	0.37	0.20	0.38	0.35	0.40
ASUNEM_L	0.39	0.32	0.16	**0.04**	0.25	**0.05**	0.20	*0.07*	0.13	0.26	0.27	0.38	0.38	0.60
EMPGRO_L	*0.06*	0.79	0.57	0.12	0.48	*0.09*	**0.04**	0.18	0.53	0.30	0.67	0.84	**0.03**	**0.00**
EMPR_L	0.23	0.17	**0.04**	**0.03**	**0.02**	*0.07*	0.11	**0.02**	**0.03**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
GCSE_L	0.13	0.17	0.60	0.78	0.97	0.47	0.54	0.62	0.69	0.29	0.43	0.53	0.40	0.22
HHINC_L	0.25	0.52	**0.01**	**0.00**	**0.02**	**0.05**	*0.09*	*0.08*	0.28	0.21	0.22	0.87	0.46	0.64
HPRICE_L	0.19	0.21	0.43	0.63	0.91	0.73	0.92	**0.00**	0.10	**0.01**	**0.01**	**0.05**	0.56	**0.04**
PVAC_L	0.31	0.62	0.26	0.43	0.14	0.87	0.50	0.53	0.26	0.55	0.72	0.54	0.55	0.70
TPOPN_Y_L	0.67	0.39	0.42	0.67	0.99	0.90	0.94	0.71	0.47	0.40	0.19	0.37	0.54	0.30
LONDONDUMMY	0.86	0.65	0.20	0.33	0.22	0.10	0.29	**0.04**	0.16	**0.03**	**0.04**	0.19	0.11	0.11

Finally, in Figure 5, a set of 12 maps represent the spatial distribution of the parameter estimates for employment rate, as this variable has a significant spatial variation for 10 out of 14 years of analysis. Although the range of the parameter estimates varies over time, the spatial patterns appear to be very stable and the North-South, or better, North East - South East divide very clear. It seems that high employment rates have a double or triple effect in producing out-migrants from the North East than at the South East. This divide is stronger after 1991.

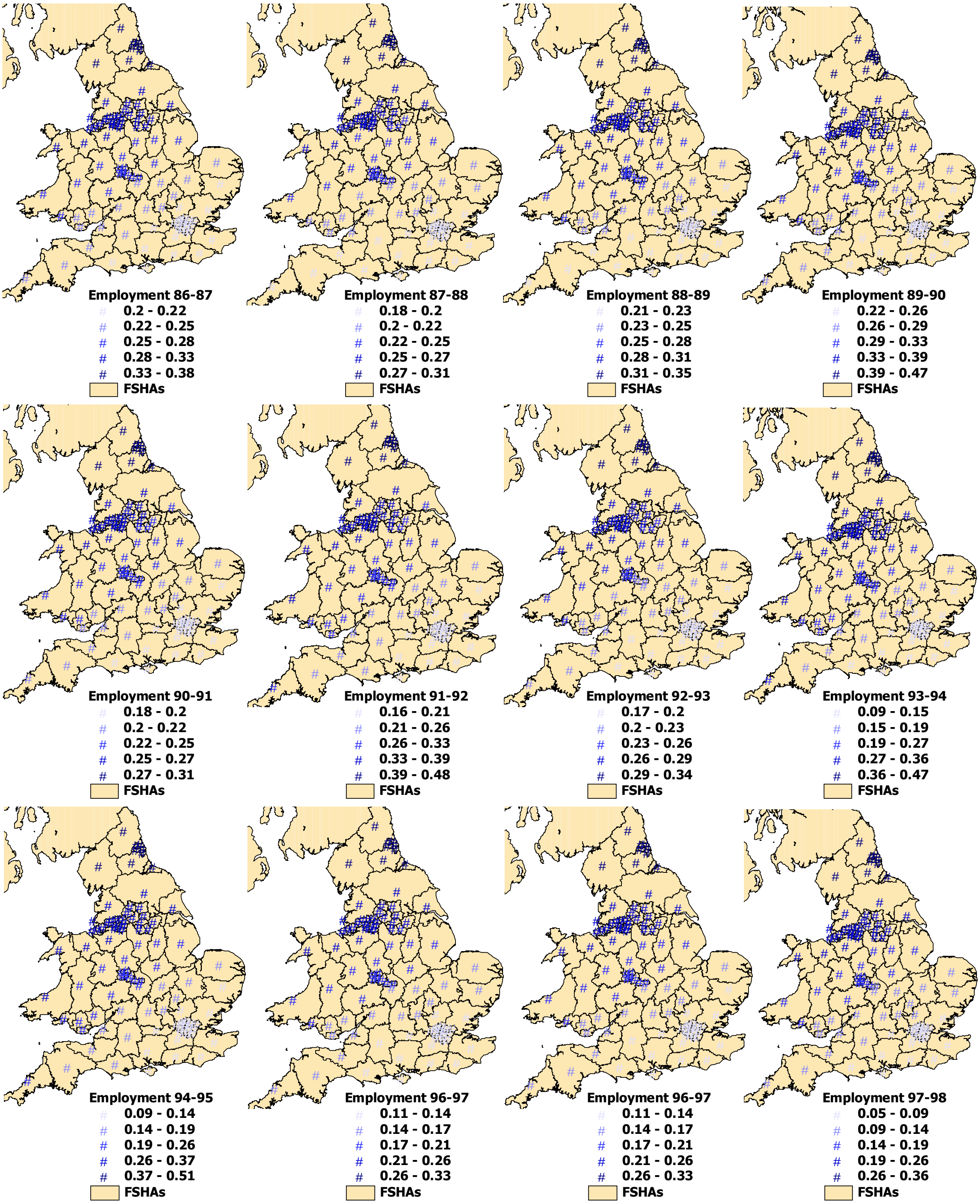


Figure 5. Spatial Variation of parameter estimates for employment rates.

CONCLUSIONS

In this paper we examine the trends of parameter estimates of out-migration models for males aged 30-44. It is important to stress that local models can reveal the spatial variation of the parameter estimates that otherwise would have been missed. In traditional global modelling there is evidence that certain labour force variables, such as employment rate are significant out-migration components and have a significant spatial variation. Finally, there are very interesting temporal trends such as the role and significance of housing variables in affecting out-migration. However, more detailed examination of the relationships between migration and its determinants is left to another time due to space constraints in this paper.

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