An examination of the drivers of spatial employment and population growth within the rural economy

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Abstract

Regional employment and population change have displayed considerable spatial disparities within Northern Ireland in recent years. It is important to gain a better understanding of the causes of these spatial disparities to facilitate the development of effective policies to promote economic growth within the rural economy. Growth equilibrium models provide a means to examine the multiple, integrated economic, social and geographical factors that contribute to economic growth and analyse their synergistic effect on each other (Adelaja *et al.*, 2009). This modelling framework has been developed to analyse the interaction of economic phenomena occurring in spatial dimensions and account for interdependencies between population and employment change. This study applies the growth equilibrium model framework to analyse the linkages between population and employment patterns and other exogenous determinants of spatial growth within Northern Ireland. The analysis is based on ward level data over the period 2001 to 2007. The analysis suggests that employment and population growth are interdependent. An increase in population has a positive impact on employment, while an increase in employment has a positive impact on population. Moreover, there is evidence that the spatial spillover effects are significant, indicating that changes in employment/population growth in one region has knock-on impacts on neighbouring regions.

Keywords Rural development, regional growth and growth equilibrium model

JEL code Q1, R1 and R2

An examination of the drivers of spatial employment and population growth within the rural economy

1. Introduction

There are considerable spatial disparities in terms of regional economic growth, measured in terms of employment and population changes over time, within the rural economy of Northern Ireland in recent years. While some rural areas within Northern Ireland have waned, others have displayed strong economic growth. This presents challenges to policy makers in terms of provision of adequate infrastructure such as roads, schools and other public services. In addition, residential and industrial development associated with strong economic growth may lead to loss of agricultural land; habitat fragmentation; degradation of the rural landscape; and increased traffic levels. Understanding the causes of spatial disparities in economic growth will facilitate the development of effective policies to promote rural development. This requires a systematic framework to accurately identify the drivers of growth.

Growth equilibrium models provide a means to examine the multiple, integrated economic, social and geographical factors that contribute to economic growth and analyse their synergistic effect on each other (Adelaja *et al.*, 2009). This modelling framework has been developed to analyse the interaction of economic phenomena occurring in spatial dimensions and account for interdependencies between population and employment change. Using data from rural wards in Northern Ireland over the period 2001 to 2007, this paper describes the application of a growth equilibrium model framework to analyse the linkages between population and employment patterns and other exogenous determinants of spatial growth. The model framework provides an insight into:

- the relative responsiveness of different forms of economic growth (employment and population) to a variety of growth drivers, e.g. infrastructure and socio-economic conditions;
- how different forms of economic growth work together (the extent to which 'people follow jobs' and/or 'jobs follow people'); and
- the linkages between economic growth in rural and urban areas.

Preliminary results are presented using a range of specifications, which will form the basis of future model development.

2. Methodology and Data

Methodology

The growth equilibrium modelling framework used to estimate the relative contributions of alternative drivers of growth is outlined below. Growth equilibrium models measure the linkages between population and employment change patterns and other exogenous determinants of economic growth. They are based on the premise that residential and firm location choices are interdependent. People move to regions in which employment growth is high. The reverse also potentially applies, firms move to regions in which population growth is high due to the availability of labour and demand for final goods. This interdependence implies that a simultaneous relationship exists between regional population and employment changes. In addition to being interdependent, employment and population growth are each affected by a variety of other factors. For example, population growth may be affected by house prices, socio-economic conditions, amenities, etc., while factors such as infrastructure, availability of an educated labour force and structure of the economy may affect employment growth (Adelaja *et al.*, 2009).

This study follows the partial adjustment framework developed by Steinnes and Fisher (1974). This framework leads to the following employment and population change equations, which can be econometrically estimated:

(i) $\Delta E = \alpha_E + \beta_{1E}E_{t-1} + \beta_{2E}P_{t-1} + \gamma_{1E}\Delta P + \sum\delta_{iE}\Omega^E + \mu$

(ii) $\Delta P = \alpha_P + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \gamma_{1P}\Delta E + \sum\delta_{iP}\Omega^P + \varepsilon$

where ΔE and ΔP are the region's changes in population and employment; E_{t-1} and P_{t-1} are initial conditions of population and employment. The set of variables contained in Ω represents the characteristics of the region at the beginning of the period. Equations (i) and (ii) indicate that employment and population changes depend on their own initial levels, respective changes in employment and population and a vector of exogenous factors. Within this paper, we refer to equations (i) and (ii) as the basic specification for employment and population change. Estimation is complicated by the interdependence between employment and population change, which leads to an endogeneity problem. This issue may be addressed using Two-Stage Least Squares (TSLS). However, there is a cost associated with using TSLS. When there is not an endogeneity problem associated with the empirical data, TSLS is not as efficient as OLS and hence, endogeneity tests are undertaken to assess the extent of this problem (Durbin-Wu-Hausman test). The efficiency of TSLS can be improved using Generalised Method of Moments (GMM) and hence, GMM estimation is implemented in this analysis. However, OLS remains the most efficient when there is no endogeneity problem.

Alternative model specifications allow for spatial spillover effects, wherein growth in population or employment in one area could spillover to neighbouring areas. Population change in an area may depend not only on employment changes in that area but also employment changes in a labour market that extends beyond the unit of observation. Similarly, employment changes may depend on population changes in surrounding areas. Spillover effects are particularly important where there is extensive commuting across the units of analysis, rendering individual units too small to be their own labour market. Following Boarnet (1994), this may be addressed by adding spatial lags of the endogenous variable (weighted averages of neighbouring areas) to the basic model. Within this specification, population change is dependent upon the change in employment aggregated over all areas within commuting range, while employment change is dependent upon the change in population within commuting range of the area in question. Within the spatial econometric literature this is known as a spatial cross-regressive lag model. The spatial cross-regressive models used in this study are as follows:

(iii) $\Delta E = \alpha_E + \beta_{1E}E_{t-1} + \beta_{2E}P_{t-1} + \gamma_{1E}(I+W)\Delta P + \sum\delta_{iE}\Omega^E + \mu$

(iv) $\Delta P = \alpha_P + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \gamma_{1P}(I+W)\Delta E + \sum\delta_{iP}\Omega^P + \varepsilon$

where I is an identity matrix and W is a spatial weight matrix (with diagonal terms equal to zero), which defines how geographic units of observation relate to their neighbours. Essentially, the spatial cross-regressive term $(I+W)\Delta P$ is the weighted average of population change within the area in question and neighbouring areas, while $(I+W)\Delta E$ is the weighted average of employment change within the area in question and neighbouring areas. Typically most studies employ a distance weights matrix, wherein geographic regions that are further away are weighted less heavily and hence, the spatial spillover effect diminishes with distance. However, distance may not accurately capture regional connectivity. In contrast, this study employs a weight matrix based on commuting data from the 2001 census, with each element equal to the number of commuters travelling between specific wards[1]. Compared to the standard distance weight matrix, the commuting weight matrix is regarded as preferable from a theoretical point of view since it allows the labour market area (or commuter-shed) centred on any one area to be based on actual commuting patterns between that area and other areas.

The spatial cross-regressive terms in (iii) and (iv) make no distinction between urban and rural wards, i.e. all wards within the commuter-shed are treated the same. However, spatial spillover effects may differ between rural and urban wards due to underlying differences in the linkages between these areas. Differential spatial spillover effects for rural and urban wards may be accounted for by decomposing the spatial cross regressive term into rural and urban effects. Following Fesser and Isserman (2006), this is achieved through interaction terms:

(v) $\Delta E = \alpha_E + \beta_{1E}E_{t-1} + \beta_{2E}P_{t-1} + \gamma_{1E}\Delta P + \gamma_{2E}WP_{t-1}U + \gamma_{3E}WP_{t-1}M + \gamma_{4E}WP_{t-1}R + \gamma_{5E}\Delta WPU + \gamma_{6E}\Delta WPM + \gamma_{7E}\Delta WPR + \gamma_{8E}U_{dummy} + \gamma_{9E}U_{dummy}\Delta WPU + \gamma_{10E}U_{dummy}\Delta WPM + \gamma_{11E}U_{dummy}\Delta WPR + \sum\delta_{iE}\Omega^E + \mu$

(vi) $\Delta P = \alpha_P + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \gamma_{1P}\Delta E + \gamma_{2P}WE_{t-1}U + \gamma_{3P}WE_{t-1}M + \gamma_{4P}WE_{t-1}R + \gamma_{5P}\Delta WEU + \gamma_{6P}\Delta WEM + \gamma_{7P}\Delta WER + \gamma_{8P}U_{dummy} + \gamma_{9P}U_{dummy}\Delta WEU + \gamma_{10P}U_{dummy}\Delta WEM + \gamma_{11P}U_{dummy}\Delta WER + \sum\delta_{iP}\Omega^P + \varepsilon$

Within the employment change equation

γ_{2E} to γ_{4E}: coefficients for spatially weighted initial population in urban/mixed/rural areas on rural areas

γ_{5E} to γ_{7E}: coefficients for spatially weighted change in population in urban/mixed/rural areas on rural areas

[1] Within the population change equation, the weight matrix used for the employment change variable refers to where people commute to since it is hypothesised that population is dependent upon nearby employment opportunities. In contrast, the weight matrix for population change within the employment change equation is based on where people come from.

$\left.\begin{array}{l}\gamma_{5E} + \gamma_{9E} \\ \gamma_{6E} + \gamma_{10E} \\ \gamma_{7E} + \gamma_{11E}\end{array}\right\}$ coefficients for spatially weighted change in population in urban/mixed/rural areas on urban areas

Within the population change equation

γ_{2P} to γ_{4P}: coefficients for spatially weighted initial employment in urban/mixed/rural areas on rural areas

γ_{5P} to γ_{7P}: coefficients for spatially weighted change in employment in urban/mixed/rural areas on rural areas

$\left.\begin{array}{l}\gamma_{5P} + \gamma_{9P} \\ \gamma_{6P} + \gamma_{10P} \\ \gamma_{7P} + \gamma_{11P}\end{array}\right\}$ coefficients for spatially weighted change in employment in urban/mixed/rural areas on urban areas

In summary, six equations are presented as part of this preliminary analysis:

(i) Basic employment change specification;
(ii) Basic population change specification;
(iii) Spatial cross-regressive employment change specification;
(iv) Spatial cross-regressive population change specification;
(v) Urban-rural spillover employment change specification; and
(vi) Urban-rural spillover employment change specification.

Data Definitions and Descriptive Statistics

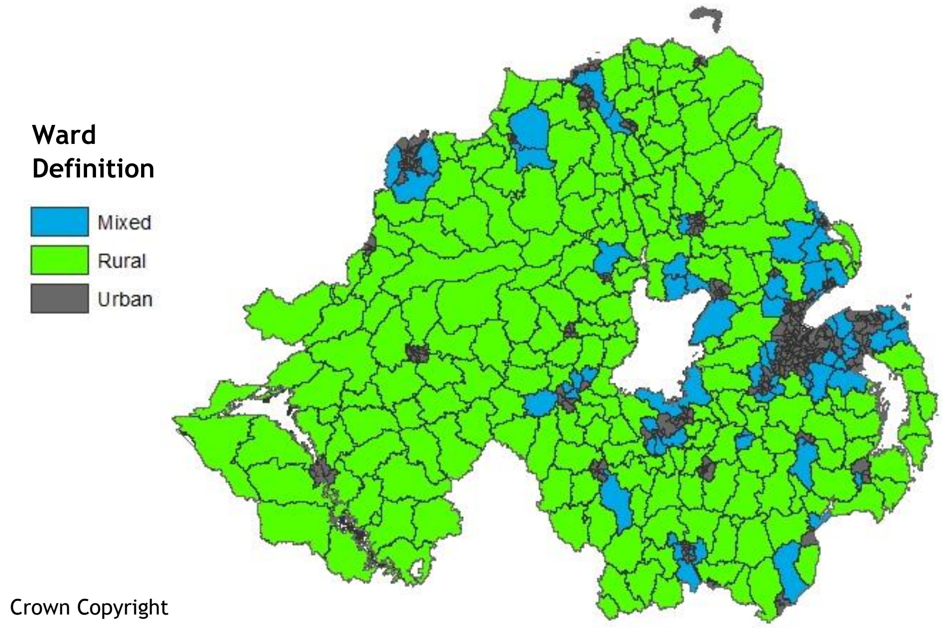
Wards within Northern Ireland are used as the unit of observation within the analysis outlined in this paper[2]. Wards are classified as rural, urban or mixed using the settlement-based approach adopted by the Inter-Departmental Urban-Rural Definition Group (NISRA, 2005). The inter-departmental group defined settlements on the basis of settlement development boundaries and classified settlements with a population above 4,500 as urban and geographic areas outside these boundaries as rural. Census output areas are defined as urban or rural depending on whether the population weighted centroid of an area falls inside or outside these boundaries. These are then aggregated to create definitions at the ward level. Where a ward is composed of both urban and rural census output areas it is classified as mixed. Under this classification system 212 wards are classified as rural, 306 as urban and 64 as mixed. This classification system is depicted graphically at the ward level in Figure 2.

The extent to which drivers of economic growth may influence employment/population change may differ for urban and rural wards. Since the focus of this study is on the rural economy, model specifications (i) to (iv) are restricted to just rural wards. Note, however, the spatial endogenous terms include spillover effects from urban and mixed areas, i.e. the spillover effects are weighted according to the entire commuting matrix. In contrast, model

[2] It would be desirable to account for interdependencies between NI and RoI but the commuting dataset used in this study provides information on commutes to RoI as a whole, rather than specific small areas within RoI.

specifications (v) and (vi) include both rural and urban wards to allow for differential spillover effects[3].

Figure 2: Rural-urban definition of wards based on the inter-departmental group settlement classification system



Descriptive statistics for the main variables of interest are given in Table 1. The descriptive statistics refer to rural wards only and exclude Ballinderry (ward code 95SS01, which lies within the Lisburn district council) as this ward generates outlier problems[4]. Employment data is obtained from the Census of Employment and refers to non-agricultural businesses. Employment growth between 2001 and 2007 displays considerable variation, with a mean increase of 26 per cent within rural wards. This average increase reflects the favourable economic climate, particularly in the construction sector, over the time period of the data[5]. This is controlled for within the employment equation by including the term 'Percentage of employment construction'. As indicated in Figure 3, employment growth between 2001 and 2007 exhibits some spatial patterns, with spatial clusters of high (red and orange) and low (dark and light green) growth.

Population data is sourced from the small area population estimates provided by NISRA. The percentage variation in population change is less marked, but the overall average change is positive. Similar to employment change, it appears from the geographic depiction of population change shown in Figure 4 that this variable exhibits some spatial patterns. The spatial econometric techniques applied in this study will help to explain this spatial variation in both employment and population change.

[3] Note that mixed wards are excluded from the analysis for these specifications due to problems of finding suitable instruments for the endogenous terms associated with mixed areas. This issue will be explored further at a later date.
[4] Employment growth within this ward significantly exceeds growth elsewhere and consequently, the parameter value differs depending on whether this is included or not. Retaining this observation may provide a false impression of the contribution of the explanatory variables. The robustness of the results to outliers will be explored further at a later date.
[5] At the Northern Ireland level, employment in the construction sector grew by 23 per cent between 2001 and 2007, while the service sector grew by 16 per cent and the manufacturing sector fell by 13 per cent (Census of employment data).

Table 1: Descriptive Statistics

	Mean	Standard Deviation	Minimum	Maximum
(Employment 07/Employment01)-1	0.26	0.38	-0.67	2.13
(Population 07/Population 01)-1	0.09	0.06	-0.07	0.32
Initial Employment	462.89	308.86	31.00	1813.00
Initial Population	2410.46	631.57	769.00	4314.00
% of population with high qualifications	16.15	5.44	7.90	43.28
% of employment construction	15.22	5.33	4.30	29.80
Distance to key corridor (metres)	11538.02	9249.50	220.88	37134.87
% 25 to 44 age group	28.46	2.46	22.73	36.56
% of persons aged 16-74 long-term unemployed	1.48	0.75	0.25	4.90
% of ward agriculture land	93.28	6.56	46.67	99.65
Distance to secondary school (km)	5.37	2.69	0.37	13.75
Distance to opticians (km)	5.45	3.02	0.32	14.67
Median income 2001 (£)	14040.28	2313.94	12500.00	17500.00

A wide range of explanatory variables were considered at the outset. However, many of these variables are highly collinear, which creates estimation problems. Following preliminary exploratory data analysis, the following variables are included within the employment equation:

- '% of population with first degree and above',
- '% of employment construction' and
- 'Distance to key corridor'[6].

A wider range of variables are included within the population equation, namely:

- '% 25 to 44 age group',
- '% of persons aged 16-74 long-term unemployed',
- '% of ward agriculture land',
- 'Distance to key corridor',
- 'Distance to secondary school',
- 'Distance to opticians' and
- 'Median income 2001'.

Estimates of these variables, along with the interdependence between employment and population change are provided in the next section.

[6] These key corridors are based on the Regional Strategic Transport Network developed by the Department of Regional Development.

Figure 3: Employment Change within Rural Wards 2001 to 2007 (Classification based on standard deviation from the mean)

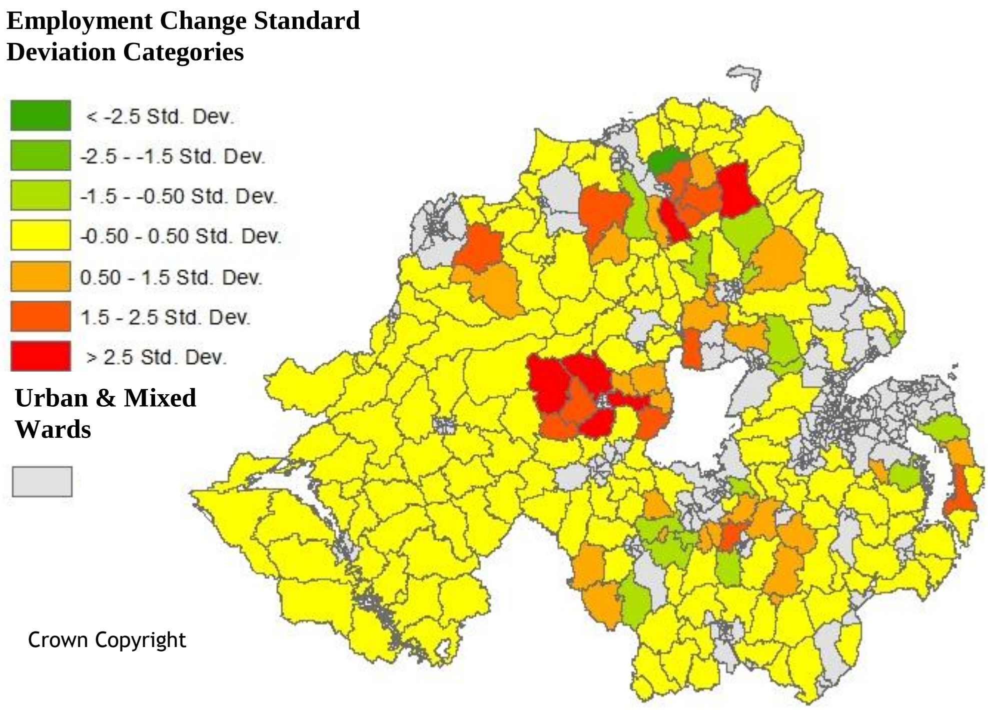
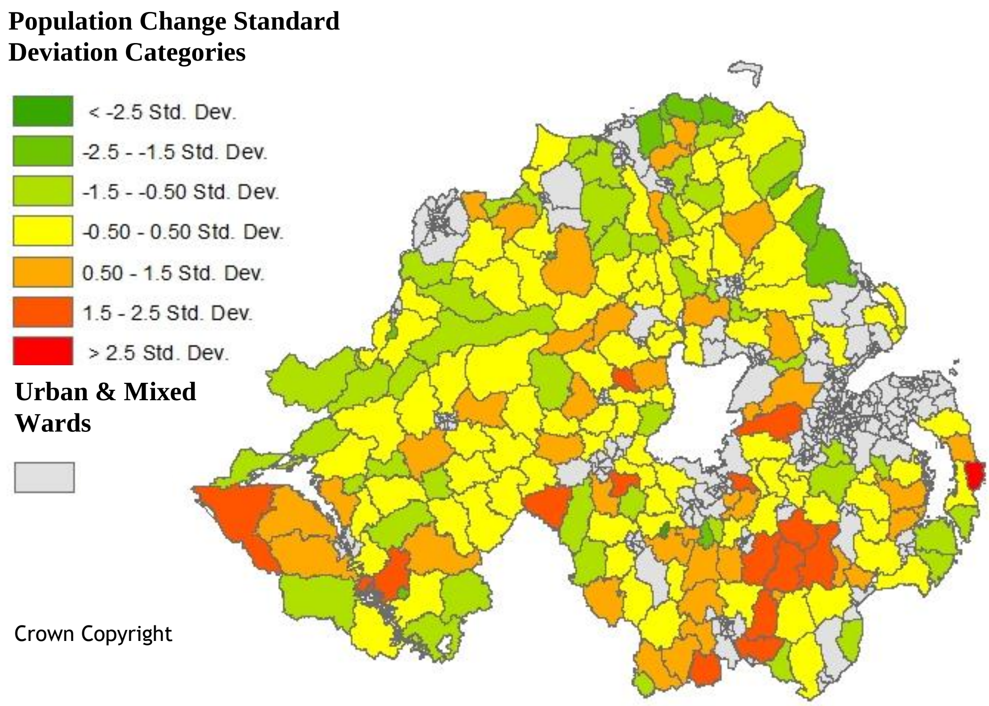


Figure 4: Population Change within Rural Wards 2001 to 2007 (Classification based on standard deviation from the mean)



3. Preliminary Findings

3.1 Basic and Spatial Cross Regressive Models

Employment Change [Models (i) and (iii)]

Estimates of the basic and spatial cross-regressive models for employment change [specifications (i) and (iii)] are shown in Table 2. The estimates for both equations are based on OLS estimation since the GMM estimation produces similar results[7].

Table 2: Employment Change Equations – Basic and spatial cross-regressive specifications

Variable	Basic Model Specification (i) Coefficient	P-value	Elasticity	Spatial Cross-Regressive Model Specification (iii) Coefficient	P-value	Elasticity
Initial Variables						
Initial employment	-0.000293	0.0013	-0.530	-0.000272	0.0027	-0.492
Initial population	1.19E-06	0.9805	0.011	-3.32E-05	0.6239	-0.330
Endogenous Variable						
Population change	0.670434	0.1037	0.237			
Spatial population change				1.558404	0.0175	0.493
Exogenous Variables						
% first degree & above	-0.008580	0.3418	-0.549	-0.007089	0.4502	-0.454
% of employment construction	0.013446	0.0154	0.800	0.012085	0.0298	0.719
Distance to key corridor	-6.11E-06	0.0297	-0.276	-5.35E-06	0.0580	-0.241
Sample size	211 (rural wards only)			211 (rural wards only)		
Estimation	OLS			OLS		

Note: Cells shaded blue are statistically significant at the 1% level
Cells shaded green are statistically significant at the 5% level
Cells shaded red are statistically significant at the 10% level

With regards to the basic model for employment change [specification (i)], the variables 'Initial employment', '% of employment construction' and 'Distance to key corridor' are all significant at the 10 per cent level. The positive coefficient for '% of employment construction' indicates that the economic structure at the beginning of the period affects

[7] While there are some differences in the values of the parameters, the OLS confidence intervals are entirely contained within the GMM confidence intervals.

employment growth. This is unsurprising given that the economic conditions during the time period used in the analysis favoured growth in the construction sector (Census of employment data). The statistically significant negative coefficient for ‘Distance to key corridor’ is consistent with expectations and indicates that distance from key corridors has a negative impact on employment growth. The derived elasticity (evaluated at the means for rural areas), indicates that, holding all other factors constant, a 1% increase in distance from a key corridor has a 0.28% negative impact on jobs. The population change variable is not quite significant at the 10 per cent level (p-value 0.1037).

The estimates for the spatial cross-regressive employment change model [specification (iii)] are fairly close to the basic model. As before, the variables ‘Initial employment’, ‘% of employment construction’ and ‘Distance to key corridor’ are significant at the 10 per cent level and the coefficients are similar to the previous equation. In contrast to the Basic Model, the spatial population change variable, which combines population change within the own ward and neighbouring wards, is significant (p-value 0.0175), indicating that an increase in population in neighbouring wards has a positive impact on employment change. The elasticity value is approximately twice as large as that for the population change variable within the basic model and indicates that a 1% increase in population within the commuting zone results in a 0.49% increase in the number of jobs. This supports the hypothesis that spatial spillover effects are important and the spatial variable provides a more complete measure of the impact of population growth on employment change.

Population Change [Models (ii) and (iv)]

The estimates for the basic and spatial cross-regressive models for population change [specifications (ii) and (iv)] are presented in Table 3. These estimates are based on the GMM estimation procedure since diagnostic tests support the assumption of endogeneity.

Focusing firstly on the basic model for population change [specification (ii)], the following exogenous variables are statistically significant at the 10 per cent level: ‘% 25 to 44 age group’, ‘Long-term unemployed’ and ‘% of ward agricultural land’. The positive coefficient for ‘% 25 to 44 age group’ suggests that wards with a high proportion of people within the young age group attract additional people. In contrast, an increase in the proportion of long-term unemployed is associated with a decrease in population. This is perhaps an indication that it is difficult for economically stressed places to attract new migrants and existing residents tend to move out.

Table 3: Population Change Equations – Basic and spatial cross-regressive specifications

Variable	Basic Model Specification (ii)			Spatial Cross-Regressive Model Specification (iv)		
	Coefficient	P-value	Elasticity	Coefficient	P-value	Elasticity
Initial Variables						
Initial population	1.73E-05	0.096	0.461	1.36E-05	0.213	0.362
Initial employment	2.67E-05	0.241	0.137	1.23E-06	0.795	0.035
Endogenous Variable						
Employment change	0.1465	0.020	0.414			
Spatial employment change				0.2456	0.014	0.539
Exogenous Variable						
% 25 to 44 age group	0.0039	0.094	1.227	0.0044	0.033	1.382
Long-term unemployed	-0.0125	0.078	-0.204	-0.0114	0.165	-0.185
% of ward agricultural land	0.0027	0.005	2.743	0.0025	0.002	2.535
Distance to secondary school	-0.0009	0.640	-0.052	-0.0009	0.552	-0.055
Distance to opticians	-0.0013	0.582	-0.077	-0.0014	0.484	-0.087
Median income	2.56E-06	0.205	0.397	2.90E-06	0.089	0.450
Sample size	211 (rural wards only)			211 (rural wards only)		
Estimation	GMM			GMM		

Note: Cells shaded blue are statistically significant at the 1% level
Cells shaded green are statistically significant at the 5% level
Cells shaded red are statistically significant at the 10% level

It is not straightforward to interpret the variable '% of ward agricultural land'. It is perhaps acting as a proxy for the environmental attractiveness of a region, with individuals attracted to more open space. The distance variables display negative coefficients (locations further away from amenities/services deter population), but are insignificant. The significantly positive coefficient for Median Income indicates that people are attracted to areas with higher average incomes. Finally, the employment change variable is also significant at the 5 per cent level within the basic population change equation. Based on the derived elasticity, a 1% increase in employment within a rural ward leads to a 0.41% increase in population.

The results for the spatial cross-regressive population change equation are comparable to the basic model. While the variable 'Long-term unemployed' is not significant at the 10 per cent level, the magnitude of the coefficients is similar to before. Within this model the spatial employment change variable is significant at the 5 per cent level and suggests that the influence of employment change on population change extends beyond individual areas. The coefficient for this variable is greater than that for employment change within the basic model since the former accounts for the influence of employment change over a wider area.

3.2 Urban-Rural Spillover Model [Models (v) and (vi)]

The following specifications allow for differential spatial spillover effects for urban and rural areas. The results for the urban-rural spillover model for employment change [specification (v)] are presented in Table 4. Focusing first on the exogenous variables, the variables '% first degree & above' and '% of employment construction' are statistically significant at the 10 per cent level. The negative coefficient for the former is perhaps counterintuitive but this is possibly related to the strength of the growth in the construction sector during the period of analysis since typically degree level qualifications are not required for this type of employment. The influence of this variable may differ during a period of recession or non-construction based economic growth. Unlike the previous specifications, the 'Distance to key corridor' variable is not significant. This result needs to be treated with care as it does not necessarily imply that the transport system is not an important driver of economic growth. Rather this may reflect the adoption of the commuting weights matrix within the spatial spillover terms, which implicitly accounts for ease of commuting.

Urban-rural spatial spillover effects are derived based on estimates in Table 4 and presented in Table 5. This table provides an insight into the influence of neighbouring population growth on employment growth. The most important relationship appears to be the impact of population growth in urban wards on employment growth in rural wards. This relationship is significant at the 1 per cent level and the magnitude of the impact is larger than the other relationships shown in Table 5. Rural wards proximate to urban areas displaying strong population growth performed better than those proximate to urban areas in which population growth is less marked. This suggests that population growth in urban areas influences the wider rural economy. The growth in population in urban areas may be generating new employment opportunities in nearby rural areas as the growing population consumes goods and services in these rural communities (Henry *et al.*, 1999). While the other relationships are not statistically significant, the impact of rural population growth on rural employment is positive. The impact of rural population growth on urban employment growth is smaller in magnitude, but still positive.

Similar results emerge for the population change equation. The estimates for the urban-rural spillover model for population change [specification (vi)] are presented in Table 6. In this case, three exogenous variables are statistically significant, namely '% 25 to 44 age group', 'Long-term unemployed' and '% of ward agricultural land'. The combined impact of the interaction terms are shown in Table 7. Again, the most important spatial spillover affect appears to be from urban areas to rural areas. An increase in employment growth in neighbouring urban wards leads to an increase in rural population growth. This is the only spatial spillover effect that is statistically significant.

Table 4: Employment Change Equation – Urban-Rural Spillover [Specification (v)]

Variable	Coefficient	P-value
Initial Variables		
Initial employment	-1.13E-06	0.8782
Initial population	2.19E-05	0.3481
Endogenous Variables		
Population change	0.429433	0.3782
Urban dummy * Population change	-0.451973	0.4296
Spatial weighted initial urban population	1.84E-05	0.7145
Spatial weighted initial mixed population	-2.79E-05	0.3925
Spatial weighted initial rural population	-7.80E-05	0.2473
Spatial weighted population change urban	3.096365	0.0033
Spatial weighted population change mixed	-0.130146	0.8186
Spatial weighted population change rural	1.368450	0.2552
Urban dummy	0.621577	0.3308
Urban dummy * Spatial weighted population change urban	-2.928086	0.0361
Urban dummy * Spatial weighted population change mixed	-0.165588	0.8156
Urban dummy * Spatial weighted population change rural	-0.398789	0.7963
Exogenous Variables		
% first degree & above	-0.010598	0.0813
% of employment construction	0.014671	0.0099
Distance to key corridor	-2.93E-06	0.4070
Urban dummy * Distance to key corridor	-2.83E-06	0.5517
Sample size	512 (rural and urban wards)	
Estimation	OLS	

Note: Cells shaded blue are statistically significant at the 1% level
Cells shaded green are statistically significant at the 5% level
Cells shaded red are statistically significant at the 10% level

Table 5: Influence of neighbouring population growth on ward employment growth

	Influence on employment growth of wards of type	
Neighbouring population growth in wards of type	Urban	Rural
Urban	0.1683	3.0967
Mixed	-0.2957	-0.1301
Rural	0.9697	1.3685

Note: Cells shaded blue are statistically significant at the 1% level
Cells shaded green are statistically significant at the 5% level
Cells shaded red are statistically significant at the 10% level

Table 6: Population Change Equation – Urban-Rural Spillover [Specification (vi)]

Variable	Coefficient	P-value
Initial Variables		
Initial population	-5.74E-06	0.555
Initial employment	4.97E-06	0.002
Endogenous Variables		
Employment change	0.1570	0.178
Urban dummy * Employment change	-0.0694	0.648
Spatial weighted initial urban employment	2.07E-07	0.955
Spatial weighted initial mixed employment	-4.66E-06	0.500
Spatial weighted initial rural employment	2.67E-05	0.503
Spatial weighted employment change urban	1.4553	0.067
Spatial weighted employment change mixed	-0.2273	0.209
Spatial weighted employment change rural	-0.2960	0.360
Urban dummy	0.1828	0.422
Urban dummy * Spatial weighted employment change urban	-1.7045	0.179
Urban dummy * Spatial weighted employment change mixed	0.3340	0.355
Urban dummy * Spatial weighted employment change rural	0.3101	0.518
Exogenous Variables		
% 25 to 44 age group	0.0067	0.000
Long-term unemployed	-0.0115	0.076
% of ward agricultural land	0.0009	0.001
Distance to secondary school	0.0032	0.350
Distance to opticians	-0.0023	0.501
Median income	-4.02E-07	0.903
Distance to key corridor	2.93E-06	0.197
Urban dummy * Distance to key corridor	-2.41E-06	0.472
Sample Size	512 (rural and urban wards)	
Estimation	GMM	

Note: Cells shaded blue are statistically significant at the 1% level
Cells shaded green are statistically significant at the 5% level
Cells shaded red are statistically significant at the 10% level

Table 7: Influence of neighbouring employment growth on ward population growth

Neighbouring employment growth in wards of type	Influence on population growth of wards of type: Urban	Rural
Urban	-0.249	1.455
Mixed	0.107	-0.227
Rural	0.014	-0.296

Note: Cells shaded blue are statistically significant at the 1% level
Cells shaded green are statistically significant at the 5% level
Cells shaded red are statistically significant at the 10% level

4. Conclusions

The results are preliminary and thus the following conclusions are tentative.

Overall, the evidence outlined in this paper indicates that employment and population growth in Northern Ireland are interdependent. The finding that (i) population change influences employment growth and (ii) employment change affects population growth, indicates that 'jobs are drawn to locations that appeal to personal preference' (jobs follow people), in addition to the better known process of 'people are drawn to locations that offer economic opportunities' (people following jobs). From a policy perspective this suggests that rural development strategies should not only focus on creation of work schemes, but should also strive to make rural places desirable places to live. Policies that help to retain or attract people will encourage employment to follow.

At the same time care needs to be taken that population growth does not detract from the desirability of rural places which attract people in the first place. The sustainability of rural development polices should be assessed in terms of the knock-on impact of economic growth to ensure that they do not undermine the desirability of rural areas as places to live. Rural development policies designed to directly stimulate employment growth should be carefully balanced so as to consider the implications on population growth. While the amenity variables within this analysis provide a broad indication of the drivers of residential location decisions, further research using alternatively methodologies is required to explore the role of various factors in determining the attractiveness of areas as places to live.

In addition, the finding of spatial spillover effects means that changes in economic growth in one region has knock-on impacts on neighbouring regions. This implies that rural development policies should not focus on small localised regions but should cover a wider area and take into consideration the regional connectivity of places.

The research also sheds light on the linkages between urban and rural areas. Both employment and population growth within rural areas appear to be affected by the diffusion of economic growth from urban areas. Thus, the success of rural areas partly depends on the economic growth potential of urban areas that are within commuting distance. This suggests that rural development policies should not just target rural areas, but should also aim to strengthen urban-rural linkages. Moreover, government policies should be co-ordinated across departments to ensure rural development policies are integrated within the wider regional policy agenda.

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