Measuring the determinants of relative economic performance of rural areas

MEASURING THE DETERMINANTS OF RELATIVE ECONOMIC PERFORMANCE OF RURAL AREAS

ABSTRACT

This paper examines the determinants of economic performance of 149 English rural Local Authority Districts (LADs). A Three Stage Least Squares (3SLS) estimation procedure was employed to jointly determine the influence of a wide range of indicators representing economic, human, cultural and environmental capital, as well as less tangible or 'soft' factors on three distinct components of economic performance: *productivity*, *employment* and *labor market participation*. The results reveal that a range of facets of economic and human capital, including the three key drivers of productivity (*skills*, *investment* and *enterprise)*, spatial factors (*peripherality* and *accessibility*), and other key factors (*economic structure*, *government infrastructure*, *road infrastructure*, and *occupational health)*, are significant determinants of economic performance in rural areas. This study is of value since it proposes a method for modelling the determinants of economic performance which is transferable to other environments in the UK and beyond. In addition, it proposes a set of benchmarks of economic performance using readily available data, and highlights some implications for rural policy and several avenues for future research.

Key words: determinants of economic performance, rural England, econometric models.

Introduction

Despite the existence of a well established body of literature on differential economic performance, specific research into this issue in rural areas only really began in the late 1980s and early 1990s. Since then, research has evolved from investigations of single issues, to analyses of multiple issues particularly of the five types of capital – economic, human, social, cultural and environmental. More recently, building on previous research of these five types of capital, there has been growing interest amongst policy-makers and researchers in the distinction between 'leading' and 'lagging' rural areas. Various studies undertaken in the UK, Europe and Canada, for example, the Dynamics of Rural Areas (DORA) (Bryden and Hart, 2001), Rural Employment (RUREMPLO) (Terluin and Post, 2000) and the 'New Rural Economy' (Reimer, 2003), have sought to distinguish 'leading' and 'lagging' areas and to compare their characteristics. However, despite these studies, there is still a dearth of knowledge of the underlying factors that explain the uneven geography of economic performance across rural England, and of the most appropriate mechanisms and policies to foster improvements. This is surprising in light of Defra's (Department of Environment, Food and Rural Affairs, UK) Public Service Agreement (PSA) commitment to 'reduce the gap in productivity between the least performing quartile of rural areas and the English median by 2006', by facilitating 'more cohesive and productive rural communities'. There is thus, great scope for, and value of, investigations of this nature.

This paper investigates the determinants of economic performance of English rural areas and highlights some implications for rural policy. This is achieved by first determining factors that explain differences in rural economic performance and by second, identifying up to three measures readily available in secondary data for rural areas, which are indicative of key policy-relevant facets of local economic performance. Thus, the paper makes a theoretical contribution

with practical value. With respect to the latter, it develops a set of acceptable benchmarks of economic performance using readily available data, whilst also contributing to debates on rural development. In terms of the former, it proposes a method for modelling rural economic performance, which is transferrable to other UK environments and beyond. It begins by reviewing the literature relating to differential economic performance in relation to rural areas of advanced economies, with a specific emphasis on discussing the contribution of economic, human, social, cultural and environmental capital. Next, the analytical framework, available data and variables used in the study are detailed. Then, the three empirical models are outlined and the results are documented. This is followed by a discussion of the results and some implications for rural policy are highlighted.

The determinants of relative economic performance of rural areas

There is an increasing body of research which examines the differential economic performance of nations (Porter, 1990; Porter and Ketels, 2003), regions (Abdel-Rahman, 1998; Armstrong and Taylor, 2000; Cook and Morgan, 1998; Putnam, 1995; Storper, 1998), localities (Piore and Sabel, 1984; Pyke *et al.*, 1990) and rural environments (Bryden *et al.*, 2004; Dawe and Bryden, 1999). This reveals that differential economic performance is multi-dimensional and that the availability and deployment of economic, human, social, cultural and/or environmental capital is crucial for successful economic performance. More recent studies such as the DORA project (Bryden *et al*., 2004), RUREMPLO (Terluin and Post, 2000) and the 'New Rural Economy' (Reimer, 2003), have enhanced further knowledge and understanding of this field of study. They highlighted the marked variation in economic performance between similar and different types of rural environments, distinguishing between 'leading' and 'lagging' areas, and attempted to explain why some rural areas were performing better than others. They also re-emphasized that

differential economic performance is multi-dimensional and is influenced by the complex interplay between economic, human, social, cultural and environmental capital, which is unevenly distributed from place to place.

Economic capital

Economic capital relates generally to 'capital resources that are invested and mobilized in pursuit of profit' (Lin, 2001:3). In broad terms, areas that are rich in economic capital are often well performing, whilst areas which lack economic capital are usually under-performing. Economic capital is however a rather amorphous concept as it comprises different factors, all of which have been identified previously as influencing rural economic performance, including 'productivity' (Bryden *et al*., 2004; Porter and Ketels, 2003), 'employment' (Bryden *et al*., 2004; Reimer, 2003; Terluin and Post, 2000), 'investment' (Bryden and Hart, 2001; HM Treasury, 2000), 'enterprise' (Bryden and Hart, 2001; Lowe and Talbot, 2000) and 'innovation' (Countryside Agency (CA), 1999; Keeble *et al*., 1992; North and Smallbone, 2000).

Moreover, each factor consists of a number of facets. For example, associated with 'productivity' is Gross Domestic Product (GDP) per capita / per resident. 'Employment' meanwhile, comprises of type of employment, participation rate, the nature of employment and unemployment rate. In the case of 'investment', existing research identified the accessibility of infrastructure and telecommunications (Bryden *et al*., 2004), along with distance of firms to motorways, railways or airports, the distance of firms to main markets and the distance of firms to the internet and other telecommunications (North and Smallbone, 1996). In addition, public investment in transport and private investment by firms and households (HM Treasury, 2000) are also important facets. Related to 'enterprise' are the facets of business start-ups (Bryden and Hart, 2001) and the prevalence of micro-businesses and artisan firms, and capital availability

(Lowe and Talbot, 2000). With respect to 'innovation', its related facets include the degree to which new technologies are adopted, investment in research and development (Porter and Ketels, 2003), and the degree to which there is diversification and/or specialization (Centre for Rural Economy (CRE), 2000; Keeble *et al*., 1992).

Human capital

Human capital has also been identified as a key ingredient of rural economic development. Contemporary understanding of human capital can be attributed to Johnson (1990) and Becker (1964) who refer to it as 'the value added to a laborer when the laborer acquires knowledge, skills and other assets useful to the employer or firm in the production and exchange processes' (Lin, 2001:5). More recent explanations of human capital emphasize that it is an attribute that may be associated with the individual and relates to the stock of skills, qualifications and knowledge that individuals possess (Office of National Statistics (ONS), 2001). Thus, in comparison with economic capital, there are a number of factors that comprise human capital that have been identified as influencing rural economic performance. These factors include 'education' and 'skills' (Bryden and Hart, 2001; Reimer, 2003; Porter and Ketels, 2003), 'entrepreneurship' (CA, 1999; North and Smallbone, 1996), 'demography' (Bryden *et al.*, 2004; Reimer, 2003), 'migration' (Bryden *et al*., 2004; van Dam *et al*., 2002), 'access to services' (Bryden *et al.*, 2004), 'housing' (Bryden *et al*., 2004; Cloke *et al.*, 1994), and 'quality of life' (Cloke and Thrift, 1987; Longino, 2001).

Related to each of these factors are a number of facets. For example, with respect to 'education' and 'skills', this comprises the facets of the presence of higher and further education institutions and the level of educational attainment (Bryden and Hart, 2001). Meanwhile, associated with 'entrepreneurship' are the facets of the availability of capital (Marsden and Little,

1990; Porter and Ketels, 2003), perceived risk (Bryden and Hart, 2001), the degree of relevant prior experience, knowledge and skills (Porter and Ketels, 2003), the awareness and use of business advice and support (Bryden and Hart, 2001), and the awareness and use of the internet and other information technologies (Bryden *et al*., 2004; Mitchell and Clark, 1999). In terms of 'demography', various studies have highlighted the relevance of the facets of population change (Bryden *et al*., 2004; Defra, 2003; Bryden and Hart, 2001), notably population density (Organization for Economic Co-operation and Development (OECD), 1996), age structure (Defra, 2003) and occupational structure (Ford *et al*., 1997; Rugg, 1999; van Dam, 2002). Associated with the factor of 'migration' are the facets of in-migration (Boyle, 1994; Champion, 1992), out-migration (Furlong and Cooney, 1990; Jamieson, 2000; Stockdale, 2002) and commuting (Bryden *et al*., 2004), whilst facets of the 'access to services' factor include the availability of employment information and advice, and access to public transport. Meanwhile, access to housing, affordability of housing and housing conditions are facets linked to the factor of 'housing', and the degree to which 'quality of life' is valued by local residents is an important facet of quality of life.

Social capital

Social capital is another dimension that has been associated with differential economic performance. Definitions of social capital vary but it is generally understood to relate to the property of the group rather than the individual, and refers to connections among individuals and social networks and to reciprocity whish arises from these connections (ONS, 2001; Putnam, 2000). There are a number of different factors and facets that may be associated with social capital some of which relate to existing stock. Others meanwhile, relate more to processes, organizations and/or institutions which may positively or negatively affect this stock and which

may in turn affect levels of economic performance. Trust, reciprocity and norms of behavior are important factors of social capital (Coleman, 1988; Fukuyama, 1995; Putnam, 1993), and trust has subsequently been considered as a critical component of social cohesion (Sixsmith *et al*., 2001) and an essential requirement for economic transactions. In addition, the degree of autonomy, co-operation and effectiveness within and between institutional structures (Amin and Thrift, 1994; Nelson and Sampat, 2001; Whiteley, 2000), the existence of public and private sector networks and the degree of interaction between these networks (Bryden *et al.,* 2004), the role of partnerships in relationship-building between sectors, and the role of community and voluntary organizations in the development process (Bryden *et al.,* 2004; Flora *et al.,* 1997; Putnam, 1993, 1995), are all aspects of social capital that have been highlighted as key factors that influence economic performance.

Whilst social capital is not sufficient alone in explaining economic performance, it is nevertheless a necessary ingredient for successful economic development as it has the potential to enhance the benefits of investment in other forms of capital. Porter (1990) argues that the social and cultural environment that surrounds business is important in encouraging their innovative capability and competitiveness. This argument is particularly relevant to rural areas which tend to lack the traditional factors of production, such as labor and infrastructure. Consequently according to Atterton (2001), there is now a body of writers who agree on the role of social relations, networks and institutions in embedding economic interactions, and highlight the need for investment in social capital as well as in financial and human capital.

Cultural capital

Cultural capital has also been identified as an explanatory dimension of the differential performance of rural areas (Bryden and Hart, 2001; Dawe and Bryden, 1999), and like the

concept of social capital, it has a range of definitions. Matarasso (1999), for example, considers cultural capital to be an aspect of human capital, something that an individual can accumulate over time through talent, skills, training and exposure to cultural activity. Meanwhile, cultural capital as conceptualized by Bourdieu (1996) derives its analytical contribution from notions of social practice and from the social reproduction of symbols and meanings (Lin, 2001). In this respect, cultural capital is associated with place, a definition that is re-iterated by Geertz (1993) who describes cultural capital as the web of significance that man has spun. Thus, like the other types of capital, cultural capital also consists of a number of many factors, which include the 'degree of commercialization of 'heritage', the 'environment' and 'identity', the existence of 'heritage sites', and 'civic engagement'. It has an important role to play in the economic development of an area as the components of a place and/or its historical and cultural identity may be exploited commercially and developed further (Lash and Urry, 1994).

Environmental capital

Environmental capital plays a key role in encouraging or limiting economic growth and development. The growing perception of the rural environment as an area of consumption combined with the increase in 'green' consumerism has created opportunities for both farmers and entrepreneurs, particularly in those environments which are endowed with high quality and natural assets. Thus, the quality of the environment is proving to be of increasing importance to the economic growth, development and performance of rural areas, particularly in light of changes in agriculture and the growth of tourism and recreation (Hoggart *et al*., 1995). By contrast, the peripherality and remoteness of some rural environments or the existence of negative environmental impacts as a result of poor rural development, may serve to discourage or limit business operations and performance. Environmental capital consists of a number of factors

which include natural resource endowment, peripherality and remoteness, the cost of environmental maintenance, and pollution and congestion.

So far, the importance of economic, human, social, cultural and environmental capital has been emphasized, and in doing so the multi-dimensional nature of economic performance is highlighted. Explanations of differential economic performance are complex as its determinants are likely to differ within and between rural areas. Given this complexity, measuring the economic performance of rural areas is fraught with difficulty, not least because each factor and facet may differ fundamentally in terms of their role in the economic process. Some factors such as 'productivity' are production outputs, others for example, 'employment', 'investment', 'enterprise' and 'innovation' are production inputs. Moreover, each factor and facet differs in their relationship with each other and with the overall level of performance of an area.

It is also important to distinguish between those factors and facets that are endogenous to the process, from those that are exogenous. In basic terms, endogenous factors are those which are produced mainly by local impulse and are grounded largely on local resources (Picchi, 1994). They are factors in a causal model or system whose value is determined by the values of other variables in the system, and in theory, the benefits of development based on such factors tend to be retained in the local economy and local values are respected (Slee, 1994). Conversely, exogenous factors are externally determined by factors or variables outside the causal system under study. It is considered that such factors can be transplanted into local regions or localities, that benefits of local development can be exported and that local values tend to be trampled (Slee, 1994). In addition, in order to fully understand the economic process within an area, where relevant, it is also important to distinguish between those factors that relate to the 'stock' that

currently exists from those that may be associated with institutions and/or processes which may have a positive or negative influence on the economic process.

Methodology

Measuring local economic performance is challenging given the absence of existing studies which have examined this issue in this way, or indeed in any considerable detail. A prime concern was the design of a robust and well-specified model with which to examine the determinants of rural economic performance in England. However, before a model could be constructed, it was first imperative to decide upon an appropriate geographical unit of analysis at which to measure economic performance since this can affect results and mask trends. Such a decision therefore needed to be based on a clear appreciation of the strengths and weaknesses of the options, with explicit regard to any potential boundary effects that may occur as a result of the selection.

Local Authority Districts (LADs), administrative units of local government which form the lower tier of the UKs two-tier local government structure and which typically serve a population of 100,000 or more, were chosen as the most appropriate unit of analysis, with this decision being fundamentally driven by data availability. The use of LADs though is problematic since their labor markets are not self-contained and significant amounts of inward and outward commuting are likely to occur. Consequently, any value added (VA) created by residents from outside the LAD is included in the study results; conversely, any that is created outside of the LAD by local residents is excluded. Since there is no alternative information available, the two types of transactions were assumed to largely offset each other. In other words, the inclusion of VA created by outsiders within the LAD is likely to make-up for exclusion of VA created by residents of LAD outside its boundaries.

Thus while LADs may not be the most ideal unit of measurement, the adoption of a larger county or regional unit of analysis at which data is freely available, would inevitably result in subtle variations in the performance of the local economy being lost. Moreover, given that local government and their partners play an important role in shaping local policy and local service delivery, combined with the study's aims of highlighting local policy implications it is important that such a focus should be adopted. Indeed, this reasoning goes some way towards explaining why the adoption of a LAD level of analysis, despite the difficulties associated with its use, has been replicated in numerous subsequent studies (e.g. Local Futures Audit, 2006; Rural Economics Unit, 2005; Cambridge Econometrics and SQW, 2006).

Having selected the most appropriate unit of analysis, it was next necessary to differentiate between those LADs which may be considered to be 'rural' from those that are not. Given that the definition of rural is contested (Hodge and Monk, 2003), Defra's classification of 149 English rural LADs was adopted (Rural Evidence Research Centre, 2005). A list of available secondary data was compiled for these LADs, from which the model's dependent and explanatory variables were selected. Then, a wide range of data representing economic, social, human, cultural and environmental characteristics of these 149 rural LADs was assembled from a range of data sources including the 2001 Census of population, the National Online Management Information System (Nomis), the Labor Force Survey, Inland Revenue, Land Registry and ONS.

The analytical framework

In practice, devising the modeling framework was based partly on the theoretical insights provided by previous research on rural economic performance, and is remarkably similar to other approaches that have been used in subsequent studies, most notably the OECD's (2007) evaluation of economic differences amongst the regions of its member countries. However, in

order to ensure the study's policy relevance, considerable attention was also paid to the findings of a series of Her Majesty's (HM) Treasury studies undertaken in 2000 and 2001, which identified five key drivers of productivity: (1) *skills*; (2) *investment*; (3) *enterprise*; (4) *innovation*; and, (5) *competition*. These studies also found that regional variation of GDP per capita was a function of productivity (defined as the output that each worker produces) and employment (defined as the number of people who are working). The latter in turn depends on demographics (the working age population) and labor market participation and unemployment rates. The results of these Treasury studies suggest that productivity differentials alone account for 60 percent of regional per capita GDP differentials, while a significant proportion of the remainder is accounted for by variations in participation and unemployment rates, and by the percentage of a region's population who are of working age (HM Treasury, 2000; 2001). It is, therefore, imperative that these factors should be incorporated into any measurement of local economic performance.

Thus, based on the framework utilized by the HM Treasury studies (2000; 2001), the GDP per capita (GDP/P) was decomposed into three key components: (i) productivity (GDP/E), defined as output per worker; (2) employment rate (E/L), defined as the ratio of the number of economically active workers to the labor market participation rate; and (iii) labor market participation rate (L/P), defined as the ratio of economically active population to population. The decomposition is expressed as:

$$\frac{GDP}{P} \equiv \frac{GDP}{E} * \frac{E}{L} * \frac{L}{P}$$

and is based on a specific measure of GDP (defined as earnings per capita as outlined by Defra's PSA) as the proxy measure of output. However, it is important to note that this attempt to measure productivity, and more specifically the productivity of labour, may be overestimated as

the composition of the GDP measure may, in some cases, include earnings from sources without direct use of labour as well as other operating surpluses. Despite this, it enables each of its three components to be modelled separately to identify their determinants. For example, the output per worker component, which may be conveniently defined as 'productivity' is determined through the production process and depends on the availability (and efficient use) of different types of capital and on a given level of technology. The employment rate is determined by the interaction of demand and supply within the labor market, and the labor force participation rate is determined largely by demographic factors, although it is also influenced by labor market conditions. The exact definitions of the three dependent variables are provided in the upper panel of Table 1.

[Insert Table 1. about here]

Identification of explanatory factors

The next stage in the development of the modelling framework involved the identification of the explanatory variables. As a starting point, the five key drivers – *skills, investment, innovation, enterprise* and *competition* – identified by the HM Treasury studies (2000; 2001) provided the initial explanatory factors. However, it was not possible to include in the analysis two of the five key drivers, *innovation* and *competition*, as it was impossible to find data or a suitable proxy measure for these drivers disaggregated at the level of rural English LADs. Therefore, only *skills, investment* and *enterprise* were focused upon, and appropriate proxy variables were chosen to represent these key drivers. For example, the *skills* driver may be measured by drawing on data of: (a) the proportion of people aged 16-74 with higher education (level 4/5) in 2001; or (b) the occupational structure (defined as the proportion of people working as managers and professionals). The proportion of people aged 16-74 with the highest level of education

qualification (level 4/5) was selected as the proxy to represent the *skills* driver, based on data availability, and on the assumption that skilled population are likely to be contribute more economically than their unskilled counterparts. For the *investment* driver the 'average net capital expenditure per capita between 1998 and 2001' was selected as the measure, whilst data pertaining to the 'total number of VAT registrations per 1000 population in 2000' was chosen to represent the *enterprise* driver.

Given the recognition that a focus on economic capital alone does not adequately capture the dynamics of economic performance, a number of additional explanatory factors were also included in the modelling. This was to provide a better estimate of the influence of selected explanatory variables on the economic performance of rural LADs as compared with models that do not explicitly take into account 'residual' factors which have previously been found to be important determinants of rural economic performance (Bryden *et al.*, 2004; Terluin and Post, 2000; Reimer, 2003). However, the extent to which economic, human, social, cultural and environmental capital factors and facets could be incorporated into the model was severely limited in two ways. First, by the lack of data which were available at the appropriate spatial scale of analysis (i.e. at the level of rural LADs). Second, by the importance of selecting variables whose relationship with the economic process generally, and to production specifically, were clearly definable and exogenously determined. Thus, only a handful of additional spatial, vocational, economic, and government infrastructural indicators were incorporated into the modelling, all of which are summarised in the lower panels of Table 1. Despite these constraints, the analytical framework still represents a major departure from the HM Treasury studies (2000, 2001) of economic performance and growth, thereby making a theoretical and empirical contribution to the measurement of rural economic performance in England.

The empirical models

A series of models were therefore individually designed around three components of productivity, these being: (1) productivity; (2) employment rate; and (3) labor market participation rate, in order examine the determinants of rural local economic performance. Given that spatial factors may affect each of these three components, they were included in all the models. However, the first component, productivity, was specifically couched in terms of three key drivers: *skills*, *investment* and *enterprise*, whilst the second, employment rate, was conceived as a measure of labor use in the economy, and was therefore, postulated as a function of both wages (productivity) and capital Since previous research (e.g. Terluin and Post, 2000) highlighted that the rate of labor market participation (the third component) is more likely to be conditioned by demographic and labor market conditions than by capital and infrastructure, it was modelled as a function of only one of the key drivers, this being *skills*.

In addition though, a number of other key demographic variables including population density, household size and occupational health were also included in this third component of the modelling. Population density was incorporated since it can affect the labour market participation rate positively or negatively. This is because sparsely populated areas may be less productive due to the occurrence of labor shortages, whereas densely populated areas may be more productive due to an abundance of labor. Household size was included since it reflects the number of people actively seeking work, and who are therefore able to participate in the labor market. It is however based on an assumption that larger families will contain more household members actively seeking work, and doesn't take into account the effect of dependents (i.e. children, the elderly or the infirm) on reducing productivity. Occupational health was incorporated also as it reflects a population's health or in other words, provides an indication of

those who are able to participate in the labor market. Thus, areas with a high incidence of people with Limiting Long Term Illnesses (LLTIs) are likely to be less productive than those with fewer people experiencing this condition.

Thus, the three empirical models were specified as:

$$\ln Y_P = \alpha_P + \gamma_P \ln Y_E + \sum_{i=1}^{3} \alpha_{Pi} \ln D_{Pi} + \sum_{j=1}^{3} \omega_{Pj} \ln L_{Pj} + \beta_P \ln A_P + \delta_P \ln I_P + \varphi_P \ln R_p + \eta_P S + \varepsilon_P \quad (1)$$

$$\ln Y_E = \alpha_E + \gamma_E \ln Y_P + \sum_{i=1}^{3} \alpha_{Ei} \ln D_{Ei} + \sum_{j=1}^{3} \omega_{Ej} \ln L_{Ej} + \beta_E \ln A_E + \delta_E \ln I_E + \varphi_E \ln R_E + \eta_E \ln S_E + \kappa_E \ln H + \varepsilon_E \quad (2)$$

$$\ln Y_A = \alpha_A + \gamma_A \ln Y_P + \alpha_{A1} \ln D_{A1} + \sum_{j=1}^{3} \omega_{Aj} \ln L_{Aj} + \eta_A \ln S_A + \kappa_A \ln H_A + \iota_A \ln F + \varepsilon_A \quad (3)$$

where Y represents dependent (endogenous) variables and the subscripts P, E, and A stand for productivity, employment rate and labor market participation rate, respectively. Definitions of all dependent and independent variables are given in Table 1; α, β, γ, δ, ω, φ, η, κ, and τ are the parameters to be estimated; ε is the error term; and *ln* is the natural logarithm. This system of three structural equations, thus specified, is over-identified and is, therefore, estimable[1]. A Three

[1] In order to enable estimation of a linear system of equations, the necessary condition for identification of an individual structural equation is as follows: if $m_i > (K - k_i)$, then the equation is under-identified and cannot be estimated; where, m_i is the number of endogenous variables in an individual structural equation; k_i is the number of exogenous variables in the same structural equation; and K is the total number of exogenous variables in the system (STATA Corp, 2003). In this system of structural equations, the value of m_i in each model is one. Meanwhile the value of $(K - k_i)$ in the productivity model is two, in the employment rate model it is one, and in the labor market participation rate model it is five. Therefore, the identification condition is satisfied and the system as a whole is over-identified and can be estimated.

Stage Least Squares (3SLS) method was used to estimate the system based on the results of the Hausman specification test[2] (see Table 2).

Extension of the empirical model to account for less tangible factors

A further attempt was made to incorporate additional explanatory variables which could act as proxies for some of the less tangible or 'softer' factors that also influence economic performance (Bryden and Hart, 2001; Terluin and Post, 2000; Reimer, 2003). Three proxy variables representing quality of life, access to employment opportunities and vibrancy of civic engagement were added (see Table 1 for definitions).

The three empirical models using additional proxy variables were re-specified as:-

$$\ln Y_P = \alpha_P + \gamma_P \ln Y_E + \sum_{i=1}^{3} \alpha_{Pi} \ln D_{Pi} + \sum_{j=1}^{3} \omega_{Pj} \ln L_{Pj} + \beta_P \ln A_P + \delta_P \ln I_P + \varphi_P \ln R_p + \eta_P S + \sum_{k=1}^{3} \mu_{Pk} \ln X_{Pk} + \varepsilon_P \quad (1a)$$

$$\ln Y_E = \alpha_E + \gamma_E \ln Y_P + \sum_{i=1}^{3} \alpha_{Ei} \ln D_{Ei} + \sum_{j=1}^{3} \omega_{Ej} \ln L_{Ej} + \beta_E \ln A_E + \delta_E \ln I_E + \varphi_E \ln R_E + \eta_E \ln S_E + \kappa_E \ln H + \sum_{k=1}^{3} \mu_{Ek} \ln X_{Ek} + \varepsilon_E \quad (2a)$$

$$\ln Y_A = \alpha_A + \gamma_A \ln Y_P + \alpha_{A1} \ln D_{A1} + \sum_{j=1}^{3} \omega_{Aj} \ln L_{Aj} + \eta_A \ln S_A + \kappa_A \ln H_A + \iota_A \ln F + \sum_{k=1}^{3} \mu_{Ak} \ln X_{Ak} + \varepsilon_A \quad (3a)$$

where, X_k is the proxy indicator; μ is the parameter to be estimated; all other variables are as aforementioned. The system is again over-identified as before and, therefore, estimable. The

[2] The Hausman specification test is used to finalise the choice of estimation technique. Acceptance of the null hypothesis implies that all the structural equations in the system are correctly specified and hence 3SLS will provide an efficient estimator as compared to 2SLS.

Hausman specification test was performed to finalize the choice of estimation technique between 2SLS and 3SLS (see Table 3), and based on the results, 3SLS was again chosen.

Results

Table 2 presents the results of the estimation process. A Likelihood Ratio test was performed to test the hypothesis that all the model's parameters apart from the constant terms are zero, and was rejected at the 1% significance level. Hence, it is established that all indicators used in the structural model of economic performance jointly explain variations in productivity, the employment rate and the labor market participation rate. The value of R^2 obtained from the initial Two-stage Least Squares (2SLS) estimate reveals that these indicators jointly explain approximately 40% of the total variation in the productivity model, 74% in the employment model, and 79% in the labor market participation rate model, hence reinforcing confidence in the results[3]. A correlation matrix of all exogenous variables used in the model to measure economic performance is presented in Table 3. The results show that there is no evidence of serious multi-collinearity amongst the indicators. Only six out of a possible 101 correlation coefficients are 0.50 or above. The implication is that the chosen indicators are independent and, therefore, do not violate the assumptions necessary to perform multivariate regression analysis without bias.

[Insert Table 2. about here]

[Insert Table 3. about here]

Overall, within all three models, none of the instrumental endogenous variables were significantly different from zero, although they have expected signs. For example, a lower unemployment rate increases productivity and vice-versa, as revealed in the productivity and employment rate models. In terms of the 'productivity' model, all three key drivers of productivity growth (*skills*, *investment* and *enterprise*) influence productivity thereby supporting

[3] Although the 3SLS estimate also provides R^2 values, they are not valid (STATA Corp, 2003).

the claims of the HM Treasury studies (2000; 2001). It is the *skills* driver though which has the strongest influence in explaining variation in earnings per worker of English rural LADs, estimated at 0.42, thereby indicating that a 1% increase in the proportion of people with a higher education qualification will raise productivity by 0.4%. This finding is consistent with those revealed in a subsequent study undertaken by the Rural Economics Unit (2005) which found that poor productivity in rural areas was manifested by an increased incidence of low pay, associated with low educational attainment levels.

However, according to the Rural Economics Unit (2005) skills should not be viewed solely in relation to educational attainment and training since they should also include job-specific skills, and on-the-job training and experience. Indeed they revealed that the proportion of people in most English rural areas receiving job-related training is consistently lower than the England average, and a high proportion of firms were making little use of training and business support even though firms in the more peripheral areas frequently cite labor shortages, especially of managers as a constraint to expansion. This is due to the fact that small companies are less likely to be able to afford to spend time training staff because of its impact on business operations. In addition, there are fewer training providers in rural areas which may mean that there are few opportunities for them to specialise in areas needed by local employers. There is also the potential for information failures as informal job searches and recruitment networks are found to be important in rural areas (Rural Economics Unit, 2005).

In addition to skills, the investment driver also has a significant influence on productivity. Its elasticity value reveals that a 1% increase in capital expenditure will raise productivity by 0.06%. This of course is no surprise since investment in physical plant, machinery and buildings helps to make labor more productive and is a way of embedding new technologies into the

production process. Such a finding reinforces existing studies (e.g. Bryden and Hart, 2001; Lin, 2001; Terluin and Post, 2000), particularly those which focus on the lack of investment in Information and Communication Technologies (ICT) in rural areas and its potential impact on productivity (e.g. North *et al.*, 1997; Talbot, 1997). Warren (2000) cites the potential benefits of ICT as including: enhanced effectiveness of public sector organizations in providing services, improved access to education and training at a distance, improved communications for individual businesses and managers, provision of an improved market place for products and inputs, and improved access in terms of business credit. However, there are many barriers which must be overcome if investment in ICT is to benefit rural areas, including a lack of ICT skills amongst the labor force (Freshwater, 2000), and inadequate telecommunications infrastructure in rural areas (Bryden *et al.*, 2004).

Besides skills and investment, the most important determinant of productivity however, was road infrastructure, the elasticity value suggesting that a 1% increase in this variable will boost productivity by 1.4%. In addition, peripherality and accessibility were also found to greatly influence productivity, with the latter being significantly higher in regions nearer to London as opportunities for higher-paid jobs decline with increasing peripherality. Conversely, lack of accessibility to big cities with a population over 250,000 appears to have a depressing impact on productivity. The elasticity value suggests that a 1% increase in the distance from big cities decreases productivity by 0.04%. These findings confirm a plethora of studies (e.g. Bryden and Hart, 2001; Lowe and Talbot, 2000; Smallbone *et al.*, 1999) which all reveal that the peripherality and the location of areas *vis-a-vis* main markets still matters for economic performance. Moreover, a recent study undertaken by Cambridge Econometrics and SQW (2006) examining rural economic performance inside and outside of city regions found that levels

of productivity in rural areas within city regions were about 8% higher than those in rural areas outside city-regions, and a 5% differential was explicable by location in relation to city-regions. According to the Rural Economics Unit (2005), productivity appears to be an intrinsic feature of geographical 'peripherality' as opposed to the result of specific market failures. Differences in growth can be attributed to economic mass which due to agglomeration effects, provides benefits such as raising productivity through knowledge transfer, thickening labor markets and improved access to consumers and suppliers.

In the 'employment' model, only the *enterprise* driver (measured as the number of businesses registered for VAT per 1,000 of population) has a significant influence in raising employment, but it exhibits a very low elasticity value, suggesting that any increase in enterprise will not greatly benefit employment. This finding perhaps may best be explained by the prevalence of self-employment and micro or small businesses in rural areas which are sole traders with no employees (Lowe and Talbot, 2000). The 'economic structure' as well as 'government infrastructure' also influences the employment rate, with a counterintuitive sign on the former. With respect to the 'economic structure', whilst primary industries may be considered more labor intensive, given claims of the decline in agriculture, the fact that the primary sector also positively influences employment is surprising and serves to demonstrate that the it is still a key employer in rural areas. The positive influence of the 'government infrastructure' on employment is logical and expected since the public sector is a key employer in many rural areas (Moss *et al.,* 2004). However, such a dependency is not necessarily advantageous to productivity as it focuses on non-traded goods, thereby limiting the supply chain. After all, well performing districts are those which sell more goods to the wider economy and reach out beyond the locality for business contacts and information (Rural Economics Unit, 2005).

Whilst road infrastructure was found to benefit productivity, it was not found to significantly influence the employment rate, although the coefficient sign is positive. Locational factors however do significantly influence economic performance, with increasing distance from London having a detrimental influence on the employment rate; a 1% increase results in a 0.01% decrease in employment. Accessibility to smaller urban centres also has a similar depressing effect but again the elasticity is low; a 1% increase in distance from cities with a population of over 100,000 decreases employment by 0.001%. These findings may reflect a restricted choice of jobs, limited training opportunities and difficulties in accessing public transport in rural areas. Moreover, they may also demonstrate the existence of 'thin' labor markets with few available employment opportunities often associated with peripheral rural areas (Rural Economics Unit, 2005).

Finally one of the major determinants affecting the employment rate appears to be occupational health (measured by 'the proportion of people with a LLTIs'). This result suggests that a 1% rise in the proportion of people with LLTIs will decrease employment by 0.04%. Such a finding may reflect the average age of residents in rural England, which is 50 compared to 42 for residents in towns and cities, with the number of older people living in rural areas continuing to rise due to the in-migration of older people (Harrop and Palmer, 2002). However, it may also be associated with the incidence of poverty, multiple deprivation and social exclusion, all of which are well recognised problems in rural areas affecting all segments of society (Fabes *et al.*, 1983; McLaughlin, 1986; Pavis *et al.*, 2000) but particularly older people (Shucksmith, 2000).

In terms of the 'labor participation rate' model, as expected and reinforcing the results of the 'employment model', LLTIs were also found to be significantly influential. The elasticity value indicates that a 1% rise in the 'proportion of people with LLTIs' reduces the 'labor market

participation rate' by a staggering 0.3%, a finding which again highlights the potential importance of poverty, multiple deprivation and social exclusion affecting rural areas. In addition, household size was found to be the most important demographic determinant of the 'labor market participation' rate, thereby confirming the notion that larger families potentially contain more economically productive household members. Indeed, a 1% increase in household size, from its average of 2.35 persons per household, raises the labor participation rate by 1.1%.

However, in contrast to the 'productivity' and 'employment' models, the 'labor market' model revealed some anomalous results. Usually a lower level of skills is associated with a higher proportion of people who are either out of, or are seeking work. Instead, the modelling revealed the opposite, this being that a 1% increase in the skilled population base reduces the relative size of the economically active population by 0.06%. One possible explanation for this finding relates to a lack of employment opportunities which often characterises rural areas (Bryden *et al.*, 2004), and which prevents labor market participation irrespective of available skills. Another anomaly occurred in relation to the proportion of the population which is economically active. This was found to be higher in the periphery (i.e. further away from London) as opposed to being lower in the periphery as might be expected, given that English rural areas tend to attract retirees (Forsythe, 1983). According to the model, a 1% increase in distance from London will increase labor market participation by 0.03%, and perhaps reflects the fact that although distance may prevent people from being employed, due to advances in telecommunications, it does not stop them from being economically active. An additional surprising result occurred in relation to population density as this model indicated that a 1% increase actually lessens, instead of raises as might be expected, the labor market participation by

0.001%. This finding might of course demonstrate the existence of 'thick' labor markets and thus, greater competition for jobs (Rural Economics Unit, 2005).

The results of the estimation of the extended models incorporating the proxy variables (i.e., equations 1a, 2a, and 3a) are presented in Table 4. The models' diagnostics were similar to those reported in Table 2. The results indicate that the coefficient on the 'access to employment opportunity' variable (measured by 'the proportion of people travelling to work by public transport') has a significant influence on the 'employment rate' model only. Overall, the explanatory power of the 'employment rate' model falls with the inclusion of these proxy variables, whilst the explanatory power of the remaining two models slightly improves. However, it seems that none of the three proxy variables serve as important determinants of economic performance. The reasons might be either the quality of the available data, or the inadequacy of these proxy indicators to represent the 'soft factors' assumed to influence economic performance.

[Insert Table 4. about here]

Discussion and implications

Overall, the study's findings highlight three sets of factors that are associated with higher levels of productivity. Two of these factors – *enterprise* and *investment*, and *accessibility* and *road infrastructure* – relate to facets of economic capital, whilst the third – *skills* and *education* – is an aspect of human capital. The results reinforce the findings of a raft of previous studies which have examined aspects of rural economic performance (e.g. Bryden *et al.*, 2004; Terluin and Post, 2000), and in doing so, they demonstrate the value of the proposed model and methodology. Indeed, in recognizing the endogeneity of the three dependent variables leading to the specification of a structural model using a simultaneous equations framework, this approach marks a major improvement upon previous studies of rural economic performance which

implemented less rigorous empirical evaluation. Moreover, such an approach may be adjusted and applied relatively easily to measure economic performance in other geographical contexts. However, given the over-arching aim of the UK Government's rural policy to create sustainable communities, perhaps the true value of this investigation lies in the many ways that are highlighted, in which policy may improve rural economic performance.

Beginning with *enterprise* and the improvement of rural economic performance through the generation of more entrepreneurial activity, obviously policy can achieve this by creating a favorable general economic situation and fertile environment in which to establish new firms. Indeed, the importance of a vibrant enterprise culture has long been recognized as essential for growth (Bryden *et al.*, 2004). Thus, local authorities and other agencies have a key role to play in supporting these enterprises, particularly as many are established by relative newcomers who have few contacts and find it difficult to link into appropriate support structures (McAdam *et al.*, 2004). However, the study results highlight the fact that it is not enough to merely cultivate business opportunities, and to encourage and support new firm growth. In order for enterprise to improve rural economic performance, it is also important that it stimulates rural employment. With this in mind, this study reinforces calls for an entrepreneurship policy (Gilbert *et al.*, 2004), but one which focuses on encouraging specific types of entrepreneurial activity, preferably high growth business developments, which have the potential to maximize opportunities for rural employment.

In terms of using policy to improve rural economic performance through the generation of more *investment*, again creating conducive economic conditions is paramount. But in rural areas encouraging greater investment is often problematic since many businesses are small, they often tend to be in low margin sectors with little capital to invest, and are more focused on survival as

opposed to growth (North and Smallbone, 2000). Given these barriers, perhaps it is instead important to create local economic hubs or clusters of related businesses which pool scarce capital and human resources, and which encourage skills development, technology and knowledge transfer, supply chain improvement, and innovation. Such hubs or clusters are better able to exploit attractive markets where the local area has existing or potential strengths and in doing so, have the capacity to generate income and employment, and increase productivity. Of course, the idea of spatial clustering is not new, its antecedents based in agglomeration economics (e.g. Fujita *et al.*, 1999; Krugman, 1991). But, its application to rural development within the UK is relatively recent, and generally occurs on a regional basis, promoting only sectors such as transport and logistics, defense and aerospace, and the media and creative industries. There is no reason to suggest why such an approach could not be applied to local rural development, however, the need for the involvement of key local business owners with strong networking skills, industry connections, and the ability to earn private sector credibility through performance, should not be under-estimated.

It is more problematic for policy to influence economic performance by overcoming problems associated with poor accessibility and peripherality. This is because, despite the growing importance of ICT in shaping the economy and society of rural areas (Warren, 2000), relative proximity to markets (Bryden and Hart, 2001), and in particular the close positive relationship, which this study found, between productivity, the road infrastructure and public investment in transport infrastructure (Porter and Ketels, 2003), continues to be important. But, given the UK Government's emphasis on the need to reduce carbon dioxide emissions and to deliver a sustainable transport network (Department of Transport, 2007) clearly, massive investment in the national, regional, sub-regional and local road infrastructure is neither

appropriate nor realistic. Thus, innovative solutions to rural accessibility and peripherality problems must be generated, based on a sound understanding of the barriers and challenges facing rural areas.

By contrast, improving rural economic performance by raising *skills* and levels of educational attainment is more amenable to policy intervention. Of prime concern should be the rural-proofing of the provision of skills, training and education (Rural Economics Unit, 2005). Such proofing should not only include the provision of skills, education and on-the-job training currently in demand in rural areas, and the identification of gaps in provision, but should also ensure that changes taking place in rural employment patterns are taken into account in future skills and education funding and planning. Strategies to support businesses should also be rural-proofed, and in particular enhanced incentives should also be offered to rural SMEs to encourage investment in skills provision, and to promote work-based experiential learning. However, improving rural economic performance is not just about raising local peoples' skills and levels of educational attainment. Since migration is a key ingredient of rural economic performance (Bryden *et al*., 2004; van Dam *et al.*, 2002), attracting and retaining highly skilled, educated, dynamic and economically active in-migrants, and encouraging a proportion to engage in enterprising activities, including business start-up, is also critical.

In addition, this study revealed the prevalence of LLTIs and their negative impact on productivity, employment and labor market participation rates, and consequently highlighted the importance of maintaining a healthy population base which would then improve the labor market as well as the employment rate in those rural areas it affects. Therefore, policies should focus on preventing and/or controlling the incidence of such illnesses, and on supporting those with such illness so that they remain active participants of the rural work-force. However, the results also

draw attention to the need for more in-depth investigation of LLTIs, and in particular, of their association with poverty, multiple deprivation and social exclusion.

Furthermore, this investigation reinforces the complex multi-dimensional nature of economic performance, and in doing so, highlights the importance of integrating broad thrusts of policy. Such multi-dimensionality is particularly well illustrated with regards to enterprise since it is dependent on many factors including good road and ICT communication links, availability of managerial and skilled labor and investment, and access to business services and training facilities (Rural Economics Unit, 2005). Thus, effective interventions are likely to be those which include measures which work across the range of rural productivity drivers. By implication, it is also important that regional and local delivery bodies have the freedom and flexibility to pursue interventions that are fit for local circumstances and that, having established a clear vision of what outcomes it wants to achieve, central government is not prescriptive about what may prove effective in each area.

Finally, this study highlights several avenues for further research. First, due to the lack of data, it was not possible to consider the influence of *innovation* or *competition*, two important drivers of productivity, on economic performance. Thus, in both cases, research needs to be undertaken into the development of indicators which enable their influence on rural economic performance to be rigorously evaluated. Second, in order to capture fully the nuanced processes of rural development, it is imperative that its dynamics are studied over time. Due to the lack of comparable time-series data, this again was not possible, thereby highlighting a need for the design of information systems which enable planners and/or managers to have the right set of data to inform decision-making and policy formulation. Third, in order to transcend the supposed dualism between the hard quantitative models of economics and the soft qualitative ways of

knowing' (Plummer and Taylor, 2001:220), further research is required of more satisfactory ways of incorporating the less tangible or 'softer' factors into any modelling exercise. Only by addressing these research shortcomings, can there be in-depth knowledge and understanding of the relative determinants of rural economic performance.

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Table 1. Definition and summary statistics of the variables.

Capital categories	Factors/facets	Variable name	Symbol	Para-meter	Definition	Mean	Standard deviation
Dependent variables							
Economic capital	Productivity: earnings	Productivity	Y_P	γ_P	Earnings per worker (in GBP) in 2001 (PSA classification, and worker in turn is defined as economically active population – unemployed)	14424.860	3800.935
Economic capital	Employment: participation rate	Employment rate	Y_E	γ_E	Proportion of people aged 16-74 years engaged in employment in 2001 (where employment rate = 100 - unemployment rate)	0.980	0.011
Human capital	Demography: Size of the labour force	Labour market participation rate	Y_A	γ_A	Proportion of people aged 16 – 74 working or seeking work in 2001)	0.490	0.033
Explanatory variables							
Economic capital	Employment: participation rates	Occupational health	H	κ	Proportion of people of working age with a limiting long term illness (LLTI)	0.102	0.021
	Type of employment (e.g. non-agricultural employment)	Economic structure	I	δ	Proportion of people aged 16-74 employed in primary industries (i.e. agriculture, forestry, fisheries and mining)	0.040	0.021
		Government infrastructure	A	β	Proportion of people aged 16-74 employed in the public sector (i.e. administration and defence)	0.062	0.028
	Enterprise Business entry and exists (VAT registered start-ups and VAT de-registrations	Enterprise driver	D_3	α_3	Total number of VAT registrations per 1000 population in 2000)	3.889	3.056
	Investment	Investment driver	D_2	α_2	Average net capital expenditure per capita in £s (1998-2001)	2240.367	1325.929
	Existence of transport infrastructure	Road infrastructure	R	φ	Length of motorways and/or dual carriageways per square km of land area	0.025	0.030
	Distance of firms to main markets	Accessibility-1	L_1	ω_1	Distance in km from a city with a population over 250,000	53.546	36.368
		Accessibility-2	L_2	ω_2	Distance in Km from a town or city with a population above 100,000)	19.322	12.182
Human capital	Skills and education	Skills driver	D_1	α_1	Proportion of people aged 16-74 with higher education (level 4/5) in 2001)	0.189	0.045

Capital categories	Factors/facets	Variable name	Symbol	Para-meter	Definition	Mean	Standard deviation
	Demography	Population density	S	η	Number of persons per hectare of land area	1.988	1.568
	Housing	Household size	F	τ	Number of persons per household)	2.353	0.076
Environmental capital	Peripherality and remoteness	Peripherality	L_3	ω_3	distance in km from London	135.736	79.649
'Soft'/less tangible capital (representing economic, human and the environment)	Quality of life	Natural beauty	X_1	μ_1	Index of natural beauty (GB=100). Hectares per sq km of AONBs, heritage coasts and presence / absence of forest and national parks; indexed to GB average	169.127	149.170
	Access to employment opportunities	Public transport	X_2	μ_2	Proportion of people in employment who travel to work by public transport, 2001	0.054	0.030
	Vibrancy of civic engagement	Election turnout	X_3	μ_3	Proportion of eligible voters who voted at the most recent local election, 2001-2	0.351	0.071

Note: The age banding (i.e., 16 – 74 years) is based on ONS classification of age group. Our choice to use this age banding instead of a more logical 16 – 65 years is due to limitation posed by data availability. There is a potential for bias if a high proportion of 65-74 year olds exist in the data set, which may bias the value of the estimated coefficients upwards when the relationship is positive, and downwards when it is negative.

Table 2. Determinants of economic performance in rural local authority districts

Variables	Capital category	Joint estimation of productivity, employment rate and labour market participation rate models using 3SLS regression		
		Productivity model	**Employment model**	**Labour market participation rate model**
Constant		10.759***(18.20)	0.210	-3.131*** (-5.56)
Endogenous variables				
Productivity	Economic	-	-0.024 (-1.59)	0.071 (1.32)
Employment	Economic	-5.074 (-1.20)	-	-
Key drivers				
Skills	Human	0.420*** (4.30)	0.010 (1.43)	-0.063** (-2.24)
Investment	Economic	0.063* (1.67)	0.001 (0.29)	-
Enterprise	Economic	0.053 (1.79)	0.002* (1.81)	-
Spatial factors				
Peripherality	Environmental	-0.187*** (-3.25)	-0.008*** (-2.68)	0.034*** (3.17)
Accessibility-1	Economic	-0.046* (-1.89)	-0.002 (-1.57)	-0.005 (-1.08)
Accessibility-2	Economic	-0.016 (-0.58)	-0.002** (-2.14)	0.004 (0.90)
Other key characteristics				
Economic structure	Economic	-0.040 (-0.58)	0.063*** (3.10)	-
Government infrastructure	Economic	0.068 (1.54)	0.004** (2.48)	-
Road infrastructure	Economic	1.372** (2.34)	0.050 (1.63)	-
Population density	Human	-0.043 (-0.98)		-0.009* (-1.74)
Occupational health	Economic	-	-0.038*** (-6.31)	-0.252*** (-8.22)
Household size	Human	-	-	1.051*** (8.20)
Model diagnostics				
Adj. R-Squared (from 2SLS regressions)		0.49	0.74	0.79
F value		13.17***	36.94***	80.15***
Degrees of freedom		413		
Hausman test for the choice of estimation technique (3SLS vs 2SLS) Chi-square (11 degrees of freedom)		4.72		
Decision		Accept 3SLS		
Likelihood Ratio test Chi-square (31 degrees of freedom)		504.82***		

Note: Figures in parentheses are t-ratios
***= significant at 1 percent level (p<0.01)
** = significant at 5 percent level (p<0.05)
* = significant at 10 percent level (p,0.10)

Table 3. Determinants of economic performance in rural local authority districts (including proxy variables to account for less tangible factors)

Variables	Capital category	Joint estimation of productivity, employment rate and labour market participation rate models using 3SLS regression		
		Productivity model	Employment model	Labour market participation rate model
Constant		11.111*** (17.53)	0.361** (1.96)	-2.980*** (-5.95)
Endogenous variables				
Productivity	Economic	-	-0.036** (-2.20)	0.053 (1.10)
Employment	Economic	-5.364* (-1.82)	-	-
Key drivers				
Skills	Human	0.477*** (3.48)	0.021*** (2.62)	-0.055** (-2.05)
Investment	Economic	0.079* (1.90)	0.001 (0.74)	-
Enterprise	Economic	0.071** (2.06)	0.004*** (2.55)	-
Spatial factors				
Peripherality	Environmental	-0.188** (-2.09)	-0.012***(-4.35)	0.038*** (3.92)
Accessibility-1	Economic	-0.042 (-1.51)	-0.002 (-1.47)	-0.003 (0.555)
Accessibility-2	Economic	-0.012 (-0.39)	-0.002** (-1.97)	0.004 (0.93)
Other key characteristics				
Economic structure	Economic	-0.042 (0.54)	0.004 (1.36)	-
Government infrastructure	Economic	0.084* (1.70)	0.004** (2.31)	-
Road infrastructure	Economic	1.439** (2.27)	0.063* (1.89)	-
Population density	Human	-0.005 (0.08)	-0.001 (-0.03)	-0.009* (-1.80)
Occupational health	Economic	-	-0.026*** (-4.14)	-0.265*** (-8.60)
Household size	Human	-	-	1.037*** (8.39)
Proxy variables				
Natural beauty	Environmental	-0.016 (-0.85)	-0.001 (-0.60)	-0.005 (-1.55)
Public transportation	Economic	0.008 (1.10)	-0.004** (-2.28)	0.003 (0.46)
Election turnout	Human	0.040 (0.41)	0.000 (0.09)	-0.021 (-1.36)
Model diagnostics				
Adj. R-Squared (from 2SLS regressions)		0.49	0.44	0.80
F value		9.66***	23.59***	52.88***
Degrees of freedom		371		
Hausman test for choice of estimation technique (3SLS vs 2SLS) Chi-square (11 degrees of freedom)		3.28		
Decision		Accept 3SLS		
Likelihood Ratio test Chi-square (31 degrees of freedom)		497.22***		

Note: Figures in parentheses are t-ratios
***= significant at 1 percent level (p<0.01)
** = significant at 5 percent level (p<0.05)
* = significant at 10 percent level (p,0.10)

Appendix Table A1. Correlation matrix of explanatory variables including proxy indicators

	Skills	Invest-ment	Enter-prise	Peri-pherality	Access-ibility-1	Access-ibility-2	Econ-omic struc-ture	Govern-ment infra-struc-ture	Road infra-struc-ture	Populati on density	Occup-ational health	House-hold size	Natural beauty	Public trans-port	Election turnout
Skills	1.00														
Investment	0.16	1.00													
Enterprise	0.04	0.00	1.00												
Peripherality	-0.26	-0.04	-0.04	1.00											
Accessibility-1	-0.23	-0.08	-0.06	0.13	1.00										
Accessibility-2	-0.18	0.01	-0.13	0.24	0.38	1.00									
Economic structure	-0.16	-0.21	0.03	0.58	0.29	0.35	1.00								
Government infrastructure	0.10	-0.14	-0.07	0.15	0.20	0.04	0.11	1.00							
Road infrastructure	0.03	0.19	-0.03	-0.27	-0.29	-0.12	-0.47	-0.15	1.00						
Population density	-0.10	0.09	-0.12	-0.47	-0.23	-0.28	-0.84	-0.21	0.47	1.00					
Occupational health	-0.72	-0.15	-0.14	0.64	0.22	0.26	0.23	-0.04	-0.06	0.04	1.00				
Household size	0.30	0.13	0.08	-0.45	-0.48	-0.37	-0.46	-0.08	0.41	0.24	-0.48	1.00			
Natural beauty	0.21	-0.02	0.07	0.29	0.38	0.27	0.32	0.18	-0.15	-1.34	0.01	-0.33	1.00		
Public transport	0.23	0.08	0.09	-0.56	-0.12	-0.23	-0.67	-0.13	0.31	0.54	-0.22	0.30	-0.13	1.00	
Election turnout	0.22	0.07	0.10	-0.01	0.14	0.06	0.06	0.06	-0.16	-0.21	-0.22	0.13	0.06	-0.03	1.00