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Regional Determinants of Entrepreneurship in a Small Economy: Panel Data Evidence from Scotland.

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Abstract

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Regional Determinants of Entrepreneurship in a Small Economy: Panel Data Evidence from Scotland.

This paper analyses the spatial variation of new entrepreneurial activity across 32 Scottish regions for the period 1998-2007. Entrepreneurship is widely recognised as a key determinant of economic growth, regional prosperity and sustainable development. Using data from the Value Added Tax (VAT) register, this paper estimates spatial variation in new entrepreneurial activity using a panel data model. Results show that there is considerable variation in entrepreneurship across Scottish regions and that this variation may be explained by demand and supply factors, policy and cultural factors and agglomeration benefits. Given that Scotland has recently suffered from low levels of entrepreneurship compared with other parts of the UK and similar sized smaller countries, this paper provides relevant and timely findings, as Scotland attempts to recover from the recent recession.

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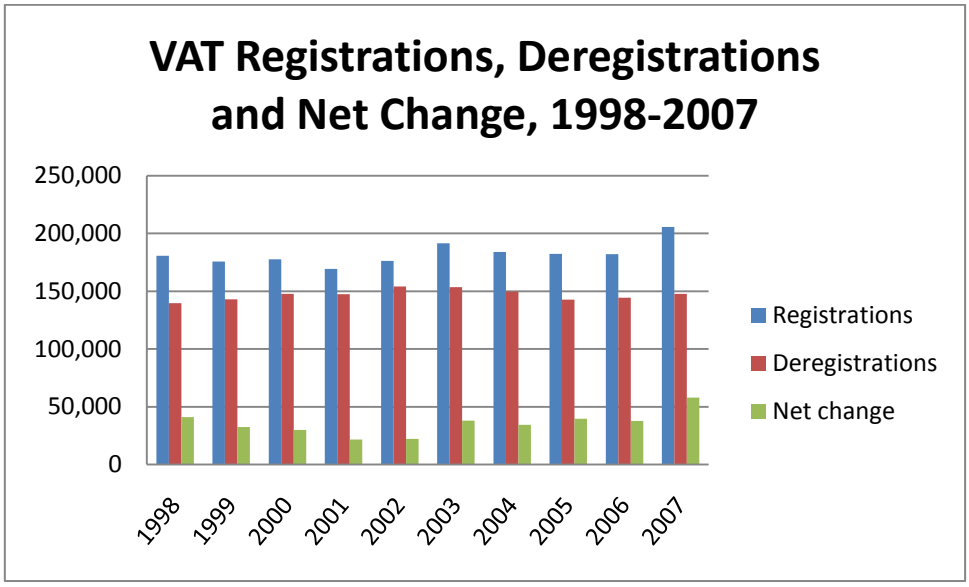
1. Introduction

This paper identifies and analyses spatial determinants of entrepreneurial activity across Scottish regions for the period 1998-2007. A number of studies recognise entrepreneurship, as a key determinant of economic growth, regional prosperity and sustainable development (Audretsch and Keilbach, 2004; Lee *et al,* 2004; Valliere and Peterson, 2009). As a result of this perceived importance entrepreneurship has become a key policy instrument and has been placed high on the agenda of both national and regional authorities. Scottish Enterprise (2008a) highlight there are positive links between high levels of entrepreneurship and more rapid levels of economic growth, however, the Fraser of Allander Institute (2009, p9) report that in Scotland "domestic business birth rate remains stubbornly low and business R&D is amongst the lowest in the world". Consequently this may adversely affect levels of economic growth, employment, and regional competitiveness. The Scottish First Minister states "a low growth economy is a concern… [i]t affects our job opportunities, our incomes and the aspirations of our young people" (Scottish Government Economic Strategy, 2007 p5). Scottish Enterprise (2008a) stress the importance of enterprise as a driver of economic growth stating that between 1999 and 2002 of the 559,000 jobs created, one quarter were created through new firm formation. According to Scottish Government the total number of private sector enterprises in Scotland was 296,780 in March 2010, with small enterprises accounting for 99% of all enterprises and 53% of employment (Scottish Corporate Sector Statistics, 2010).

While the focus of the paper is on entrepreneurial activity in Scotland, it is worth briefly contextualising the situation in Scotland with overall levels of entrepreneurial activity in the UK, as this allows us to discuss Scotland in the wider context with the UK and other constituent regions. Between 1998 and 2007 firm formation in the UK rose from 180,000 in 1998 to 205,000 in 2007, with an annual average of 182,527. Yet throughout this period, figure 1 shows that, there has been a degree of fluctuation in both annual registrations and deregistrations falling, as low as 169,000 in 2001 before peaking in 2007.

Figure 1. VAT Registrations, Deregistrations and Net Change, 1998-2007 for UK

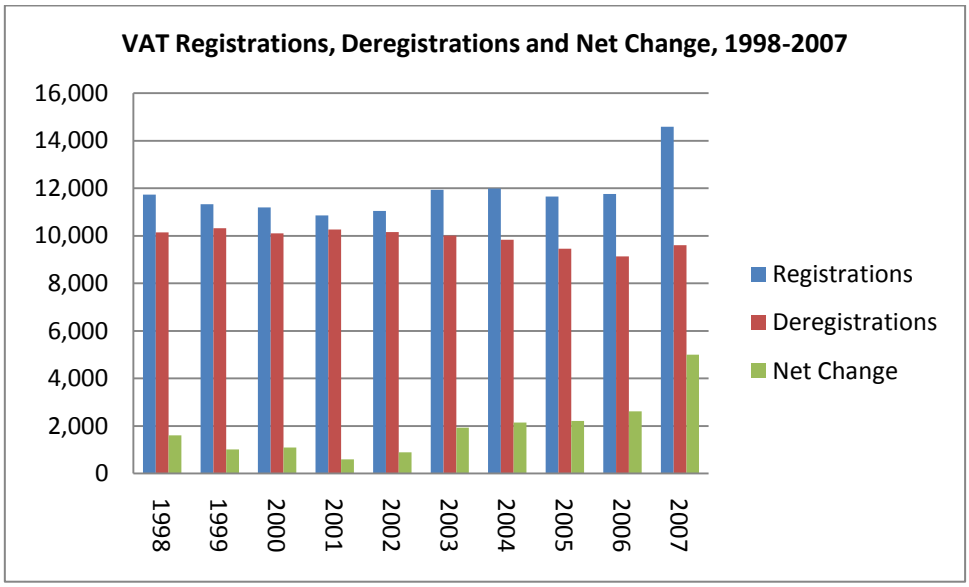


Source: VAT Register

Therefore, while business gross birth rates are important death rates are also critical in understanding the overall situation. That said annual registrations should also be contextualised with the number of deregistrations in a given year and while deregistrations have also been high, net business registrations have always been above deregistrations, resulting in an a net increase in business stock at the UK level from 1.7 million in 1998 to over 2.0 million by the end of 2007 an increase of 17.6%.

Figure 2 summarises total VAT registrations in Scotland over the period 1998-2007. It shows a somewhat similar trend line the UK over the same period with a peak of 14,595 in 2007 and a low of 10,855 in 2001 and a yearly average of 11,811.

Figure 2. VAT Registrations, Deregistrations and Net Change, 1998-2007 for Scotland



Source: VAT Register

Similar to the UK the stock of Scottish businesses has also increased from 124,000 in 1998 to 142,000 in 2007, albeit at a lower growth rate of 14.5% compared with 17.6% in the UK.

While the stock of UK businesses has increased, figure 3 shows per capita firm formation rates across UK Government Office Regions. In the UK there are nine GOR in England plus the countries of Scotland, Wales and Northern Ireland. Scotland, Wales and Northern Ireland are all devolved countries with different degrees of autonomy. Figure 3 reveals that four regions have above average per capita firm formation rates in the UK. As might be expected those regions are located in the South of England and particularly in the South East of England: London (70.4), the South East (56.9), East (51.7) and the South West (50.5). London has by far the highest level of entrepreneurial activity in the UK, especially when compared with Scotland, Wales and Northern Ireland. Scotland lies 10th from 12th with 35.9 registrations per 10000 of working age population, ahead of the North East region of England and Wales regions. Figure 3 also reveals a clear North-South divide, with entrepreneurial activity concentrated in the most economically prosperous parts of the United Kingdom, shown by both London and the South East regions having entrepreneurial rates double those of the North East and Wales, the least entrepreneurial regions in the UK. Finally, it is also apparent that there are elements of a core-periphery.

Figure 3. VAT Registrations, 1998-2007 per 1000 of Working Age Population.

Region	Rate
London	70.47
South East	56.93
East	51.78
South West	50.55
East Midlands	44.61
West Midlands	43.80
North West	41.29
Yorkshire and The Humber	39.89
Northern Ireland	36.61
Scotland	35.93
North East	28.16
Wales	27.78
UK	47.91

Although, there has been a net increase in the stock of UK businesses over the period by 17.6%, firm formation rates over the same period show significant differences between UK regions with a clear North-South divide, which can perhaps be accounted for by past industrial structure.

Therefore, despite a positive trend in the stock of both UK and Scottish entrepreneurial activity, initial analysis shows, that the rate of entrepreneurship is highly skewed across UK regions. However, given that most entrepreneurs start new businesses in close proximity to the areas in which they live, it is surprising that little research has examined the local context in which the entrepreneur must operate (Malecki, 2009). Gordon and McCann (2000) identify external factors as those factors that are related to the location or environment of new firms and to some extent are able to take account of the local environment; an area that is identified as being under-researched (Schutjens and Weaver, 2000; Mueller, 2006; Malecki, 2009).

Specifically, few studies within Scotland have empirically examined regional determinants of new firm formation and/or tried to explain why certain regions have higher levels of entrepreneurial activity than others. Furthermore, for the small number of studies that do exist, Scotland has generally been treated, as a region or self administering nation-region within the UK, ignoring regional differences and excluding in depth analysis of entrepreneurial activity at the local level, which may be specific to Scotland. This provides the gap in knowledge and

the opportunity for up to date empirical study, of entrepreneurial activity in Scotland. Given the small size and geographical position of Scotland, the paper also adds to the limited amount of studies addressing entrepreneurial activity in small and peripheral countries. In addition to the best of the authors' knowledge this is the first paper to address regional determinants of new business formation using panel data in Scotland. This paper therefore provides a more up to date summary of spatial entrepreneurial activity in Scotland in doing so lays the foundations for future research.

The paper is structured as follows. Section 2 presents the literature review and hypothesis, section 3 the data and method, section 4 describes regional variation in entrepreneurship, the empirical results are presented in section 5 and section 6 concludes with some comments and recommendations for further research.

2. Literature Review and Hypotheses

Although few studies exist on the extent and location of entrepreneurial activity in Scotland, the conceptual framework adopted in this study is similar to those adopted in other spatial studies (Keeble and Walker, 1994; Audretsch, 2002; Tamásy and Le Heron, 2008; Gaygisiz and Koksal, 2003 Bosma et al., 2008). Conceptually, this study groups the explanatory variables into three broad categories, as identified by Bosma et al. (2008) including demand and supply factors, agglomeration effects and policy and culture determinants. Tamásy and Le Heron (2008) contend that demand side variables represent the structural features of regional economies and markets and, therefore entrepreneurial opportunities, while supply side variables represent the entrepreneurial capacity of a region focussing on the individual entrepreneurial characteristics including demographics, wage rates and employment status.

Demand and Supply Factors

Previous research suggests that new businesses are likely to serve local markets (Tamásy, 2006; Dahl and Sorensen, 2009). Therefore, it can be expected, that increasing demand for goods and services will be associated with higher firm births and as a result it may be expected that an increase in population growth will have a positive effect on new firm formation (Keeble and Walker, 1994; Reynolds et al., 1995; Armington and Acs, 2002;

Tamásy and Le Heron, 2008). Income levels are also likely to affect demand for local businesses. As incomes increase demand may also rise creating a positive impact on the level of new firm formation (Reynolds et al., 1994). Therefore, spatial differences in the demand for goods and services are likely to influence the demand for entrepreneurship and it is likely, that spatial variations occur as a result in differences or changes in local demand conditions. Therefore, to assess the effects of local demand on entrepreneurship two hypotheses are tested.

H1a: A regions rate of wage growth is positively related to the level of entrepreneurial activity. (WAGGRO)

H1b: A regions rate of population growth is positively related to the level of entrepreneurial activity (POPGRO)

Previous studies highlight that the level of unemployment may also impact the supply of entrepreneurship. However, the relationship between unemployment and entrepreneurial activity is not clear. At one level a negative change in labour market conditions and the limited availability of waged employment may push individuals into entrepreneurial activity (Storey, 1991; Keeble and Walker, 1994; Evans and Leighton, 1990). Tervo (2008) interprets high levels of entrepreneurship in rural areas to be the result of limited employment opportunities, rather than opportunities presented by the markets. Similarly Brooksbank and Thompson et al. (2008) find entrepreneurship is higher in Welsh rural regions, but more significantly that necessity entrepreneurship is twice that of Welsh urban regions. Based on Scottish GEM data Levie (2009) finds, that levels of entrepreneurship are significantly higher in the rural Highlands and Islands region (7.6%) and similar to other UK rural regions including Devon (7.3%), Cornwall and Scilly Isles (7.5%) and Dorset and Somerset (6.7%). However, Audretsch (1993) disputes the unemployment push hypotheses finding that unemployment has a negative impact on entrepreneurial activity, as low employment levels create less disposable income and, therefore a lower level of demand for goods and services within a locality. Therefore, based on the ambiguity of previous empirical findings unemployment may increase entrepreneurial activity, if regions have limited alternative employment opportunities, yet unemployment may also create low demand for goods and services in a region and a local environment, that is not conductive to entrepreneurial activity (Grilo and Thurik, 2005). To account for the ambiguity in previous research findings, while attempting to account for the effects of unemployment at the Scottish level we suggest, that

entrepreneurial activity may be higher in rural regions because the availability and range of other employment opportunities will be limited compared with urban regions. We hypothesise that:

H2a: Unemployment will have a positive effect on entrepreneurial activity. (UNEMP)

The number of skilled workers in a region may also influence the level and location of entrepreneurial activity. Lee et al. (2004) and Armington and Acs (2002, 2004) find that regions with a higher number of university graduates are more likely to have higher levels of entrepreneurial activity. The number of people with a degree acts, as a proxy for the technical skills that an economy requires in terms of engineers and scientists, but also for the skills needed to commercialise a business opportunity in terms of finance and marketing. Furthermore, a higher level of education may indicate a greater degree of knowledge and therefore the ability to perceive profitable opportunities (Kirzner, 1997). In line with previous findings, it should be expected, therefore, that a greater degree of human capital, given by the share of the population with an NVQ4 or above would be expected to have a positive impact on a regions entrepreneurial activity.

H3: A regions rate of entrepreneurial activity is positively associated with the number of individuals holding an NVQ level 4 or above qualification. (NVQ4)

Agglomeration Factors

The location of entrepreneurial activity may also be influenced by the presence of agglomeration economies. In urban areas the concentration of people and firms can lead to lower search costs for individuals and suppliers (Porter, 1998; Reynolds, 1994). Agglomeration economies can be classified into urbanisation economies and localisation economies or the localisation (specialisation) versus urbanisation (diversity) debate. Urbanisation economies are externalities arising from the variety of general economic activity, while localisation economies are industry specific benefits including access to a pool of well qualified labour, the existence of specialised suppliers and knowledge spillovers arising from the close proximity of firms in the same industry (Marshall, 1890). Jacobs (1969) disputes Marshall's assumption, that externalities are caused by same industry specialisation, arguing instead, that externalities are a result of economic diversity created by a range of economic activity and that diversity of both firms and knowledge is greatest in cities. However, results regarding whether localisation or urbanisation economies are strongest have

proved inconclusive (Beaudry and Schiffauerova, 2009) and while it can be accepted, that economic activity in general is not evenly distributed, it cannot be agreed as to the factors that cause this uneven distribution of economic activity. Therefore, we test two hypotheses for the effects of both urbanisation (Jacobian) and localisation (Marshallian) economies.

H4a: A regions entrepreneurial activity may be affected by localisation economies, however, the direction of this relationship is indeterminate. (SPEC)

H4b: A regions entrepreneurial activity may be affected by urbanisation economies, however, the direction of this relationship is indeterminate. (POPDEN)

Policy and Cultural Factors

Other than the aforementioned structural determinants that may influence entrepreneurial activity, the local environment in which business is undertaken may also influence the location decision of potential entrepreneurs. Audretsch and Keilbach (2004a) argue that entrepreneurship capital will have a positive effect on levels of entrepreneurship. While Audretsch and Keilbach do not specifically define entrepreneurship capital; only that it constitutes factors that are conductive to the creation of new businesses and measure it only as the number of start ups relative to the population they do argue that entrepreneurship capital is comprised of aspects of local institutional and cultural dimensions in entrepreneurship. We propose two testable hypotheses, as a proxy for regional entrepreneurship capital.

First, the institutional environment, which underlies the incentive structure of an economy and its capacity to generate economic growth. Therefore, if the institutional capacity is both limited and geographically constrained, it may influence the extent and location of entrepreneurial activity. Nystrom (2008) finds evidence, that a large government sector has a negative impact on entrepreneurship in Sweden. Given that 32% of Scotland's workforce is employed in the public sector, and not in profit seeking businesses, this may partially explain why Scotland has historically lagged behind other UK regions and similar sized smaller countries for entrepreneurial activity and economic growth. Therefore, it may be hypothesised that a large government sector will negatively impact the level of entrepreneurial activity measured by the number of people in each region employed in the public sector.

H5a: The size of a regions public sector will be negatively associated with its level of entrepreneurial activity. (GOVSEC)

Third, Malecki (2009) and Aoyama (2009) argue that the local environment for entrepreneurship is shaped by its societal and cultural institutions and therefore, an environment with positive attitudes towards entrepreneurship, is more likely to see higher levels of entrepreneurial activity. Adopting the approach of Stam (2009) that the number of current entrepreneurs within a locality acts as a proxy for how well entrepreneurship is accepted, it is estimated that the share of small business within a region acts as a proxy for the entrepreneurial culture of a region.

H5b: A regions rate of entrepreneurial activity will be positively associated with the number of existing small businesses. (ENTPOP)

3. Data and Method

Data

The indicator of new entrepreneurial activity used in this paper is the number of new annual VAT registrations. The VAT register is the most comprehensive measure of new firm formation statistics available in the UK and has been employed in a number of related studies (Ashcroft et al., 1991, 2007; Keeble and Walker, 1994; Gleave and Mitra, 2010). The number of VAT registrations in a region indicates the general health of a business population and in addition to being used in academic studies is widely used in regional and local planning to examine the number of new entrants into the UK economy (Ball, 2007).

With over 2 million listed businesses the VAT register represents nearly 99% of UK economic activity. However, the IDBR estimate there are 4.7 million enterprises in the UK, therefore, while VAT registration and deregistration, do provide trends for start up and closures, they are likely to underestimate the total number of starts and closures and, as a result should be treated with some caution. The register also excludes businesses not required to pay VAT including book companies, food producers, and the manufacturers of children's clothing firms. In addition the VAT register is quantity driven, failing to distinguish between type and motivation of entrepreneur; as a result researchers employing the VAT register are operationally constrained to adopting Gartner's definition of entrepreneurship as, anybody

who starts a business. Furthermore, some businesses are not VAT registered and never will be, as firm turnover will remain below the VAT threshold, which is historically subject to change (Johnson, 2007). Therefore, VAT registration is not synonymous with business births and deaths, as registration includes businesses, which have been trading previously, but have only just crossed the VAT threshold (Campbell, 1998). Johnson and Conway (1997) also highlight that VAT registration may not be the result of a new business, but rather the reorganisation, change in ownership or business acquisition. However, they also state the "relative comprehensiveness, their 'official' status, and the regularity with which they are collected, give them a powerful advantage, despite their limitations" (Johnson and Conway, 1997, p408). Similarly, Keeble and Walker (1994, p413) acknowledge the limitations of the data but, also state the data "represents the most up-to-date, comprehensive, reasonably long-term and spatially disaggregated data source currently available for such investigation".

As a result of differences in population and region size, it is necessary to standardise the number of new entrants (Storey and Johnson, 1987; Ashcroft *et al.*, 1991; Keeble and Walker, 1994; Armington and Acs, 2002; Sutaria and Hicks, 2004; Tamásy and Le Heron, 2008; Gleave and Mitra, 2010). In line with the previous literature standardisation methods are grouped into two categories: the *'labour'* market approach and the '*ecological'* approach. The labour market approach standardises the number of new entrants relative to the size of a regions workforce or population. The benefit of this approach is that it can indicate a regions entrepreneurial potential, based on the assumption, that new entrepreneurial activity is most likely to arise from the actions of individuals within a given region (Gleave and Mitra, 2010; Cheng and Li, 2010; Sutaria and Hicks (2004). Alternatively, the ecological approach measures new entrants relative to the stock of existing businesses. Selection of an appropriate method can be crucial, as the respective methods often produce differing results and as a result method of standardisation is part of a long running debate.

Independent variables

In order to explain the causes of spatial variation in entrepreneurial activity 9 explanatory variables are identified (refer to table 1 for operational definition). The explanatory variables fall into three broad categories: (1) demand and supply factors (2) agglomeration factors and (3) policy and cultural factors. The explanatory variables are represented by at least one specific indicator that has either been employed in previous empirical studies or reflect specific regional factors predicted to account for new entrepreneurial activity in the Scottish

context. In line with Reynolds et al., (1994) and Sutaria and Hicks (2004) a one year lag is built into the independent variables are new firm formation is likely to have been affected by what has happened previously.

Figure 4. Selection of Explanatory Variables

Variable	Operational Definition	Expected Effect	Data Source
Demand and Supply factors			
WAGGRO	Annual wage growth change	+	Office of National Statistics
POPGRO	Annual population growth change	+	General Register Office for Scotland
UNEMP	Average % of unemployed	-	Office of National Statistics
GRADPOP	% of population with NVQ 4 or higher	+	ONS: Annual population Survey
Agglomeration factors			
LQMAN (SPEC)	Number of firms in manufacturing sector relative to the total business population (LQ)	+/-	IDBR: VAT register
LQBS (SPEC)	Number of firms in the business sector relative to the total business population (LQ)	+/-	IDBR: VAT register
POPDEN (URBAN)	Population density, measured as inhabitants divided by regional area	+/-	General Register Office for Scotland
Policy and cultural factors			
GOVSEC	% of work force employed in the public sector	-	ONS: Annual population Survey
ENTPOP	% of small businesses in the overall business population	+	IDBR: VAT register

Statistical Model and Method

A panel data set was constructed for Scotland's 32 council regions using VAT registration statistics. Panel data estimation differs from regular cross section and time series estimation in that panel data is a combination of both cross section and time series, signified with variables having a double subscript. The basic OLS pooled panel model can be written as:

$$Y_{it} = \alpha + X_{it}\beta + \mu_{it} \qquad i = 1,2,...,N;\ t = 1,2,...,T \qquad \textbf{(1)}$$

where i denotes the individual region and t denotes time. The individual unit i denotes the cross section and t the time series. α is a common intercept, β is k x 1 and X_{it} the it^{th} observation on K explanatory variables. The error term is written simply as $\mu_{it,}$ assuming the classical OLS assumptions are met. The pooled OLS model assumes that the error term μ_{it} is independent and uncorrelated with the predictor variables X_{it}. Therefore, if X_{it} is correlated with the error term μ_{it} the OLS estimator will be biased and inconsistent. In addition for the pooled OLS model to be consistent the standard errors must be homoscedastic: Var ($\mu_{it} = \sigma \frac{2}{u}$).

When there are significant differences between individual regions, it is more appropriate to model heterogeneity using an individual effects model:

$$Y_{it} = \alpha_i + X_{it}\beta + \mu_{it} \qquad i = 1,2,...,N;\ t = 1,2,...,T \qquad \textbf{(2)}$$

where α_i is the only differentiating factor between the individual and pooled models. However, major differences exist in the way α_i is assigned and assumptions made between the fixed and random effects models. Furthermore, in the individual effect model the error component is decomposed where:

$$\mu_{it} = \mu_i + \nu_{it}$$

following from Baltagi (2005) μ_i denotes the unobserved individual specific effect and ν_{it} denotes the remainder disturbance. μ_i is time invariant and absorbs any individual unit effect, that is not in the in the estimated regression, such as the regional climate, crime rate or religion. ν_{it} is the remaining disturbance, that varies with the individual units and time and is regarded as the normal disturbance in a regression. The key differentiating factor between the two individual effect models is the way the individual specific error component is modelled. In the fixed effect model it is assumed to be part of the intercept, while in the random model it forms part of the error variance.

Fixed Effect Model

The fixed effect model assumes that the individual effect is captured by the intercept term α_i, which means that every individual region gets their own intercept and that this individual effect will vary across groups. Therefore, the fixed effect model can be expressed as:

$$Y_{it} = (\alpha + \mu_i) + X_{it}\beta + \nu_{it} \qquad i = 1,2,...,N;\ t = 1,2,...,T \qquad \textbf{(3)}$$

where in the fixed effect model μ_i are assumed to be fixed parameters to be estimated, ν_{it} is the remaining stochastic disturbance, which is assumed to be independent and identically distributed IID $(0\ \sigma^2_\nu)$. In the fixed effect model the individual effect $(\alpha + \mu_i)$ is allowed to be correlated with the independent variables X_{it}, while assuming that X_{it} remains uncorrelated and independent of idiosyncratic error (ν_{it}) for all *i* and *t*. Therefore, given that each individual region has unique characteristics, that may or may not influence the predictor variables, the fixed effect model controls for this by removing the time invariant factors $(\nu_{it} - \mu_i)$ in order to assess the predictors net effect, which indicates that if the unobserved effect does not change over time, it must follow, that any change in the dependent variable must be due to influences other than the fixed effects (Stock and Watson, 2003, p289-290). The other assumption for OLS to be valid is that the errors μ_{it} are homosdedastic $\text{Var}(\mu_{it}) = \sigma^2_u$ for all *t* and the idiosyncratic errors are serially uncorrelated $\text{Cov}(\mu_{it},\mu_{is}|X_i,\alpha_i) = 0$ across all time periods.

Random Effects Model

In the fixed effect model, μ_i is treated as fixed, but can be correlated with the regressors Cov $(X_{it}, U_i) \neq 0$. However, in the random effects model μ_i is assumed to be randomly distributed with a constant mean and variance, but crucially that μ_i is uncorrelated with the regressors Cov $(X_{it},a_i) = 0$, for all *t*. Therefore, in the random model the individual effect is treated as a random component and part of the error structure and not the intercept. The random effects model can be written as

$$Y_{it} = \alpha + X_{it}\beta + (\mu_i + \nu_{it}) \qquad i = 1,2,...,N;\ t = 1,2,...,T \qquad \textbf{(4)}$$

where the only difference between the fixed effect model (3) is that μ_i is now part of the error term and not the intercept. Therefore, the random effects model meets all of the same assumptions, as the fixed effects model plus the additional requirement that the individual effect μ_i is uncorrelated with the regressors in all time periods (in other words the individual effect is constant). Therefore, ν_{it} are independent random variables with $N(0, \sigma_v^2)$ distribution, with Var $(\nu_{it}) = \sigma_v^2$. Similarly, μ_i are independent variables with $N(0, \sigma_u^2)$ distribution with Var $(\nu_{it}) = \sigma_u^2$. Finally, it is assumed that ν_{it} and μ_i are uncorrelated with each other and the regressors. Therefore, given that in the RE model the error structure is comprised of $\mu_{it} = \mu_i + \nu_{it}$, combined with the assumption that that both ν_{it} and μ_i are normally distributed with constant variance, because μ_i is part of the composite error, the combined error μ_{it} is correlated over time, highlighting that the cross sectional errors for the same individual region are correlated with each other Cov $(\nu_{it,} \nu_{is}) \neq 0$ and as a result the regression errors violate the assumption that errors should be uncorrelated with each other, which again indicates that OLS would not be appropriate and as a result the random effect model estimates parameters using GLS.

As Kangasharju (1999) highlights deciding whether to use a fixed or random effects model are not easy, but it is crucial, as both models are liable to produce very different results. In general the fixed effect is consistent, but at the cost of not being able to measure time constant variables, whereas the random effect model produces biased estimates if the individual effect is fixed. Alternatively, the random model, permits the use of time constant variables, however, if the μ_i (individual effect) is not independent of the explanatory variables then the random effects model is inconsistent and bias. Ultimately, the common way of selecting between the fixed and random effects model is to conduct a Hausman test for which the result is reported in section 5.

The final model can be given as:

$$NEA = f\ (WAGGRO_{it-1}, POPGRO_{it-1}, UMEMP_{it-1}, GRADPOP_{it-1}, LQMAN_{it-1}, LQBUS_{it-1}, POPDEN_{it-1}, GOVSEC_{it-1}, ENTPOP_{it-1})$$

Where:

Dependent Variable

NEA= the annual average firm formation rate per 1000 of working population in each region 1998-2007.

Demand and Supply

WAGGRO= average annual wage growth change 1998-2007.

POPGRO= average annual population growth rate change 1998-2007.

UNEMP= average percentage share of unemployment 1998-2007.

GRADPOP= average percentage share of population with NVQ or higher 1998-2007.

Agglomeration Factors

LQMAN= number of firms in same sector relative to business population 1998-2007 (LQ).

LQBS= number of firms in same sector relative to business population 1998-2007 (LQ).

POPDEN= average annual population density of region 1998-2007.

Policy and cultural factors

GOVSEC= average annual share percentage share of work force in public sector 1998-2007.

ENTPOP= average annual percentage share of existing small businesses 1998-2007.

4. Spatial Pattern of Firm Formation in Scotland

The geographical unit of analysis in this paper are the 32 local authority council regions in Scotland. Council areas are least disaggregated level at which VAT data is available and represent the local environment of the entrepreneur. Located in the northern periphery of both the UK and Europe Scotland is a small country with a total population of 5.14 million and a working age population of 3.38 million[2]. Internally, Scotland is divided into 32 council regions ranging in size, the number of inhabitants and in population density. Glasgow City (582,000) is the most populous region and the Orkney Islands (20,000) the least populous. The Highlands region is the largest in size (25,659 km^2) and Dundee City the smallest (60 km^2). Scotland is also one of the least densely populated countries in Europe, ranging from 8 people per km^2 in the Highlands region to 3316 individuals per km^2 in Glasgow City. Overall 70.1% of the population live in urban areas with 29% of the population living in the two largest cities Glasgow and Edinburgh.

Appendix 1 shows that there is considerable spatial variation in new entrepreneurial activity across Scottish regions. The average firm formation rate in Scotland ranges from a low of 19.3 (West Dunbartonshire) to a high of 48.8 (Aberdeenshire) with a Scottish average of 35.9 registration per 1000 of working age population. In total there are 12 regions with above average firm formation rates. The highest level of entrepreneurial activity is in the North East in Aberdeenshire (48.8), followed by Stirling (48.5) and the Orkney Islands (48.1). Those regions with the lowest firm formation rates include: West Dumbartonshire (19.3), Inverclyde (23.4) and North Ayrshire (25.8), which are all situated west of Glasgow. Interestingly, appendix 1 shows that some of the highest levels of entrepreneurial activity are located in the more Northern regions of Scotland and in rural areas reflected by 9 of the above average 12 regions being considered rural[3]. However, unlike the UK there is no evidence of a core-periphery relationship, with many of the most entrepreneurial regions being considered as

[2] Data from NOMIS.

[3] The Randall definition is based upon population density within a unitary authority. Where a unitary authority has a population density of less than one person per hectare it is considered Rural. On this basis there are 14 rural unitary authorities. Unitary Authority data is readily available and it is therefore very easy to apply this definition to a wide range of data sources. One disadvantage, however, is since it is Unitary Authority based, some urban areas, including Stirling and Inverness, are classified as rural. Using the Randall definition of rurality 89% of Scotland's landmass and 29% of its population is classified as rural.

rural and located on the periphery, while some of the least entrepreneurial regions are located in the urban central belt and south western parts of Scotland. However, it is worth highlighting that both of Scotland's major cities, which are located in the Eastern and Western parts of the central belt have above average entrepreneurial activity: Edinburgh (44.7) and Glasgow (40.2). Edinburgh City is Scotland's most entrepreneurial city, while Dundee (27.0) is the least entrepreneurial. With the exception of the Edinburgh and Glasgow city regions, it is also worth noting the relatively low levels of entrepreneurial activity in the in the central belt and the South West of Scotland.

5. Empirical Results

This section presents the results of the empirical model. As previously mentioned picking the correct econometric model is not always straightforward. Diagnostic tests of the OLS pooled model reveal that why multicollinearity as reported by the variance inflation factor method (see appendix 2) is not a problem a Cook Weisberg test indicated heteroscedasticity at the 0.01 level. As a result, it would be inefficient to estimate the coefficients using OLS. Instead we follow protocol and correct for the heteroscedasticity by implementing Huber-white robust standard errors, which does not change the coefficients, but does ensures accurate p-values. Given that each of the 32 regions is not homogenous and that firm formation rates vary significantly between regions over time, in order to take account of these differences an individual effect model is used. Officially, we test whether intercepts vary across cross sectional units by employing the Breusch-Pagan Lagrange Multiplier. The test statistic produced a $\mathcal{X}^2$ of 440.96 strongly rejecting the hypothesis that the intercept is invariant across cross sectional units. As a result the individual effects model is used to take account of regional variation in firm formation rates. However, the choice of whether to estimate coefficients using a fixed or random effects model is made using the Hausman Test, which tests if the μ_i are uncorrelated with the independent variables. In this case with a $\mathcal{X}^2$ result of 4.52 we do not reject the null hypothesis indicating, that it is appropriate to use the random effects model.

Figure 6 displays the econometric estimation for new entrepreneurial activity in Scotland. Overall, the model is statistically significant explaining 40.1% of the variation in regional levels of new entrepreneurial activity. Results show that demand and supply, agglomeration and policy and cultural factors are all significant in explaining regional differences in levels

of new entrepreneurial activity. Similar to other studies Reynolds et al. 1994; Kangasharju, 2000; Armington and Acs, 2002; Tamasy and Le Heron, 2008; Gaygisiz and Koskal, 2003) population growth was identified as positive and statistically significant. While population growth arguably relates to an increase in the supply of entrepreneurs in the short-term, it is more likely to reflect an increased demand for goods and services and as a result new businesses will be established to service this increasing demand.

Figure 6. The Determinants of Regional Variation in New Firm formation: Scottish Regions, 1998-2007

Variable	Coefficient	Standard Error[1]
Demand and Supply factors		
WAGGRO	-0.041	0.040
POPGRO	1.500	0.872*
UNEMP (Log)	-4.053	1.797**
NVQ4POP	0.206	0.057***
Agglomeration factors		
LQMAN	0.564	0.546
LQBS	-0.522	2.711
POPDEN	0.002	0.001**
Policy and cultural factors		
GOVSEC	-0.005	0.054
ENTPOP	1.197	0.308***
Constant	-73.76	28.25
Breusch-Pagan test of Independence	440.96	0.000***
R^2	0.40	
N	320	

Significance at the 0.01, 0.05 and 0.10 level indicated by ***, ** and *.

1. Robust standard errors used to correct for heteroscedasticity.

However, wage growth, which also acts as a proxy for demand was not found to influence entrepreneurial activity. The coefficient was negative and not statistically significant, indicating that as wages grow people are less likely to consume goods and services locally. Two potential explanations include, that as individual wages grow people are not satisfied by the local availability of goods and services and secondly, as the correlation coefficients show (see Appendix 3) population growth and wage growth are negatively correlated indicating, that while population growth may increase demand for goods and services, growth in any population also drives down wage rates and as result individuals may have less disposable income to spend locally.

The unemployment rate was found to be strongly negative and statistically significant. In line with other studies (Kangasharju, 2000; Gaygisiz and Koskal, 2003; Bosma et al., 2008) this suggest, that a negative change in labour market conditions does not lead to more people starting businesses as a way of creating employment. In addition higher unemployment rates may lead to a falling demand for goods and services within a region, as result of lower incomes for the unemployed. In Scotland there is no evidence of the unemployment push hypothesis. Although, given the high rates of new firm formation in Scottish rural regions, it may well be that individuals start businesses as a result of limited employment opportunities.

Similar to other studies (Lee et al., 2004; Armington and Acs, 2002; Gleave and Mitra, 2010) higher levels of education or human capital has a strongly positive and statistically significant effect on rates of entrepreneurship. This may suggest that higher levels of education and skills allow an individual to foresee business opportunities, as a result of their ability to access and acquire knowledge, but importantly that they also know how or where to obtain the expertise, that allows them to commercialise those activities. It may also be that firms are attracted into regions with a well educated and skilled workforce.

Results show the effects of agglomeration are mixed. Results show that localisation economies in manufacturing and business services are not significant factors in new entrepreneurial activity in the respective sectors. Indeed although not significant, the coefficient for specialisation economies in business services was negative, which as Tamásy and Le Heron (2008) suggest may actually mean that advantages of the localisation economies, such as labour market pooling, access to specialised suppliers and knowledge spillover may be outweighed by the level of competition in business services. However, population density which acts as a proxy for urbanisation economies has a positive effect and is statistically significant (Reynolds et al, 1994; Gaygisiz and Koskal, 2003). This tells us that why firms do not necessarily concentrate to take advantage of same industry specialisation, firms do locate in regions where economic activity and diversity is greatest. That said while firm formation rates vary significantly in Scotland the vast majority of the total number of firms are located in the urban central belt between Glasgow and Edinburgh where populations are greatest as this is where the variety of demand and knowledge are also greatest. Finally given the relatively small size of Scotland as a country factored with the relatively high level communication and transportation infrastructure and relatively short commuting times, it may be that firms do not feel they must locate in close proximity.

At the cultural level although the size of the public sector workforce has a negative effect on the level of entrepreneurial activity the coefficient is very small and not significant. One plausible alternative given the very small size of the coefficient is that the relatively large public sector in Scotland may actually create many new business opportunities, as the public sector undertakes many of its duties and services by contracting work to the private sector.

Finally, the percentage of small businesses that exist in a region acting as a proxy for how well entrepreneurship is accepted by society is strongly positive and highly statistically significant. It is also the strongest indicator of regional differences in entrepreneurial activity in Scotland. A region with a high number of existing small firms indicates a positive attitude and an enterprising culture, which may encourages others to establish businesses and given the previous references relating to the positive impact of small firms on economic growth and job creation, there could be regional benefits associated with this. Additionally a high number of small firms may act as role models for would be business owners from whom advice can be sought.

6. Conclusion and Recommendations for Future Research

This paper has attempted to identify and explain regional variation in new entrepreneurial activity across Scotland's 32 regions over the period 1998-2007. The paper identified that there is considerable spatial variation in firm formation rates, with new firm creation being particularly high in some rural areas. It is also noticeable that levels of entrepreneurial activity in Scotland are far below the UK average, which may account for relative and prolonged levels of low economic growth in Scotland.

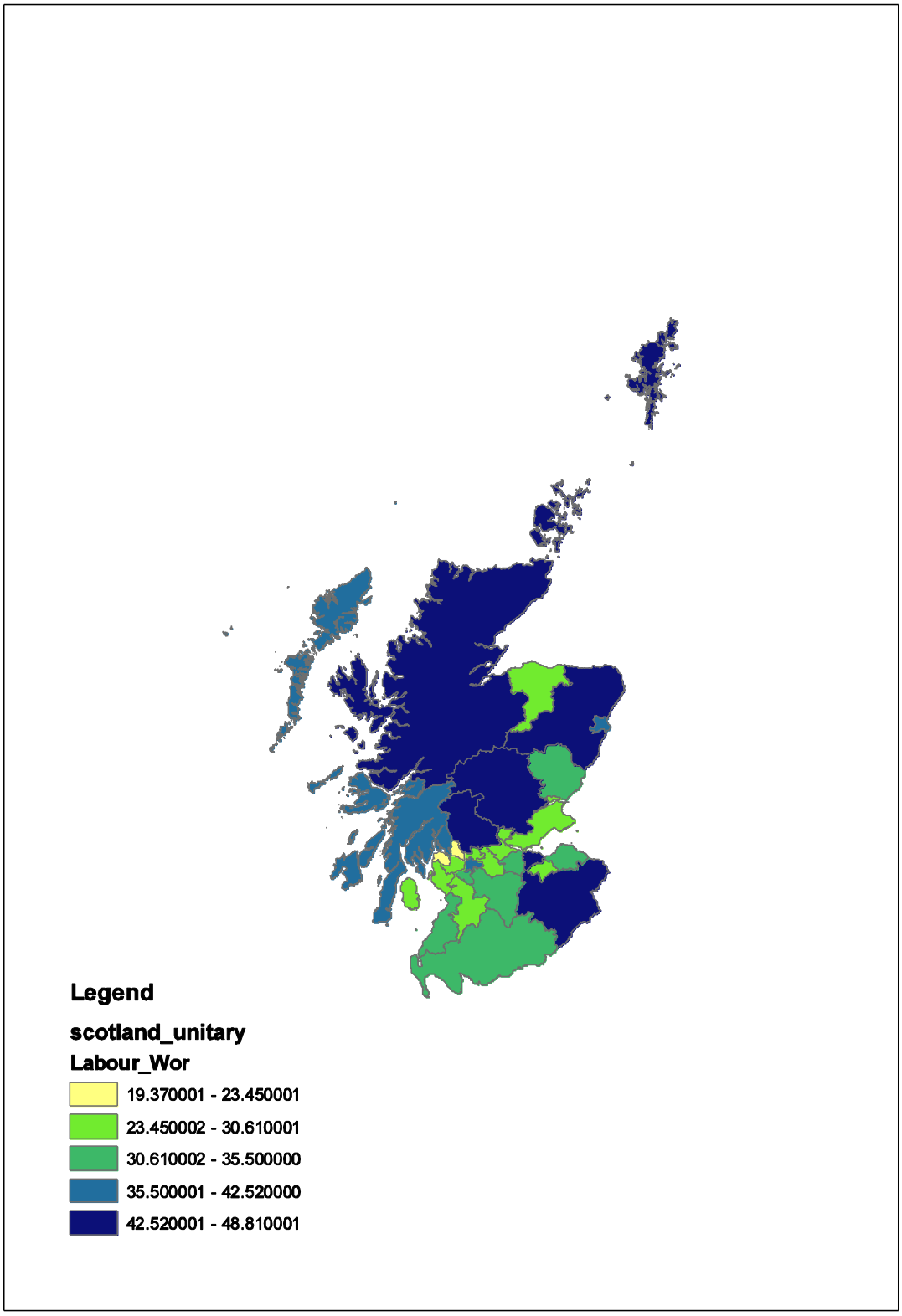
Using the VAT registration database a panel data set was constructed. Results show that differences in firm formation rates can firstly be explained most significantly by the number of existing small businesses within a region and secondly by population growth an indicator of local demand conditions. Human capital or education was also found to significantly influence levels of entrepreneurial activity across regions. Findings relating to agglomeration factors were mixed with no statistically significant effects for specialisation economies, but population density, which acts, as a proxy for urbanisation was positively related and significant. The unemployment push hypothesis was rejected, as the unemployment rate was

found to negatively affect levels of new firm formation. Unemployment may mean individuals do not have enough capital or access to capital because of unemployment. Equally, unemployment may mean there is not sufficient demand for new businesses in regions with high and prolonged levels of unemployment. Finally, both the number of people employed in the public sector and wage growth variables were identified as having a negative and insignificant effect on the levels of new firm formation in Scottish regions.

This paper has provided a timely study relating to the empirical determinants of new firm formation in Scotland using a panel data set for the first time. It identified that identified that demand and supply, agglomeration and cultural factors can help explain regional variation in new entrepreneurial activity in Scotland. It has also added to the limited number of studies on entrepreneurship in small and peripheral countries.

Having identified external factors in this paper future research should seek to address internal factors such as motivation for entrepreneurship, as there is increasing evidence that economic growth is driven not simply by the number of businesses, but by high growth firms. Therefore, in the Scottish context this raises the question, that while firm formation rates in rural regions are amongst the highest, what type of businesses are these and what contribution are they making towards economic growth and job creation. It may be that high firm formation rates alone are deceptive and as a consequence, we need to know more about the individuals involved. Therefore, at the policy level in Scotland it is important to ensure, that business numbers alone do not simply increase, but that these businesses are high quality, capable of driving both economic growth and the creation of high quality employment opportunities, which will ensure high and sustainable levels of economic growth in Scotland and its regions .

Appendix 1. Spatial Variation in new entrepreneurial activity rates per 1000 of working population at 2002 population, 1998-2007.



Appendix 2. Result of Variance Inflation Factor (VIF) for pooled OLS.

```
. vif
```

Variable	VIF	1/VIF
logunemp	1.99	0.501592
lq_bs	1.99	0.503418
small_bus	1.79	0.557752
nvq4_pop	1.78	0.560658
pop_density	1.77	0.564799
gov_sector	1.31	0.765755
pop_grow	1.27	0.790249
lq_man	1.15	0.870433
wge_grow	1.01	0.993214
Mean VIF	1.56	

Appendix 3. Correlation Coefficients for Regression Variables.

```
. pwcorr lab_wp wge_grow pop_grow logunemp nvq4_pop lq_man lq_bs pop_density gov_sector
>  small_bus
```

	lab_wp	wge_grow	pop_grow	logunemp	nvq4_pop	lq_man	lq_bs
lab_wp	1.0000						
wge_grow	-0.0569	1.0000					
pop_grow	0.2669	-0.0339	1.0000				
logunemp	-0.5226	0.0144	-0.3840	1.0000			
nvq4_pop	0.2568	0.0262	0.1157	-0.3104	1.0000		
lq_man	0.0198	-0.0102	-0.1587	0.0144	-0.1962	1.0000	
lq_bs	0.0691	-0.0321	0.1600	-0.0770	0.4964	-0.3029	1.0000
pop_density	-0.0678	-0.0152	-0.2005	0.3917	0.2592	-0.0670	0.3582
gov_sector	-0.0168	0.0074	-0.1871	-0.0168	0.1551	0.1851	-0.2567
small_bus	0.4846	0.0272	0.1525	-0.5115	-0.0286	0.0637	-0.3248

	pop_de~y	gov_se~r	small_~s
pop_density	1.0000		
gov_sector	0.1102	1.0000	
small_bus	-0.5167	0.0636	1.0000

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