| Title | Local labour market diversity and business innovation: evidence from Irish manufacturing businesses |
| --- | --- |
| Authors | McGuirk, Helen;Jordan, Declan |
| Publication date | 2012-09-25 |
| Original Citation | McGuirk, H. and Jordan, D. (2012) Local labour market diversity and business innovation: evidence from Irish manufacturing businesses, European Planning Studies, 20:12, 1945-1960, DOI: 10.1080/09654313.2012.722918 |
| Type of publication | Article (peer-reviewed) |
| Link to publisher's version | http://www.tandfonline.com/doi/abs/10.1080/09654313.2012.722918 - 10.1080/09654313.2012.722918 |
| Rights | © 2012 Taylor & Francis. This is an Accepted Manuscript of an article published by Taylor & Francis in European Planning Studies on 25 Sep 2012, available online: http://www.tandfonline.com/doi/abs/10.1080/09654313.2012.722918 |
| Download date | 2025-08-22 21:08:26 |
| Item downloaded from | https://hdl.handle.net/10468/2437 |

# Local Labour Market Diversity and Business Innovation: Evidence from Irish Manufacturing Businesses

## Helen McGuirk[1] and Declan Jordan[2]

[1] *Graduate Centre for Business, Kemmy Business School, University of Limerick*
[2] *Department of Economics, University College Cork. Corresponding author: d.jordan@ucc.ie*

**Local Labour Market Diversity and Business Innovation: Evidence from Irish Manufacturing Businesses**

*Abstract*

This paper estimates the effect of diversity within local labour markets on business-level innovation. Using survey data and Irish census data, the paper explores whether diversity of human capital at county-level is associated with higher innovation output. Diversity in age, nationality and educational attainment is measured using an index of heterogeneity and its effect on business innovation is estimated using an innovation production function approach. It is found that diversity in nationality and educational attainment is positively associated with the probability of a business product innovating. The findings also suggest that greater external labour market diversity and greater levels of internal third-level education may be substitutes. Where a business is in a diverse location it may not require higher levels of educational attainment among its workforce to source knowledge for product innovation.

## 1. Introduction

This paper examines the role of labour market diversity on business-level innovation in Ireland, using original survey data and data from two Irish censuses. Innovation is widely regarded as the driving force behind economic growth and sustaining prosperity (Grossman and Helpman, 1994; Baumol, 2002 and Bhidé, 2008). There is a growing literature dedicated to the process of innovation within businesses and it is increasingly clear that a business' ability to innovate is conditioned by the characteristics of its location. Porter refers to sustainable competitive advantages in a global economy lying "increasingly in local things – knowledge, relationships and motivation" (1998:77).

There has been an increasing focus on the role of diversity as a source of new knowledge and, in turn city, regional and national economic growth, perhaps most popularly in Florida's (2002) promotion of the importance of a 'creative class' for urban growth and prosperity (Quigley, 1998; Alesina and La Ferrara, 2005; Boschma and Fritsch, 2009). Much of this appeals to Jacob's (1969) emphasis on the role of diversity as a driver of city growth through the generation of new knowledge for innovation. Baycan-Levent (2010) presents a comprehensive survey of empirical literature on the effects of diversity on a range of economic and social variables such as productivity, labour market outcomes and economic growth.

While there is a growing acceptance that the environment within which a business is located influences its ability to innovate, it remains difficult to measure and test the

effect on innovation of these external factors. To date, the literature has focused on measures at aggregate regional or city level to estimate the effects of diversity on innovation, competitiveness or growth. The latter 'output' measures are also measured at an aggregate level. Also, studies of diversity in a region or city have focused on the extent to which sectoral specialisation or diversification enhances innovation. The contributions of this paper are to examine how business-level innovation is influenced by diversity in the local labour market and also to consider diversity within the local labour market, rather than diversity in the sectoral structure of a region. This is done by combining original business-level survey data and data from two Irish censuses. This paper addresses the critical question posed by Baycan-Levent and Nijkamp (2010) relating to how diversity can lead to higher innovativeness.

The next section sets out the theoretical and empirical concepts underpinning the analysis. This is followed by a description of the data and the method adopted. Results of the analysis are then presented followed by concluding remarks.

## 2. Diversity and Innovation: Theoretical and Empirical Contexts

While earlier studies on innovation focus on the characteristics of the business to explain innovation performance, (for example Acs and Audretsch, 1988 and Mansfield, 1981) more recent studies have focused less on the business itself, and more on its position within a network or system of interactions and relationships (see Moulaert and Sekia (2003) for a review of frameworks of networks for innovation).

The importance of interaction and networks for business-level innovation is based on knowledge spillovers, deriving from the public good nature of knowledge, which is non-rival and partially excludable. This raises the prospect of spillovers of knowledge and or positive externalities from new knowledge creation. In particular the transfer of tacit, uncodified knowledge is facilitated by shared experiences and trust, which are developed through interaction (Cooke and Morgan, 1998:34).

Cooke and Morgan (1998: 33) argue that to "develop a better understanding of innovation, we need to focus not on the individual firm but on the ensemble of relations in which firms, states and systems interact". This means the ability of businesses to innovate depends not only on internal capabilities and research effort but increasingly on the business' ability to identify, access and exploit external sources of knowledge (Cohen and Levinthal, 1990; Kline and Rosenberg, 1986). There is a growing acceptance that vertical supply-chain interaction, with suppliers and customers, is an important source of knowledge for business-level innovation (for example, Tether, 2002; Miotti and Sachwald, 2003; Roper, Du and Love, 2008). Alternative external sources of knowledge identified in the growing literature on business-level innovation include competitors, academic-based researchers and publicly-funded agencies (for example Roper, 2001; Freel, 2003; Nieto and Santamaria, 2007; Arranz and de Arroyabe, 2008; Jordan and O'Leary, 2008).

Literature on regional growth and development has increasingly addressed the debate on whether and the extent to which regional specialisation or diversity facilitates regional

competitiveness, innovation and growth (for example, see Fritsch and Slavtchev (2010), which also provides a thorough treatment of the relevant literature). This debate has focused on two types of agglomeration economies. The first are localisation economies "which derive from the common location of independent firms in the same industry" (Parr, 2002). The second is urbanization economies, which stress the importance of common location of unrelated independent businesses. More recently there have been attempts to synthesize these frameworks, such as the concept of related variety which holds that knowledge may spillover effectively between businesses in sectors where there are complementarities in shared competences (Boschma and Iammarino, 2009). To date the specialization, diversity or variety has primarily been measured by the degree to which business sectors are concentrated within regions. It is surprising, given the focus on labour markets in both localization and urbanization explanations of regional development, that research has mainly focused on regional concentration of business sectors rather than the local labour market. This is despite the important role of the individual within the innovation process being widely acknowledged (Rothwell, Freeman and Horlsey 1974, Lucas, 1988, Ottaviano et al 2003). The individual defines problems, has ideas and interacts to develop creative links with internal and external associates.

Localisation economies are advantages to individual businesses arising from the common location of independent businesses in the same industry. Localisation economies are derived from three sources, identified by Marshall (1890). These are information spillovers, the availability of a local skilled labour pool and the growth of

subsidiary and specialised services and trades. Marshall explains information spillovers as the "advantages which people following the same skilled trade get from near neighbourhood to one another. The mysteries of the trade become no mysteries; but are as it were in the air" (1890:271). This suggests that information spillovers are market or non-market mediated transfers of knowledge that occur from face to face contact between individuals from different businesses. Marshall (1890) also identified a local skilled labour pool as a source of localisation economy. Employers are attracted to locations where there is a supply of labour with the skills required for their business. Marshall's third source of localisation economy is the growth of subsidiary services and/or trades. Marshallian sources of agglomeration economies are echoed in Porter's (1990 and 1998) cluster framework. Porter describes a cluster as a "geographic concentration of interconnected companies and institutions in a particular field" (1998:78). Similarly to Marshall's description of localisation advantages, Porter states that clusters feature suppliers of specialised inputs and businesses that are connected through shared skills needs and technologies. Within both Marshall's and Porter's frameworks, knowledge spillovers is an important agglomerating influence.

The second type of external agglomeration economy is urbanisation economies. These are advantages to individual businesses arising from the common location of businesses from different and unrelated industries. In this situation businesses benefit from shared inputs such as transportation services, public utilities and business and commercial services. While localisation economies suggest that businesses benefit from

specialisation of businesses within a specific area, urbanisation economies suggest that businesses benefit from diversity within the area.

Gordon and McCann suggest that these "differences in the geography of creativity and entrepreneurship" (2005:528) are based on a diversity of skills, ideas and cultures that enable new combinations of knowledge to emerge, a permissive environment that allows different and unorthodox ideas to emerge and a highly competitive environment, including discriminating consumers of new products. Jacobs (1969) and Glaeser et al (1992) argue that more diverse cities grow faster than specialised cities. This is based on the existence of cross-sectoral knowledge spillovers, where businesses identify new products and processes and new uses for existing products and processes in businesses in different sectors. Florida argues that creativity, which is the ability to create meaningful new forms, is now "the *decisive* source of competitive advantage" for cities and regions (2002:5 – italics in original). Creativity is a function of a more permissive and open-minded environment, which enables greater acceptance of new and different ideas. Florida (2002) argues that innovation in urban areas is positively associated with the existence of a "creative class".

While Glaeser (2005) notes that Florida (2002) may not distinguish between the 'creative class' view and the mainstream view that human capital drives regional growth, the debate has increased attention on the role of diversity as a driver of business and regional development.

The ability of an individual business to innovate is important for business growth and depends greatly on the quality of human capital (Ederer, Schuller and Wilmms, 2007; Grossman and Helpman, 1994). Diversity in human capital facilitates those businesses which innovate and strive for continuous improvements in products and/or processes by enhancing creativity and problem-solving capability and enhance customer relations (Bassett-Jones, 2005:171 and Mulholland, Ozbilgin & Worman 2005:19).

There is no agreed definition of diversity within the literature (Mulholland et al 2005). This may not be surprising since different aspects such as measurement or managing diversity have emerged in studies in management, regional or urban development and cultural or sociology. In essence diversity may be considered as differences among a population in characteristics such as lifestyle, marital status, gender, nationality, sexual orientation, physical capabilities, race, education level, religion and age (Bassett-Jones, 2005, Mullholland et al, 2005:4, Florida, 2004:124, Wladowsky-Beger, 2006 and Blau, 1977:8).

Literature suggests that diversity in the labour market in which the business is located is associated with greater creativity and innovation at the regional level (McCann & Simonen, 2005, Florida 2002 and Grossman & Helpman, 1994). As innovation involves the creation of new knowledge, and this comes from the interaction of different peoples' talents, interests, insights and experiences (Lundvall, 2009). This paper is not concerned per se with the levels of human capital in local labour markets which comprises of people's skills, knowledge and expertise (Schiuma and Lerro, 2008), though the level of

human capital is controlled for in the analysis. Rather the focus is on diversity within that labour market, which traditionally is concerned with differences in variables such as formal education (Romer, 2007; Kavanagh and Doyle, 2007) or 'cultural diversity' where language, or skin colour are sometimes used as indicators (Alesina and La Ferrara, 2005; Ottaviano, Maignau and Pinelli, 2003; Ottaviano and Peri, 2006).

There is a growing literature focusing on the effect of labour market diversity on a variety of economic performance indicators; Lee (2010) examines the effect on economic growth in English cities, Audretsch, Dohse and Niebuhr (2010) the effect on entrepreneurship in German regions and Niebuhr (2009) the effect on German regional R&D activity. This paper contributes to this emerging literature by focusing on business-level performance as opposed to the higher aggregate level of analysis in these studies.

Diversity may not have solely positive effects on business-level innovation output. Alesina and La Ferrara (2005) survey the potential benefits and drawbacks of diversity for economic performance. Diversity may boost productivity and/or innovation where it is a source of new knowledge or combinations of knowledge and/or where the skills of, for example, foreign workers complement those of native workers (Ottaviano and Peri, 2006).

Alternatively, diversity may hinder innovation because of cultural and linguistic barriers impede knowledge sharing and reduce trust among a more diverse workforce (Parrotta,

Pozzoli and Pytlikova, 2010).   It is for this reason that concentrating on diversity in the local labour market, as opposed to the traditional approach of focusing on differences in industrial or sectoral classifications, may be more likely to shed light on the relationships between diversity and innovation.

## 3.  Modelling Diversity and Innovation

This paper adopts an innovation production function approach (Acs and Audretsch, 1988; Roper, 2001; McCann and Simonen, 2005; Roper and Hewitt-Dundas, 2008). This models innovation output as a function of the R&D effort of the business and external sources of knowledge through interaction, while controlling for business characteristics that may affect innovation output, such as size, age and sector. This paper also includes variables to represent local labour market diversity.

The innovation production function takes the form:

$$IO_i = \alpha_0 + \alpha_1 Z_i + \alpha_2 R\&D_i + \alpha_3 EI_{ij} + \alpha_4 D_{kc} + \alpha_5 DL_{kc} + L_{ci} + T + \mu_i \qquad [1]$$

Where; $IO_i$ is an indicator of innovation output in business i.

$Z_i$ is a range of business-specific factors that may affect business i's capacity to innovate

$R\&D_i$ is the research and development activity by business i

$EI_{ij}$ is external interaction for innovation by the business i with external knowledge source j

$D_{kc}$ is the diversity in human capital variable k in county c

$DL_{kc}$ is the level of human capital variable k in county c.

$L_{ci}$ is an interaction variable for diversity in county c and workforce education in business i

T is a time dummy variable taking a value of 1 for 1996 and 0 for 2002

$\mu_i$ is the error term.

Innovation production functions are estimated for product and process innovation. Innovation output of business i ($IO_i$) is measured as a binary variable taking a value of 1 if the business introduced a new or improved product or a new or improved process during the relevant reference period.

The specific business factors ($Z_i$) that may affect a business' capacity to innovate include the age of the business, the size of the business, as measured by the number of employees, and the sector in which the business operates. There is empirical evidence that the age of a business may affect innovation output (Galende and de la Fuente, 2003; Gordon and McCann, 2005). It is also worthwhile to control for age of a business for product and process innovation. The implication is that younger businesses may tend to operate with newer technologies and offer new products to the market, while older businesses maybe more likely to engage in productivity improvements through process innovation (Jordan, 2011).

Empirical evidence is divided on the effect of business size on innovation (for example, Acs and Audretsch (1988), Mansfield (1981), Damanpour, (1992)), The basis for a size effect is Schumpeter's hypothesis that larger businesses are more innovative than smaller ones (1943:105-106). Scherer also argues that R&D may benefit from scale economies in other parts of a large business' operations (1980:414).

Controlling for sectors is prompted by empirical evidence that levels and determinants of innovation differ across sectors (Pavitt, 1984). Malerba (2004) notes that innovation activity takes place in substantially differentiated sectoral environments; identifying that the sources of knowledge available to firms, the actors involved in the innovation process and the institutions available to firms varies across sectors. Doran and O'Leary (2011), in an Irish study, and Hall (2009) also identify differing propensities for firms in various sectors to innovate.

There are three measures of R&D effort. Respondent business were asked to indicate whether they perform in-business R&D, whether the business had a dedicated R&D department during the relevant reference period and whether, if they are part of a group of businesses, R&D was performed elsewhere within the group. Each of these produce a binary variable used to estimate the innovation production function. Since businesses that have a dedicated R&D department by definition must perform R&D there is perfect collinearity between these two variables. To overcome potential estimation difficulties the model is estimated using two binary variables, the first taking a value of 1 if the

business performed R&D without a dedicated R&D department and the second taking a value of 1 if the business had a dedicated R&D department.

A business may source knowledge externally through interaction ($EI_{ij}$) with a range of interaction agents. Similarly to Roper, Du and Love (2008), this paper estimates the effect on business innovation of forward interaction with clients or customers, backward interaction with suppliers or consultants, horizontal interaction with competitors or joint ventures and public interaction with universities, industry operated labs or public laboratories.

The more critical variable for this paper is the measure of diversity in the local labour market ($D_{kc}$). Diversity is measured for educational attainment, nationality and age of the local workforce, as these are the only indicators available in the Census of Population Sample of Anonymised Records (COPSAR).

Similarly to Richard (2000) and Murray (1989) this paper uses a Blau Diversity Index (Blau, 1977) of heterogeneity to calculate a local labour market diversity index for each variable. This diversity index measures the probability of two individuals chosen at random from the population being in different age, nationality and educational categories (Blau, 1977). A Blau Diversity Index for each variable is estimated for each of the 26 counties using the following formula (Blau, 1977:9):

$$\mathbf{D_s = 1 - \sum P_{st}^2.} \qquad \qquad \mathbf{[2]}$$

Where $D_s$ is the diversity index for variable s and $P_{st}$ is the proportion of the total population in category t of variable s. For example, if the entire workforce is within a single category of any variable $D_s$ equals zero. If each category has an equal proportion of the total population, $D_s$ will approach 1. A higher value of $D_s$ means more diversity or a greater spread across all categories.

Table 1 presents Blau Diversity Index values for educational attainment for a sample of four counties. The table reports the proportion in each county who indicated the highest level of education attained was primary school (including no formal education), lower secondary school, upper secondary school, third level-non degree and third level degree or higher.

[Table 1 about Here]

It can be seen in Table 1 that the Blau Diversity Index value for educational attainment in Dublin is 0.7769. This is calculated as follows:

$$D = (1 - ((0.2019)^2 + (0.1838)^2 + (0.3247)^2 + (0.1205^2) + (0.1692^2))) = \mathbf{0.7769}$$

In this educational attainment example the maximum possible value for D is 0.80, where each of the five groups has 20 percent of the population of the county (*1- 5x(0.2)$^2$*).

Five categories are used for calculating the Blau Diversity Index for nationality. Nationality is determined by place of birth and the categories are Republic of Ireland, Northern Ireland, Other UK, Other EU and Other. Four categories are used for calculating the Blau Diversity Index for age, which are 20 to 29 years, 30 to 39 years, 40 to 49 years and more than 50 years.

While this paper focuses on the effects of diversity in human capital within local labour markets on business-level innovation, it is also important to control for the levels of human capital within local labour markets that may influence innovation in local businesses. The estimation controls for the level of human capital by including levels of education (measured by the proportion of the labour force with third level qualifications or higher), the quality of employment (measured by the , proportion of the labour force in managerial/professional occupations) and the entrepreneurialism of the labour force (measured by the proportion in self-employment). Therefore, $DL_{kc}$ in equation 1 represents the level of human capital within the county in which the business is located, as measured by the percentage of the population with at least a third-level degree, the percentage employed at managerial/professional levels and the percentage self-employed.

Aiello and Cardamone (2009) suggest that the level of a business' absorptive capacity will affect its ability to identify, evaluate and exploit external knowledge. The extent to which a business can exploit a diverse local labour market may be influenced by the level of human capital within the business. An interaction variable is included in

equation 1 ($L_{ci}$) which represents the percentage of workers within the business with at least a third-level degree multiplied by the aggregate diversity index for the county where the business is located. The aggregate diversity index is the sum of diversity index values for the three diversity variables. This variable is included to capture the extent to which it is a combination of internal and external human capital which affects business-level innovation.

## 4. Data

The empirical analysis is based on data from two sources: the Irish Innovation Panel (Hewitt-Dundas and Roper, 2008) and the Irish Census of Population Sample of Anonymised Records (COPSAR) (Central Statistics Office, 2010). The Irish Innovation Panel (IIP) comprises of data from five surveys or waves conducted using similar survey methodologies and questionnaires with common questions from 1991 to 2005. Each wave of the survey was addressed to manufacturing businesses throughout the island of Ireland. This paper uses data from the third and fifth wave of the IIP and focuses on innovation activities in Republic of Ireland businesses.

The third wave refers to innovation activity during the reference period from 1997 to 1999 and achieved a response rate of 32.8% (Roper and Hewitt-Dundas, 2006). The fifth wave, referring to 2003 to 2005 had a response rate of 28.7%.

The IIP dataset provide this paper with information on age and size of respondent businesses. The IIP also provides data on the location of headquarters (where

17

appropriate), plant type, the percentage of the workforce with a third-level degree, research and development undertaken in the firm, the presence of an R&D department and R&D activity elsewhere in the group (where appropriate).

The Census of Population Sample of Anonymised Records (COPSAR) datasets for 1996 and 2002 provide data on the local workforce for each county in the Republic of Ireland. COPSAR comprises of a 5% random sample of the recorded persons from each county. The records within each county were sorted randomly before output to the sample file. The records relating to persons within households were anonymised by stripping out all identifiable information such as household number, person number within household and by recoding variables where the number of categories could lead to the identification of an individual when combined with other information on the record.

A time dummy variable is included in the innovation production function in equation 1 to control for differences in innovation behaviour between Wave 3 and Wave 5 of the IIP. A log-likelihood test of stability of coefficients rejects the hypothesis that coefficients do not vary across years.

COPSAR 1996 and 2002 contain 181,321 and 195,877 observations respectively. Since the focus of this study is labour force diversity, persons aged less than 20 years and over 65 years were excluded leaving 100,510 and 116,478 observations for 1996 and 2002 respectively. While COPSAR reports for 34 administrative areas, including city boroughs where relevant, this paper aggregates to county level since only county

identifiers are available in the IIP. The characteristics of the labour market; age, educational attainment and place of birth, as a proxy for nationality, of the respondents were combined with the business specific variables of IIP for 1996 and 2002 to create a new dataset with 525 observations for 1996 and 573 for 2002. A limitation in the use of the COPSAR dataset is that individual characteristics, from which diversity is measured, refer to residence rather than workplace, which would be addressed with evidence on commuting patterns.

Table 2 presents descriptive statistics for combined data from the two waves of the IIP and COPSAR 1996 and 2002. In relation to innovation activity, it can be seen that between the two waves, 67% of businesses introduced a new or improved product during the relevant reference period. This corresponds to 65% in the third wave and 70% in the fifth wave. 64% of respondents in the third wave introduced a new or improved process during the reference period. The corresponding figure for the fifth wave is 55%.

**[Table 2 about Here]**

## 5. Local Labour Market Diversity and Business-Level Innovation: Empirical Results

Table 3 presents the results of a logit estimation of the probability of introducing product and process innovation. Logit estimation is appropriate because the dependent

variables are binary. In relation to product innovation it can be seen that the statistically significant effects on the probability of innovation are educational levels among the internal workforce, R&D effort, certain types of external interaction and the diversity of the local labour market in which a business is located.

**[Table 3 about Here]**

In relation to internal sources of knowledge, the percentage of the workforce with a third-level degree is positively associated with product innovation, a one percent increase in the proportion of graduates raises the probability of product innovation. Whether a business engages in R&D, using a dedicated R&D Department or not, is also strongly positively associated with the probability of product innovating. Businesses that perform R&D without having a dedicated R&D Department are almost 21.18% more likely to product innovate than those that do not. This is a consistent finding throughout the literature and is to be expected as businesses will continue to invest in R&D only where it leads directly or indirectly to innovation output. The presence of a dedicated R&D department, which may indicate performing R&D on a routine or formal basis, has a stronger effect on the probability of product innovating than performing R&D in an 'informal' manner. The presence of R&D by other businesses within the group is also strongly positively associated with the likelihood of product innovation.

With regards to external knowledge sources, it can be seen that both backward and horizontal knowledge sourcing are positively associated with product innovation, raising

the probability of introducing a new product by 13.24% and 11.07% respectively. It is notable that forward knowledge sourcing, which in most studies is significantly positively associated with product innovation, is here insignificant.

The results of the estimation in relation to diversity in the local labour market are particularly notable. Two of the three variables for which the effect of diversity is tested (nationality and education) are positively associated with the probability of a business product innovating. The estimation controls for the levels of educational attainment, professional/managerial occupations and self-employment within the county in which the business is located, but none of these level indicators are significant. This indicates that diversity in the labour market has a positive effect on product innovation within a business, while higher absolute levels of human capital within the local labour market are not found to affect business-level innovation.

The interaction variable linking external labour market diversity and internal absorptive capacity, as measured by the proportion of the workforce with a third-level degree, is strongly negatively significant. While caution is required in this analysis due to the potential for correlation between some of the diversity variables, the results suggest that a higher proportion of graduates within a business located where there is greater labour market diversity reduces the probability of that business introducing new products. This finding suggests that greater external labour market diversity and greater levels of internal third-level education may be off-setting and substitutes. Where a business is in a

diverse location it may not require higher levels of educational attainment among its workforce to source knowledge for product innovation.

Turning to process innovation it is again seen that internal and external knowledge sources are significant. Performing R&D within the business and within the group are both positively associated with process innovation. It is interesting to note that the relative importance of R&D within or outside a dedicated R&D Department has reversed compared to product innovation. This may reflect relatively greater importance to 'on-the-job' learning for process innovations or relatively greater focus on product development in R&D activity. Backward knowledge sourcing increases the probability of process innovation, which may be expected as process innovation may be stimulated by, for example, new equipment or new sources of materials from suppliers. New equipment may enable or require new processes to be adopted in a business. The suppliers of this equipment may provide training or suggestions on how best to utilize the new equipment. In this context, businesses may look to backward linkages to suppliers to identify new processes that increase productivity or reduce cost. Public knowledge sourcing is positively associated with process innovation but is marginally insignificant.

In relation to local labour market diversity it is seen that only diversity in nationality has a significant effect on process innovation and in this case it is a negative effect. This means that greater levels of diversity in nationality reduce the likelihood of businesses engaging in process innovation. Age and education diversity are found to be

insignificant. Explaining the different results for the effect of diversity on product and process innovation must focus on the differing nature of both types of innovation. It may reflect that process innovation is by more reliant on 'learning by doing' and 'on the job' process improvements which may be hindered by communication barriers arising from different nationalities. Osborne (2000:473) argues that diversity within a business' workforce may be beneficial where it provides greater information on that business' product markets. While this paper has evidence only on labour force diversity outside the business it may be that businesses have more opportunities to exploit diverse local consumer demand by introducing more products.

Since process innovations are by their nature more likely to be driven by the need for greater efficiency within the business and less driven by external market opportunities. Parrotta, Pozzoli and Pytlikova (2010:8) note that ethnic-cultural diversity may negatively affect business performance because of cultural and linguistic barriers hindering knowledge sharing or through weaker social ties and trust among a more diverse workforce. Fitjar and Rodríguez-Pose (2011) note that a common base of cultural customs facilitates knowledge transfer. Diversity in nationality may hinder the sharing of knowledge due to a lack of such a common base. It may be that these ties and knowledge sharing are particularly important for process innovation where production teams need to work together to implement process improvements.

The finding in relation to process innovation is consistent with Parrotta, Pozzoli and Pytlikova (2010) who find that ethnic and demographic diversity within a firm is

negatively associated with total factor productivity within that firm. They also find when using interaction variables that the positive effect of skills/education diversity will outweigh the negative ethnic/demographic effect.

The results in this paper suggest that some effort may be required by businesses and policy makers to overcome such communication barriers to improve process innovation outcomes.

## 6. Conclusions

This paper examines the effect of local labour market diversity on business level innovation in manufacturing businesses in Ireland. Using a novel measure of diversity and combining Census data and survey data of businesses, it addresses the question of whether greater levels of local labour market diversity are a source of knowledge for new product and process development.

It finds that diversity in nationality and education are positively associated with product innovation. For process innovation, only diversity in nationality is found to have a significant effect and this is negative, suggesting greater levels of diversity in nationality makes it more difficult for businesses to introduce new processes. Higher levels of education and occupational status within the local labour market are not found to be significant for either product or process innovation. This indicates that local labour market diversity may stimulate new ideas that businesses may exploit to generate

product innovation. This is consistent with the importance that Jacobs (1969) places on diversity as a source of knowledge for innovation, typically seen in urban areas, where this diversity facilitates the blending of different types of knowledge for what Schumpeter refers to as "new combinations" (1934:66). This means that businesses should positively view local labour market diversity as a source of knowledge for innovation and policy-makers should likewise embrace diversity as a support for business innovation.

The study generates an interaction variable combining internal absorptive and external labour market diversity, as it may be expected that an educated workforce may be better at identifying, evaluating and exploiting knowledge external to the business. It is found however, that a combination of greater diversity externally with higher levels of education internally is negatively associated with product innovation. This finding suggests these sources of knowledge may be substitutes. A business may look to higher levels of workforce education or greater diversity externally to generate knowledge for product innovation. This suggests that businesses should be aware of the extent of external labour market diversity, since the structure of a business' workforce may need to reflect the local labour market structure to enable it to capture the knowledge available externally. However to test this survey data is required on the diversity of internal workforces.

This paper introduces a useful approach to testing the effects of labour market diversity on business-level innovation and further research could fruitfully adopt this approach.

There are potentially fruitful ways to bring the research agenda forward. The analysis presented here, although based on panel data, adopts a pooled approach to the estimation. This limits the temporal sophistication and does not explore lagged effects of local labour market diversity on business-level innovation. To fully explore this effect would require longitudinal data panels, such as the IIP, and corresponding external census or labour market data over a similar longer-term period. As mentioned earlier, more survey data should be generated on diversity within businesses as opposed to the current focus on levels of education as the sources of knowledge for innovation. In addition, this study is limited in relation to the measures of diversity it could use. A broader range of indicators of diversity in the local labour market and within businesses would also be valuable, including for example diversity in length of service, continuing professional education and range of experience of employees. This approach could be adopted to conduct international comparative analyses, perhaps between urban agglomerations, on the relationship between innovation and diversity.

**References**

Acs, Z.J. and Audretsch, D.B. (1987). "Innovation, Market Structure and Business Size" **Review of Economics and Statistics**, 69:567-575.

Acs, Z.J. and Audretsch, D.B. (1988) Innovation in Large and Small Businesses, **American Economic Review**, 78(4), pp. 678-690.

Aiello, F. and Cardamone, P. (2009) R&D Spillovers and Firms' Performance in Italy: Evidence from a Flexible Production Function in Arbia, G. and· Baltagi, B.H. (Eds) **Spatial Econometrics: Methods and Applications,** pp. 143-166. Physica-Verlag, Heidelberg.

Alesina, A and La Ferrara, E. (2005) Ethnic Diversity and Economic performance **Journal of Economic Literature,** 43(3), pp 762-800.

Arranz, N. and Fernandez de Arroyabe, J.C. (2008) The choice of partners in R&D cooperation: An empirical analysis of Spanish firms. **Technovation**, 28 (1-2), pp. 88–100.

Audretsch, D.B., Dohse, D. and Niebuhr, A. (2010) Cultural diversity and entrepreneurship: a regional analysis for Germany. **Annals in Regional Science**, 45 pp. 55-85.

Basset-Jones, N. (2005) The Paradox of Diversity Management Creativity and Innovation. **Creativity and Innovation Management** 14(2), pp. 69-175.

Baumol, W.J. (2002). **The Free-Market Innovation Machine: Analysing the Growth Miracle of Capitalism.** Princeton University Press, Princeton.

Baycan-Levent, T. (2010) Diversity and Creativity as Seedbeds for Urban and Regional Dymanics. **European Planning Studies** 18(4):565-594

Baycan-Levent, T. and Nijkamp, P. (2010) Diversity and Creativity as a Research and Policy Challenge. **European Planning Studies** 18(4):501-504.

Bhidé, A. (2008) **The Venturesome Economy: How innovation sustains prosperity in a more connected world.** Princeton University Press, Princeton, NJ.

Blau, P. (1977). **Inequality and Heterogeneity**. Free Press, New York

Boschma, R.A. and Fritsch, M. (2009) Creative class and regional growth. Empirical evidence from seven European countries, **Economic Geography**, 85 (4), pp. 391-423.

Boschma, R. and S. Iammarino (2009). Related Variety, Trade Linkages, and Regional Growth in Italy. **Economic Geography,** 85(3), pp. 289-311.

Central Statistics Office (2010) **Irish Census of Population 1996 and 2002**. www.cso.ie

Cohen, W. M. and Levinthal, D. A. (1990) Absorptive Capacity: A New Perspective on learning and Innovation, **Administrative Science Quarterly**, 35(1), pp. 128-152.

Cooke, P. and Morgan, K. (1998) **The Associational Economy Firms, Regions, and Innovation**, Oxford University Press: Oxford

Doran, J. and O'Leary, E. (2011) External Interaction, Innovation and Productivity: An Application of the Innovation Value Chain for Ireland. **Spatial Economic Analysis**, 6(2), pp. 199-222.

Ederer, P., Schuller, P. and Willms, S. (2007) Innovation at Work: The European Human Capital Index **Lisbon Council Policy Brief**

Fitjar, R. D and Rodríguez-Pose, A. (2011) Innovating in the Periphery: Firms, Values and Innovation in Southwest Norway **European Planning Studies** 19(4), pp. 555 – 574.

Florida, R. (2002) **The Rise of the Creative Class**. Basic Books: New York.

Florida, R. (2004) America's Looming Creativity Crisis **Harvard Business Review** 82:10. October

Freel, M., 2003. Sectoral Patterns of Small Firm Innovation, Networking and Proximity **Research Policy,** 32, pp. 751-770.

Fritsch, M. and Slavtchev, V. (2010) How does industry specialisation affect the efficiency of regional innovation systems? **Annals in Regional Science** 45, pp. 87-108.

Galende, J. and de la Fuente, J.M. (2003). Internal Factors Determining a Business's Innovative Behaviour **Research Policy** 32, pp. 715-736.

Glaeser, E.L., Kallal, H.D., Scheinkman, J.A. and Shleifer, A. (1992). Growth in Cities **Journal of Political Economy**, 100(6), pp. 1126-1152.

Glaeser, E.L. (2005) Review of Richard Florida's The Rise of the Creative Class **Regional Science and Urban Economics**, 35 (5), pp. 593-596.

Gordon, I. and McCann, P. (2005) Innovation, Agglomeration and Regional Development **Journal of Economic Geography,** 5(5), pp. 523-543.

Grossman, G. and Helpman, E. (1994) Endogenous Innovation in the Theory of Growth **Journal of Economic Perspectives** 8(1), pp. 23-44.

Hall, B., Lotti, F. and Mairesse, J. (2009) Innovation and Productivity in SMEs: Empirical Evidence from Italy. **Small Business Economics** 33(1), pp. 13-33.

Hewitt-Dundas, N and Roper, S (2008) Ireland's Innovation Performance: 1991-2005 **Quarterly Economic Commentary**, Summer 2008, pp. 46-68, ESRI, Dublin.

Jacobs, J. (1969) **The Economy of Cities.** Pelican: London.

Jordan, D. (2011) **Innovation, Interaction and Space: Interaction and Proximity for High-Tech Business Innovation**, Lambert Academic Publishing, London.

Jordan D. and O'Leary, E. (2008) Is Irish Innovation Policy Working? Evidence from Irish High-Technology Businesses, **Journal of the Statistical and Social Inquiry Society of Ireland**, 37, pp. 1-44.

Kavanagh, C. and Doyle, E. (2007) Growth and Productivity: The Role of Human Capital in Aylward, C. and O'Toole, R. (Eds) **Perspectives on Irish Productivity**, Dublin: Forfás

Kline, J. and Rosenberg, N. (1986) An Overview of Innovation in Landau, R. and Rosenberg, N. (Eds) **The Positive Sum Strategy: Harnessing Technology for Economic Growth**. National Academy Press, Washington

Lee, N. (2010) Ethnic Diversity and Employment Growth in English Cities **Urban Studies**, 48(2), pp. 407-425.

Lucas, R. E. (1988) On the mechanics of economic development, **Journal of Monetary Economics**, 22, pp. 3-42.

Lundvall, B-A. (2009) The Future of Innovation is in the Learning Economy in van Stamm, B. and Trifilova, A. (Eds.) **The Future of Innovation**, Surrey:  Gover UTEK

Malerba, F. (2004) Introduction in Malerba, F. (Ed) **Sectoral systems of innovation: concepts, issues and analyses of six major sectors in europe**, Cambridge University Press, United Kingdom.

Mansfield, E. (1981) Composition of R&D expenditures: relationship to size of firm, concentration and innovative output, **The Review of Economics and Statistics** 63(4), pp. 610–615.

Marshall, A. (1890) **Principles of Economics,** Macmillan, London.

McCann, P. and Simonen, J. (2005) Innovation, Knowledge Spillovers and Local Labour Markets, **Regional Science**, 84(3), pp. 465-485.

Miotti, L. and Sachwald, F. (2003). Co-operative R&D: Why and With Whom? An Integrated Framework of Analysis, **Research Policy** 32(8), pp. 1481-1499.

Moulaert, F. and Sekia, F. (2003) Territorial Innovation Models: A Critical Survey, **Regional Studies** 37(3), pp. 289-302.

Mulholland, G., Ozbilgin, M. and Worman, D. (2005) Change agenda: Managing Diversity linking theory and practice to business performance, **Chartered Institute of Personnel and Development** April 2005 Ref 3281

Murray, A. I. (1989) Top Management Group Heterogeneity and Firm Performance, **Strategic Management Journal**, 10, pp. 125-141.

Niebuhr, A. (2009) Migration and innovation: Does cultural diversity matter for regional R&D activity?, **Papers in Regional Science**, 89(3), pp. 563-585.

Nieto, M. J. and Santamaria, L. (2007) The importance of diverse collaborative networks for the novelty of product innovation, **Technovation** 27(6-7), pp. 367-377.

Osborne, E, (2000) The deceptively simple economics of workplace diversity, **Journal of Labor Research,** 21(3), pp. 463-475.

Ottaviano, G., Maiguan, C. and Pinalli, D. (2003) (ed) Economic Growth, Innovation Cultural Diversity; What are we all talking about. A critical survey of the state of the art. **FEEM Working Paper** No. 12.2003. Available at SSRN: http://ssrn.com/abstract=389042 or doi:10.2139/ssrn.389042

Ottaviano, G. and Peri, G. (2006) The economic value of cultural diversity: evidence from US cities, **Journal of Economic Geography** 6, pp. 9-44.

Parr, J.B. (2002) Missing Elements in the Analysis of Agglomeration Economies, **International Regional Science Review**, 25(2), pp. 151-168.

Parrotta, P., Pozzoli, D. and Pytlikova, M. (2010) Does labour diversity affect firm productivity? **University of Aarhus Department of Economics Working Paper** WP10-12. Available at: http://www.hha.dk/nat/wper/10-12_pipaetal.pdf

Pavitt, K. (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory, **Research Policy** 13, pp.343-373.

Porter, M. (1990) **The Competitive Advantage of Nations**, Macmillan, London.

Porter, M. (1998) Clusters and the New Economics of Competition, **Harvard Business Review** November-December 1998.

Quigley, J.M. (1998) Urban diversity and economic growth, **Journal of Economic Perspectives** 12(2), pp. 127-138.

Richard, O. C. (2000) Racial Diversity, Business Strategy, and Firm Performance: A Resource-Based View **Academy of Management Journal**, 43(2), pp. 164-177.

Romer, P. (2007) Economic Growth, in Henderson, D. R. (Ed) **Concise Encyclopaedia of Economics,** Liberty Fund

Roper, S. (2001) Innovation, Networks and Plant Location: Some Evidence for Ireland, **Regional Studies**, 35(3), pp. 215-228.

Roper, S. And Hewitt-Dundas, N. (2008) Innovation Persistence: Survey and Case-Study Evidence **Research Policy,** 37(1), pp. 149-62

Roper, S and Hewitt-Dundas, N. (2006) Irish Innovation Panel – Wave 5 Survey Report [Available online at **www.innlab.org** – Accessed August 6, 2010]

Roper, S., Du, J. and Love, J. (2008) Modelling the innovation value chain **Research Policy** 37, pp. 961-977.

Rothwell, R., Freeman, C. and Horlsey, A. (1974) SAPPHO updated: Project SAPPHO Phase II in Paul Trott (Ed) (2005) **Innovation Management and New Product Development,** Prentice Hall Financial Times, Essex England

Scherer, F M. (1980) **Industrial Market Structure and Economic Performance.** Second edition. Rand McNally, Chicago.

Schiuma, G. and Lerro, A. (2008). Knowledge-based capital in building regional innovation capacity **Journal of Knowledge Management**, 12(5), pp. 121-136.

Schumpeter (1934) **The Theory of Economic Development** Transaction Publishers New Brunswick USA

Schumpeter, J. (1943). **Capitalism, Socialism and Democracy**, Allen and Unwin, London.

Tether, B., 2002. Who co-operates for innovation, and why? An empirical analysis **Research Policy** 31, pp. 947–967.

Wladowsky-Berger, I. (2006). Innovation and Diversity **Innovation: America's Journal of Technology Commercialisation,** October/November**,** 4(5).