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Cultural Diversity, Cities and Innovation: Firm Effects or City Effects?

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Abstract
Growing cultural diversity is seen as important for innovation. Research has focused on two potential mechanisms: a *firm* effect, with diversity at the firm level improving knowledge sourcing or ideas generation, and a *city* effect, where diverse cities helping firms innovate. This paper uses a dataset of over 2,000 UK SMEs to test between these two. Controlling for firm characteristics, city characteristics and firm and city diversity, there is strong evidence for the firm effect. Firms with a greater share of migrant owners or partners are more likely to introduce new products and processes. This effect has diminishing returns, suggesting that it is a 'diversity' effect rather than simply the benefits of migrant run firms. However, there is no relationship between the share of foreign workers in a local labour market and firm level innovation, nor do migrant-run firms in diverse cities appear particularly innovative. But urban context does matter and firms in London with more migrant owners and partners are more innovative than others.

Keywords: Cultural diversity, innovation, cities, SMEs, migration
JEL: J61, L21, M13, 011, 031, R23

1. Introduction

Cultural diversity is increasingly seen as important for innovation (e.g. Østergaard et al. 2011; Ozgen et al. 2011; Pozzoli et al. 2012; Kemeny 2012; Nathan & Lee 2013). Research has focused on two scales through which this might happen. First, studies have considered how diversity influences innovation at the *firm* level. Management or workforce diversity may improve approaches to problem solving or ideas generation, provide international connections or the ability to learn from external sources (Østergaard et al. 2011). While the evidence is not conclusive, and context appears important, research suggests there is a small but significant 'diversity bonus' for innovation (Nathan & Lee 2013).

A second body of research suggests that diverse *cities* may aid innovation (Florida et al. 2008; Ottaviano & Peri 2005; Audretsch et al. 2010; Niebuhr 2010). Diverse cities may have concentrations of creative staff (Florida 2002), a wider range of external stimuli or allow international knowledge sourcing (Saxenian 2006). Case study evidence has highlighted the importance of diversity to the world's most innovative cities (Saxenian 2006; Sepulveda et al. 2011). Empirical studies have estimated city-level innovation production functions, and shown a link between population diversity, innovation and growth, although such research is sensitive to the indicator used for diversity (Lee 2011).

These two effects – the firm effect and the city effect – are analytically distinct. Yet little research has attempted to test between them. City level studies rarely test if links between diversity and innovation are driven by the presence of more diverse firms. Firm level studies rarely test for geographical context. Only one study, Trax et al. (2012) investigates both firm diversity and local context, although their work considers productivity rather than innovation. This paper begins to address this gap using a dataset of over 2,000 British Small and Medium Sized Enterprises (SMEs). It test for relationships between firm level cultural diversity (the share of owners or partners who are foreign born or members of an ethnic minority) and local workforce diversity (the share of workers in the travel to work area who are foreign born or non-white) on six measures of product and process innovation.

The paper finds significant evidence for the firm effect: SMEs with more owners or partners born abroad are more likely to introduce new products and processes. On average, an increase of 10 per cent in the share of migrant owners and partners is associated with just over a 1 per cent increase in the predicted probability of a firm introducing a new product or process. This effect suffers from diminishing returns, suggesting it derives from diversity rather than migrant ownership. The benefit appears to be both for the creation of entirely new products and introducing processes from elsewhere and so is not simply migrants importing new products already in use in other countries.

However, there is no relationship between city diversity and innovation, nor do diverse firms in diverse cities appear to be particularly innovative. However, city context does matter in the case of London, where diverse firms are more innovative than those elsewhere, in contrast to other large cities. These results are robust to selection effects. Overall, the results suggest that the influence of diversity on urban innovation is principally due to *firm effects* rather than *city effects*.

The paper is novel in two main ways. First, it is the first to simultaneously consider city and firm level effects on innovation. In this it builds on Maré et al. (2013), who consider the impact of local workforce characteristics and innovation, but not firm characteristics, and research such as Østergaard et al. (2011) who consider only firm characteristics. The only study testing both city and firm effects simultaneously is Trax et al. (2012) who find a positive effect from regional cultural diversity (but not share of migrants) on productivity, rather than innovation. This paper extends this to innovation. Second, the data discriminates between entirely new innovations or those learnt from elsewhere. This makes it possible to distinguish between two potential channels: whether diversity allows entirely new innovations or simply the introduction of products from elsewhere.

The paper is structured as follows. Section two review the literature on diversity and innovation. Section three discusses the data. Section four presents a model which tests for the links between cultural diversity and innovation. Section five tests the results for robustness. Section six gives conclusions and implications for policy.

2. Diversity and innovation

2.1 Firm diversity and innovation

Research has suggested that cultural diversity at the firm level may help innovation, with a number of theoretical mechanisms suggested for this link. Cultural diversity may help bring new cognitive perspectives, improving problem solving and helping create new products and processes. In situations of new product or process development, a variety of diverse cultures can help introduce ideas from elsewhere to be adapted and introduced in new forms (Syrett & Sepulveda 2011; Nijkamp & Poot 2011). Diverse perspectives on a single problem may produce better solutions than similar, homogenous teams, even when these teams have higher human capital (Hong & Page 2004).

Yet some aspects of cultural diversity may hinder innovation. Misunderstandings and conflict can arise between individuals with different backgrounds and diverse teams may find it harder to communicate (Pozzoli et al. 2012). Individuals can subconsciously favour members of their own ethnic group, resulting in sub-optimal decision making (King et al. 2011). Because of this, the link

between diversity and innovation is potentially non-linear – increasing with initial diversity, but then subject to diminishing and even negative returns (Niebuhr 2010).

Perhaps appropriately, evidence on the link between diversity at a firm level and innovation is mixed. Simonen and McCann (2008) use data for Finnish high-technology firms and show that firms hiring labour from outside the region are more likely to introduce new products and processes. Investigating firms in London, Nathan and Lee (2013) show that culturally diverse firms in London are more innovative. Nathan (2013) uses a similar firm-level dataset for the UK and shows an inverse U-shaped relationship between ethnic minority senior management and process innovation, although the effect is significant at only the 10% level.

These studies also suggest that the magnitude of any effect is significant. Nathan and Lee (2013) show that firms with a migrant founder are 1.75 times more likely to introduce a new product or service and that firms with at least half minority owners or founders are 1.25 times more likely to do so. Yet not all studies find a positive effect: Østergaard et al. (2011) find Danish firms with ethnically diverse workforces no more innovative than others. Note an important distinction, however, between migrant diversity and ethnic diversity. Evidence linking migrant diversity and innovation is stronger than that for ethnic diversity.

2.2 City innovation effects

A second body of literature suggests that it is at the city level through which diversity may aid innovation, for a number of related reasons. The diversity of economic actors which cities provide was suggested by Jacobs (1969) to help firms share ideas and innovate. Similar effects may operate with cultural diversity: as cities may provide the meeting point for people from different backgrounds, culturally diverse cities may help innovation. Alongside this, others have argued that skilled workers may be attracted to diverse consumption opportunities (Ottaviano & Peri 2005). In a series of controversial but important studies, Richard Florida (2005; 2002; Florida et al. 2008) suggests that members of the 'creative class' – an economically important group of workers working in creative, innovative occupations – would be attracted to cities with tolerant environments and diverse populations. Most simply, the firm effects outlined above may simply be magnified in cities with a large number of diverse firms.

Most city level studies investigating the economic impact of cultural diversity have compared city level cultural diversity with indicators such as wages. These city level studies have tended to find positive links between cultural diversity – measured both using ethnicity and migration proxies – and economic performance or innovation. In the seminal study in this area, Ottaviano and Peri (2005) showed that US cities which saw increases in their foreign born population also experienced wage growth and rising rental values, a finding robust to endogeneity challenges. Since then, there have

been a number of similar studies – normally using wages as a proxy for productivity rather than focusing on innovation specifically. These find positive links between racial diversity and wages in US cities (Sparber 2010) and diversity of country of birth and wages in the UK (Nathan 2011), Germany (Suedekum et al. 2012) and, with some empirical caveats, the Netherlands (Bakens et al. 2013).

In contrast, Longhi (2011) uses UK longitudinal data on individual wages combined with measures of local cultural diversity. She finds that cultural diversity has a positive impact on wages in cross-sectional regressions, it has no impact when considering panel data on individual wages. And it appears context is important in determining whether a link exists. Kemeny (2012) shows that cultural diversity only increases wages in US cities with high levels of trust. Other city characteristics may be important in helping translating cultural diversity to innovation.

Several studies have also considered the link between cultural diversity and innovation specifically at the city level. Case study work of Silicon Valley suggests migration can facilitate knowledge sourcing, new firm creation and innovation (Saxenian 2006). Econometric work has tended to support these case studies. Niebuhr (2010) shows that cultural diversity is a significant determinant of patenting levels in German regions, a result robust to instrumental variable (IV) estimation. Gagliardi (2011) suggests that skilled migrants increase average innovative activity in British travel to work areas.

Fewer studies have used a second methodology: using firm level data linked to local cultural diversity to investigate city specific effects. Using a sample of around 6,000 firms in New Zealand, Maré et al. (2013) show that while there is a link between the share of migrants in the labour market and the average level of innovation amongst local firms, such an effect is not robust to controls such as firm size and sector. However, they do not control for firm level diversity. Using Danish data, Pozzoli et al. (2012) find a robust relationship between ethnic diversity and innovation in different firms. While their focus is not explicitly on city diversity, their instrument for diversity is a lagged measure of local workforce diversity. Thus, there may be link between local and city level diversity.

One study does find that both firm level and local diversity matters. Trax et al. (2012) use a large panel of German firms. They test for workforce, rather than management, diversity and find that while firms with *more* foreign-born workers are no more productive, those with a *greater diversity* of foreign-born workers are. Similarly, region specific diversity of foreign-born workers (but not share of foreign born) is a determinant of firm productivity with this effect similar in magnitude. This results is robust to most controls with the exception of one for migrant human capital (albeit with a reduced number of observations).

Overall, studies show good evidence linking diversity at a city level with positive economic outcomes, although the literature has focused on wages with fewer studies considering innovation. Evidence at the firm level is mixed, however, and context appears important. But no study has yet tested the impact of the two effects simultaneously on innovation. The remainder of this paper sets out to do this.

3. Data and methodology

Data

The main data for this paper is the Annual Small Business Survey (ASBS) 2004/5, a UK government survey. The survey is a stratified sample of firms with fewer than 250 employees and was conducted by telephone with decision makers or management within the firms. Firms were randomly selected from the Dun & Bradstreet database, but stratified by size. The survey contains information on a wide range of firm characteristics, including size, sector and legal structure. It also includes information on ownership characteristics and innovative activity.

The ASBS includes a geographical indicator for local authority.[1] This is used to match firms to travel to work areas (TTWAs). TTWAs are defined according to the 2001 Census as areas with a 75% self-containment for commuting purposes, and are the best available indicator of local labour market in the UK. Boundaries are taken from the University of Manchester's GeoConvert service. If firms are in local authorities which are in more than one TTWA, all firms are allocated to the TTWA with the largest overlap (i.e. if 30% of a local authority is in TTWA A and 70% in B, all firms are allocated to B).

Firms with missing values on any of the variables used are removed (because of the survey structure, many questions used here are only asked of a random selection of ASBS participants). Sole traders are removed as they are not asked the complete set of questions used here. The final sample is 2,223 firms.

The model

To test the relative influence of firm and city effects a simple innovation production function is used. The unit of analysis is the firm and the dependent variable is a binary variable for whether a firm innovates in each way. The model is estimated as follows:

[1] Most versions of the survey lack this identifier, although it is possible to construct a similar dataset using the 2010 survey. However, this survey has a significantly smaller sample size (around 1,300 firms) and the variables for ethnic diversity and migrant diversity are less specific and not comparable. However, basic results using the 2010 survey show findings consistent with those of this paper.

$$INNOV_i = \alpha + \beta_1 FIRMDIV_i + \beta_2 CITYDIV_i + \beta_3 FIRM_i + \beta_4 CITY_i + \varphi_i + \varepsilon_i \quad (1)$$

For firm 'i'. Where 'INNOV' is one the six measures of innovation outlined below, FIRMDIV is a measure of ownership diversity in firms, CITYDIV is a measure of diversity at the city level, FIRM is a set of variables for firm level characteristics, CITY are controls for city characteristics. There are also controls for sector ('φ'). The constant is 'α' and the error term is 'ε'. Details on variables and definitions are given in table 1.

Measuring innovation

The dependent variable, INNOV, is a measure of either product or process innovation. Innovation is not a simple concept, and it can be hard to measure it objectively. Gordon and McCann (2005: 525) define innovation as: "the successful implementation of a new product, service, or process, which for most activities entails their commercial success." This definition links closely to the variables in the ASBS.

There are six measures of innovation. The first three are for product innovation. These are (1) any product innovation: Has a firm introduced a new product in the previous 12 months? The subsequent two variables are for whether an innovation was (2) new to the firm (i.e. in use elsewhere) or (3) new to the market (not in use elsewhere). The same three measures are also used for process innovation: (4) any process innovation (5) new to the firm process innovation and (6) new to the market process innovation.

These measures are useful as they distinguish between different sources of innovation. For example, if diversity facilitates external knowledge sourcing new innovations might be merely new to the firm and in active use elsewhere. However, if diversity enables new combinations of knowledge to create entirely new ideas and products the innovations will be entirely new (Lee & Rodríguez-Pose 2013). The distinction between these two effects helps identify which processes are linking diversity and innovation. A further benefit of these measures is that they are appropriate for innovation in services as well as other forms of innovation and so are more inclusive that patenting measures (for example, only 4 percent of innovation active firms patent (Hall et al. 2013)).

However, as with all measures of innovation these have some limitations. The data does not show the significance of innovations or the extent to which they are successfully commercialised (Criscuolo et al. 2012). This is particularly important given that only a small proportion of innovations will lead to significant benefits to the firm (Coad & Rao 2008). Moreover, the 12-month timescale is relatively tight, meaning that firms which introduce major but occasional innovations may not appear as innovative as those introducing frequent but trivial ones (Lee & Rodríguez-Pose 2013).

Diversity measures

The key variables are the measures FIRMDIV, firm diversity, and CITYDIV, city diversity. Our main firm level measure of diversity is the share of partners or directors who are born outside the UK ("Migrant share (%)"). This is a measure of diversity of management structure, rather than diversity of staff in the firm. However, this measure is appropriate as management are the most important group in making decisions at a firm level, introducing new ideas and processes and potentially helping the firm innovate.

This variable is share of migrants running the firm rather than a measure of actual diversity. A firm where all owners or partners are from the same non-UK country will be equally as (un)diverse as one which employs no migrants at all, but on our measure will be seen as diverse when it is not. Because of this a further set of regressions are run using the quadratic term (the share of migrant owners / partners squared). If migrant *diversity* in ownership is important for innovation, rather than simply migrant run firms being more innovative, a positive effect on the migrant share variable would be expected along with and a negative effect on the quadratic term.

Studies have considered a number of different measures of firm level innovation, with varying results. For example, Nathan and Lee (2013) find results for migrant run firms significantly stronger than those for ethnic-run firms. Because of this, a further test for the results is a variable for the proportion of owners from ethnic minority backgrounds ("Ethnic share (%)") and the quadratic term (Ethnic share^2 (%)). This will help test whether it is diversity of country or birth or ethnicity.

The variable for diversity at a city level is CITYDEV. To maintain comparability with the firm level variable, this is the share of the TTWA population who were born outside of the UK (City migrant share (%)). This is calculated using the Annual Population Survey 2004, a sample survey of individuals across the UK. TTWA measures are constructed using Local Authority identifiers (LA).[2] As with firm diversity, a quadratic term is also used to test for 'diversity' relative to 'migrants' (City migrant share^2 (%)). And to test whether there is an effect from ethnic, rather than migrant, diversity, a final variable is the proportion of residents in a city who are not of white ethnicity.

Correlations between the diversity and innovation variables are given in table 2. The first point of note is that there is a positive and statistically significant relationship between the firm diversity and city diversity variables, i.e. diverse firms are more likely to be located in diverse cities. Alongside this, there are significant correlations between migrant run firms and entirely new product innovations and both measures of process innovation. The share of owners / partners who are not of white ethnicity is not significantly related to any of the measures of innovation

[2] For more on this measure, which has been shown in past work to correlate well with official statistics, see Sissons et al. (2013).

In contrast, there is no relationship between the share of migrants or non-white residents in a city and either measure of innovation. In short, while there are clear correlations between migrant ownership and innovation at the firm level, similar relationships do not exist for either firm ethnicity nor city level diversity.

Control variables

FIRM is a set of standard firm level variables. Firms with several locations may have access to a greater number of potential knowledge sources than others. One control is a variable for whether a firm has more than one site ("Multisite"). A second activity associated with innovation is whether a firm takes advice from elsewhere ("Advice"). External knowledge sourcing of this form is strongly associated with innovation, and firms taking advice should to be more innovative (Gordon & McCann 2005).

Firms which aim to grow will invest more in new products and processes to achieve this (Stam & Wennberg 2009), and a variable is introduced for this ("Aims to grow"). There is also evidence linking the human capital of firms and innovation. This is controlled for in two ways. At the firm level, better educated leadership should lead to more innovations. A variable is used for whether the respondent to the survey is a graduate ("Graduate owner"). As the survey was screened so only decision makers within the firm responded, this should be a good measure of human capital of the management. Workforce skills may have a similar effect, and so a further control is a sector / region measure. The variable is the proportion of employees in each of 161 sector / region combinations who have degrees.

A further set of controls are the standard characteristics of the firm. The first control is age, with younger firms assumed to have fewer existing products and so needing to introduce them more frequently (Criscuolo et al. 2012). There are three age categories: under three years, aged four to ten and eleven plus. Similarly, larger firms will need to introduce new firms and a control for three firm size categories is also used (Micro, Small and Medium). In addition, 4 different dummy variables for legal status are used to control for the differences in these firms (Private Limited Company, Public Limited Company, Partnership or 'Other'). Finally, as innovation processes will differ between sectors 15 sector dummies are used. Table 2 gives further details on each of the above control variables.

Two measures for CITY are also used. London is by far the largest city in the UK, and innovation in the city is seen as operating according to distinct processes (Wood 2009). The first variable is a dummy simply for firms in the capital ("London"). A final control is whether firms are in other large cities – defined as a TTWA with more than 250,000 employees – with another variable ("City"). Roughly half (52.4 per cent) of firms are in urban areas of this size.

4. Model and results

4.1 Basic results: Migrant diversity and innovation

Table 3 gives the results of the base regressions which focus on linear measures of both management and city diversity. They show that migrant ownership increases innovation. A higher share of migrant owners is positively associated with an increased likelihood of introducing both product and process innovations. For product innovation, the effect seems to be driven by the creation of entirely new products. For process innovation, the effect is driven by innovations which are merely new to the firm. The results suggest that the benefits of culturally diverse owners and partners extend beyond modifications of products and processes already introduced elsewhere; at least part of the benefit of diversity is in the production of entirely new innovations. The size of the effect, however, is relatively small. On average, an additional 10 per cent share of migrant owners and partners is only associated with a 1 per cent increase in the predicted probability of a firm introducing a new product innovation.[3]

In contrast, there is no relationship between local migrant diversity and firm innovation. The sign on the coefficient is negative but only significant in one case: without controls, being located in a city with more migrants is associated with a lower probability of introducing process innovations which are new to the firm, but not the market. However, this effect is not robust to the inclusion of controls. Overall, these results imply that firm characteristics are more important than location in determining innovation, a finding which reflects other work in this area (Stephan 2011). The results strongly suggest that firm effects are important. Rather than being an independent phenomenon, any 'city effect' seems to stem from the characteristics of local firms.

The control variables show some of the other factors related to firm innovation. Firms are more likely to introduce new product innovation if they have applied for finance, use ICT, have multiple sites, export and seek advice. The strongest relationship is for firms which aim to grow, which is associated with a 22 per cent higher chance of introducing any product innovation, an effect driven largely by a greater chance of product innovations which are new to the firm. Firms which seek advice are more likely to introduce products which are new to the firm, not the market, suggesting advice is used to help bring in ideas from elsewhere. In contrast, applying for finance is associated with a greater chance of introducing entirely new products.

The results for process innovation differ slightly. Generally firms which have applied for finance, use ICT, have more directors, multiple sites, seek advice and are growth oriented are more likely to introduce new processes. In contrast to product innovation, firms which seek finance are more likely to introduce processes which are only new to the firm (although the coefficient on entirely new innovations is larger, so are the standard errors). Advice seeking is also associated with introducing

[3] Values for the 'migrant run' variable are expressed on a scale of 0.00 – 1.

processes which are only new to the firm. Firms which aim to grow are likely to bring in both types of new process innovation.

An important question is whether these results show the benefits of migrant owners and partners or whether it is the combination of migrants and non-migrants which matters. The former is simply the benefits of a migrant run firm; the latter is a diversity effect. Following Østergaard et al. (2011) a test quadratic term is used to control for this. If the benefits of migrant owners and partners are inverse u-shaped the sign on the share of migrant owners / partners to be positive, but the quadratic term to be negative. Results are given in table 4.

The results lend support to the idea that the benefits of migrant run firms are non-linear, i.e. there is a diversity effect rather than a migrant-run firm effect. Across all six regressions, there is a negative sign on the quadratic term and a positive sign on the migrant run variable. For product innovation, the variables are only significant for the overall measure of any product innovation. However, the results are more conclusive for process innovation: both coefficients are significant for the general measure of any process innovation; for the two more specific measures of innovation the linear term is positive and significant while the quadratic term is negative, albeit not significant. Thus, in contrast to findings from other research there is evidence of an inverse U-shaped effect, with the share of migrants having diminishing returns to innovation (Østergaard et al. 2011).

The quadratic terms for the city level diversity variables are at least indicative of an effect, but they are not conclusive. The linear term for diversity is positive against overall and new to the firm measures of product and process innovation, but negative against entirely new innovation. It is not close to significance at standard levels. However, the quadratic term is weakly significant for two measures of any product innovation and new to the firm product innovation, suggesting that firms in highly diverse cities are actually less likely to introduce these innovations. Overall, these provide some weak evidence that firms in highly diverse cities may actually be less innovative, if anything.

4.3 Cultural diversity and city types

There may be an interaction between firm level diversity and city level diversity – diverse firms may be the ones which benefit from the city level channels. For example, firms with diverse owners / managers may be better able to recruit from the diverse city workforce. Alternatively, it may be easier for them to access knowledge and contacts from overseas in a more diverse city. If this was the case, diverse firms would be more likely to innovate in diverse cities.

To test this, the base regressions are rerun using an interaction term between the city and the firm level diversity measures. Table 5 presents the results. The coefficient for the interaction term never even approaches significance at standard levels. These suggest that diverse firms are not more

innovative in diverse cities. The results also provide further evidence for the robustness of the firm effect.

A second test is whether the benefits of innovation differ in London and other cities. Nathan and Lee (2013) suggest that diverse firms in London may be more innovative, with the capital providing a focal point for international migrants and knowledge sourcing from elsewhere. Using data for firms in London only, however, they are unable to test whether their findings generalise to other cities. Table 6 presents a test of this question: it uses two interaction terms (1) between firm level diversity and a location in London and (2) firm level diversity and location in a city (defined as TTWAs which have more than 250,000 employees).

The interaction term between diverse firms and location in a city is negative in most cases, but only statistically significant against the measures of any and new to the firm process innovations. In both cases, this suggests that diverse firms in large cities are less likely to introduce process innovations than those elsewhere.

However, the reverse is true for diverse firms in London. Diverse firms in London are more likely to introduce process innovations, with this result driven by innovations which are new to the firm – i.e. original rather than learned. Culturally diverse firms in London create entirely new processes, in contrast to other major cities. However, there is no effect from a London location on product innovation. In this respect, the results are inconsistent with Nathan and Lee (2013) who find that diverse firms in London are more likely to produce new products. They contrast with the results of Nathan (2013) who considers ethnically diverse firms in the capital and finds no significant effect, suggesting the results here are due to migrants.

There are a number of potential explanations for the different effect of diverse firms in London. The first is the nature of London, which is often seen as a nodal point for international processes. Migrant run firms in London may focus on more competitive external markets, with this driving our results. Second, there may be unobserved heterogeneity in the nature of our migrant variables. London traditionally attracts many of the most highly qualified and talented entrepreneurs in the UK. It may attract more talented migrants than other cities, with these migrants being drawn to the capital's successful economy (Gordon 2013). Past work has suggested that innovation in London operates slightly differently to other major UK cities (Wood 2009). The results here confirm this idea.

5. Checks of main results

5.1 Selection effects

One important objection to our results is selection bias. Diverse owners and partners may self-select into particular types of firms, with – for example – migrants buying into or becoming partners in firms which are good at producing new products and processes. As cultural diversity will appear to be more important for innovation than it actually is, such an effect will bias the coefficient upwards and so overstate the impact of cultural diversity (Nathan 2013).

To address this potential problem, we use a two-stage correction (for an applied example of this methodology, see Lee and Cowling (2012)). First, regressions are estimated using the firm level controls (excluding diversity variables) where the dependent variable is either firm level diversity or city level diversity.[4] Using these, based on observable characteristics predicted probabilities are calculated, i.e. the predicted share of migrant owners and partners and the predicted probability of a firm being located into a highly diverse city. These predicted probabilities are then entered into the base regressions as "Predicted Migrant Share" and "Diverse City Probability" respectively. If diverse owners / partners are particularly likely to apply in certain types of firms, or certain types of firm are more likely to locate in diverse cities, this will capture this effect. Any remaining effect should be due to an independent 'diversity' effect.

Table 7 presents the results. Even when controlling for the latent propensity for firms to be diverse, migrant run firms are more likely to introduce any product innovation, entirely new products, any process innovations and new to the firm processes. The predicted diversity variables are only significant in one case, with predicted diversity negatively related to introducing processes which are new to the firm (albeit only at the 10 per cent significance level). While there may still be unobserved heterogeneity in the data which causes selection within the observed characteristics, this suggests the core results are robust to observable selection effects.

5.2 Ethnic diversity and innovation

A second challenge to the results is the measure of diversity, and it is a useful check to test whether the results apply equally to ethnic diversity. Past work has suggested that ethnic and migrant diversity and related but different concepts. For example, Lee (2011a) shows that while migrant diverse English cities experienced faster employment growth between 1981 – 2001, growth was slower for ethnically diverse cities. Ethnicity and migrant status are very different concepts, and the

[4] Note that to avoid collinearity the predicted probability of a firm being in the top 25% of most diverse cities is estimated as a logit regression for the city effects. However, even without this correction the results are very similar.

characteristics of people of non-white ethnicity differ to those of migrants. Yet empirical work on this topic has tended to conflate the two.

To test whether our results apply equally for ethnic run firms, regressions are run with the number of non-white rather than migrant owners and partners. Table 8 gives the results. The first model considers simple linear terms. There is no statistically significant relationship between ethnic firms and innovation, controlling for relevant firm characteristics. Other research using a larger sample finds a significantly smaller effect from ethnic relative to migrant run firms (Nathan & Lee 2013). The results presented here may reflect this smaller effect. Only one of the city-level variables is significant, with firms in ethnically diverse cities actually less likely to introduce product innovations.

Regressions are also run with the quadratic terms (model 2). For product innovation, the relationship is not significant. For process innovation, there is some evidence of a quadratic effect for process innovations, with the effect driven by learned process innovation. The effect is only cautiously indicative of a non-linear relationship between ethnic diversity and the introduction of process innovations which are new to the firm. There also appears little relationship between ethnic shares at a city level and innovation.

Overall, the results for ethnic diversity are considerably weaker and show little or no effect on firm innovation. The likely explanation is unobserved heterogeneity between migrant groups, who tend to be relatively better qualified, and those of non-white ethnicity who are often less so. Moreover, migrant groups will all come from different countries, and so bring new ideas with them. Ethnic minorities in the UK, while having diverse experiences, may be UK born and with extremely similar cultural backgrounds to those of non-white ethnicity. Moreover, migrants are more likely to have 'self-selected' into the UK to take advantage of particular opportunities. These results suggest considerable caution is needed in specifying the measure of 'diversity'.

5.3 Alternative city-level specifications

An additional potential specification issue is omitted variable bias with the local level variables. To address this concern, several alternative specifications of the city-diversity variables were attempted. First, the base results were re-estimated with TTWA-level fixed effects. This leads to considerable collinearity, and a reduced sample size due to perfect prediction in the probit model, but did not change the city-level results.

Table 9 presents results with an additional city level variable included, the share of the population qualified to degree level or above (proxied in the UK as National Vocational Qualification (NVQ) level four and above). There is considerable collinearity in the model (while mean VIF is only 4.77 and 4.23 for model 1, column 1 and model 2, column 2, the equivalent figures for city level migrant

share is 14.04 and 3.76 respectively and for city level share with degree is 25.9 and 19.03, far above the standard acceptable threshold of 7. Yet there is relatively little change in the variable for local workforce diversity. In short, the results do not appear to be affected by the number of additional city level controls. In common with other studies, these results suggest that the impact of city characteristics on firm level innovation may be overstated (Maré et al. 2013).

6. Conclusions

Growing cultural diversity is increasingly seen as important for innovation. Research has suggested that this can happen in both firms and cities, yet no study has tested both simultaneously. This paper has addressed this gap using a survey of over 2,000 UK SMEs with both data on cultural diversity of ownership and the firm's local labour market.

There is strong evidence for a firm effect. Firms with more owners / partners born outside of the UK are more innovative. The results suggest the effect is non-linear, with diminishing returns to the number of migrant founders. And the effect is not simply importation: while migrant run firms introduce new processes from elsewhere, they are also likely to introduce products which are entirely new to the market. It seems that diverse firms both import ideas from elsewhere, particularly for processes, and are better at coming up with new products themselves. These results are robust to selection effects for observable characteristics. The size of the effect is not large, but neither is it trivial. While diversity at the firm level is related to innovation, other firm level factors are more important.

However, this study finds no evidence of a city effect. Research in economic geography has focused on the city as the focal point of processes (Florida 2002). The results here suggest that average city diversity is unimportant compared to firm level diversity. Yet, as past research has shown city context does still appear important (Kemeny 2012). In particular, diverse firms in London tend to innovate more while those in other large cities innovate relatively less. So while the general level of city diversity is unimportant, other city factors still matter.

The results help in identifying the mechanisms through which cultural diversity influences innovation. They suggest that the primary channel through which cultural diversity influence innovation is migrant run firms, rather than wider benefits of culturally diverse local labour markets. Migrant-run firms are both better at creating new ideas and also introducing processes learnt from elsewhere. The results provide an important caveat to studies portraying the benefits of cultural diversity as widespread amongst urban firms. In this, the results support other work which argues that local context can be overstated as a driver of innovation (Huber 2011). However, the results do suggest that

urban context may be important in the specific case of London. Diversity may be more of an asset for firms in London than elsewhere. This is an important area for future research.

The paper opens up a number of other areas for research. A useful extension would be to introduce an employee level diversity variable alongside those for management and the city, to control for the differential effects of employee and management diversity and innovation (see Ostergaard et al. 2011). Second, replicating these results using different data sources would validate the findings, particularly related to city effects. In particular, there may be sectoral variation with the knowledge intensive firms which gain from agglomeration benefiting particularly in diverse cities. Larger samples may also allow detailed consideration of more city characteristics, such as trust, and how these interrelate with diversity to produce innovation. Third, this study could not control for the characteristics of entrepreneurs in more detail. As with most studies in this area, there is a danger of confusing the benefits of certain migrant groups with the broader concept of diversity (Suedekum et al. 2012). An important question is whether results are driven by differences between migrant and non-migrant entrepreneurs. Alongside this, including a more specific measure of diversity (such as a Herfindahl index) rather than simply the share of migrant owners or partners would be a useful extension.

References

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

Bakens, J., Mulder, P. & Nijkamp, P., (2013) Economic Impacts of Cultural Diversity in the Netherlands: Productivity, Utility, and Sorting. *Journal of Regional Science*, 53(1), pp.8–36.

Coad, A. & Rao, R., 2008. Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy*, 37(4), pp.633–648.

Criscuolo, P., Nicolaou, N. & Salter, A., (2012) The elixir (or burden) of youth? Exploring differences in innovation between start-ups and established firms. *Research Policy*, 41(2), pp.319–333.

Florida, R., (2005) *The flight of the creative class: The new global competition for talent*, London: HarperCollins.

Florida, R., Mellander, C. & Stolarick, K., (2008) Inside the black box of regional development--human capital, the creative class and tolerance. *Journal of Economic Geography*, 8(5), pp.615–649.

Florida, Richard, (2002) *The rise of the creative class: And how it's transforming work, leisure, community and everyday life*, New York, NY: Basic Books.

Gagliardi, L., (2011) Does Skilled Migration Foster Innovative Performance? Evidence from British Local Areas. *SERC Discussion Paper*, 97.

Gordon, I. & McCann, P, (2005) Innovation, agglomeration, and regional development. *Journal of Economic Geography*, 5, pp.523–543.

Gordon, I.R., (2013) Ambition, Human Capital Acquisition and the Metropolitan Escalator. *Regional Studies*, p.Forthcoming.

Hall, B. et al., (2013) The importance (or not) of patents to UK firms. *NIESR Discussion Paper*, 410.

Hong, L. & Page, S., (2004) Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proceedings of the National Academy of Sciences in the United States*, 101(46), pp.16385–16389.

Huber, F., (2011) Do clusters really matter for innovation practices in Information Technology? Questioning the significance of technological knowledge spillovers. *Journal of Economic Geography*, 12(1), pp.107–126.

Jacobs, J., (1969) *The economy of cities.* London, Vintage Books.

Kemeny, T., (2012) Cultural diversity, institutions, and urban economic performance. *Environment and Planning A*, 44(9), pp.2134–2152.

King, E.B. et al., (2011) Why organizational and community diversity matter: Representativeness and the emergence of incivility and organizational performance. *Academy of Management Journal*, 54(6), pp.1103–1118.

Lee, N & Rodríguez-Pose, A., (2013) Original Innovation, Learnt Innovation and Cities: Evidence from UK SMEs. *Urban Studies*, p.DOI: 10.1177/0042098012470395.

Lee, N (2011) Ethnic Diversity and Employment Growth in English Cities. *Urban Studies*, 48(2), pp.407–425.

Longhi, S., (2011) Impact of cultural diversity on wages and job satisfaction in England. *ISER Working Paper*, 2011-19.

Maré, D.C., Fabling, R. & Stillman, S., (2013) Innovation and the local workforce. *Papers in Regional Science*, DOI: 10.11.

Nathan, M., (2011) The Long Term Impacts of Migration in British Cities: Diversity, Wages, Employment and Prices. *SERC Discussion Paper*, 67.

Nathan, M., (2013) Top team demographics, innovation and business performance: Findings from English firms and cities 2008-9. *SERC Discussion Paper*, 129.

Nathan, M. & Lee, N, (2013) Cultural Diversity, Innovation, and Entrepreneurship: Firm-level Evidence from London. *Economic Geography,* 89 (4): 367-394.

Niebuhr, A., (2010) Migration and innovation: Does cultural diversity matter for regional R&D activity? *Papers in Regional Science*, 89(3), pp.563–585.

Nijkamp, P. & Poot, J., (2011) Immigration and Innovation in European Regions. *IZA Discussion Paper*, 5676.

Østergaard, C.R., Timmermans, B. & Kristinsson, K., (2011) Does a different view create something new? The effect of employee diversity on innovation. *Research Policy*, 40(3), pp.500–509.

Ottaviano, G. & Peri, G., (2005) The economic value of cultural diversity: evidence from US cities. *Journal of Economic Geography*, 6(1), pp.9–44.

Ozgen, C., Nijkamp, P. & Poot, J., (2011) The impact of cultural diversity on innovation: Evidence from Dutch firm-level data. *IZA Discussion Paper*, 6000.

Pozzoli, D., Pytlikova, M. & Parrotta, P., (2012) The Nexus between Labor Diversity and Firm's Innovation. *IZA Discussion Paper*, 6972.

Saxenian, A., (2006) *The New Argonauts: Regional Advantage in a Global Economy*, Cambridge, MA: Harvard University Press.

Sepulveda, L., Syrett, S. & Lyon, F., (2011) Population superdiversity and new migrant enterprise: The case of London. *Entrepreneurship & Regional Development*, 23(7-8), pp.469–497.

Simonen, J. & McCann, Philip, 2008. Firm innovation: The influence of R&D cooperation and the geography of human capital inputs. *Journal of Urban Economics*, 64(1), pp.146–154.

Sissons, P., Lee, N & Hughes, C., (2013) *Econometric analysis of the link between growth and poverty in British cities*, London: The Work Foundation.

Sparber, C., (2010) Racial Diversity and Macroeconomic Productivity across US States and Cities. *Regional Studies*, 44(1), pp.71–85.

Stam, E. & Wennberg, K., (2009) The roles of R&D in new firm growth. *Small Business Economics*, 33(1), pp.77–89.

Stephan, A., (2011) Locational conditions and firm performance: introduction to the special issue. *The Annals of Regional Science*, 46, pp.487–494.

Suedekum, J., Wolf, K. & Blien, U., (2012) Cultural Diversity and Local Labour Markets. *Regional Studies*, p.DOI:10.1080/00343404.(2012)697142.

Syrett, S. & Sepulveda, L., (2011) Realising the diversity dividend: population diversity and urban economic development. *Environment and Planning A*, 43(2), pp.487–504.

Trax, M., Brunow, S. & Suedekum, J., (2012) Cultural Diversity and Plant-Level Productivity. *IZA Discussion Paper*, 6845.

Wood, P., (2009) Service Competitiveness and Urban Innovation Policies in the UK: The Implications of the "London Paradox". *Regional Studies*, 43(8), pp.1047–1059.

Tables

Table 1. Variable and definitions

Measure	Variable
Innovation	
Any product innovation	If firm has introduced any product innovation in previous 12 months
Learned product innovation	Firm has introduced new or significantly improved product which is new to the firm
Original product innovation	Firm has introduced new or significantly improved product which is entirely new
Process innovation	If firm has introduced any process innovation in previous 12 months
Learned product innovation	Firm has introduced new or significantly improved process which is new to the firm
Original product innovation	Firm has introduced new or significantly improved process which is entirely new
Firm diversity	
Migrant run (%)	Percentage partners / directors born outside the UK
Migrant run^2 (%)	Percentage partners / directors born outside the UK, squared
Ethnic run (%)	Percentage partners / directors from minority ethnic groups
Ethnic run^2 (%)	Percentage partners / directors from minority ethnic groups, squared
City Diversity	
City migrant share (%)	Percentage of those in TTWA born outside the UK
City migrant share^2 (%)	Percentage of those in TTWA born outside the UK, squared
City ethnic share (%)	Percentage of those in TTWA from ethnic minority group
City ethnic share^2 (%)	Percentage of those in TTWA from ethnic minority group, squared
City Controls	
London	If firm is located in London
City	If firm located in TTWA with >250,000 employees
Firm controls	
Multisite	Firm has multiple sites
Exports	Firm sells abroad
Advice	Firm takes advice from elsewhere
Aims to Grow	Firm aims to grow
Graduate	Respondent is a graduate
Sector degree (%)	Percentage of those in sector / region combination with degree
Firm age	Nine age categories (less than one year, one, two, three, four, five years, six – ten years, eleven to twenty years; more than twenty)
Firm size	Three dummies for Micro (1-9 employees), Small (10 – 49) and Medium (50 – 250) size
Legal status	Dummies for whether a firm is (1) Private Ltd Company (LTD) (2) Public Ltd Company (PLC) (3) Partnership (4) Other (e.g. partnership, co-operative).
Sector	Fifteen sector dummies. These are: (1) A - Agriculture, hunting and forestry (2) B - Fishing (3) C - Mining and quarrying (4) D - Manufacturing (5) E - Eletricity, gas and water supply (6) F - Construction (7) G - Wholesale and retail trade, repair (8) H - Hotels and restaurants (9) I - Transport, storage and communication (10) J - Financial intermediation (11)K - Real estate, renting and business (12) L - Public administration and defence (13) M - Education (14) N - Health and social work (15) O - Other community, social and personal services

Table 2. Correlation between diversity and innovation variables

	Migrant run (%)	City migrant share (%)	Ethnic run (%)	City ethnic share (%)	Any product innovation	Learned product innovation	Original product innovation	Any process innovation	Learned process innovation	Original process innovation
Migrant run (%)	1.0000									
City migrant share (%)	0.2081***	1.0000								
	(0.0000)									
Ethnic run (%)	0.5413***	0.1908***	1.0000							
	(0.0000)	(0.0000)								
City ethnic share (%)	0.2064***	0.9424***	0.2108***	1.0000						
	(0.0000)	(0.0000)	(0.0000)							
Any product innovation	0.0608***	0.0053	0.0082	-0.0056	1.0000					
	(0.0042)	(0.8042)	(0.7000)	(0.7937)						
Learned product innovation	0.0322	0.0023	0.0174	-0.0006	0.7992***	1.0000				
	(0.1318)	(0.9131)	(0.4163)	(0.9770)	(0.0000)					
Original product innovation	0.0460**	0.0020	-0.0090	-0.0109	0.4318***	-0.1970***	1.0000			
	(0.0313)	(0.9240)	(0.6722)	(0.6109)	(0.0000)	(0.0000)				
Any process innovation	0.0559***	-0.0114	0.0155	-0.0196	0.5029***	0.3922***	0.2368***	1.0000		
	(0.0084)	(0.5907)	(0.4665)	(0.3552)	(0.0000)	(0.0000)	(0.0000)			
Learned process innovation	0.0391*	-0.0332	0.0165	-0.0341	0.4149***	0.4595***	-0.0092	0.8635***	1.0000	
	(0.0658)	(0.1188)	(0.4386)	(0.1089)	(0.0000)	(0.0000)	(0.6663)	(0.0000)		
Original process innovation	0.0352*	0.0312	-0.0016	0.0192	0.2341***	-0.0668***	0.4882***	0.3921***	-0.1253***	1.0000
	(0.0985)	(0.1420)	(0.9417)	(0.3660)	(0.0000)	(0.0018)	(0.0000)	(0.0000)	(0.0000)	

Significance in parenthesis. Observations: 2,223. *** p<0.01, ** p<0.05, * p<0.1

Table 3. Probit results: Migrant run firms, migrant cities and innovation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Product						Process					
	Any new product		New to the firm		Entirely new		Any new process		New to the firm		Entirely new	
Migrant run (%)	0.00123***	0.00114**	0.000597	0.000500	0.000518**	0.000414*	0.00109***	0.00114***	0.000807**	0.000862**	0.000241	0.000166
	(0.000432)	(0.000453)	(0.000394)	(0.000403)	(0.000241)	(0.000222)	(0.000387)	(0.000394)	(0.000356)	(0.000362)	(0.000178)	(0.000146)
City migrant share (%)	-0.000716	-0.00407	-0.000395	-0.00371	-0.000411	-0.000181	-0.00199	-0.00127	-0.00330**	-0.00208	0.000921	0.000638
	(0.00183)	(0.00427)	(0.00169)	(0.00375)	(0.00112)	(0.00234)	(0.00169)	(0.00389)	(0.00158)	(0.00344)	(0.000834)	(0.00171)
London		0.0425		0.0235		0.0112		0.0416		0.0196		0.0251
		(0.0794)		(0.0716)		(0.0445)		(0.0732)		(0.0643)		(0.0394)
City		0.0128		-0.00527		0.0158		0.0227		0.00807		0.0112
		(0.0255)		(0.0229)		(0.0138)		(0.0228)		(0.0206)		(0.00978)
Applied for finance		0.0569**		0.0225		0.0274*		0.0943***		0.0721***		0.0107
		(0.0268)		(0.0239)		(0.0157)		(0.0250)		(0.0231)		(0.00996)
Family run firm		0.0174		0.0268		-0.0131		-0.0147		-0.00768		-0.00298
		(0.0230)		(0.0204)		(0.0125)		(0.0207)		(0.0189)		(0.00858)
ICT		0.126***		0.102***		0.0221		0.0867**		0.0466		0.0334***
		(0.0402)		(0.0335)		(0.0247)		(0.0374)		(0.0354)		(0.0113)
Number of directors		0.00948		0.00781		1.08e-05		0.0115*		0.0136**		-0.00213
		(0.00780)		(0.00690)		(0.00378)		(0.00683)		(0.00604)		(0.00264)
Multiple sites		0.0453		0.0128		0.0297*		0.0427*		0.0180		0.0179
		(0.0277)		(0.0245)		(0.0165)		(0.0249)		(0.0224)		(0.0114)
Seeks advice		0.0749***		0.0611***		0.0115		0.0704***		0.0579***		0.00978
		(0.0231)		(0.0205)		(0.0130)		(0.0206)		(0.0186)		(0.00852)
Aims to grow		0.220***		0.153***		0.0592***		0.149***		0.116***		0.0294***
		(0.0214)		(0.0194)		(0.0122)		(0.0196)		(0.0178)		(0.00874)
Graduate owner		0.0159		0.00852		0.00631		0.0187		-0.000349		0.0183**
		(0.0226)		(0.0202)		(0.0122)		(0.0204)		(0.0184)		(0.00890)
Sector / region degree share		0.0899		0.306		-0.156		-0.463		-0.342		-0.166
		(0.407)		(0.366)		(0.221)		(0.367)		(0.333)		(0.153)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2,208	2,208	2,187	2,185	2,187	2,183	2,217	2,215	2,204	2,202	2,204	2,197
Pseudo R2	0.0028	0.0950	0.000892	0.0682	0.00310	0.0662	0.00307	0.0823	0.00325	0.0634	0.00398	0.0801

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Estimated as a probit regression. Unreported controls are size, sector, age and legal status. Sample sizes vary due to perfect prediction groups.

Table 4. Probit results: Quadratic effects for diverse firms and cities

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Migrant run (%)	0.00488**	0.00207	0.00152	0.00511***	0.00287*	0.00124*
	(0.00220)	(0.00195)	(0.00108)	(0.00190)	(0.00172)	(0.000688)
Migrant run^2 (%)	-4.08e-05*	-1.73e-05	-1.18e-05	-4.30e-05**	-2.19e-05	-1.16e-05
	(2.32e-05)	(2.05e-05)	(1.14e-05)	(2.00e-05)	(1.82e-05)	(7.28e-06)
City migrant share (%)	0.0137	0.0136	-0.000728	0.00171	0.00658	-0.00425
	(0.0112)	(0.0100)	(0.00598)	(0.0100)	(0.00907)	(0.00408)
City migrant share ^{2} (%)	-12.01*	-11.87*	0.311	-2.087	-5.912	2.984
	(7.014)	(6.466)	(3.606)	(6.233)	(5.710)	(2.416)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,208	2,185	2,183	2,215	2,202	2,197
Pseudo R2	0.0972	0.0698	0.0670	0.0843	0.0645	0.0845

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Estimated as a probit regression. All regressions contain full controls included in table 4 and controls for size, sector, age and legal status.
Sample sizes vary due to perfect prediction groups

Table 5. Interactions between migrant run firms and migrant cities

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Migrant run (%)	0.00173**	0.00101	0.000438	0.000612	0.000161	0.000303
	(0.000824)	(0.000723)	(0.000389)	(0.000704)	(0.000658)	(0.000242)
City migrant share (%)	-0.00369	-0.00308	-0.000379	-0.00212	-0.00285	0.000492
	(0.00422)	(0.00372)	(0.00232)	(0.00387)	(0.00340)	(0.00170)
Migrant run (%) * City migrant share (%)	-6.20e-05	-5.44e-05	-2.49e-06	5.64e-05	7.48e-05	-1.38e-05
	(6.84e-05)	(6.07e-05)	(3.43e-05)	(6.00e-05)	(5.54e-05)	(2.15e-05)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,208	2,185	2,183	2,215	2,202	2,197
Pseudo R2	0.0953	0.0682	0.0659	0.0820	0.0638	0.0792

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Estimated as a probit regression. All regressions contain full controls included in table 4 and controls for size, sector, age and legal status.
Sample sizes vary due to perfect prediction groups

Table 6. Interactions between migrant run firms and city size

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Migrant run (%)	0.00222**	0.00157*	0.000352	0.00288***	0.00237***	0.000244
	(0.00103)	(0.000903)	(0.000490)	(0.000860)	(0.000758)	(0.000318)
City migrant share (%)	-0.00390	-0.00322	-0.000412	-0.00120	-0.00174	0.000365
	(0.00423)	(0.00372)	(0.00232)	(0.00384)	(0.00336)	(0.00171)
Migrant run (%) * City	-0.00122	-0.00128	9.27e-05	-0.00314***	-0.00315***	2.38e-05
	(0.00126)	(0.00110)	(0.000593)	(0.00106)	(0.000967)	(0.000381)
Migrant run (%) * London	-0.000269	-0.000190	-3.49e-05	0.00194**	0.00238***	-0.000237
	(0.000997)	(0.000889)	(0.000497)	(0.000874)	(0.000822)	(0.000318)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,208	2,185	2,183	2,215	2,202	2,197
Pseudo R2	0.0955	0.0687	0.0659	0.0855	0.0688	0.0794

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Estimated as a probit regression. All regressions contain full controls included in table 4 and controls for size, sector, age and legal status.
Sample sizes vary due to perfect prediction groups

Table 7. Selection effects and diversity effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Migrant run (%)	0.00102**	0.000311	0.000441*	0.00130***	0.00102***	0.000171
	(0.000474)	(0.000419)	(0.000230)	(0.000419)	(0.000382)	(0.000152)
Diverse city (1/0)	-0.00836	-0.0107	0.00250	-0.0122	-0.00805	-0.00447
	(0.0283)	(0.0251)	(0.0151)	(0.0255)	(0.0231)	(0.0103)
Predicted migrant run (%)	0.0146	0.0662	-0.0411	-0.105	-0.106*	-0.0124
	(0.0780)	(0.0700)	(0.0390)	(0.0694)	(0.0626)	(0.0281)
Predicted diverse city (1/0)	-0.352	0.0719	-0.224	-0.397	-0.302	-0.0128
	(0.494)	(0.439)	(0.263)	(0.445)	(0.403)	(0.173)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,206	2,185	2,181	2,215	2,202	2,197
Pseudo R2	0.105	0.0713	0.0767	0.0906	0.0680	0.0890

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Estimated as a probit regression. All regressions contain full controls included in table 4 and controls for size, sector, age and legal status.
Sample sizes vary due to perfect prediction groups.

Table 8. Ethnic diversity and innovation

Model 1: Basic variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Ethnic run (%)	9.01e-05	0.000205	-5.19e-05	0.000586	0.000602	-6.20e-05
	(0.000529)	(0.000459)	(0.000299)	(0.000474)	(0.000423)	(0.000194)
City ethnic share (%)	-0.00394**	-0.00222	-0.00131	-0.00222	-0.00136	-0.000459
	(0.00188)	(0.00164)	(0.00106)	(0.00171)	(0.00151)	(0.000776)
Observations	2,208	2,185	2,183	2,215	2,202	2,197
Pseudo R2	0.105	0.0712	0.0767	0.0877	0.0654	0.0882

Model 2: Quadratic terms

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Ethnic run (%)	0.00100	-0.00152	0.00162	0.00589**	0.00455*	0.000538
	(0.00336)	(0.00317)	(0.00148)	(0.00296)	(0.00261)	(0.00103)
Ethnic run^2 (%)	-9.75e-06	1.77e-05	-1.77e-05	-5.53e-05*	-4.14e-05	-6.25e-06
	(3.46e-05)	(3.24e-05)	(1.55e-05)	(3.05e-05)	(2.69e-05)	(1.07e-05)
City ethnic share (%)	0.00393	0.00466	-0.00143	-0.00458	-0.000253	-0.00334
	(0.00551)	(0.00490)	(0.00298)	(0.00493)	(0.00440)	(0.00212)
City ethnic share^2 (%)	-0.000319	-0.000282	5.91e-06	9.63e-05	-4.27e-05	0.000112
	(0.000212)	(0.000188)	(0.000116)	(0.000188)	(0.000167)	(7.75e-05)
Observations	2,208	2,185	2,183	2,215	2,202	2,197
Pseudo R2	0.105	0.0722	0.0775	0.0892	0.0666	0.0910

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Estimated as a probit regression. All regressions contain full controls included in table 4 and controls for size, sector, age and legal status.
Sample sizes vary due to perfect prediction groups.

Table 9. Alternative city-level variables and innovation

Model 1: Basic variables

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Migrant run (%)	0.00131***	0.000591	0.000429**	0.00116***	0.000829**	0.000195
	(0.000448)	(0.000399)	(0.000218)	(0.000391)	(0.000360)	(0.000146)
City migrant share (%)	-0.00704	-0.00500	-0.00169	-0.00197	-0.00165	-0.000189
	(0.00459)	(0.00407)	(0.00255)	(0.00417)	(0.00367)	(0.00187)
NVQ 4+ (%)	0.281*	0.140	0.122	0.0305	-0.0802	0.0817
	(0.161)	(0.145)	(0.0872)	(0.145)	(0.129)	(0.0645)
Observations	2,241	2,215	2,213	2,236	2,223	2,218
Pseudo R2	0.0939	0.0676	0.0671	0.0815	0.0628	0.0786

Model 2: Results excluding London

	(1)	(2)	(3)	(4)	(5)	(6)
	Product innovation: Any new product	New to the firm	Entirely new	Process innovation: Any new product	New to the firm	Entirely new
Migrant run (%)	0.00149**	0.000766	0.000463*	0.000869*	0.000388	0.000267*
	(0.000586)	(0.000511)	(0.000272)	(0.000503)	(0.000473)	(0.000159)
City migrant share (%)	-0.00712	-0.00475	-0.00202	-0.00192	-0.00156	-0.000100
	(0.00463)	(0.00407)	(0.00256)	(0.00422)	(0.00375)	(0.00172)
NVQ 4+ (%)	0.286*	0.134	0.133	0.0345	-0.0753	0.0724
	(0.161)	(0.145)	(0.0865)	(0.146)	(0.132)	(0.0594)
Observations	1,839	1,821	1,817	1,839	1,830	1,825
Pseudo R2	0.0944	0.0672	0.0749	0.0815	0.0598	0.0997

Marginal effects presented. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.1
Estimated as a probit regression. All regressions contain full controls included in table 4 and controls for size, sector, age and legal status. Sample sizes vary due to perfect prediction groups. Panel 2 excludes firms in London.

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