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EXPLAINING THE INDUSTRIAL VARIETY OF NEWBORN FIRMS: THE ROLE OF CULTURAL AND TECHNOLOGICAL DIVERSITY

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Explaining the industrial variety of newborn firms: The role of cultural and technological diversity

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ABSTRACT.

We investigate the determinants of the sectoral variety of newborn firms in different regional contexts. Based on the knowledge spillovers theory of entrepreneurship, we study the role of different dimension of knowledge variety, i.e. technological diversity and cultural diversity. This latter is measured with respect to the nationality of both foreign residents and foreign entrepreneurs. We use a unique dataset stemming from the combination of different sources of information. The results confirm that all the dimensions of knowledge variety are relevant in shaping the sectoral variety of newborn firms and point to the differential contribution of immigrant entrepreneurs in fostering the sectoral diversification in unrelated activities.

1 Introduction

The analysis of the determinants of new firm creation has received increasing attention in the last decades, based on the acknowledgment of the key impact of entrepreneurial dynamics for growth, innovation and new job creation. Empirical analyses have focused on the one hand on the individual characteristics that are more conducive to the decision to start a new venture and to better post-entry performances. On the other hand, extensive efforts have been devoted to the analysis of entry dynamics in regional contexts (Acs and Storey, 2004). These studies were primarily concerned with the impact of new firm formation on local economies, as well as with the features of the local environment that affect these dynamics[1] (Audresch and Fritsch, 1999; Armington and Acs, 2002; Vivarelli, 2013; Quatraro and Vivarelli, 2015; Colombelli, 2016).

The industrial dynamics literature has largely stressed the importance of sector-specific factors in explaining entry and exit rates (Klepper, 1996; Dunne and Samuelson, 1998; Klepper and Simons, 2000; Buenstorf, 2007). On complementary grounds, regional analyses have documented that the sectoral composition of local economies is likely to affect the dynamics of new firm formation, due to uneven distribution of entry rates across sectors and to the differential sensitivity of entrepreneurship in different sectors to the features of regional contexts (Johnson, 1983 and 2004; Nystrom, 2007; Renski, 2014).

Moreover, entrepreneurship as a channel of creative destruction has also proved to ease local economies to cope with the transition associated to structural change to be itself a key driver of industrial diversification, regional branching, innovation and ultimately growth (Boschma and Wenting, 2007; Noseleit, 2013).

While the extant literature focuses on the rate of new firm formation, sector studies of entrepreneurship have devoted little effort s to understand from where the sectoral variety of newborn firms comes. This issue is crucial since there is evidence that more (relatedly) diversified regions have better growth and employment opportunities with respect to strongly specialised regions (Frenken et al., 2007; Boschma and Iammarino, 2009; Boschma et al., 2012). Therefore, if entrepreneurship contributes the process of regional branching, i.e. the emergence of new industries at the local level, it is important to understand which are the factors affecting the degree of polarization (or dispersion) of newborn firms across different economic activities. In this perspective, several studies have shown that skills' diversity and cultural diversity at the local level contribute to new firm formation (e.g. Lee et al, 2004; Audretsch et al., 2009). Cultural diversity is

1 See the Special Issues of *Regional Studies* November 2004 on 'Entrepreneurship and Economic Development', and *Small Business Economics* May 2011 on 'Entrepreneurial Dynamics and Regional Growth'.

also likely to play a crucial role through the channel of immigrant entrepreneurs acting as 'boundary breakers' spurring innovation and new firm formation (Williams, 2007; Cheng and Li, 2011; Kemeny, 2012; Lee, 2015).

In this paper, we focus on the determinants of industrial variety of newly founded firms in Italian NUTS 3 regions. We have in particular investigated the role of different forms of knowledge diversity in Italian NUTS3 regions: technological diversity, cultural diversity of residents and cultural diversity of entrepreneurs.

This paper contributes this literature in many respects. First, we focus specifically on the analysis of the on sectoral variety of newborn firms, while extant literature mostly focused on entry rates. Second, previous empirical studies have never investigated together the two dimensions of knowledge variety, i.e. cultural and technological diversity. Third, while previous analyses have mainly measured the plurality of cultures in cities/regions by focussing on the diversity of nationalities in the local population or in the local workforce, we complement this indicator with information on the plurality of nationalities of foreign born local entrepreneurs, which is a more direct indicator of the capability of people with different backgrounds to exploit different ideas, transform them into valuable commercial activities thus creating new, and possibly sectorally diverse, enterprises. Fourth, we blend together very different and yet complementary databases, generating a rather unique source of information.

Our database combines information on new firm formation and incumbent firms at the three-digit NACE level, Chambers of Commerce data on immigrant entrepreneurs at the same level of disaggregation, and the OECD RegPat database on patent applications. These data allow us to measure variety in the local knowledge stock in terms of technological diversity, as well as cultural diversity of both residents and entrepreneurs. Therefore, we understand cultural diversity of entrepreneurs as a specific form of knowledge variety, assuming that immigrant entrepreneurs' ability to confront their home and host country economic opportunities contributes to enlarging the set of locally available knowledge inputs.

The results of uur analysis confirmed the role of technological diversity in promoting sectoral variety of newborn firms, both related and unrelated, and provided new insights on possibly different channels through which cultural diversity may affect sectoral diversity.

The rest of the paper is organized as it follows. Section 2 provides a review of the literature on new firm formation, sectoral and cultural variety; Section 3 presents the data, variables and the methodology; Section 4 discusses the econometric results; the last Section concludes the paper.

2 Theoretical perspectives and testable hypotheses

2.1 New firm formation and industry-level peculiarities

The rate of creation of new firms is unevenly distributed across industries and in the same industry over time. This is due to inherent differences across sectors in terms of skills and competences required to carry out economic activities, demand conditions, and other aspects of the industry structure that engender systematic barriers to entry, like industrial concentration, cost of inputs and the capital intensity (Bain, 1956; Shane, 2003). Industries are moreover subject to lifecycles that make the creation of new ventures more likely to occur in the expansion phases than in the maturity ones (Klepper, 1996). This creates within-sector variance over time, and augments cross-sector variance as different sectors at a given moment are likely to be in different stages of their lifecycle (Kuznets, 1971).

The appreciation of the context-specific factors moulding entrepreneurial dynamics makes industry-level peculiarities even more relevant. Actually, since Perroux' growth pole theory, it is well known that regions differ in many respects, including the industry structure. Thus, regional economic performances also depend on their specialization patterns and industry-specific rounds of growth (Perroux, 1955). Accordingly, regional variation in entry rates is partially explained by the diverse industry mix characterizing the different regional economic structures.

Former analyses of the role of industry-mixes in explaining cross-regional differences in new firm formation can be found in Johnson (1983) and Storey and Johnson (1987), in which a decomposition of regional net entry rates is applied to UK data so as to appreciated the differential effect of the formation vis-à-vis the structural component. The same methodology is also applied in Johnson (2004) to relatively newer data about UK entry rates. Further analyses of these dynamics can be found in Fritsch (1997) and Fritsch and Falk (2007), who focus on the German evidence, while Nystrom (2007) and Cheng (2011) focus respectively on Swedish and US data.

All these studies provide support to the idea that industry-specific conditions explain large part of regional variance of entry rates. In other words, regional industrial variety affects regional variation in new firm formation.

2.2 Entrepreneurship, variety and regional performances

The aforementioned literature has the merits to stress the importance of industrial variety in explaining cross-regional differences with respect to entrepreneurship.

This aspect is particularly intriguing, due to the economic effects of entrepreneurship itself. Since Schumpeter (1934; 1942), the creation of new ventures has been regarded as a channel to bring about innovation in the economic system. Schumpeter himself used the expression 'industrial mutation' to explain the effects of newborn firms, which ultimately result in the creation of new variety in different places (Stam, 2010).

It follows that entrepreneurship is both affected by industrial variety, and contributes itself to produce further variety. In this sense the economic effects of new firm formation concern not only the (net) creation of new jobs, but also the emergence of local externalities. Entrepreneurship as a source of variety thus feeds the process of regional branching that is key to regional economic development (Boschma and Wenting, 2007; Frenken et al., 2007; Quatraro, 2010). Recent contributions in this framework, based on the well-known knowledge spillovers theory of entrepreneurship (KSTE), have analysed the impact of technological diversity on the regional differences in new firm formation (Colombelli and Quatraro, 2013; Colombelli, 2016).

However, if new firms are important in that they generate variety, it seems important to understand the factors affecting the distribution of entry rates across sectors in different regions. The extant literature did not pay much attention to this issue, and this paper aims to filling this gap, by focusing on somewhat neglected mechanisms.

2.3 Cultural diversity and entrepreneurship

While several studies have concentrated on the impact of variety (mainly economic, technological or sectoral) on innovation and performance, until recently much less attention has been devoted to the role of "cultural proximity/diversity". However, a recent stream of literature, focussing either on firms or on cities/regions has highlighted several mechanisms through which the plurality of cultures may affect productivity, innovation and entrepreneurship.

This literature builds on the insights of Jane Jacobs (1969) highlighting how differences among people result in different ways of evaluating new ideas, thus facilitating knowledge creation and knowledge spillovers in cities. The mechanisms through which cultural diversity affects performance and the variables affected by diversity differ in the various studies.

One line of research has argued that cultural diversity can foster the production of a larger variety of goods and services in a particular location thus increasing the productivity and utility of people living in that location, with a positive impact on wages and rents (Ottaviano and Peri, 2006). The impact of diversity may differ according to the quality of local institutions: in high-trust cities, diversity is associated with strong positive gains in expected wages, whereas its effect on wages in

low-trust cities is much weaker (Kemeny, 2012).

Other studies analyse whether a more diverse labour force, from a cultural point of view, fosters innovation due to production complementarities, or whether negative effects of diversity, caused, for example, by language barriers, outweigh the benefits. These studies focus either on firms or on cities/regions. At the firm level, management or workforce diversity may improve approaches to problem solving or ideas generation. Empirical analysis testing this hypothesis find partial support: diversity in education and gender, but not in ethnicity, positively affects the likelihood of introducing an innovation in Danish firms (Østergaard et al., 2011) and more diverse firms located in London enjoy a small but significant 'diversity bonus' for innovation (Nathan and Lee, 2013). A second body of research suggests that culturally diverse cities or regions may enhance innovation. Within this line of research, several studies show a positive impact of skilled immigration on innovation in the US (Chellaraj et al. 2008; Hunt and Gauthier-Loiselle, 2008; Kerr and Lincoln, 2008), while Niebuhr (2010) finds a positive impact of diversity in nationalities of R&D employees on innovation in German regions. Finally, Lee (2015) using a dataset of over 2000 UK small- and medium-sized enterprises and taking both a firm and a city perspective finds a strong evidence for the firm effect but mixed results for the city effect.

More relevant to our contribution are the recent studies investigating the impact of cultural diversity on entrepreneurship (Lee et al, 2004; Audretsch et al. 2010; Bishop, 2012; Cheng et al. 2012). The presence of a diverse population and diverse culture may attract innovation prone human capital, foster knowledge creation and lead to a high rate of new firm formation. This hypothesis finds some support in US metropolitan areas, where new firm creation is found to be positively and significantly associated with diversity (measured by the concentration of same-sex male unmarried partners), but not with the percentage of the population that is foreign born (Lee et al., 2004).

A positive relationship between cultural diversity and entrepreneurship derives also from the KSTE: diverse backgrounds and perspectives embedded in a diverse set of agents may lead one person to decide that an idea is potentially valuable while others do not. Consequently, the more different kinds of people evaluate any given idea, the higher will be the probability that one of these persons will arrive at the conclusion that she wants to commercially exploit it. This hypothesis finds strong support for a sample of German regions over 1998–2005: cultural diversity positively affects entrepreneurship and is highly significant in the case of technology oriented start-ups, technology oriented services and high tech start-ups (Audretsch et al., 2010). However, when extending the analysis to new firm formation in United States' regions and distinguishing between cultural and

racial diversity, significant differences across sectors in the impact of diversity emerge (Cheng et al., 2012). Finally, no impact of local economy-wide ethnic diversity of new firm formation is found across local unitary authorities and districts in Great Britain over 2001–2007 (Bishop, 2012).

Differently from previous studies, our contribution focuses on the impact of cultural diversity on sectoral variety of newborn firms. Moreover, while previous analyses have mainly measured the plurality of cultures in cities/regions by focussing on the diversity of nationalities in the local population or in the local workforce, we complement this indicator with information on the plurality of nationalities of foreign born local entrepreneurs. Cultural diversity of entrepreneurs is a more direct indicator of the capability of people with different backgrounds to exploit different ideas, transform them into valuable commercial activities thus creating new, and possibly sectorally diverse, enterprises.

2.4 Testable hypotheses

The knowledge spillover theory of entrepreneurship suggests that diverse backgrounds and perspectives embedded in a diverse set of agents may lead one person to decide that an idea is potentially valuable while others do not. Therefore, entrepreneurship should increase with cultural diversity (Audretsch et al. 2010). We extend this concept to the sectoral variety of newborn firms. Our first hypothesis is that cultural variety contributes not only to new firm formation but also to the sectoral diversity of newborn firms: diversity results not only in exploiting a larger set of ideas but also in exploiting them differently according to the different traditions, experiences and capabilities of culturally diverse people. A positive support for this hypothesis would also be consistent with the evidence of significant differences across sectors in the impact of cultural diversity on entrepreneurship (Cheng et al., 2012).

Secondly, there can be different channels through which cultural diversity may affect sectoral diversity. The presence of a diverse population and diverse culture may attract innovation prone human capital, foster knowledge creation and lead to a high rate of new firm formation in different sectors (Lee et al, 2004). In this case cultural diversity acts by providing the “right” environment for sectoral diversity. Secondly, as stressed above, culturally diverse people may engage in different activities, thus directly contributing to enlarge the set of entrepreneurial opportunities across sectors. The availability of information on both the cultural diversity of residents and entrepreneurs will help disentangling between these two different mechanisms. In particular, a stronger effect of diversity of immigrant entrepreneurs with respect to diversity of residents would support the second

channel.

Finally, we ask which kind of variety (related or unrelated), if any, is affected by cultural diversity. On the one hand, we can expect that a more diverse local environment may favour the exploitation of unrelated entrepreneurial opportunities, thus giving rise to more unrelated variety. On the other, the limited knowledge of the local context by immigrants may limit their attitude towards risk, leading to related rather than unrelated sectoral diversification. Overall, the finding of cultural diversity (particularly the diversity in nationalities of entrepreneurs) affecting unrelated more than related variety would support the hypothesis of immigrant entrepreneurs acting as 'boundary breakers' (Williams, 2007; Cheng and Li, 2011; Kemeny, 2012; Lee, 2015).

3 Data, Variables and Methodology

3.1 Data

In order to implement our empirical analysis we take the number of new businesses registered for value added tax (VAT). These data are provided by the Union of the Chambers of Commerce (Unioncamere) through the Movimprese dataset. These statistics exclude some types of entrepreneurial activity, which is not subject to compulsory registration with the Chamber of Commerce, i.e. 'small entrepreneurs' - mainly artisans, or small businesses based exclusively on the work of the members of the owning family, or sharecrop farmers. For the purposes of the present study, this exclusion allows us to exclude from the analysis "necessity entrepreneurs". The statistics about new registered firms are broken down to the 3-digit NACE code sectoral classification. This will allow us to calculate the variety index based on information entropy measure, and eventually its two components related and unrelated variety (see next Section for the details).

The source of data on foreign-born entrepreneurs is Infocamere. For each Italian province (103 provinces) we have information on the total number of registered enterprises owned by foreign born entrepreneurs by nationality of origin of the entrepreneur and by sector of activity (ATECO 2002 and 2007) over the period 2000-2013.

This is complemented by official data on the stocks of the resident population with foreign citizenship by NUTS3 region and country of citizenship over the period 2002-2010 (the data are publicly available on the website of the National Statistical Office at http://demo.istat.it).

The measures of technological diversity are based on the information contained in patent documents, and in particular that concerning technological classes. This is drawn from the OECD

RegPat Database (July 2015). The OECD's RegPat is derived from the Patstat database which ensures worldwide coverage; it provides bibliographic patent data, citations, and family links. These data include applications to the European Patent Office (EPO) and applications to national patent offices, going back to 1920 in the case of some patent authorities. This overcomes the limitations of EPO data due to its relatively young age. Patent applications are regionalized at the NUTS 3 level on the basis of inventors' addresses. Applications with several inventors residing in different regions are assigned to the relevant regions on the basis of their respective share. Our study is limited to applications submitted by inventors residing in Italian regions, and uses the International Patent Classification (IPC) maintained by the EPO to assign applications to technological classes.

Finally, data about employment, population, GDP, active population are drawn from the Cambridge Econometrics regional database.

3.2 Variables

Dependent variable

The main purpose of this paper is to enquire into the determinants of entrepreneurial diversity, i.e. sectoral variety in newborn firms. This is measured using the information entropy index. Entropy measures the degree of disorder or randomness of the system; systems characterized by high entropy are characterized by high degrees of uncertainty (Saviotti, 1988). Informational entropy is a diversity measure which allows variety to be taken into account, i.e. the number of categories into which system elements are apportioned, and also balance, i.e. the distribution of system elements across categories. (Stirling, 2007).

Formally, let p_i the probability that in each region r newborn firms are created in sector i (NACE divisions, two-digit level), then the sectoral variety of newborn firms is defined as it follows:

$$NBorn_{TV} = \sum_i p_i \, log_2 \left(\frac{1}{p_i}\right)$$

Information entropy has some interesting properties (Frenken and Nuvolari, 2004) including the possibility to be decomposed into 'within' and 'between' parts whenever the events being investigated can be aggregated into a smaller number of subsets. Within-entropy measures the average degree of disorder or variety within the subsets; between-entropy focuses on the subsets, measuring the variety across them. Following the extant literature, we label between- and within-entropy as unrelated sectoral variety ($NBorn_{UV}$) and related sectoral variety ($NBorn_{RV}$) of newborn firms respectively (Frenken et al., 2007; Boschma and Iammarino, 2009, Quatraro, 2010).

Let the sector *i* fall in the one-digit sector S_g. The probability to observe a newborn firm in this larger group, p_g, is defined as $p_g = \sum_{i \in S_g} p_i$. The sectoral unrelated variety is defined as it follows:

$$NBorn_{UV} = \sum_{g=1}^{G} p_g log_2 \left(\frac{1}{p_g}\right)$$

Related variety is instead defined as the weighted sum of entropy within each one-digit sector:

$$NBorn_{RV} = \sum_{g=1}^{G} p_g h_g$$

Where:

$$h_g = \sum_{i \in S_g} \frac{p_i}{p_g} log_2 \left(\frac{1}{p_i / p_g}\right)$$

Independent variables

As discussed, we expect that sectoral variety of newborn firms in each region will be affected by the variety at the cultural and technological levels. So, for each region *r* at time *t*, we measure the following:

- ***Cultural diversity ($CD_{r,t}$),*** measured through an entropy index calculated on the nationalities of the stock of immigrants residents in the region;
- ***Cultural diversity of entrepreneurs ($CDE_{r,t}$)***, measured as nationalities' entropy within the subsample of immigrant entrepreneurs;
- ***Technological diversity ($TD_{r,t}$)*** measured by an entropy index applied to the IPC sectors of regional patent applications;

Consistent with previous literature we have also included the following control variables in the empirical analyses:

- ***Population density ($DENS_{r,t}$),*** defined as the ration between total population and the regional land use area;
- ***Occupation rate ($OCCRATE_{r,t}$)***, measured as the ratio between employed people and active population;
- ***GDP per capita ($GDP\_PC_{r,t}$)***, measured as the ratio between the GDP (constant values at 2000 prices) and population;
- ***Immigration rate ($IMMIRATE_{r,t}$)***, defined as the share of immigrants over total resident population.

Table 1 reports the summary statistics of our variables while Table 2 displays the correlation

matrix.

>>> INSERT TABLES 1 AND 2 ABOUT HERE <<<

3.3 Methodology

The estimation of the determinants of the sectoral variety of newborn firms should provide results that could be interpreted as elasticities. This would require the logarithmic transformation of both the dependent and the independent variables. However, the lower bound of the entropy index is zero, and this would obviously raise a problem with the logarithmic transformation. For this reason we resort to the inverse hyperbolic sine transformation of variables, defined as $log\left[x_{r,t} + \left(x_{r,t}+1\right)^{\frac{1}{2}}\right]$. This transformation can be interpreted as a logarithmic transformation which is preferred when the dependent variable assumes zero values for some observations. It allows also for mitigation of the influence of extreme observations (Johnson, 1949; Burbidge et al., 1988)[2].

Then we estimated the following basic econometric models:

$$NBorn_{TV_{r,t}} = a + \beta_1 TD_{r,t-1} + \beta_2 CD_{r,t-1} + \beta_3 CDE_{r,t-1} + Z\gamma + \sum \rho_r + \sum \psi t + \varepsilon_{i,t}$$

$$NBorn_{RV/UV_{r,t}} = a + \beta_1 TD_{r,t-1} + \beta_2 CD_{r,t-1} + \beta_3 CDE_{r,t-1} + Z\gamma + \sum \rho_r + \sum \psi t + \varepsilon_{i,t}$$

$$NBorn_{RV_{r,t}} = a + \beta_1 TD_{r,t-1} + \beta_2 CD_{r,t-1} + \beta_3 CDE_{r,t-1} + Z\gamma + \sum \rho_r + \sum \psi t + \varepsilon_{i,t}$$

$$NBorn_{UV_{r,t}} = a + \beta_1 TD_{r,t-1} + \beta_2 CD_{r,t-1} + \beta_3 CDE_{r,t-1} + Z\gamma + \sum \rho_r + \sum \psi t + \varepsilon_{i,t}$$

These equations can be estimated by implementing the OLS estimator. ***Z*** is the vector of control variables discussed in the previous section, while the error term is decomposed in ρ_r, which is the NUTS 2 fixed effects, the time dummies $\sum \psi t$, and the error component ε_{it}.

The dependent variable of the second model, $\boldsymbol{NBorn_{RV/UV}}$, is the ratio between the related and unrelated sectoral variety of newborn firms in region *r* at time *t*. This index allow us to appreciate the effects of cultural diversity on the balance between the two components of total variety, and detect structural transformation of the local economy when it decreases.

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[2] This transformation is particularly useful when applied to dependent variables, since it reduces extreme values and renders the assumption of normally distributed error terms on the right-hand-side reliable (MacKinnon and Magee, 1990).

4 Econometric results

In table 3 we present the results of our analysis on the regional determinants on the overall sectoral variety of newborn firms. In columns (1)-(3), we include our variety measures, i.e. cultural diversity of residents, cultural diversity of entrepreneurs, and technological variety of the region separately within three models with controls and fixed effects for region and time. The results show that, taken individually, each of these has the expected positive coefficient and is significantly affecting the sectoral variety of newborn firms. In columns (4)-(6), we include our variety measures in pairs. The results show that the effect of cultural variety of immigrant entrepreneurs prevails over the effect of cultural variety of residents; the effect of the cultural variety of residents also vanishes when in combination with technological variety. When adding simultaneously cultural variety of immigrant entrepreneurs and variety of the technological portfolio, the coefficients for both variables remain significant, nor is their magnitude significantly affected. Column (7), finally, reports the results for the specification where the three measures are included in the model. Again, the estimates are significant for technological diversity and cultural diversity of entrepreneurs, but not for the cultural diversity of residents.

>>> INSERT TABLE 3 ABOUT HERE <<<

On the one hand, these results are broadly in line with the implications deriving from the knowledge spillover theory of entrepreneurship: a more diversified knowledge base leaves more unexploited opportunities for entrepreneurship in a wider variety of sectors. Also, these results support our hypothesis that cultural diversity provides a greater variety of ideas which can potentially be activated for business purposes. Furthermore, they seem to confirm that the cultural variety of entrepreneurs, with respect to the cultural variety of residents, is a more precise indicator of the ability of a local system to move from a diversity of ideas and perspectives to their commercial exploitation. Furthermore, our results show that the effect of cultural diversity of entrepreneurs on sectoral variety of start-ups is actually larger than the effect of variety in the knowledge base – the average values of the two variables being comparable.

As regards the controls, the positive coefficient associated with population density suggests, in line with network theory, that greater density provides more opportunities for knowledge exchange and, thus, also increases the probability of establishing new firms as well as their sectoral variety. Employment rate per se does not significantly affect the sectoral diversity of new firms, once we control for regional per capita value added, which has the expected positive sign. We find a negative coefficient for the share of the immigrant population over the residents. This suggests that a larger share of foreign residents per se does not promote sectoral diversification; if one considers

that the majority of immigrant workers concentrate in a few sectors, they are found to decrease the sectoral diversity of new firms. Our results suggest that the interaction of sectoral diversity and immigration is complex and characterized by different and partially countervailing dynamics. On the one hand, a larger overall immigration rate is associated with sectoral concentration among start-ups; on the other hand, if the variety of cultures is effectively channelled to the realization of economic opportunities through the entrepreneurial channel, it is found to also increase sectoral diversity.

In table 4, we run our model using as a dependent variable the ratio of related to unrelated variety. Thus, we are studying whether the variables that we analyse affect whether diversification *within* the two-digit sectoral classification prevails over the diversification *between* sectoral classifications. Besides confirming the expected positive sign of technological diversity, our results suggest that different diversity measures portray partially different mechanisms. Indeed, when taken individually, cultural diversity of residents results to drive the ratio towards a prevalence of the related over the unrelated component, while cultural diversity of entrepreneurs has no significant effect. However, when the two are included jointly in the specification, the coefficient of the cultural diversity of entrepreneurs becomes strongly negative and significant, while the cultural diversity of residents maintains its positive coefficient. When the two are jointly included, instead, cultural diversity of residents results to promote the prevalence of related variety over unrelated variety, while cultural diversity of entrepreneurs promotes the prevalence of unrelated over related variety. This result signals that the cultural variety of entrepreneurs acts on sectoral variety through mechanisms that differ from those activated by the cultural variety of residents. In particular, the cultural variety of immigrant entrepreneurs better captures the potential for exploiting entrepreneurial production opportunities in areas that are not correlated with the pre-existing local industrial structure. This is consistent with the view that people with different cultures assess differently entrepreneurial opportunities. However, the presence of a culturally heterogeneous workforce does not automatically lead to firm creation in (unrelatedly) differentiated sectors.

>>> INSERT TABLE 4 ABOUT HERE <<<

Among our control variables, density results to most strongly affect the prevalence of related sectoral variety of new firms over the unrelated component. Greater density provides more opportunities for knowledge exchange, and the most direct effect is likely to be the diversification into related sectors. The non-significant results found for other control variables, e.g. per capita GDP, actually only imply that these variable do not significantly draw the ratio towards the prevalence of one component over another.

These results get confirmed in the specifications presented in tables 5 and 6, where we study separately the determinants of related and unrelated sectoral variety. As it turns out, related and unrelated variety in the sectors of newborn firms seem to be driven by quite different dynamics. Related variety, i.e. diversification within sectoral classifications, is mainly driven by knowledge variety and cultural variety of residents – i.e. the variables which in the previous discussion were found to promote the prevalence of related variety over unrelated variety. Greater population density, as before, and higher per-capita GDP are also found to be associated with greater sectoral diversification of new firms within the two-digit sectoral classification. Greater unrelated variety, i.e. diversification across different macro-sectors, is instead mainly affected by the cultural diversity of immigrant entrepreneurs. Knowledge variety has a positive but only weakly significant coefficient.

>>> INSERT TABLES 5 AND 6 ABOUT HERE <<<

Consistent with the picture sketched so far, both the cultural diversity of the foreign residents the share of immigrants a result to be negatively associated with greater diversification between broad sectoral classifications, though the former showing weakly significant coefficients. Instead ,the cultural diversity of entrepreneurs seems to promote such diversification.

This implies, partly, that cultural diversification of immigrant entrepreneurs plays a role in the overall sectoral diversification of newborn firms; notice however that, as we discussed, within this group we are able to exclude at least part of the "necessity" entrepreneurs. Hence, we can conclude that this result underlines a positive correlation of the cultural diversity of entrepreneurs to sectoral variety in unrelated sectors. This is consistent with the argument of foreign workers acting as "boundary brokers" for local systems (Williams, 2007; Cheng and Li, 2011; Kemeny, 2012; Lee, 2015). The comparison of the results concerning the cultural diversity of residents with those of the cultural diversity of entrepreneurs, however, highlights that this effect is far from being automatic, but must be activated: the channel we identify here is entrepreneurship.

5 Discussion and conclusions

This paper has addressed the issue of the regional determinants of sectoral variety among newly founded firms. We have in particular investigated the role of different forms of knowledge diversity in Italian NUTS3 regions: technological diversity, cultural diversity of residents and cultural diversity of entrepreneurs, which we measured through a set of entropy indices. Our analysis confirmed the role of technological variety in promoting sectoral variety, both related and unrelated, and provided new insights on possibly different channels through which cultural diversity may affect sectoral diversity.

Both our cultural diversity measures were found to be positively and significantly associated with at least one of our measures of sectoral diversity, confirming our hypothesis that greater cultural diversity in a region can enlarge the set of economic activities and thus of economic opportunities available to economic agents. More specifically, our results showed that overall sectoral diversity is mainly affected by the diversity of entrepreneurs. When we disentangle related and unrelated, it appears that the cultural diversity of entrepreneurs triggers the dominance of unrelated over related variety. This suggests that diversity of entrepreneurs tends to enlarge the set of entrepreneurial opportunities across the whole spectrum of sectors, in line with the theoretical approach that sees foreign entrepreneurs as potential "boundary brokers".

On the other hand, cultural diversity of residents is also found to have a positive and significant effect on sectoral diversity of newborn firms, but mainly in these regions where the related variety of newborn firms prevails over the unrelated variety, i.e. in those cases where the sectoral diversification of start-ups occurred mainly within a more limited set of macro-sectors.

This positive coefficient is also compatible with our main hypothesis that diversity enlarges the overall set of entrepreneurial opportunities, but the divergent effects of the two cultural diversity measures on related variety calls for further investigation. Assuming that a wider variety of cultures provides a wider variety of opportunities, there may be differing degrees to which such variety can actually be translated into new firm formation. Indeed, greater entrepreneurial diversity implies that, on the one hand, the economy is more accessible to foreign entrepreneurs and possibly to a wider set new ideas; on the other hand, if they are actively participating in the economy, foreign entrepreneurs are more likely to contribute to knowledge spillovers with more economically relevant ideas. With respect to entrepreneurial diversity, cultural diversity of residents can be seen as providing a less "marketable" set of opportunities. While also cultural diversity of residents can be seen to provide new ideas and knowledge spillovers, these may be more "noisy" and less

business oriented; knowledge spillovers of this kind may actually occur primarily within existing firms and lead to diversification into related sectors which more strongly rely on the existing regional specialization and, overall, strengthen the related variety vis-à-vis the unrelated variety of newly founded firms. Indeed, our results also show that, while higher immigration rates tend to decrease the overall sectoral variety of firms, they tend to draw the related/unrelated ratio towards greater relatedness.

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Table 1 – Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$NBorn_{TV}$	1133	1.538	0.055	1.190	1.658
$NBorn_{RV}$	1133	0.931	0.149	0.384	1.399
$NBorn_{UV}$	1133	2.730	0.141	1.904	3.050
$NBorn_{TV/UV}$	1133	0.293	0.038	0.184	0.424
CD	824	1.652	0.092	1.053	1.869
CDE	1030	1.626	0.113	1.148	1.847
TD	1100	1.930	0.427	0.000	2.545
DENS	1133	0.201	0.189	0.036	1.287
OCC_RATE	1133	0.641	0.051	0.497	0.802
GDP_PC	1133	3.153	0.252	2.566	3.664
IMMIRATE	824	4.658	2.909	0.378	12.963

Table 2 – Correlation matrix

		1	*2*	3	4	5	6	7	8	9	10	11
1	**$NBorn_{TV}$**	*1.0000*										
2	**$NBorn_{RV}$**	*0.8255*	*1.0000*									
3	**$NBorn_{UV}$**	*0.7903*	*0.3097*	*1.0000*								
4	**$NBorn_{TV/UV}$**	*0.6334*	*0.9572*	*0.0273*	*1.0000*							
5	**CD**	*0.3706*	*0.3094*	*0.2911*	*0.2387*	*1.0000*						
6	**CDE**	*0.4538*	*0.3328*	*0.4109*	*0.2207*	*0.5725*	*1.0000*					
7	**TD**	*0.5102*	*0.5350*	*0.2786*	*0.4834*	*0.3980*	*0.5061*	*1.0000*				
8	**DENS**	*0.2251*	*0.4700*	*-0.1331*	*0.5356*	*0.1982*	*0.1628*	*0.3509*	*1.0000*			
9	**OCC_RATE**	*0.4742*	*0.4242*	*0.3447*	*0.3382*	*0.3073*	*0.3483*	*0.4476*	*0.2322*	*1.0000*		
10	**GDP_PC**	*0.5561*	*0.4196*	*0.4896*	*0.2907*	*0.4195*	*0.5262*	*0.6034*	*0.1824*	*0.7061*	*1.0000*	
11	**IMMIRATE**	*0.3737*	*0.3341*	*0.2694*	*0.2675*	*0.1723*	*0.3790*	*0.4574*	*0.1304*	*0.5101*	*0.7103*	*1.0000*

Table 3 - Determinants of industrial variety of newborn firms (Dep. Var. $NBorn_{TV}$)

	(1) $NBorn_{TV}$	(2) $NBorn_{TV}$	(3) $NBorn_{TV}$	(4) $NBorn_{TV}$	(5) $NBorn_{TV}$	(6) $NBorn_{TV}$	(7) $NBorn_{TV}$
Cultural diversity (residents)	0.0378**			0.0068	0.0254		0.0037
	(0.0182)			(0.0212)	(0.0180)		(0.0207)
Cult. diversity (entrepreneurs)		0.0598***		0.0565***		0.0430**	0.0412**
		(0.0170)		(0.0199)		(0.0170)	(0.0197)
Knowledge variety			0.0231***		0.0217***	0.0202***	0.0202***
			(0.0048)		(0.0049)	(0.0049)	(0.0050)
Density	0.0427***	0.0425***	0.0370***	0.0422***	0.0360***	0.0363***	0.0362***
	(0.0097)	(0.0096)	(0.0095)	(0.0096)	(0.0095)	(0.0094)	(0.0095)
Occ_rate	0.0120	-0.0040	0.0814	-0.0048	0.0727	0.0596	0.0592
	(0.0538)	(0.0538)	(0.0533)	(0.0539)	(0.0537)	(0.0538)	(0.0539)
GDP_pc	0.1172***	0.1283***	0.0554**	0.1271***	0.0546**	0.0653**	0.0648**
	(0.0246)	(0.0244)	(0.0256)	(0.0247)	(0.0256)	(0.0258)	(0.0260)
Immirate	-0.0165***	-0.0194***	-0.0208***	-0.0188***	-0.0184***	-0.0204***	-0.0200***
	(0.0055)	(0.0052)	(0.0051)	(0.0055)	(0.0054)	(0.0051)	(0.0054)
_cons	1.1076***	1.0553***	1.3398***	1.0520***	1.2993***	1.2507***	1.2484***
	(0.0690)	(0.0705)	(0.0645)	(0.0713)	(0.0705)	(0.0733)	(0.0744)
Time dummies	YES	YES	YES	YES	YES	YES	YES
Region dummies	YES	YES	YES	YES	YES	YES	YES
N	679	679	664	679	664	664	664
R^2	0.525	0.530	0.524	0.531	0.526	0.529	0.529
AIC	-2650.7184	-2659.0189	-2634.3482	-2657.1261	-2634.4320	-2639.0200	-2637.0541
BIC	-2506.0585	-2514.3591	-2490.4032	-2507.9456	-2485.9887	-2490.5767	-2484.1125

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 – Determinants of the ratio between related and unrelated variety (Dep. Var. $NBorn_{RV/UV}$)

	(1) $NBorn_{RV/UV}$	(2) $NBorn_{RV/UV}$	(3) $NBorn_{RV/UV}$	(4) $NBorn_{RV/UV}$	(5) $NBorn_{RV/UV}$	(6) $NBorn_{RV/UV}$	(7) $NBorn_{RV/UV}$
CD	0.0295**			0.0474***	0.0206		0.0443***
	(0.0137)			(0.0159)	(0.0137)		(0.0157)
CDE		-0.0094		-0.0325**		-0.0243*	-0.0452***
		(0.0129)		(0.0150)		(0.0130)	(0.0149)
TD			0.0163***		0.0152***	0.0179***	0.0168***
			(0.0037)		(0.0037)	(0.0038)	(0.0038)
Density	0.1057***	0.1078***	0.1018***	0.1060***	0.1010***	0.1023***	0.1009***
	(0.0073)	(0.0073)	(0.0072)	(0.0072)	(0.0072)	(0.0072)	(0.0072)
Occ_rate	-0.0093	0.0055	0.0371	0.0003	0.0301	0.0494	0.0449
	(0.0404)	(0.0408)	(0.0406)	(0.0406)	(0.0408)	(0.0410)	(0.0408)
GDP_pc	0.0807***	0.0829***	0.0401**	0.0750***	0.0394**	0.0345*	0.0283
	(0.0185)	(0.0185)	(0.0195)	(0.0186)	(0.0195)	(0.0197)	(0.0197)
Immirate	0.0078*	0.0050	0.0045	0.0091**	0.0064	0.0043	0.0082**
	(0.0041)	(0.0039)	(0.0039)	(0.0041)	(0.0041)	(0.0039)	(0.0041)
_cons	-0.1142**	-0.0590	0.0425	-0.0822	0.0097	0.0928*	0.0655
	(0.0518)	(0.0534)	(0.0490)	(0.0537)	(0.0537)	(0.0559)	(0.0564)
Time dummies	YES	YES	YES	YES	YES	YES	YES
Region dummies	YES	YES	YES	YES	YES	YES	YES
N	679	679	664	679	664	664	664
R^2	0.538	0.535	0.541	0.542	0.542	0.543	0.549
AIC	-3039.9736	-3035.6487	-2997.4799	-3042.8840	-2997.8395	-2999.1490	-3005.4744
BIC	-2895.3138	-2890.9889	-2853.5349	-2893.7036	-2849.3961	-2850.7057	-2852.5328

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 – Determinants of industrial variety of newborn firms (Dep. Var. $NBorn_{RV}$)

	(1) $NBorn_{RV}$	(2) $NBorn_{RV}$	(3) $NBorn_{RV}$	(4) $NBorn_{RV}$	(5) $NBorn_{RV}$	(6) $NBorn_{RV}$	(7) $NBorn_{RV}$
CD	0.0671**			0.0689**	0.0472*		0.0627**
	(0.0272)			(0.0318)	(0.0269)		(0.0311)
CDE		0.0303		-0.0033		0.0001	-0.0295
		(0.0257)		(0.0299)		(0.0256)	(0.0294)
TD			0.0366***		0.0339***	0.0366***	0.0350***
			(0.0072)		(0.0074)	(0.0074)	(0.0074)
Density	0.1684***	0.1710***	0.1597***	0.1684***	0.1579***	0.1597***	0.1578***
	(0.0144)	(0.0144)	(0.0141)	(0.0144)	(0.0142)	(0.0142)	(0.0142)
Occ_rate	-0.0009	0.0076	0.1070	0.0000	0.0909	0.1069	0.1006
	(0.0803)	(0.0810)	(0.0797)	(0.0808)	(0.0801)	(0.0808)	(0.0807)
GDP_pc	0.1867***	0.1977***	0.0934**	0.1861***	0.0919**	0.0934**	0.0847**
	(0.0367)	(0.0368)	(0.0383)	(0.0371)	(0.0383)	(0.0388)	(0.0390)
Immirate	0.0009	-0.0049	-0.0066	0.0011	-0.0021	-0.0066	-0.0009
	(0.0082)	(0.0078)	(0.0076)	(0.0083)	(0.0080)	(0.0076)	(0.0081)
_cons	-0.1957*	-0.1586	0.1678*	-0.1924*	0.0925	0.1676	0.1289
	(0.1028)	(0.1062)	(0.0963)	(0.1070)	(0.1053)	(0.1100)	(0.1114)
Time dummies	YES	YES	YES	YES	YES	YES	YES
Region dummies	YES	YES	YES	YES	YES	YES	YES
N	679	679	664	679	664	664	664
R^2	0.545	0.542	0.548	0.545	0.550	0.548	0.551
AIC	-2108.2086	-2103.2895	-2100.7662	-2106.2213	-2101.9944	-2098.7662	-2101.0527
BIC	-1963.5487	-1958.6296	-1956.8211	-1957.0408	-1953.5511	-1950.3229	-1948.1111

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 – Determinants of industrial variety of newborn firms (Dep. Var. $NBorn_{UV}$)

	(1) $NBorn_{UV}$	(2) $NBorn_{UV}$	(3) $NBorn_{UV}$	(4) $NBorn_{UV}$	(5) $NBorn_{UV}$	(6) $NBorn_{UV}$	(7) $NBorn_{UV}$
CD	0.0140			-0.0280*	0.0088		-0.0286*
	(0.0138)			(0.0159)	(0.0140)		(0.0159)
CDE		0.0627***		0.0763***		0.0575***	0.0710***
		(0.0128)		(0.0149)		(0.0131)	(0.0151)
TD			0.0100***		0.0095**	0.0062	0.0069*
			(0.0037)		(0.0038)	(0.0038)	(0.0038)
Density	-0.0372***	-0.0389***	-0.0397***	-0.0378***	-0.0400***	-0.0407***	-0.0398***
	(0.0073)	(0.0072)	(0.0073)	(0.0072)	(0.0074)	(0.0072)	(0.0072)
Occ_rate	0.0162	-0.0094	0.0480	-0.0064	0.0450	0.0189	0.0218
	(0.0409)	(0.0404)	(0.0414)	(0.0403)	(0.0417)	(0.0414)	(0.0413)
GDP_pc	0.0511***	0.0598***	0.0222	0.0645***	0.0219	0.0354*	0.0394**
	(0.0187)	(0.0183)	(0.0199)	(0.0185)	(0.0199)	(0.0199)	(0.0199)
Immirate	-0.0212***	-0.0219***	-0.0228***	-0.0243***	-0.0220***	-0.0222***	-0.0248***
	(0.0042)	(0.0039)	(0.0040)	(0.0041)	(0.0042)	(0.0039)	(0.0042)
_cons	1.2103***	1.1215***	1.3152***	1.1352***	1.3013***	1.1960***	1.2136***
	(0.0523)	(0.0529)	(0.0500)	(0.0534)	(0.0548)	(0.0563)	(0.0571)
Time dummies	YES	YES	YES	YES	YES	YES	YES
Region dummies	YES	YES	YES	YES	YES	YES	YES
N	679	679	664	679	664	664	664
R^2	0.477	0.495	0.472	0.497	0.472	0.488	0.490
AIC	-3025.5730	-3049.2679	-2970.5181	-3050.5310	-2968.9282	-2988.5320	-2989.9237
BIC	-2880.9131	-2904.6081	-2826.5731	-2901.3505	-2820.4849	-2840.0887	-2836.9821

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$