Regional Studies

ISSN: 0034-3404 (Print) 1360-0591 (Online) Journal homepage: https://www.tandfonline.com/loi/cres20

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To cite this article: Jeroen Content, Koen Frenken & Jacob A. Jordaan (2019) Does related variety foster regional entrepreneurship? Evidence from European regions, Regional Studies, 53:11, 1531-1543, DOI: 10.1080/00343404.2019.1595565

To link to this article: https://doi.org/10.1080/00343404.2019.1595565

REGIONAL STUDIES
2019, VOL. 53, NO. 11, 1531–1543
https://doi.org/10.1080/00343404.2019.1595565

Does related variety foster regional entrepreneurship? Evidence from European regions

Jeroen Content[a], Koen Frenken[b] and Jacob A. Jordaan[c]

ABSTRACT

Several studies have identified positive effects of related variety among a region's economic sectors on employment growth. However, the exact mechanisms through which knowledge spillovers between related sectors translate into employment growth are yet to be demonstrated. Entrepreneurship may be a possible transmission mechanism via which spillovers lead to the creation of new jobs. In this paper, we analyze novel pan-European regional survey data that distinguishes between opportunity- and necessity-driven entrepreneurs and we find that related variety has a positive effect on opportunity-driven entrepreneurship. In addition, we also find that different 'varieties of capitalism' influence regional entrepreneurship.

KEYWORDS

related variety; entrepreneurship; regional growth; institutions; varieties of capitalism; Global Entrepreneurship Monitor

JEL L16, L26, O33, R11

HISTORY Received 24 November 2017; in revised form 28 February 2019

INTRODUCTION

Following the seminal contributions by Glaeser, Kallal, Scheinkman, and Shleifer (1992) and Henderson, Kuncoro, and Turner (1995), numerous studies have investigated whether regional diversity ('Jacobs externalities') or specialization ('MAR externalities') is more important for regional economic growth. To date, however, the empirical evidence is largely inconclusive as to which of these two sources of regional externalities is more important (Beaudry & Schiffauerova, 2009; de Groot, Poot, & Smit, 2016). In related research, Frenken, Van Oort, and Verburg (2007) distinguish between related and unrelated variety and argue that related variety is more likely to generate intersectoral spillovers, as knowledge from related sectors is more easily understood and recombined compared with knowledge from unrelated sectors. A recent review by Content and Frenken (2016) concludes that, although the evidence base is still rather small, the majority of studies on related variety support the hypothesis that related variety is an important driver of regional employment growth.

Although studies that associate related variety with regional growth are suggestive of the presence of processes where inter-industry spillovers create new business opportunities, the exact mechanisms through which such opportunities are identified and exploited remain underexplored. In this study, we examine whether related variety fosters entrepreneurship – assuming that entrepreneurship, in turn, leads to employment growth. Access to knowledge spillovers enables individuals to identify new business opportunities (Acs, Audretsch, & Lehmann, 2013; Audretsch, 1995; Audretsch & Lehmann, 2005). Related variety facilitates this as it is easier for individuals to discover new ways of combining knowledge from activities and sectors that are technologically proximate. Hence, familiarity with a given knowledge area makes it easier for individuals to identify entrepreneurial opportunities in related knowledge areas (Shane, 2000). In turn, as many studies have shown, entrepreneurship is then expected to promote regional employment growth (Acs & Armington, 2004; Audretsch, Keilbach, & Lehmann, 2006; Carree & Thurik, 2010; Fritsch, 2007; Fritsch & Mueller, 2004).

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Supplemental data for this article can be accessed at https://doi.org/10.1080/00343404.2019.1595565.

Our study is not the first to examine whether related variety increases regional entrepreneurship. Previous studies have identified positive associations between these key variables for regions in Great Britain, Italy, China and Sweden (Bishop, 2012; Colombelli, 2016; Guo, He, & Li, 2016; Tavassoli & Jienwatcharamongkhol, 2016). Another study by Fritsch and Kublina (2017) on West Germany, however, finds that unrelated variety positively moderates the effect of the start-up rate of new firms on employment growth.

The present study extends upon these studies in two ways. First, instead of using the level of new firm creation as indicator of entrepreneurship, we measure entrepreneurship using survey data that distinguishes between necessity and opportunity-driven entrepreneurship. This distinction is important, as necessity and opportunity-driven entrepreneurship are motivated by different reasons. Also, regional policies that try to stimulate entrepreneurship focus primarily on the promotion of opportunity-driven entrepreneurship, given its expected larger positive impact on regional employment growth (Block & Wagner, 2010; Vivarelli, 2004). Second, we use a novel regional pan-European data set covering many more regions than previous country studies have analyzed. This also allows us to control for institutional effects at the national level, as we hypothesize that different 'Varieties of Capitalism' (VoC) (Hall & Soskice, 2001) influence levels and types of entrepreneurship. In particular, we distinguish between liberal market economies (LMEs), coordinated market economies (CMEs), Mediterranean market economies (MMEs) and dependent market economies (DMEs).

The paper is organized as follows. The next section provides a literature review that we use to develop our hypotheses. We then discuss the data, regression model and methodology. After that we present and discuss our main empirical findings. The final section provides a summary, conclusions and suggestions for further research.

THEORETICAL FRAMEWORK

Building on the early work of Marshall (1920), scholars have argued that firms benefit from positive externalities when they are located in proximity to other firms that operate in the same sector (Arrow, 1962; Romer, 1990). This type of agglomeration externalities is usually referred to as localization externalities. A high spatial concentration of an economic sector creates efficiency-enhancing opportunities, caused by labour market pooling and the use of common suppliers (Henderson, 2003). Furthermore, the co-location of firms is likely to create knowledge spillovers, as firms can easily understand and adopt each other's knowledge and innovations. In contrast, scholars have also argued that firms benefit from being located in an agglomeration that contains a variety of economic activities (Jacobs, 1969). The spatial proximity of firms operating in different sectors can create opportunities for the exchange and recombining of ideas between these sectors, benefitting the development of the local economy. Such externalities are usually referred to as Jacobs externalities. Following Glaeser et al. (1992) and Henderson et al. (1995), numerous studies have examined the effects of these different types of agglomeration externalities. The resulting evidence is inconclusive, however, as to which of these agglomeration externalities is more important as driver of regional growth. To a large degree, the heterogeneous nature of the evidence can be explained by measurement and methodological differences and differences in the levels of geographical and industrial aggregation (Beaudry & Schiffauerova, 2009; de Groot et al., 2016).

Frenken et al. (2007) agree with Jacobs that innovation constitutes a recombinant process, whereby different pieces of knowledge are recombined to develop new innovations. However, they also point out that some pieces of knowledge may be easier recombined than others. By distinguishing between related and unrelated variety, Frenken et al. (2007) propose a new interpretation of Jacobs externalities by arguing that some level of technological proximity needs to exist for these externalities to materialize. Regions with a high degree of related variety – economic activity in cognitive proximate sectors – are more likely to experience employment growth, as it facilitates new re-combinations of pieces of knowledge that lead to new products and services. Economic activity in cognitive distant sectors – unrelated variety – can make regions more resilient to sector specific shocks, causing them to experience lower unemployment growth.

Frenken et al. (2007) present evidence for Dutch regions showing that related variety increases employment growth and unrelated variety decreases unemployment growth. Following these findings, a number of studies have tested the variety hypothesis for regions in other countries. In their review of these studies, Content and Frenken (2016) conclude that the majority of these studies present findings supporting the hypothesis that related variety enhances regional employment growth. Mixed evidence, however, is found regarding the hypothesis that unrelated variety dampens unemployment growth.

Although the evidence indicates that related variety fosters regional employment growth, it is less clear how this effect is transmitted. Entrepreneurship may be a channel through which related variety fosters employment growth, as entrepreneurs can be seen as economic agents that recognize new business opportunities by associating knowledge from different knowledge domains (Shane, 2000). This is in line with the Knowledge Spillover Theory of Entrepreneurship (KSTE), which highlights the role of entrepreneurs in identifying and exploiting opportunities generated by regional knowledge spillovers (Audretsch, 1995; Acs et al., 2013).

At this point, it is important to distinguish between two types of entrepreneurship that are driven by different motives (Reynolds, Camp, Bygrave, Autio, & Hay, 2001). First, there is 'opportunity-driven' entrepreneurship, representing individuals that start new firms to exploit business opportunities. This type of entrepreneurship is likely to generate employment growth, as it is based on the exploitation of untapped market opportunities created by spillovers (Vivarelli, 2004). Second, there is 'necessity-driven'

entrepreneurship, referring to individuals who set up firms due to a lack of other employment opportunities. Firms created by this type of entrepreneur are often less productive (Vivarelli, 2004) and typically remain small without creating additional new employment.

Audretsch (1995) represents a first attempt to link regionally bounded knowledge spillovers to entrepreneurship, theorizing that the knowledge generated by incumbent firms is often not fully appropriated. Audretsch and Lehmann (2005) test this hypothesis by examining the association between the level of regional investment in knowledge creation by universities and the level of entrepreneurial activity. Their findings show that the number of firms located around universities is positively associated with the knowledge capacity and knowledge output of those universities. In extension of this, Acs, Braunerhjelm, Audretsch, and Carlsson (2009) propose a more general model of 'the knowledge filter', linking the stock of knowledge and the efficiency of incumbent firms in commercializing their research and development (R&D) efforts to the level of entrepreneurial activity. They argue that the stock of knowledge positively affects entrepreneurial activity, whereas the efficiency of incumbent firms in appropriating new knowledge exercises a negative effect on entrepreneurial activity (as fewer opportunities are left to exploit for entrepreneurs). In combination, both the characteristics of the economic agents and the environment in which the agents operate influence the probability that the knowledge filter is penetrated.

Turning to inter-industry spillovers between related sectors, one can analogously theorize that related variety has a positive effect on entrepreneurship. The possession of proximate knowledge increases the absorptive capacity of economic agents, enabling them to identify new entrepreneurial opportunities (Shane, 2000; Shane & Venkataraman, 2000). When the level of related variety is high, it is likely that economic agents possess such proximate knowledge, allowing them to recognize new entrepreneurial opportunities. The extent to which such opportunities lead to the creation of new firms depends on the ability and efficiency of incumbent firms to exploit spillovers among related industries. Combining the KSTE with the concept of related variety suggests that related variety in a region promotes knowledge spillovers, resulting in higher rates of opportunity entrepreneurship.

As for the effect of unrelated variety, the literature is more ambiguous. Unrelated variety may be important for regions that try to develop new growth paths or create new knowledge via radical innovations (Boschma, 2015; Castaldi, Frenken, & Los, 2015). It is not clear how this impacts upon entrepreneurship, however (Bishop, 2012). It can be argued that opportunities from the recombination of unrelated pieces of knowledge are perceived as too risky by incumbent firms (Mueller, 2006), whereas entrepreneurial firms may be more geared to explore such recombinations. If so, regions with a high level of unrelated variety may experience higher levels of entrepreneurship. However, unrelated variety may also lower entrepreneurship, as it may be more difficult for new firms to identify possible ways to recombine unrelated pieces of knowledge. Also, nascent firms are less likely to possess sufficient resources to bridge large cognitive distances and may find it difficult to obtain external funds to set up risky business ventures (Acs et al., 2009). In such cases, unrelated variety lowers the degree of regional entrepreneurship.

One way to investigate the effect of the structure of regional economic activity on entrepreneurship is to examine the link between related variety and opportunity entrepreneurship. Another way is to look at the effect of related variety on the ratio of opportunity over necessity entrepreneurship, capturing the overall quality of regional entrepreneurship given that opportunity entrepreneurship is more likely to create further employment growth. This leads to the following two hypotheses:

Hypothesis 1a: Related variety has a positive effect on the level of opportunity-driven entrepreneurship.

Hypothesis 1b: Related variety has a positive effect on the ratio of opportunity-driven entrepreneurship over necessity-driven entrepreneurship.

In our empirical analysis we also control for the effect of unrelated variety on entrepreneurship. We do not specify concrete hypotheses on the effect of unrelated variety, as it is not clear what the nature of this effect is. Whereas the KSTE and the concept of related variety provide a clear prediction that related variety fosters entrepreneurship, no such clear relationship can be derived regarding unrelated variety. Also, whereas most studies find positive effects of related variety on employment growth, the growth effect of unrelated variety is much less uniform (Content & Frenken, 2016). Likewise, findings on the effect of unrelated variety on entrepreneurship are also varied, ranging from positive (Colombelli, 2016) to insignificant (Tavassoli & Jienwatcharamongkhol, 2016) or negative (Guo et al., 2016).

A firm's innovation strategy is affected by the institutional environment it operates in (Freeman, 1987). In this context, two major 'varieties of capitalism' are generally distinguished (Hall & Soskice, 2001): CMEs, of which Germany is the most illustrative example, and LMEs, of which the UK is the most prominent example in Europe. The most important difference between these two varieties of capitalism is the extent to which institutions promote either cooperation or competition. In CMEs, patient capital, labour protection and high levels of trust among suppliers and clients promote long-term collaborations. They lend themselves for continuous innovations along the supply chain as well as for informal knowledge exchange and collaborative projects. Given the high level of training and long-term commitment of employees, entrepreneurial opportunities are often exploited within incumbent firms rather than by new firms poaching ideas and labour from established firms. High levels of labour protection and social security in CMEs lower the degree that people will be forced into necessity-driven entrepreneurship. In LMEs, relations are more transactional, opportunistic and volatile, while labour is less protected and committed.

Employees are less restricted in setting up their own businesses and more venture capital and tax relief for start-ups is available. Compared with CMEs, entrepreneurial opportunities in LMEs are more likely to be exploited by opportunity-driven entrepreneurs setting up their own firms. Also, as labour protection and social security in LMEs are relatively weak, necessity-driven entrepreneurship is also expected to be higher in LMEs than in CMEs. From this, we distil the following two hypotheses:

Hypothesis 2a: LMEs have a higher level of opportunity-driven entrepreneurship compared with CMEs.

Hypothesis 2b: LMEs have a higher level of necessity-driven entrepreneurship compared with CMEs.

In addition to these two varieties of capitalism, we also control for the effects of MMEs and DMEs. Hall and Soskice (2001) argue that Mediterranean countries do not fit well into the CME or LME categories. These countries have higher levels of government intervention, bureaucracy and regulation compared with CMEs and LMEs. Social security is reasonably well developed for selected professions and state organizations, but welfare and unemployment benefits are generally lower. Mediterranean countries are further characterized by having large agrarian and tourism sectors and lower levels of educational attainment (Amable, 2003; Schmidt, 2016).

Given their historical ties with communism, East European countries can be considered to constitute a fourth variety of capitalism (Lane & Myant, 2007). Some countries such as the Baltic States have introduced drastic liberal reforms and are now commonly classified as LMEs (Feldmann, 2006; Schmidt, 2016). In contrast, a country such as Slovenia has institutions very similar to neighbouring Austria and is commonly classified as a CME. The other Eastern European countries have reformed at a slower pace and represent a fourth variety of capitalism known as DMEs (Nölke & Vliegenthart, 2009). Their financial institutions are underdeveloped and their development strategies mostly rest on the attraction of foreign direct investment combined with the use of an educated but relatively inexpensive labour force. Also, the social security systems in these economies are typically less developed. To examine the effects of these two other varieties of capitalism on entrepreneurship, we specify the following two hypotheses:

Hypothesis 3: MMEs have the lowest level of opportunity-driven entrepreneurship.

Hypothesis 4: DMEs have the highest level of necessity-driven entrepreneurship.

DATA AND METHODOLOGY

Entrepreneurship

Our study is not the first to examine the relationship between related variety and regional entrepreneurship. Bishop (2012) investigates how the rate of new firm formation in British regions is affected by diversity of the regional knowledge stock and finds that related and unrelated variety positively impact the rate of new firm formation. Using manufacturing industry city-level data for China, Guo et al. (2016) find that related variety, relative to unrelated variety, has a larger positive effect on new firm formation. Colombelli (2016) also finds that a knowledge base that is characterized by a high level of related variety promotes entrepreneurial activity in Italian regions. Tavassoli and Jienwatcharamongkhol (2016) look at the effect of different types of agglomeration externalities on survival rates of newly established firms in Sweden and find that the survival rate of entrepreneurial firms in knowledge intensive business sectors is positively affected by related variety.

These studies all use new firm formation as indicator of regional entrepreneurship. This indicator ignores differences between firms created for opportunity reasons and firms created for necessity reasons. In the present study we are especially interested in opportunity-driven entrepreneurship to test the hypothesis that related variety creates new business opportunities through inter-industry spillovers. Importantly, entrepreneurship does not start with the creation of a new firm. Rather, it is the discovery of opportunities that is key, which (often much later) results in the creation of new firms (Shane, 2000). Therefore, indicators of entrepreneurship should capture more than only the level of new firm creation and they should distinguish between firms that are created to exploit new opportunities and firms that are created for other reasons.

Since 2001, the Global Entrepreneurship Monitor (GEM) distinguishes between opportunity- and necessity-driven entrepreneurs (Reynolds et al., 2001). Opportunity-driven entrepreneurs start a new business to pursue new opportunities, whereas necessity-driven entrepreneurs start a business out of a lack of other employment options. Empirically, this distinction has proven to be relevant from the macro-perspective, as opportunity-driven entrepreneurs are overrepresented in developed and underrepresented in less-developed regions, whereas for necessity-driven entrepreneurs it is the other way around (Wennekers, van Stel, Thurik, & Reynolds, 2005). From a policy perspective this distinction is also important, as opportunity-driven entrepreneurs have a higher probability of entry and also tend to create firms that are both more profitable and more likely to create additional employment (Block & Wagner, 2010; Vivarelli, 2004).

Using survey-based data provided by the GEM, we distinguish between necessity- and opportunity-driven entrepreneurship. The GEM conducts annual international surveys on representative samples of at least 2000 randomly selected adults per country. Total entrepreneurial activity is measured as the share of the working-age population involved in the creation of a new business in the year that the survey was conducted. A respondent is classified as an entrepreneur when he or she is either engaged in any activity to start a new business or has been running a new business for less than 3.5 years at the time of being

interviewed. Therefore, our data contain both individuals who have started a new firm and individuals who, whilst having identified an entrepreneurial opportunity, have not yet formally started a new firm.[1]

Since we are interested in regional entrepreneurship, we pool the respondents into NUTS-2 and NUTS-1 regions. The annual survey waves are not representative at these regional levels, as they contain 2000 individuals sampled at the national level. Therefore, we pool regional data over multiple waves and then take the average over these waves, which of course comes at the cost of losing time variation. We take into account the composition of the regional populations in terms of age and sex and weigh the respondents' contribution to the mean accordingly. This approach is similar to other studies that have used the GEM data to calculate indicators of entrepreneurship for European Union (EU) regions (e.g., Bosma & Schutjens, 2011; Bosma & Sternberg, 2014; van Oort & Bosma, 2013). We extract regional data on entrepreneurs at the NUTS-2 level for 24 European countries[2] (184 regions) and at the NUTS-1 level for two European countries[3] (20 regions) and calculate indicators of average entrepreneurship for the period 2007–14.

Figure 1 shows the average rates of opportunity- and necessity-driven entrepreneurship across the EU regions. As not all EU countries participate in the GEM survey or do not have enough observations to produce reliable indicators at the NUTS-2 or NUTS-1 levels,[4] some regions in Figure 1 appear white. These regions are not included in the analysis of this study. We see that opportunity-driven entrepreneurship is rather scattered and especially high in Eastern Europe and in a limited number of regions outside Eastern Europe, whereas the lowest levels of opportunity-driven entrepreneurship are found in Belgium, France, Germany and Italy. Necessity entrepreneurship displays a more pronounced core–periphery pattern with the highest levels in Eastern Europe, Greece, Spain and Ireland and the lowest levels in Scandinavia. As the correlation matrix in Appendix A in the supplemental data online shows, the correlation between opportunity- and necessity-driven entrepreneurship is rather low (0.23).

Related and unrelated variety

In line with Frenken et al. (2007) we calculate entropy-based indicators of related and unrelated variety using employment shares at different levels of industry aggregation. Following Cortinovis and Van Oort (2015), we use the ORBIS database provided by Bureau van Dijk, which contains firm-level data that can be aggregated to our spatial unit of analysis (NUTS-1 and NUTS-2). Information on the industries under the NACE classification scheme is available at the four-digit level. This allows us to construct variety indicators at a detailed four-digit level, in contrast to other European data sources which have much less detail (de Groot et al., 2016). A limitation of the data is that there is an overrepresentation of larger firms, as only firms that provide sufficient information through annual reports are included, which on average tend to be larger firms. This biases the shares towards industries with a larger firm size. In order to ensure a sufficient time-lag we calculate the indicators of related and unrelated variety using the ORBIS data for 2006.

To calculate unrelated variety, we assume that firms belonging to different two-digit sectors are unrelated. To calculate related variety we assume that firms belonging to different four-digit sectors are related within each of their two-digit sectors. The four-digit shares p_i are summed

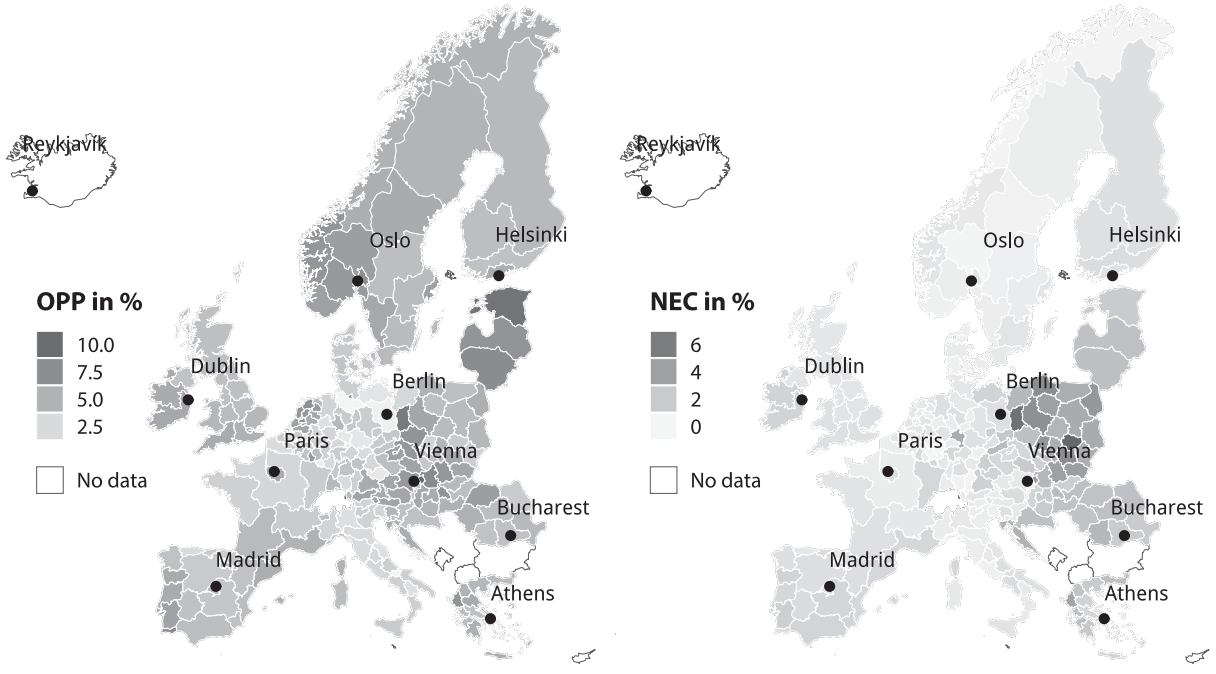

Figure 1. Opportunity (OPP)- and necessity (NEC)-driven entrepreneurship.

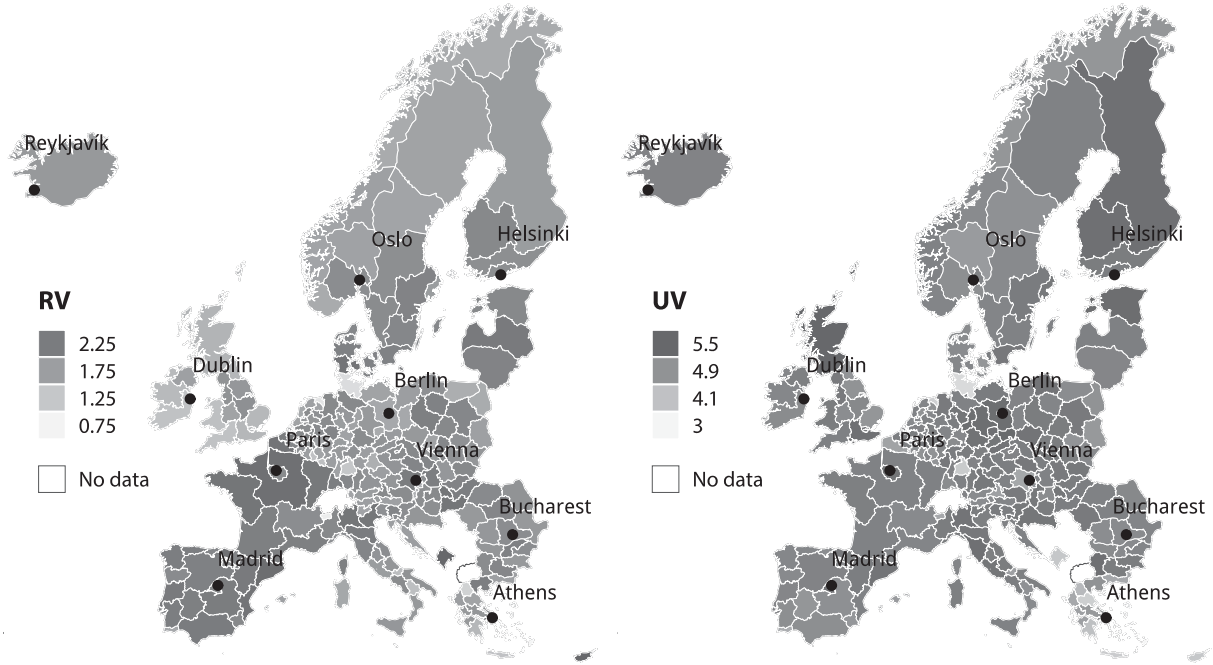

Figure 2. Related variety (RV) and unrelated variety (UV) in 2006.

to derive the two-digit shares P_g:

$$P_g = \sum_{i \in S_g} p_i \tag{1}$$

Unrelated variety (UV), that is, the entropy *between* the two-digit sectors, is then calculated as:

$$UV = \sum_{g=1}^{G} P_g \log_2 \left(\frac{1}{P_g} \right) \tag{2}$$

Entropy *within* each two-digit sector, H_g, is given by:

$$H_g = \sum_{i \in S_g} \frac{p_i}{P_g} \log_2 \left(\frac{1}{p_i / P_g} \right) \tag{3}$$

Related variety (RV), then, is given by the sum of entropy within each two-digit sector (3), weighted by employment shares (1):

$$RV = \sum_{g=1}^{G} P_g H_g \tag{4}$$

Figure 2 shows the distribution of related and unrelated variety for 2006 across the EU regions. The map on the left shows related variety, whereas the map on the right shows unrelated variety.

There are some spatial patterns observable in the regional levels of related variety. In particular, most regions in Spain, France and northern Italy have high levels of related variety, whereas regions in the UK and Ireland have relative low levels. Regional levels of unrelated variety are more diffuse. Interestingly, the correlation between related and unrelated variety is quite high (0.55).[5]

Estimation method

To test the hypotheses, we start to estimate the following cross-sectional regression model with ordinary least squares:

$$y_i = \alpha_i + \lambda W y_i + \beta_1 UV_i + \beta_2 RV_i + {}'X_i' \varphi + {}'VOC_i' \vartheta + \rho W u_i + \varepsilon_i$$

where y_i is either total entrepreneurial activity, opportunity-driven entrepreneurial activity, necessity-driven entrepreneurial activity or the ratio of opportunity over necessity-driven entrepreneurial activity in region i. The primary explanatory variables in our model are related variety RV_i and unrelated variety UV_i. The different varieties of capitalism are captured by dummy variables labelled LME_i, CME_i, MME_i and DME_i and are represented by the vector ${}'VOC_i'$. Figure 3 shows the different varieties of capitalism in Europe. CMEs are clustered more to the north of Europe, whereas DMEs are mainly present in the east. Apart from the Baltic States, most East European countries are classified as DME.

Two spatial terms are included in the model. The first term $\lambda W y_i$ accounts for the spatial autoregressive process of the dependent variable; including this term would result in a spatial error model (SEM). The second term $\rho W u_i$ captures the spatial correlation of the residuals of neighbouring regions; including this term would result in a spatial lag model (SAR). Including both spatial terms would result in a spatial autoregressive model with autoregressive disturbances (SARAR).

To test and, if necessary, control for spatial correlation in the residuals and/or dependent variable, we follow Hendry's methodology (Florax, Folmer, & Rey, 2003). We start with the restricted and unrestricted models (SARAR and SEM) using a maximum likelihood estimator and subsequently test the common factor restriction using a

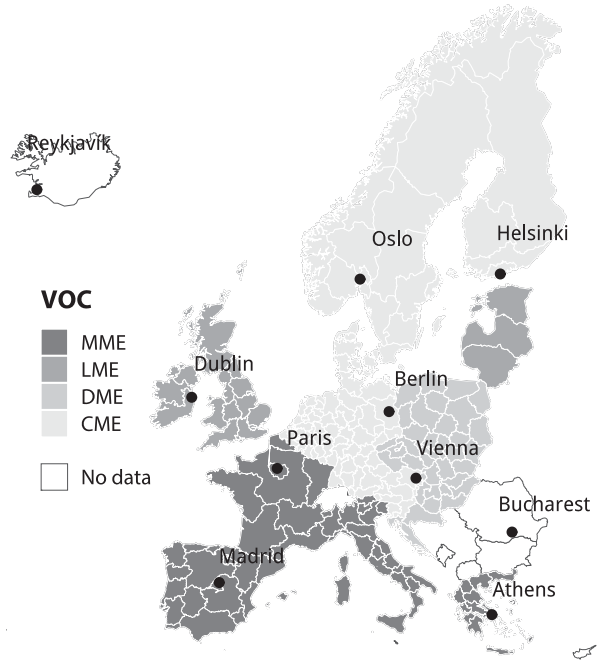

Figure 3. Varieties of capitalism.

likelihood ratio test. If spatial autocorrelation appears to be present, the result of this test will then determine whether we should make use of a spatial error model or a spatial lag model. We use an inverse distance spatial weight matrix to account for potential geographical dependencies. We classify regions as neighbours when the distance between them is smaller than 750 km, using the inverse of the distance between the regions as weight. If the distance between regions is larger than 750 km, this weight is set to zero. The distance matrix is row-standardized so that the impact of neighbouring regions is equalized.

Control variables

We control for several other factors that are likely to influence regional entrepreneurial activity. Table 1 lists all the variables used in the analysis; summary statistics and a correlation matrix are provided in Appendix A in the supplemental data online. We control for the effect of income by including gross regional product (GRP) per capita, as the overall level of development of a region is likely to influence the amount of available entrepreneurial opportunities. More densely populated regions are also expected to produce more entrepreneur activity due to urbanization economies and specialized demand. We control for population density by including two variables: the average number of inhabitants per square kilometre and a dummy variable capturing whether a region has a city with more than half a million inhabitants. The level of human capital captures the ability and skills of potential entrepreneurs to identify and exploit new business opportunities. To control for this, we include the percentage of the working-age population having completed a tertiary education. Finally, we control for the rate of unemployment as this is expected to act as push mechanism for individuals to create new firms. In particular, unemployment is expected to motivate individuals to engage in necessity-driven entrepreneurship.

RESULTS

Table 2 presents the findings from the estimation of our model in which we look at the effect of unrelated and related variety on the different indicators of regional entrepreneurship. Model (1) produces no association between related and unrelated variety and total regional entrepreneurship when we omit the other control variables. When the other control variables are included in (model

Table 1. Variables description.

Variable	Description	Source
TEA	Average percentage of the working-age population involved in entrepreneurship over the period 2007–14	GEM
TEA_OPP	Average percentage of the working-age population involved in opportunity-driven entrepreneurship over the period 2007–14	GEM
TEA_NEC	Average percentage of the working-age population involved in necessity-driven entrepreneurship over the period 2007–14	GEM
OPP/NEC	Share of *TEA_OPP/TEA_NEC*	GEM
UV	Unrelated variety in 2006	BvD
RV	Related variety in 2006	BvD
LNGRPPC	Logarithm of gross regional product per capita in 2006 (log)	EUROSTAT
LNPDEN	Logarithm of population density in 2006 (log)	EUROSTAT
HC	Percentage points of the working-age population who completed a tertiary education in 2006	EUROSTAT
CITY	Presence of a city with > 500,000 inhabitants in 2006	EUROSTAT
UNEMP	Average rate of unemployment over the period 2007–14	EUROSTAT
VOC	LME (Estonia, Ireland, Latvia, Lithuania, UK), CME (Austria, Belgium, Denmark, Finland, Germany, Luxembourg, Netherlands, Norway, Slovenia, Sweden), MME (France, Greece, Italy, Portugal, Spain) and DME (Croatia, Czech Republic, Hungary, Poland, Slovakia)	

Table 2. General estimation results.

	(1) *TEA*	(2) *TEA*	(3) *TEA_OPP*	(4) *TEA_NEC*	(5) *OPP/NEC*
UV	0.286	1.632**	1.243**	0.412**	0.061
	(0.379)	(0.413)	(0.361)	(0.156)	(0.156)
RV	0.301	0.562	0.815*	0.215	0.374*
	(0.499)	(0.485)	(0.401)	(0.178)	(0.172)
LNGRPPC		1.322*	1.939**	0.701**	0.997**
		(0.572)	(0.435)	(0.211)	(0.155)
CITY		0.705*	0.346	0.340**	0.153
		(0.298)	(0.233)	(0.12)	(0.099)
LNPDEN		0.294**	0.233**	0.045	0.092^{+}
		(0.108)	(0.084)	(0.038)	(0.048)
UNEMP		0.074*	0.037	0.044**	0.034**
		(0.033)	(0.025)	(0.013)	(0.01)
HC		0.022	0.006	0.016*	0.013*
		(0.022)	(0.018)	(0.007)	(0.006)
VOC_LME		–	–	–	–
VOC_CME		1.131*	1.142**	0.007	0.052
		(0.522)	(0.423)	(0.148)	(0.132)
VOC_MME		1.826**	1.690**	0.049	0.300*
		(0.657)	(0.529)	(0.187)	(0.135)
VOC_DME		2.785**	1.183*	1.652**	0.646**
		(0.738)	(0.586)	(0.24)	(0.14)
Constant	8.259**	0.560	8.875^{+}	9.859**	7.557**
	(1.534)	(6.19)	(4.757)	(2.301)	(1.448)
Observations	204	204	204	204	204
R^2	0.007	0.407	0.274	0.652	0.583

Note: Robust standard errors are shown in parentheses. Significance levels: $^{**}p < 0.01$, $^{*}p < 0.05$, $^{+}p < 0.1$.

2), the effect of related variety persists to be insignificant. Unrelated variety now carries a significant negative coefficient, indicating that unrelated variety lowers the degree of total regional entrepreneurship. A possible explanation for this negative effect is that unrelated variety makes it more difficult for potential entrepreneurs to identify inter-industry knowledge spillovers. As such, this finding is in line with Guo et al. (2016), who identify a negative effect of unrelated variety on the level of entrepreneurship in Chinese cities. It contrasts findings by Bishop (2012) and Colombelli (2016), who report a positive effect of unrelated variety in knowledge stocks on regional entrepreneurship in the UK and Italy.

When we distinguish between opportunity-driven entrepreneurship (model 3) and necessity-driven entrepreneurship (model 4), we find that unrelated variety persists to exercise a negative impact on both types of entrepreneurship. Related variety has a positive and significant effect only on opportunity-driven entrepreneurship. This finding provides support for our hypothesis 1a. In model (5), we use the ratio of opportunity over necessity entrepreneurship as dependent variable, capturing the relative quality of regional entrepreneurship. The importance of related variety as suggested in hypothesis 1b is confirmed, as the estimation produces a significant positive effect of related variety on the ratio of opportunity- over necessity-driven entrepreneurship. Unrelated variety does not significantly influence this indicator of regional entrepreneurship.

Regarding the effects of the other control variables, GRP per capita has a positive effect on opportunity-driven entrepreneurship and the ratio of opportunity- over necessity-driven entrepreneurship, whereas it has a negative effect on necessity-driven entrepreneurship. This result is likely to reflect that more developed regional economies offer more business opportunities, whereas individuals in less developed regional economies are more often forced into starting up new firms due to a lack of alternative employment options. Unemployment seems to act as a push mechanism for individuals to become entrepreneurial by necessity, whilst it exercises no effect on opportunity-driven entrepreneurs. Perhaps surprisingly, the control variables population density, presence of a large city and human capital do not influence opportunity-driven entrepreneurship, while they do exercise some effect on necessity-driven entrepreneurship.

The dummy variables with the prefix VOC represent the different varieties of capitalism; *VOC_LME* is the reference category against which the other VoC dummies are interpreted. The findings from model (2) show that

regions in DMEs have a significantly higher rate of total entrepreneurial activity. Regions in CMEs and MMEs have significantly lower levels of entrepreneurial activity. The findings from models (3) and (4) show that opportunity-driven entrepreneurship is significantly lower in regions in CMEs, supporting hypothesis 2a. This type of entrepreneurship, however, is also found to be significantly higher in regions in DMEs. Moreover, compared with LMEs and CMEs entrepreneurship is lower in MMEs,[6] which supports hypothesis 3. Necessity-driven entrepreneurship does not seem to differ significantly between regions in CMEs and LMEs, in contrast to hypothesis 2b. This suggests that levels of necessity-driven entrepreneurship in these groups of regions are similar, whereas we expected higher levels in LMEs. This may be the result of the fact that Germany and other countries in the CME category have implemented policies to motivate unemployed people to become entrepreneurs (Caliendo & Kritikos, 2010; Caliendo & Künn, 2014), thereby increasing the rate of necessity entrepreneurship (Dvouletý & Lukeš, 2016). This in turn would have decreased the ratio of opportunity over necessity entrepreneurship, which could explain the insignificant coefficient of the CME dummy variable in model (5). Finally, we find that regions in DMEs have the highest level of necessity-driven entrepreneurship, whereas regions in MMEs do not differ significantly with regions in LMEs and CMEs;[7] this finding supports hypothesis 4.

It is important to stress that the findings on the effects of the VoC variables need to be interpreted with the necessary caution. One issue is that for some countries it is not entirely clear which VoC category is the most appropriate. To examine whether this affects our findings, we re-estimate the model with France classified as CME instead of MME and the Baltic states as a separate VoC category. The reclassification of France does not impact our findings as presented in Table 4 The estimated effect of the additional VoC variable for the Baltic States is significant in some estimations, suggesting that these countries contain VoC elements that are distinctly different from the other groups of countries.[8]

Second, the distinction between the different VoC categories at the national level does not capture the feature that, within countries, regions may exhibit substantial deviations from national institutional arrangements (Gertler, 2010; Rafiqui, 2010; Sternberg, Kiese, & Stockinger, 2010). It also does not capture any of the effects that informal regional institutions may generate on regional industry dynamics and growth (e.g., Cortinovis, Xiao, Boschma, & Van Oort, 2017; Tabellini, 2010). Furthermore, it is important to recognize that institutional characteristics are subject to continuous change (Bathelt & Gertler, 2005), changes that may materialize and impact in different ways at subnational levels, an aspect which we cannot address in our cross-sectional analysis.

Having said this, the nature of the estimated effect of most of the VoC variables in Table 2 is broadly in line with our expectations, indicating their importance for regional entrepreneurship. Table 3 shows the findings from estimating the models without the VoC variables. The R^2 values of the models that include the VoC variables are considerably higher than the values in the corresponding models without them. Also, the sign and significance of the estimated effect of related variety in the model with opportunity entrepreneurship is affected when the estimations do not control for the effects of the varieties of

Table 3. Estimation results without *VOC* dummies.

	(1) *TEA*	(2) *TEA*	(3) *TEA_OPP*	(4) *TEA_NEC*	(5) *OPP/NEC*
UV	0.286	0.717	0.607	0.152	0.07
	(0.379)	(0.497)	(0.393)	(0.19)	(0.151)
RV	0.301	0.574	0.089	0.415*	0.307*
	(0.499)	(0.556)	(0.414)	(0.192)	(0.149)
LNGRPPC		2.078**	0.226	1.932**	1.289**
		(0.496)	(0.346)	(0.234)	(0.112)
CITY		0.965**	0.567*	0.399**	0.200*
		(0.366)	(0.267)	(0.142)	(0.096)
LNPDEN		0.115	0.134	0.033	0.112*
		(0.121)	(0.096)	(0.04)	(0.045)
UNEMP		0.053+	0.049*	0.007	0.037**
		(0.03)	(0.02)	(0.013)	(0.009)
HC		0.037	0.022	0.012+	0.005
		(0.023)	(0.018)	(0.007)	(0.006)
Constant	8.259**	31.632**	10.477**	21.615**	10.588**
	(1.534)	(5.608)	(3.949)	(2.657)	(1.29)
Observations	204	204	204	204	204
R^2	0.007	0.126	0.058	0.480	0.544

Note: Robust standard errors are shown in parentheses. Significance levels: $^{**}p < 0.01$, $^{*}p < 0.05$, $+p < 0.1$.

capitalism variables. This indicates clearly that regional entrepreneurship is to an important extent structured by national factors, confirming the importance of the varieties of capitalism for entrepreneurship. Further research is required to assess more accurately whether and how subnational deviations from national VoC institutional frameworks may influence regional entrepreneurship.

To further scrutinize our main finding that related variety fosters opportunity-driven entrepreneurship, we proceed to re-estimate the model with controls for spatial effects. The results are presented in Table 4. Following Hendry's method (Florax et al., 2003), we start by estimating a restricted spatial model (SARAR), using a maximum likelihood estimator and assuming a priori that spatial correlation among our independent and dependent variables exists, as shown in column (1). Next, we estimate an unrestricted spatial model (SEM) using a maximum likelihood estimator, shown in column (2), and test whether the model can be simplified. Using a likelihood ratio test, the common factor restriction (with its null hypothesis that $\lambda\beta = -\lambda\beta$), is not rejected. Subsequently, the next step is to test for the significance of ρ. As it is insignificant in column (2), our final specification is a spatial independence model.

As a further robustness test, we also estimate the model using shorter cut-off points for the spatial weight matrix. Models (3) and (4) are SARAR models similar to model (1), but with spatial cut-off points of 500 and 250 km, respectively. The estimated coefficient of λ increases in size when using these smaller cut-off points but remains insignificant, suggesting that at these shorter distances the level of opportunity-driven entrepreneurship in neighbouring regions has no predictive power regarding regional entrepreneurship. The coefficient on ρ is not significant

Table 4. Spatial autocorrelation.

	(1) SARAR 750	(2) SEM 750	(3) SARAR 500	(4) SARAR 250
UV	−1.204**	−1.238**	−1.149**	−1.094**
	(0.371)	(0.335)	(0.356)	(0.353)
RV	0.788^{+}	0.819*	0.757^{+}	0.705^{+}
	(0.426)	(0.417)	(0.419)	(0.417)
LNGRPPC	1.942**	1.943**	1.956**	1.886**
	(0.537)	(0.401)	(0.439)	(0.424)
CITY	0.362	0.351	0.374	0.376
	(0.241)	(0.242)	(0.240)	(0.237)
LNPDEN	−0.236**	−0.232**	−0.233**	−0.225**
	(0.087)	(0.083)	(0.084)	(0.083)
UNEMP	0.033	0.036	0.027	0.018
	(0.029)	(0.028)	(0.028)	(0.028)
HC	0.005	0.006	0.003	0.005
	(0.018)	(0.016)	(0.016)	(0.016)
VOC_LME	–	–	–	–
VOC_CME	−1.174**	−1.164**	−1.291**	−1.400**
	(0.411)	(0.400)	(0.402)	(0.404)
VOC_MME	−1.736**	−1.721**	−1.865**	−1.949**
	(0.507)	(0.483)	(0.476)	(0.472)
VOC_DME	1.129*	1.158*	0.994*	0.865^{+}
	(0.456)	(0.454)	(0.457)	(0.458)
λ	−0.073	0.097	0.053	0.237
	(0.492)	(0.442)	(0.491)	(0.415)
ρ	0.340	–	0.581	0.647*
	(0.725)		(0.428)	(0.329)
σ^2	1.599**	1.602**	1.582**	1.560**
	(0.159)	(0.159)	(0.157)	(0.155)
Constant	−8.607	−9.356*	−9.325^{+}	−9.531*
	(5.824)	(4.719)	(4.817)	(4.668)
Observations	204	204	204	204
Log likelihood	−337.474	−337.569	−336.669	−335.502

Note: Dependent variable: *TEA_OPP*. Columns (1) and (2) use 750 km as a cut-off. Column (3): 500 km and column (4): 250 km. Standard errors are shown in parentheses. Significance levels: $^{**}p < 0.01$, $^{*}p < 0.05$, $^{+}p < 0.1$.

when we use cut-off points of 750 and 500 km, while in the case with 250 km as cut-off point the coefficient becomes positive and significant. This suggest that within this smaller distance spatial correlation among the residuals exists. Looking at the estimated coefficient of related variety in models (1), (3), and (4), we notice that it is similar to the estimated coefficient from the model without spatial terms, although the effect is estimated somewhat less precisely.[9] Unrelated variety persists to exercise a negative effect on entrepreneurship in all of the estimations.

CONCLUSIONS

Recent studies report positive effects of related variety on regional employment growth. However, *how* related variety leads to employment growth has remained implicit (Content & Frenken, 2016). This study examines whether related variety fosters entrepreneurship, motivated by the KSTE which posits that regions endowed with more knowledge spillovers experience more entrepreneurial activity (Acs et al., 2009), and, in turn, more employment growth. The present study is the first to examine the effect of related variety on regional entrepreneurial activity across Europe. Importantly, we distinguish between necessity-driven and opportunity-driven entrepreneurship, in the expectation that spillovers from related industries foster the latter type of entrepreneurship in particular. Elaborating on Hall and Soskice (2001), we further hypothesize that different 'varieties of capitalism' show different rates of opportunity-driven and necessity-driven entrepreneurship.

Our findings show that related variety has a positive impact both on the level of opportunity-driven entrepreneurship and on the ratio of opportunity over necessity-driven entrepreneurship. We find no effect of related variety on necessity-driven entrepreneurship. We interpret this result as reflecting that necessity-driven entrepreneurs start a business out of a lack of alternative employment options, rather than to explore new opportunities from knowledge spillovers stemming from related variety. This interpretation is further supported by a robust positive association between regional unemployment and necessity-driven entrepreneurship. In contrast, opportunity-driven entrepreneurs leverage opportunities from knowledge spillovers caused by related variety. Furthermore, we also identify a persistent negative effect of unrelated variety on regional entrepreneurship. This suggests that the absence of cognitive proximity makes it more difficult for individuals to identify and/or exploit new business opportunities, lowering entrepreneurial activity. Our primary focus in this paper lies with the identification of entrepreneurship as a possible mechanism that transmits positive growth effects from related variety. Our finding that unrelated variety lowers entrepreneurship in European regions is clearly also important and further research will benefit from a further examination of this negative relationship.

Varieties of capitalism also explain part of the regional variation in entrepreneurship. Regions in countries classified as LMEs host more opportunity-driven entrepreneurs compared with regions in CMEs. Unexpectedly, regions in DMEs display even higher rates of opportunity-driven entrepreneurship than regions in LMEs, despite the commonly held notion that their institutions are less supportive to this type of entrepreneurship.

Although the GEM data on entrepreneurial activity is carefully weighted for the age and gender composition of the regional populations and is based on a questionnaire design that has been developed and improved for quite some years, the usual limitations that come with using survey data do apply to the present study as well. For instance, questions may be vulnerable to misinterpretation and there may be respondents that do not feel encouraged or comfortable to provide accurate answers. Another limitation of this study concerns the use of the ORBIS data set to calculate the indicators of related and unrelated variety. Large firms are overrepresented in this data set, which means that sectors with many large firms are overrepresented in the variety indicators. Lastly, our unit of analysis (NUTS-1 and NUTS-2) is arguably not the most meaningful spatial level to capture knowledge spillovers. Instead, labour market regions (NUTS-3) may constitute the more appropriate spatial unit of analysis. In this respect, the challenge will be to develop comparable data across Europe at the level of local labour markets.

Our study represents a first attempt to unpack the channels through which related variety among a region's industries fosters regional employment growth. We suggest that opportunity-driven entrepreneurship is such a channel, as spillovers create new business opportunities that entrepreneurs can exploit. Further research is required on the question what other transmission channels may be important. For example, related variety may facilitate social networking as well as labour mobility across industries (Breschi & Lissoni, 2009). Furthermore, relatedness in a region's industrial structure provides a platform for specific actors with recombinant capabilities such as knowledge-intensive business services and applied research organizations (Asheim, Boschma, & Cooke, 2011). A second suggestion for further research is to deepen the research field's understanding of how institutions influence entrepreneurship. In particular, an interesting question remains to what extent institutions – and their complementarities – relevant to entrepreneurship map onto the varieties of capitalism. Furthermore, significant differences are likely to exist between institutions and cultures across regions within countries (Charron, Dijkstra, & Lapuente, 2014; Rodriguez-Pose & Di Cataldo, 2015). It will therefore be worthwhile to develop methods to disaggregate the VoC framework at the subnational level to clarify its relation with regional entrepreneurship. A third research question for future research is whether opportunity-driven entrepreneurship, as well as the other aforementioned spillover channels, indeed foster employment growth. A fully fledged model of related variety, then, would analyze both the direct effect of related variety on employment growth and its indirect effects mediated by various spillover channels. Although such an analysis is more demanding in terms of empirical data, it is certainly worthwhile for the related variety literature to 'come full circle'.

ACKNOWLEDGEMENTS

The authors thank Nicola Cortinovis (Erasmus University Rotterdam) for sharing the ORBIS data. They also thank the participants at the ERSA conference in Vienna (2016), the three anonymous referees and the editor for helpful suggestions and comments made on earlier versions of this paper.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

FUNDING

This study was financed by the European Union's Horizon 2020 Research and Innovation Framework Programme through the Financial and Institutional Reforms for an Entrepreneurial Society (FIRES) project [grant number 649378]. FIRES-project: http://www.projectfires.eu/.

NOTES

1. For a detailed description of the GEM methodology, see Bosma, Coduras, Litvosky, and Seaman (2012).
2. Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Slovakia, Spain and Sweden.
3. France and the UK.
4. There are no data for the following countries: Bulgaria, Switzerland, Cyprus, Iceland, Liechtenstein and Montenegro.
5. Bosnia and Herzegovina, Serbia, Albania, Macedonia and Montenegro are not included in the maps as there are insufficient data to calculate the variety indicators and the dependent variables for these countries.
6. A Wald-test on the equality of the coefficients on CME and MME returned a test value of 2.75, which is significant at the 10% level.
7. A Wald-test on the equality of the coefficients on MME and CME returned an insignificant test statistic.
8. Owing to space constraints, we do not present the full findings here; they are available from the authors upon request.
9. We also estimated the SARAR750 model with total entrepreneurship, necessity-driven entrepreneurship and the share of opportunity over necessity-driven entrepreneurship as dependent variables. The results, shown in Table A3 in Appendix A in the supplemental data online, are similar to those in Table 4.

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