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Related variety and entrepreneurship: An empirical pan-European investigation.

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Abstract

Related variety and entrepreneurship: An empirical pan-European investigation. Jeroen Content, PhD candidate at Utrecht University, started august 2015, expect to finish august 2018, j.content@uu.nl. 1) The notion of related variety, introduced by Frenken et al. [1], sparked new attention in the field of agglomeration externalities by further qualifying the concept of variety of economic activity. A review by Content & Frenken [2] concluded that although the evidence base is still rather small, the majority supports the initial hypothesis that related variety may act as a driver for regional growth of employment, whereas the hypothesized dampening effect of unrelated variety on unemployment growth seems to be less straightforward. 2) However, since this strand of literature is somewhat limited in the sense that most of these studies have focused on the effect of related variety on employment growth, the precise mechanism of how related variety leads to growth remains quite implicit. Exposing it by directly analysing the impact of variety on entrepreneurship, knowledge, or innovation will likely help us understand how this mechanism might be geared exactly. Entrepreneurship, for instance, is known to play an important role in the dynamics of new job creation and technical innovation, in this respect it is likely to translate part of the effects of variety into employment growth. This brings us to our research question: Does related variety positively affect the rate of entrepreneurship on a regional level? 3) The reasoning behind this can be explained by the Knowledge Spillover Theory of Entrepreneurship (KSTE), which

states that regions endowed with knowledge spillovers experience firm formation [3] [4]. On the other hand we know that knowledge spillovers are more likely to occur in regions endowed with a high degree of related economic activities [1] [2]. If we assume related varieties to be technologically proximate -which means knowledge necessary for these activities has similarities- it will be easier for individuals involved in those activities to learn and discover new ways of combining their knowledge. The possession of proximate knowledge thus enables individuals to identify entrepreneurial opportunities [5]. 4) Using a cross-sectional regression model we estimate the effect of related and unrelated variety on entrepreneurship. Data provided by the Global Entrepreneurship Monitor (GEM), enables us to explicitly distinguish between necessity- and opportunity-driven entrepreneurship. We argue that the latter might be a better measure in the context of knowledge spillovers as it indicates the rate of individuals pursuing entrepreneurial opportunities, whereas the former includes those individuals that start a firm out of a lack of employment options. Using new firm formation would result in including the former type of entrepreneurship as well. We measure entrepreneurship as the average over 2007–2014 on the NUTS2 level for 22 EU countries. Using entropy measures we calculate related and unrelated variety in 2006 with data from Bureau van Dijk. Together this forms a new dataset, which enables us to control for cross-country differences like institutions across the EU. 5) Like expected, our results seem to indicate that related variety positively affects the regional rate of opportunity-driven entrepreneurship, whereas it has no effect on necessity-driven entrepreneurship. This suggest that, controlling for the cross-country differences like institutions, income levels, and certain demographics, part of the knowledge spillovers generated by related variety have beneficial effects on the rate of opportunity-driven entrepreneurship within European regions. Unrelated variety seems to have negative impact on entrepreneurship, regardless of the type. References 1. Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. Regional studies, 41(5), 685-697. 2. Content, J., & Frenken, K. (2016). Related variety and economic development: a literature review. European Planning Studies, 0(0), 1–16. https://doi.org/10.1080/09654313.2016.1246517 3. Audretsch, D. B. (1995). Innovation and industry evolution. Mit Press. 4. Audretsch, D. B., & Lehmann, E. E. (2005). Does the Knowledge Spillover Theory of Entrepreneurship hold for regions? Research Policy, 34(8), 1191–1202. http://doi.org/10.1016/j.respol.2005.03.012 5. Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. Academy of management review, 25(1), 217-226.

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Related variety and entrepreneurship: Empirical results across European.

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1 Introduction

Recent renewed interest into the field of agglomeration externalities has brought about a number of studies that further investigate the dynamics of diversification and specialization in regional economic development. The concept of related variety, introduced by Frenken, Van Oort, & Verburg (2007), sparked this new attention by further qualifying the concept of variety of economic activity. A review by Content & Frenken (2016) concluded that although the evidence base is still rather small, the majority supports the initial hypothesis that related variety may act as a driver for regional growth of employment, whereas the hypothesized dampening effect of unrelated variety on unemployment growth seems to be less straightforward. Moreover, since this strand of literature is somewhat limited in the sense that most of these studies have focused their research efforts on investigating the effects of related variety on employment growth, the precise mechanism of how related variety leads to regional growth remains quite implicit. Exposing it by directly analysing the impact of variety on entrepreneurship, knowledge, or innovation will likely help us understand how this mechanism might be geared exactly.

Entrepreneurship, for instance, is known to play an important role in the dynamics of new job creation and technical innovation, in this respect it is likely to translate part of the effects of variety into employment growth within regions. Some studies have touched upon or have investigated somehow the relationship between variety and entrepreneurship already (Bosma et al.,2011; Bishop, 2012; Guo et al., 2015; Colombelli, 2016). This literature overall finds that variety has positive linkages to entrepreneurship measured as new firm formation on a regional level within a single country. These studies, however, do not account for cross-country differences in entrepreneurial behaviour; not accounting for different systems with different rules and cultures can therefore lead to results that possibly are not perfectly reliable. For instance, differences in social welfare systems might result in more reluctant or bold attitudes towards entrepreneurship. In addition, relying on new firm formation as a proxy for entrepreneurship is not sufficient when one is trying to explain why it is that variety contributes to a region's development. Because regions characterized by a high degree of related economic activity are more efficient in generating knowledge spillovers, including all forms of new ventures would lead to biased results. As noted by Shane (2000) entrepreneurship does not necessarily imply a new firm is created, the discovery of opportunities plays an equal if not greater part in this as well. An entrepreneur discovers new use to certain resources, which the seller of those resources does not see. This information

asymmetry originates from the fact that some individuals are more proximate to certain technologies than others and therefore are able to learn faster the new possible ways of recombining certain bits of knowledge. This discovery of opportunities then can lead to entrepreneurship because not everyone receives this information at the same time. A region characterised by a high degree of related variety implies that individuals possess proximate knowledge and therefore would be better in recognizing entrepreneurial opportunities if one were to occur.

The second part of the translation effect consists of entrepreneurship contributing to regional growth in employment. A number of studies have demonstrated that the rate of entrepreneurship can be a positive predictor of economic development (Audretsch, Keilbach, & Lehmann, 2006; Carree & Thurik, 2003; Wennekers & Thurik, 1999). This study, however, will only focus on the effects of related variety on entrepreneurial activity. The aim of this research is thus to get a better understanding of the mechanism that makes related variety contribute to regional development by taking entrepreneurship as a mediating factor. The research question is as follows: *Does related variety positively affect the rate of entrepreneurship on a regional level?*

The remainder of this paper is divided into several chapters, of which chapter 2 will briefly review the literature of related variety and links this to the Knowledge Spillover Theory of Entrepreneurship (KSTE). Chapter 3 describes this study's methodology and data, whereas chapter 4 presents the results and finally chapter 5 will conclude this study.

2 Literature

An emerging body of empirical literature on the concept of related and unrelated variety is trying to explain the relationship of proximity of economic activity to the development of regional economies. Related variety was put forward by Frenken et al. (2007) in an attempt to overcome the common contradiction between the theories of Jacobs and those of Marshal (1920), Arrow (1962), and Romer (1986) (MAR). On the one side of these apparent opposing literatures it is argued that regions will benefit when they produce a variety of products and services, and consequently experience inter-industry knowledge spillovers. This scenario implies a greater amount of variety, will generate a greater amount of spillovers. As Jacobs (1969, p. 59) puts it "the greater the sheer numbers and varieties of divisions of labour already achieved in an economy, the greater the economy's inherent capacity for adding still more

kinds of goods and services". MAR on the other hand argue that knowledge spills over mainly within a single industry, suggesting that regions will benefit the most, in terms of economic development, by focusing their efforts on specialization (Arrow, 1962; Marshall, 1920; Romer, 1986). This contradiction was first mentioned in the seminal work of Glaeser, Kallal, Scheinkman, & Shleifer (1992), which initiated a great flow of empirical studies trying to find evidence for either one these theories. A recent review by de Groot, Poot, & Smit (2015) made clear that apparently both theories might be right, depending on certain circumstances in which they are tested. Moreover, a great share of the results for diversification was found to be insignificant. Frenken et al. (2007) agreed with Jacobs that innovation indeed is recombinant in nature, however, they explained this great share of insignificant results by further theorizing that some bits of knowledge might be easier to recombine than others. For Jacobs externalities to be effective, it is not beneficial to solely focus on increasing the 'sheer numbers and varieties of divisions' in an economy, some form of proximity between the new and already existent varieties should exist in order for knowledge spillovers and innovation to occur.

In their original related variety hypothesis, Frenken et al. (2007) stated that regions with greater amounts of related variety would experience employment growth due to new products and services as a result of new combinations of varieties and will therefore indirectly create new jobs. The unrelated variety hypothesis then states that having economic activity in legion distant sectors would make regions more resilient to sector specific shocks and will therefore in the long-run experience lower unemployment growth. They found indeed that related variety increases the rate of employment growth and unrelated variety decreases the rate of unemployment growth for Dutch regions. Following these results a number of researchers have tested this hypothesis for other countries in Europe, like Italy, Turkey, Spain, West-Germany, and Austria. Although the amount of evidence is still rather small, the majority finds a positive relation of related variety with employment growth (Content & Frenken, 2016). The relation of unrelated variety with unemployment growth seems a bit more ambiguous as the published studies show a more mixed set of results in this respect.

Another set of studies has extended this line of research to a European scale. For instance Van Oort, Geus, & Dogaru (2015) who find that especially small and medium sized urban regions benefit from having related variety, relative to larger urban regions. Cortinovis and Van Oort (2015) found that European regions' employment growth could benefit from having related variety when they are characterized by high technology. However, not all the European

evidence is positive. Caragliu, Dominicis, & Groot (2016) did not find evidence for the hypothesized enhancing effects of related variety on regional growth, in fact they find positive effects of unrelated variety. This opposing result might be explained by a different technique of measuring variety and categorization of employment growth by sector.

The currently published research efforts on related variety have been directed towards explaining differences in employment growth by taking the industrial composition as a given (Content & Frenken, 2016). Although the majority of the studies found that knowledge spillovers generated by related variety increased employment growth, a knowledge gap is still to be illuminated, which is exactly how related variety leads to employment growth. Entrepreneurship in this respect might be a device, which translates part of the knowledge spillovers caused by related variety into employment growth. The reasoning behind this can be explained by the Knowledge Spillover Theory of Entrepreneurship (KSTE), which has contributed to the literature by examining what characteristics of regional economies are detrimental in the process of local new firm formation. A first attempt to connect regionally bound knowledge spillovers to entrepreneurship was made by Audretsch (1995), which theorized that the knowledge generated by incumbent firms but for some reason is not appropriated leaves opportunities for new firms to exploit. Audretsch & Lehmann (2005) tested for this by looking whether there is an association between regional investment in knowledge by universities and entrepreneurial activity. They concluded that indeed the number of firms located around universities might be positively influenced by knowledge capacity and knowledge output of those universities. Besides this, we know from the studies already conducted on the relationship between related variety and regional development that knowledge spillovers are more likely to occur in regions endowed with a high degree of related economic activities. If we assume related economic activities are technologically proximate -which means the knowledge necessary for these activities has similarities but is not the same- it will be easier for individuals involved in those activities to learn and discover new potential ways of combining their knowledge. The possession of proximate knowledge thus enables individuals to identify entrepreneurial opportunities (Shane, 2000).

Some studies have touched upon or have investigated somehow the role of entrepreneurship within the context of related variety already. A study done by Bishop (2012) investigates how the rate of new firm formation in regions of Great Britain is affected by the diversity and stock of knowledge. He concluded that besides the stock of knowledge, related and unrelated variety in this stock positively impacts the rate of new firm formation. Knowledge variety is

measured in the same way as Frenken et al. (2007) measure variety, however, instead of using total employment only employment in high-tech manufacturing and knowledge intensive services industries is included. Consequently it effectively only measures related and unrelated variety in those sectors rather than measuring the diversity in the regional stock of knowledge. Guo et al. (2015) hypothesized that related variety, relative to unrelated variety, has a larger effect on new firm formation. They found support for this hypothesis for the manufacturing industry at the city level; related variety seems to increase the entry rate of new firms in Chinese cities. Colombelli (2016) found evidence that the availability of local knowledge is not enough on its own to lead to higher rates of entrepreneurship for Italian provinces. Especially a knowledge base with a high degree of similarity but a large variety of technologies, i.e. a knowledge base characterized by related variety, seems beneficial for regional entrepreneurial activity.

However, relying on new firm formation as a proxy for entrepreneurship, like the studies discussed here, might be an imperfect solution in the context of knowledge spillovers. The reason for that is because new firm formation also includes a lot of noise like firms that have been setup for legal reasons for instance. In addition, entrepreneurship does not necessarily imply a new firm is created, the discovery of opportunities plays an equal if not greater part in this as well (Shane, 2000). Some time may pass by between the discovery of an opportunity and the actual registration of a new venture. Only measuring the actual registration therefore might turn out to be ineffective because at the moment of the knowledge spillover few firms will be registered. Another measure for entrepreneurship, one that takes into account individuals involved in the process of developing a start-up as well, might therefore be more appropriate in this context. Measuring entrepreneurship should thus start before the registration of a firm already and it should be able to distinguish between those firms that are registered to exploit opportunities and those that are registered for different reasons. Since 2001, the Global Entrepreneurship Monitor (GEM) does exactly that, by differentiating between opportunity-driven entrepreneurs and necessity-driven entrepreneurs (Reynolds et al., 2001). The difference between these types of entrepreneurs lies within their motivation to become one. Opportunity-driven entrepreneurs start-up a business to pursue business opportunities, whereas necessity-driven entrepreneurs would start-up a business out a lack of employment options. From a macro perspective this differentiation seems justified as the presence of opportunity entrepreneurs seems to significantly become higher as regions develop and lower in less developed regions, while for necessity entrepreneurs it is exactly

the other way around (Wennekers et al., 2005). From a micro perspective this distinction seems supported as well, Block & Wagner (2010) found that opportunity entrepreneurs in general have more profitable firms and differ significantly in terms of socio-demographic factors.

Put together, the KSTE and the related variety literature, suggests that regions with high degrees of related variety can anticipate knowledge spillovers and consequently higher rates of entrepreneurship, which ultimately leads to regional economic growth. Taking into account the current issues in the literature the following hypotheses will be tested:

Hypothesis 1a: Related variety positively impacts the rate of opportunity-driven entrepreneurial activity due to knowledge spillovers between related sectors within European regions.

Hypothesis 1b: Related variety has no impact on the rate of necessity-driven entrepreneurial activity because it is independent of knowledge spilling over between related sectors within European regions.

Hypothesis 1c: Related variety within a region has a positive effect on the share of opportunity-driven relative total entrepreneurial activity within European regions.

A second issue with the studies relating entrepreneurship to variety is the fact that they have been conducted for a single country, which makes it impossible to control for cross-country differences. When differences between countries with respect to their institutions and entrepreneurial cultures or systems are not accounted for, one might run the risk of ending up with unreliable results. Especially within the European context institutional differences can be quite extensive, for instance differences in social welfare systems might result in more reluctant or bold attitudes towards entrepreneurship. A literature know under the name of varieties of capitalism has tried to catch certain aspects of institutional differences and explain the persistence of different arrangements of those aspects across countries (Hall & Soskice, 2001). The theory basically proposes two forms of capitalism in developed countries, coordinated market economies (CMEs), of which Germany is the most illustrative example, and liberal market economies (LMEs), which most Anglo-Saxon countries like the UK and US belong to. The most important difference between these two varieties of capitalism is the way in which institutions in these economies are employed. In CMEs they are in place to support cooperation between economic actors, whereas in LMEs they are there to encourage

competitive market-based relationships between economic actors. Hall & Soskice (2011) note that economies tend to adopt policy shaped by their own institutions, resulting in path dependency of institutions instead of convergence due to globalization. The institutions in question mainly determine the relationship between firms and other economic actors in five different areas: 1, industrial relations (i.e. bargaining mechanisms); 2, vocational training and education; 3, corporate governance; 4, inter-firm relations; 5, employees (i.e. participation, consensus-building, etc.).

The first area is *industrial relations* in which employers, the labour force, and labour unions bargain over wages and working conditions. CMEs tend to have centralised bargaining on sectoral, regional, or even national levels and people will be more likely to join a labour union. LMEs by contrast, have a weaker organisation of workers and employers and more often have decentralised bargaining at the firm level. As a result working conditions and contracts are expected to be more beneficial for workers in CMEs relative to LMEs, people in CMEs are therefore less likely to be pushed into entrepreneurship due to their relatively strong labour contracts. The second area is *training and education* where workers face the problem of deciding how much and in what to invest their time to become attractable for employers, who in turn need to attract the necessary people with suitable levels and types of skills. The outcome of this coordination problem determines not only the fortunes of individual companies and workers but also the skill levels and competitiveness of the overall economy. In CMEs workers usually have skills that are more specific to the firm or industry they work in, which is in contrast to LMEs. This makes workers in LMEs more flexible to switch to other types of firms or self-employment. The interaction between firms and investors is captured in area of *corporate governance*. Firms need to secure access to finance and investors need assurance that their investments will yield return. The solutions devised to these coordination problems affect both the availability of finance for particular types of projects and the terms on which firms can secure funds. In CMEs, firms are mainly dependent on long-term capital and rely on assets that cannot readily be put to other use, shareholder value seems to be less important. Firms in LMEs are controller directly by shareholders and rely more on public information about finance and short-term and mobile assets. Financing a start-up therefore seems easier for entrepreneurs in LMEs relative to CMEs. The fourth area of *inter-firm relations*, covers the relationship firms have with other firms, which could be its suppliers of input and/or technology but it could also be its clients. These relationships are there to developed market standards, technology transfer, and collaborative research and

development. In CMEs firms might form employer associations and firms are more likely to cooperate to develop industry-wide standardisation. In LMEs then, inter-firm relations are competitive. The fifth area is formed by *employees*, in which firms face coordination problems with their own employees. Firms need to make sure that their employees have the necessary competencies and are motived to attain the firm's objective. In CMEs the emphasis lies on consensus between the firm and its employees, whereas in LMEs firms usually make unilateral decisions. The likely outcome of unilateralism in favour of consensus in LMEs is a higher rate of spin-offs from employees formerly employed by firms but not being able to pursue opportunities within the firm.

In short, we expect lower rates of necessity-driven entrepreneurs in CMEs due to the usually strong employment protection in those economies. Moreover, we expect higher rates of opportunity-driven entrepreneurs and entrepreneurs in general in LMEs due to more generic and mobile skills of employees, a financial system more prone to finance start-ups, and unilateralism in firms. However, as our analysis is concerned with the European Union, just distinguishing between LMEs and CMEs would not be sufficient. In addition to these two forms of capitalism, we also distinguish between Mediterranean market economies (MME) and East-European Union economies (EEU). Hall & Suskice (2001) mention the Mediterranean group of economies as not fitting completely into either the CME group or the LME group. These countries have recently seen intensive government intervention, have a significant agrarian sector, and have lower levels of educational attainment (Amable, 2003). Their institutions are somewhere in between coordinated and liberal economies, as they usually have liberal employment protection but at the same time a non-market financial system. East-European countries have a history of socialism and since the removal of the Communist Party have become young capitalistic economies. Between these East-European economies, institutional differences exist as well, as some have developed more into the direction of LMEs and others more into the direction of CMEs (Lane & Myant, 2007). However, as these countries still have rather young capitalistic economies their history of socialism might still have significant effects on entrepreneurial activity today. Taking into account the different varieties of capitalism and their likely implications on entrepreneurial activity the following hypotheses will be tested.

> **Hypothesis 2a:** Relative to CME, MME, and EEU. LMEs have the highest rates of entrepreneurial activity due to an institutional system characterized to be more supportive for entrepreneurship.

Hypothesis 2b: Relative to LME, MME, and EEU. CMEs have the lowest rates of necessity-driven entrepreneurial activity due to their high quality of social welfare systems and employment protection.

3 Methodology & data

3.1 Methodology

To test the hypotheses a cross-sectional regression model will be applied. The model will be estimated using an Ordinary Least Squares estimator at the NUTS2 level and is specified as

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

where y_i is total entrepreneurial activity, opportunity-driven entrepreneurial activity, necessity-driven entrepreneurial activity, or the share of opportunity- relative to total entrepreneurial activity in region i. The primary explanatory variables in our model are related variety RV_i and unrelated variety UV_i. Different varieties of capitalism are included as the dummy variables LME_i, CME_i, MME_i, and EEU_i and are represented by the vector $'VOC_i$. Other control variables, captured in the vector $'X_i$, will be discussed more elaborately when the data will be discussed. Two spatial terms are included; the first term $\lambda W y_i$ accounts for the spatial autoregressive process of the dependent variable, including only this term would result in a spatial error model (SEM). The second term $\rho W u_i$ captures the spatial correlation in residuals of neighbouring regions, including only this term would result in a spatial lag model (SAR). Including both spatial terms results in a spatial autoregressive model with autoregressive disturbances (SARAR).

To test and if necessary control for spatial correlation in the residuals and/or dependant variable, we follow Hendry's methodology (Florax et al., 2003). This means 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 likelihood ratio test. If spatial autocorrelation seems 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. An inverse distance spatial weight matrix will be constructed to account for potential geographical dependencies. Regions will be classified as neighbours when the distance between them is smaller than 750 kilometres, their weight will be the inverse of the distance between them. If the distance

between regions is larger than that, their weight will be zero. The matrix will be row-standardized such that the impact of neighbouring regions is equalized.

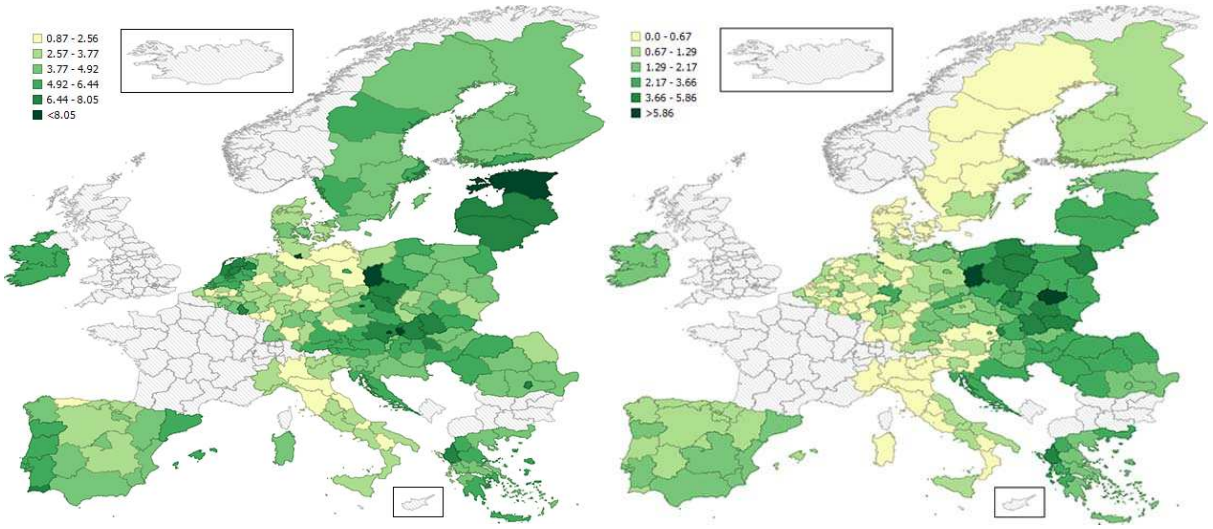
3.2 Entrepreneurship

The dependent variable is the regional rate of entrepreneurial activity. Using data provided by the Global Entrepreneurship Monitor (GEM), which is survey-based data, we will be able to explicitly distinguish between necessity- and opportunity-driven entrepreneurship[1]. Each year, the GEM conducts an adult population survey on a representative sample containing at least 2000 individuals per country, who are different each year. Using this data, total entrepreneurial activity is measured as the share of the working age population (from 18 until 64) that is involved in the creation of a business at the time the survey was conducted. Someone classifies as an entrepreneur when he or she engaged in any activity to start and those running a new business less than 3.5 years old. Therefore our data also contains individuals, which have identified an entrepreneurial opportunity, however, have not formally started a firm. Since we break down the country numbers into regional numbers at the NUTS2 level, the annual survey waves are not representative at the regional level, as these still are based on the 2000 individuals who are sampled at the national level. For this reason, we pool regional data over multiple waves, as to get a reliable number for total entrepreneurial activity in the region. Of course this comes at the cost of time variation. Regional data on entrepreneurs on the NUTS2 level for 23 EU member states[2] (181 regions) can be extracted as an average over the time period 2007 until 2014. Figure 3.2 depicts the average rate of opportunity- and necessity-driven entrepreneurship for the period 2007 until 2014.

[1] The appendix contains a more precise description on how this distinction is made and what questions are asked.

[2] Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, and Sweden.

Figure 3.1 Opportunity-(left) and necessity-driven entrepreneurship (right).



As some countries do not participate in the GEM, there are no data on the rate of entrepreneurship in these countries. Countries that are included in the most recent NUTS classification of 2013 but did not participate in the GEM survey are in the maps of figure 3.1 but are not shaded. Data on entrepreneurship at the NUTS2 is not available for the countries Bulgaria, France, Switzerland, Cyprus, Iceland, Liechtenstein, Norway, Montenegro, and the United Kingdom.

3.3 Variety

For the construction of related and unrelated variety, which are our main explanatory variables, we follow Frenken et al. (2007). Using an entropy measure, variety can be decomposed into a related- and unrelated component. In order to make this distinction, detailed sectoral classification data is necessary. Following Cortinovis & Van Oort (2015) and Van Oort, Geus, & Dogaru (2015) we use data provided by Bureau van Dijk, particularly the ORBIS dataset. This dataset contains individual firm level data that can be aggregated into NUTS2 regions from 2015 and backwards. Detailed information on the type of industry using the NACE or SIC classification schemes is available at the 4-digit level, which makes it possible to calculate the entropy measure of related variety. In order to ensure causality of our analysis related and unrelated variety will be measured in 2006. The distribution of firms in terms of their size is not completely representative as only those firms that are obligated to annually report are included. This means that smaller firms are not included in the data, which creates a bias towards larger firms. Therefore, before we calculate the variety measure, the employment variables are rescaled to match the Eurostat employment rates. For the calculation of unrelated variety we make the assumption that firms who belong to one of the

2-digit sectors are unrelated. Additionally, 4-digit sectors within each of the 2-digit sectors are assumed to be related, exactly because they belong to the same 2-digit sector. The 4-digit shares P_i are summed to derive the 2-digit shares P_g:

$$(1) \quad P_g = \sum_{i \in S_g} p_i$$

Unrelated variety, the entropy *between* the 2-digit sectors, is then calculated as:

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

Entropy *within* each 2-digit sector, H_g, is given by:

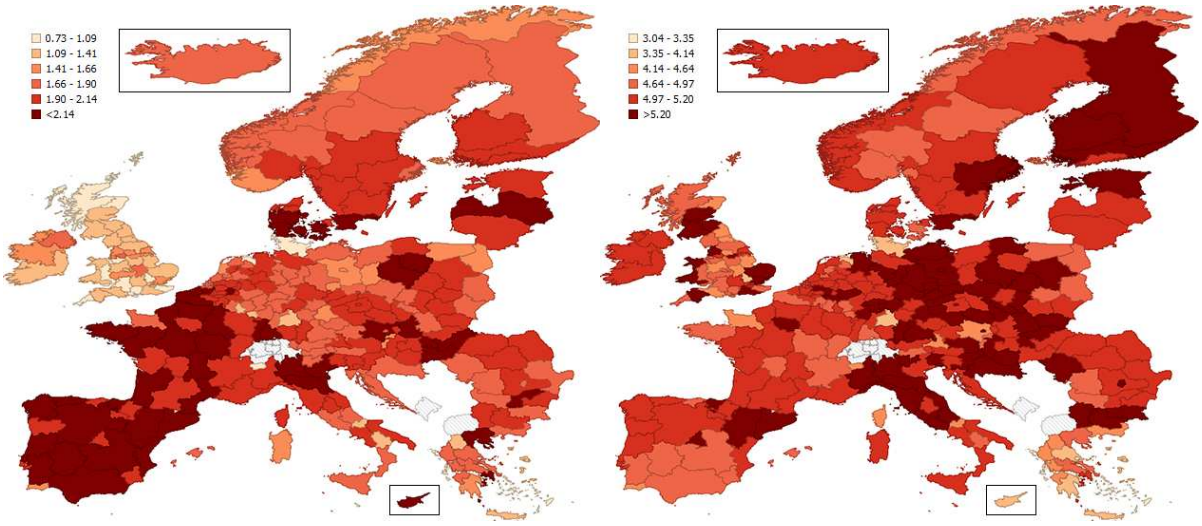
$$(3) \quad H_g = \sum_{i \in S_g} \frac{p_i}{P_g} log_2 \left(\frac{1}{p_i / P_g} \right)$$

Finally, related variety is the sum of entropy (3), weighted by employment shares (1), such that:

$$(4) \quad RV = \sum_{g=1}^{G} P_g H_g$$

The maps in figure 3.2 depict the related and unrelated variety measures for the year 2006. The left hand side map represents related variety, whereas the right hand side represents unrelated variety.

Figure 3.2 Related (left) and unrelated variety (right) in 2006.



What these maps show is that the regions with high levels of related variety usually exhibit low levels of unrelated variety and vice versa. The correlation between the variety measures is

even negative. Part of this negative correlation results from the decomposition, which splits total variety into related and unrelated variety. However, there are cases of regions with both high levels of related variety and high levels of unrelated variety (e.g., the region of Catalunya in Spain) and regions with both low levels of related variety and low levels of unrelated variety (e.g., the region of Crete in Greece). This suggests that the level of aggregation chosen as cut-off point between unrelated and related variety is a relevant one.

Some South-East European countries are excluded in the maps of figure 3.2 (i.e. Bosnia and Herzegovina, Serbia, Albania, Macedonia, and Montenegro). This is because the ORBIS dataset does not contain enough information about these specific countries to construct the variety measures. Countries that are included in the most recent NUTS classification of 2013 but are not included in the ORBIS dataset are in the maps of figure 3.2 but are not shaded.

3.4 Other variables

Much of the data not yet discussed originates from Eurostat. Table 1 gives an overview of all the variables used in this analysis. We control for income levels by including Gross Regional Product (GRP), as overall development of a region is likely to influence the amount of entrepreneurial opportunities available. More densely populated regions are expected to produce more entrepreneurs due to urbanisation advantages, we therefore control for population density as the average number of inhabitants per square kilometre and the presence of a big city. The level of human capital is likely to influence potential entrepreneurs' ability and skills to identify opportunities and consequently act upon them, we therefore control for human capital by including the percentage of the working age population having completed tertiary education in our model. We control for the growth of unemployment as this might push individuals into entrepreneurship due to difficulties finding a job. Finally, we also take into account different institutional regimes across countries. Especially within the European context some cultural distances can be quite extensive in terms of attitudes towards entrepreneurship and social welfare systems. We control for these differences by including dummies for different varieties of capitalism according to Hall and Soskice (2001).

Table 3.1 Variables description.

Variable	Description	Source
TEA	Average percentage of the working age population involved in entrepreneurship over the period 2007-2014.	GEM
TEA_OPP	Average percentage of the working age population involved in opportunity-driven entrepreneurship over the period 2007-2014.	GEM

TEA_NEC	Average percentage of the working age population involved in opportunity-driven entrepreneurship over the period 2007-2014.	GEM
OPP/NEC	Share of the working age population involved in opportunity-driven relative to necessity-driven entrepreneurship.	GEM
UV	Unrelated variety in 2006.	BvD
RV	Related variety in 2006.	BvD
GRP	Logarithm of the Gross Regional Product per/capita in 2006.	Eurostat
PDEN	Logarithm of the population density in 2006.	Eurostat
HC	Logarithm of the percentage of working age population completed tertiary education in 2006.	Eurostat
UNEMP	Unemployment growth in 2006.	Eurostat
CITY	Presence of a city with >500,000 inhabitants in 2006.	Eurostat
VOC_LME *VOC_CME* *VOC_MME* *VOC_EEU*	Varieties of capitalism dummies: LME (Ireland & United Kingdom), CME (Austria, Belgium, Denmark, Finland, France, West Germany, Luxembourg, Netherlands, and Sweden), MME(Greece, Italy, Portugal, and Spain), EEU(Croatia, Czech Republic, East Germany, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia)	Hall & Soskice (2001)

The descriptive statistics in table 2 tell us that the regions included in the dataset are highly heterogeneous, however, none of the values seem to be out of an ordinary range.

Table 3.2 Descriptive statistics.

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
TEA	181	6.269	2.210	2.332	14.358
TEA_OPP	181	4.529	1.556	0.869	10.241
TEA_NEC	180	1.432	1.145	0.084	7.145
OPP/TEA	181	0.734	0.116	0.320	0.973
UV	181	5.039	0.397	3.040	5.520
RV	181	1.907	0.290	0.727	2.445
GRP	181	9.973	0.426	8.681	11.049
PDEN	181	4.977	1.172	1.194	8.759
HC	181	3.003	0.395	2.079	3.818
UNEMP	181	-0.084	0.101	-0.333	0.286
CITY	181	0.331	0.472	0	1
VOC_LME	181	0.011	0.105	0	1
VOC_CME	181	0.387	0.488	0	1
VOC_MME	181	0.293	0.456	0	1
VOC_EEU	181	0.309	0.464	0	1

The correlation matrix in table 3 provides a first look at the relationship between variety and entrepreneurship. The correlation between the two variety measures and the rate of opportunity-driven entrepreneurship is very low, and for related variety even negative.

Whether variety enhances entrepreneurship, however, can only be determined if we control for other factors, which will be done in the next section.

Table 3.3 Correlation matrix.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. TEA	1													
2. TEA_OPP	0.871	1												
3. TEA_NEC	0.691	0.267	1											
4. OPP/NEC	-0.275	0.198	-0.773	1										
5. UV	-0.076	-0.073	-0.069	0.025	1									
6. RV	-0.063	-0.057	-0.040	0.045	0.618	1								
7. GRP	-0.301	0.010	-0.645	0.585	0.000	-0.130	1							
8. PDEN	-0.058	0.000	-0.122	0.103	0.113	-0.030	0.370	1						
9. HC	-0.094	0.056	-0.302	0.263	0.102	0.010	0.595	0.234	1					
10. UNEMP	0.099	0.120	0.026	0.019	0.251	0.140	0.296	0.423	0.237	1				
11. CITY	-0.241	-0.179	-0.187	0.079	-0.108	-0.007	0.029	-0.015	-0.108	-0.101	1			
12. VOC_LME	0.058	0.066	0.010	0.003	-0.006	-0.201	0.098	-0.087	0.102	0.039	0.155	1		
13. VOC_CME	-0.258	-0.043	-0.530	0.432	0.031	-0.079	0.559	0.174	0.447	-0.096	0.015	-0.085	1	
14. VOC_MME	-0.202	-0.176	-0.102	0.059	-0.318	0.022	0.074	-0.084	-0.178	0.129	0.084	-0.068	-0.509	1
15. VOC_EEU	0.456	0.203	0.655	-0.514	0.280	0.107	-0.683	-0.082	-0.320	-0.035	-0.132	-0.071	-0.536	-0.428

4 Estimation results

The estimation results of the model presented in the previous section are summarized in tables 1, 2, and 3 below. Table 1 presents the general estimation of our model in which we look at what the effect of unrelated and related variety is on entrepreneurship. In table 2 some additional analyses are presented, specifically we look at whether variety affects the share of opportunity- relative to total entrepreneurial activity and the role of income levels with respect to the relationship between variety and entrepreneurship. Finally table 3 summarises our results about spatial dependencies in our findings.

Table 4.1 General estimation results.

	(1) TEA		(2) TEA		(3) TEA_OPP		(4) TEA_NEC	
UV	-0.353	(0.444)	-2.280***	(0.552)	-1.619***	(0.438)	-0.720***	(0.218)
RV	-0.185	(0.632)	1.019	(0.659)	1.051**	(0.526)	-0.008	(0.237)
GRP			0.113	(0.744)	1.353**	(0.522)	-1.180***	(0.291)
CITY			0.987***	(0.355)	0.532*	(0.280)	0.442***	(0.139)
PDEN			-0.133	(0.127)	-0.150	(0.103)	0.024	(0.0474)
HC			0.023	(0.464)	-0.203	(0.374)	0.218	(0.147)

UNEMP			-4.471***	(1.170)	-2.549**	(1.041)	-1.494**	(0.646)
VOC_LME *(omitted)*			-		-		-	
VOC_CME			-2.606***	(0.609)	-1.513***	(0.492)	-1.064***	(0.217)
VOC_MME			-3.260***	(0.728)	-2.095***	(0.585)	-0.903***	(0.252)
VOC_EEU			-0.222	(0.982)	-0.020	(0.740)	0.106	(0.321)
Constant	8.403***	(1.609)	16.61**	(7.177)	-0.646	(4.924)	16.44***	(2.876)
Observations	181		181		181		181	
R-squared	0.007		0.353		0.196		0.610	

Robust standard errors in parentheses. Significant levels: *** p<0.01, ** p<0.05, * p<0.1

The first column of table 1 shows that when other factors are not controlled for, no significant effect is found for neither unrelated nor related variety. When we look at columns 2, 3, and 4, however, we see that unrelated variety seems to have a quite strong and negative impact on total entrepreneurial activity. Whether we distinguish between necessity- and opportunity-driven entrepreneurial activity does not seem to matter for the effect's significance, although its magnitude more than doubles in the case opportunity-driven relative to necessity-driven entrepreneurs. Looking at the effect of related variety, we see that it has no significant effect on total entrepreneurial activity. When entrepreneurship is split into opportunity- and necessity-driven parts, like in column 3 and 4, we see that related variety has a positive significant impact on the former part of entrepreneurship but no effect on the latter. These results support our first two hypotheses 1a and 1b.

Higher income levels seem to increase the rate of opportunity-driven entrepreneurs, whereas it decreases the rate of necessity-driven entrepreneurs. This result reflects the fact that more developed economies on average offer better opportunities for entrepreneurship and individuals in less developed economies are more often pushed into starting up a firm due to limited employment options. The presence of a big city clearly offers urbanisation advantages for entrepreneurs and higher growth of unemployment seems to push individuals into entrepreneurial behaviour, regardless of the type of entrepreneur they will become.

The variables with the prefix VOC represent our institutional indicators. Since they sum up to 1 for each observation in our dataset, the dummy variable for LMEs has been left out of the estimation as it would cause perfect multicollinearity to include all of the dummy variables. Overall their seems to be less entrepreneurial activity in CMEs relative to LMEs and even less activity in MMEs. The coefficient for EEU is not significant, meaning that the rate of entrepreneurial activity in those regions is equal to that of LMEs. We did not anticipate this, as we expected EEU to have higher rates of necessity-driven entrepreneurship and lower rates

of opportunity-driven entrepreneurship. This finding is, however, robust across the different forms of entrepreneurship and partly supports hypothesis 2a. Looking at column 3 we see that CMEs experience the lowest rates of necessity-driven entrepreneurship followed by MMEs. Again the coefficient for EEU is insignificant, where we would have expected a higher rate of necessity-driven entrepreneurship. This finding partly supports hypothesis 2b.

Table 4.2 Additional estimation results.

	(1) OPP/TEA		(2) TEA_OPP		(3) TEA_OPP		(4) TEA_OPP	
UV	0.007	(0.028)	-2.027***	(0.607)	-0.720	(0.591)	-32.34***	(11.48)
RV	0.057*	(0.032)	1.782***	(0.640)	0.431	(0.758)	25.73**	(10.54)
GRP	0.168***	(0.028)	0.793	(0.693)	2.834***	(0.988)	-9.397**	(4.694)
CITY	-0.027	(0.017)	0.691*	(0.399)	0.082	(0.346)	0.524*	(0.267)
PDEN	-0.007	(0.006)	-0.332*	(0.190)	-0.152	(0.142)	-0.170*	(0.101)
HC	-0.044**	(0.020)	-0.801	(0.550)	0.374	(0.457)	-0.237	(0.371)
UNEMP	0.022	(0.078)	-2.855**	(1.308)	-4.036**	(1.970)	-2.941***	(1.028)
VOC_LME *(omitted)*	-		-		-		-	
VOC_CME	0.043	(0.029)	0.296	(0.650)	-1.331**	(0.639)	-1.238*	(0.632)
VOC_MME	0.022	(0.034)	-		-2.047***	(0.734)	-1.886***	(0.707)
VOC_EEU	-0.008	(0.041)	1.488***	(0.520)	1.551	(1.010)	0.362	(0.791)
GRP*RV							-2.451**	(1.047)
GRP*UV							3.055***	(1.134)
Constant	-0.934***	(0.281)	6.139	(5.845)	-21.28**	(9.606)	107.2**	(47.75)
Observations	181		90		91		181	
R-squared	0.423		0.248		0.368		0.229	

Robust standard errors in parentheses. Significant levels: *** p<0.01, ** p<0.05, * p<0.1

The first column of table 2 shows the result of the estimation with the share opportunity-driven relative to total entrepreneurial activity as dependant variable. Despite the negative effect of unrelated variety and the positive effect of related variety on opportunity-driven entrepreneurial activity presented in table 1, this effect is just mildly reflected in this estimation. Unrelated variety does not seem to affect the share whereas related variety does, yet the effect is rather weak. When we take a closer look at how income levels affect the relationship of variety with opportunity-driven entrepreneurship in columns 2 and 3, we see that it is in the lower income regions where unrelated and related variety have a strong and highly significant negative and positive impact respectively. Column 4 supports this finding by showing that the interaction of income level with related variety is negative. The negative effect of unrelated variety becomes weaker with higher levels of income.

Table 4.3 Spatial autocorrelation.

	(1) TEA_OPP	(2) TEA_OPP	(3) TEA_OPP

UV	-1.007**	(0.398)	-1.605***	(0.404)	-1.069***	(0.414)
RV	0.857*	(0.472)	1.078**	(0.518)	0.950*	(0.491)
GRP	2.428***	(0.480)	1.433***	(0.480)	2.601***	(0.496)
CITY	0.250	(0.253)	0.500*	(0.278)	0.273	(0.263)
PDEN	-0.0404	(0.113)	-0.131	(0.109)	-0.0539	(0.117)
HC	-0.909**	(0.377)	-0.241	(0.353)	-1.003**	(0.391)
UNEMP	-3.970***	(1.017)	-2.576**	(1.074)	-3.999***	(1.065)
VOC_LME *(omitted)*	-		-		-	
VOC_CME	-1.015	(8.122)	-1.355	(1.088)	-0.562	(5.485)
VOC_MME	-3.339	(8.096)	-1.942*	(1.113)	-2.797	(5.475)
VOC_EEU	0.0144	(8.116)	0.0856	(1.121)	0.465	(5.487)
λ	-0.755***	(0.202)	0.164	(0.232)		
ρ	0.887***	(0.0571)			0.829***	(0.0800)
σ^2	1.581***	(0.171)	1.929***	(0.203)	1.711***	(0.182)
Constant	-8.257	(9.497)	-2.403	(5.085)	-13.66*	(7.312)
Log likelihood	-305.979		-316.361		-309.851	
Observations	181		181		181	

Robust standard errors in parentheses. Significant levels: *** p<0.01, ** p<0.05, * p<0.1

Table 3 shows what happens when we add spatial terms into our model. Following Hendry's method (Florax et al., 2003), we started by estimating our restricted spatial model and unrestricted spatial model using a maximum likelihood estimator, respectively shown in columns 1 and 2. Using a likelihood ratio test the common factor restriction got rejected at the 1% significance level. Subsequently a spatial lag model is estimated, which is shown in column 3. The significant coefficient of ρ means the specification as in column 3 is our final spatial specification. Looking at the coefficients of unrelated and related variety, we see that their impact on opportunity-driven entrepreneurial activity has declined slightly. Except for human capital, which now has a significant negative impact, the remaining control variables have not changed in terms of significance or direction of their effect.

5 Conclusion

This research is concerned with the effects of unrelated and related variety on regional entrepreneurial activity across Europe. Recent studies have published positive effects of related variety on regional employment growth, however, specifically how related variety leads to employment growth has remained implicit. This study examined whether entrepreneurship might explain part of this effect motivated by the knowledge spillover theory of entrepreneurship, which states that regions endowed with more knowledge spillovers can expect more entrepreneurial activity. This study is the first that directly analyses the effect of

unrelated and related variety on regional entrepreneurial activity, taking into account cross-country differences in Europe.

A new dataset is constructed in order combine information about a region's industrial structure and entrepreneurial activity. Using a cross-sectional regression analysis on 181 NUTS2 regions divided over 23 EU member states we tested whether variety affects the rate of total entrepreneurial activity, opportunity- & necessity-driven entrepreneurial activity, and the share of opportunity-driven relative to total entrepreneurial activity. Following Hall & Suskice (2001) we took into account institutional variations across countries by controlling for different varieties of capitalism. Furthermore we accounted for geographical proximity by testing and correcting for spatial dependencies in our results.

Overall we found that unrelated variety has significantly negative impact on the rate of entrepreneurial activity within regions. This finding is robust for different types of entrepreneurship, specifically opportunity- and necessity-driven. Related variety only has a positive and significant impact on opportunity-driven entrepreneurship, whereas it has no impact on necessity-driven entrepreneurship. This finding is expected, as necessity-driven entrepreneurs start a business out of a lack of employment options, they are unlikely to be influences by knowledge spillovers stemming from related variety. Opportunity-driven entrepreneurship, however, is expected to be positively influenced by higher rates of knowledge spillovers caused by related variety. Institutions matter as the highest rates of entrepreneurship are estimated to be found in liberal market economies, followed by coordinated market economies, which in turn are followed by mixed market economies. Regarding the type of entrepreneurs, opportunity-driven ones are most expected in liberal market economies and least expected in mixed market economies. For necessity-driven ones it is exactly the other way around. Although geographical proximity seems to matter, it does not change our findings with respect to the relationship between related & unrelated variety and the rate of entrepreneurial activity.

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Appendix

In a report published on the website of the GEM consortium it is described how the data is collected and how the measures are constructed (Bosma et al., 2012). Figure A.1 below shows how individuals that take part in the survey are labelled as either 'Nascent entrepreneur: involved in setting up a business' or 'Owner-manager of a new firm (less than 3.5 years old)'. Both types of individual are viewed as an early-stage entrepreneur and together can be aggregated to Total early-stage Entrepreneurial Activity (TEA).

Figure A.1 Identification of entrepreneurs. (Source: Bosma et al., 2012)

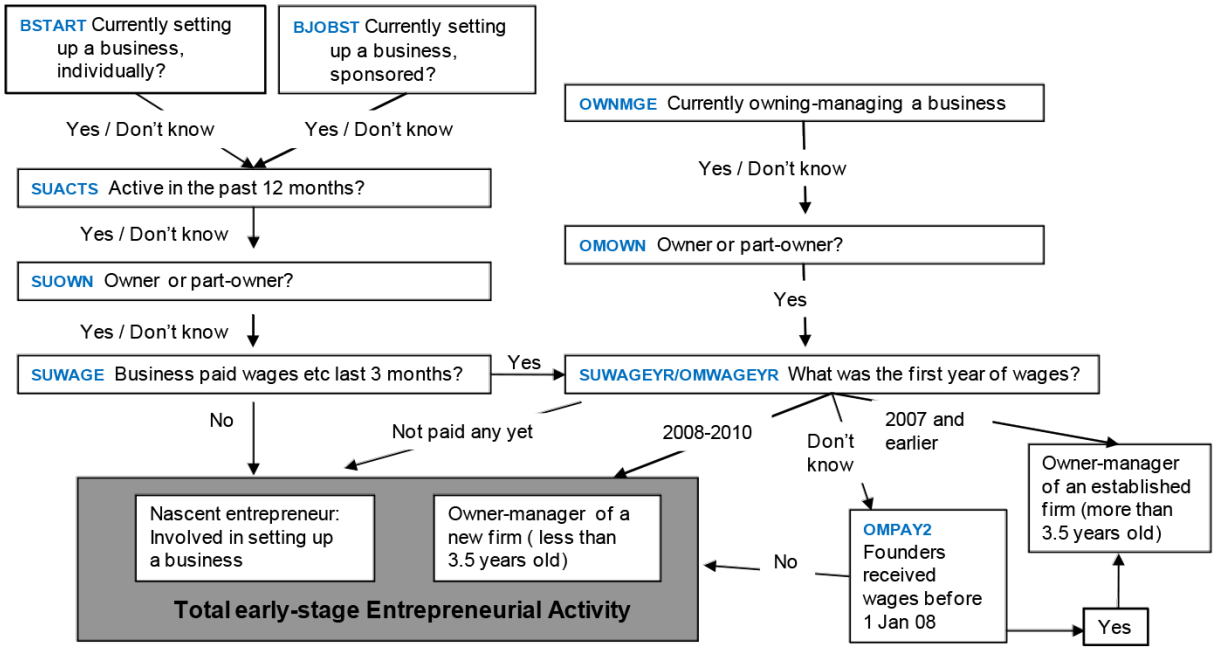

Figure A.2 then shows how individuals classified as early-stage entrepreneur are further divided into groups based on their motivation to start a business. Since 2001, GEM distinguishes between opportunity-driven and necessity-driven entrepreneurs. Necessity entrepreneurs have indicated to have no better choices for work, whereas opportunity entrepreneurs indicated that they have taken advantage of a business opportunity.

Figure A.2 Opportunity-driven or necessity-driven. (Source: Bosma et al., 2012)

Are you involved in this start-up to take advantage of a business opportunity or because you have no better choices for work?
(READ ANSWER LIST IF NECESSARY. ENTER SINGLE RESPONSE.) {SUREASON}

	Take advantage of business opportunity, or..... 1
	No better choices for work..... 2
	Combination of both of the above..... 3
	Have a job but seek better opportunities..... 4
(DO NOT READ) →	Don't know ....-1
	Refused.....-2

Which one of the following, do you feel, is the most important motive for pursuing this opportunity?
(READ ANSWER LIST IF NECESSARY. ENTER SINGLE RESPONSE.) {SUOPTYPE}

	Greater independence.....1
	Increase personal income.....2
	Just to maintain income.....3
(DO NOT READ) →	None of these **(SPECIFY)_____ {SUOPTYPE_OTH}**.....4
	Don't know .....-1
	Refused.....-2

Note: this question is asked to individuals indicating to be involved in a *start-up* (section in which the variable names start with 'SU'). For individuals indicating to be owning-managing a firm that is already operational (section in which the variable names start with 'OM') slightly different phrasing is applied.