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Capstone

The Entrepreneurial Ecosystem: Measuring the effect of its components on productive entrepreneurship at the regional level.

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Abstract

In the policy debate on regions' economic and social development, entrepreneurial activity is widely acknowledged as a key driver of economic progress. In light of this, a new framework has been developed - known as the Entrepreneurial Ecosystem - to provide a systematic picture of entrepreneurial activity and its determinants. The Entrepreneurial Ecosystem suggests that entrepreneurship occurs at the regional level and that there is a set of interconnected regional components coordinated to enable productive entrepreneurship. Productive entrepreneurship, in this case, refers to any entrepreneurial activity that contributes directly or indirectly to the net output of the economy. The literature has established a list of factors positively influencing entrepreneurial activity. Yet, the effect of the individual components on the system's outcome, defined as productive entrepreneurship, remains inadequately studied. Thus, this research examined how and to what extent the different components of the Entrepreneurial Ecosystem statistically account for variations in productive entrepreneurship, measured as the prevalence of high-growth enterprises, at the regional level. This was done by conducting a multiple regression analysis sampling different regions throughout the EU (NUTS2) between the years 2016 and 2019. The results showed that despite the rich literature providing theoretical evidence on the positive effects of all components on productive entrepreneurship, only a small number of indicators were found to influence the outcome variable on a statistically significant level. The components of regional culture, worker talent and universities are considered of great importance for explaining variance in productive entrepreneurship between regions.

Table of Contents

Introduction

Small and medium-sized enterprises (SMEs) make up 99 percent of all companies in the EU and are widely acknowledged as an engine of economic growth (European Union, n.d.a; Gavallo et al., 2019). They play a significant role in the economic success of any given nation and contribute greatly to regional development by generating new employment opportunities, providing chances for investment and innovation, and forming economic capital necessary for sustainable economic growth (Ruchinka et al., 2017). In light of their recognition as a critical economic component, different regional policies have been devised to encourage entrepreneurial activity and increase the prevalence of new small and medium-sized businesses (Stam, 2015; Malecki, 2018). This acknowledgement has been accompanied by a shift in literature on entrepreneurial activity within regions. Emphasis has been placed on the relevance of the interactions between entrepreneurs and their local economic and social context (Gavallo et al., 2019). According to recent literature, the systematic character of entrepreneurial activity is underdeveloped, with previous work in the field disregarding the role of regional context to create generalisable models of entrepreneurial activity (Stam & Spigel, 2016; Gavallo et al., 2019). Instead, it is suggested to thoroughly investigate how cultural, social, political, and economic institutions and structures affect all facets of the entrepreneurial process (Stam & Spigel, 2016). As a result, a new concept has emerged - known as the Entrepreneurial Ecosystem - intending to provide a systematic picture of entrepreneurship and its determinants. The framework has gained traction through the pioneering studies by Cohen (2006), Isenberg (2010) and Feld (2012), which have contributed towards popularizing the notion among academics and policymakers that a location's institutions, community and culture can have a significant impact on entrepreneurship (Mack & Qian, 2016). This new approach further differs as it views the

entrepreneur as a distinct entity, separate from the enterprise, operating within an environment consisting of "a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship" (Nicotra et al., 2018, Stam & Spigel, 2016). Consequently, traditional enterprise policy underwent a noticeable shift, involving changes in the unit of focus, how it functions, and how it interacts with other policies (Mason & Brown, 2014). The literature stresses that a more system-based approach must be taken to assist regional entrepreneurial activity. This involves a change from traditional interventions specific to a company or industry towards a more holistic approach recognising the multifaceted interdependent nature of productive entrepreneurship (Nicotra et al., 2018).

In Europe, in particular, businesses and governments have acknowledged the notion of entrepreneurial ecosystems as a way to strengthen the conditions enabling innovation and entrepreneurship (Acs et al., 2017). As an example, the European Entrepreneurial Region (EER) initiative recognises and awards EU cities and regions that "show an outstanding and innovative entrepreneurial policy strategy, irrespective of their size, wealth and competences" (European Entrepreneurial Region, n.d.). The title "European Entrepreneurial Region" for a particular year is granted to regions and cities with the most forward-thinking and promising vision designs (European Entrepreneurial Region, n.d.). The project is accompanied by analysis, shares of best practices, policy initiatives, and case study reports falling under the programme "Fostering collaboration through mapping, analysing and interlinking of European Entrepreneurial Regions" (European Entrepreneurial Region, n.d.).

As policymakers widely recognise the concept of Entrepreneurial Ecosystems in their efforts to foster regional economic development, it is crucial to understand the individual components of such ecosystems and their effect on facilitating the entrepreneurial activity.

Recent literature (Isenberg, 2010; Feld, 2012; Spigel, 2017) on the Entrepreneurial Ecosystem has agreed on a list of important factors for its success (Stam, 2015). This includes, among other things, a supportive culture, business-friendly regulatory frameworks, and access to capital. Today, literature on ecosystem elements that successfully contribute to entrepreneurial activity is primarily based on single regional case studies (Nicotra et al., 2018). Yet, the relationship between the ecosystem's fundamental elements and its outcome, described as productive entrepreneurship, remains inadequately measured. Thus, this research's purpose lies in contributing to the emerging conceptual framework of an Entrepreneurial Ecosystem by measuring the effect of the distinctive ecosystem components on successful entrepreneurial activity. According to the literature, the local scale is best for analysing entrepreneurial ecosystems as it is widely agreed upon that entrepreneurship occurs locally or, at most, by utilising local institutions, networks and resources (Malecki, 2018, Porter, 2003). Thus, in this study, a multiple regression analysis was conducted, investigating the impact of the individual components of an entrepreneurial ecosystem on the outcome of such a system, considered productive entrepreneurship. Prior attempts to measure the Entrepreneurial Ecosystem focused on regions within one nation. Thus, to expand on the literature, this research was carried out with improved measurements on an enlarged sample size, including different regions (NUTS2) in the EU, between 2016 and 2019. An increased sample size, including different regions from various nations, is advantageous when conducting a multiple regression analysis, as it increases the sample's representativeness by capturing the inherent variability and diversity in different regions. Further, this increases external validity by reducing specific country bias. The main findings of this analysis concluded that not all components appear to affect the outcome of productive entrepreneurship with equal significance. The component of regional culture, worker

talent, and universities are considered of great importance for explaining variance in productive entrepreneurship between regions.

To answer the following research question: How do the components of the Entrepreneurial ecosystem affect productive entrepreneurship at the regional level ? This paper is structured as follows: First, an extensive literature review is presented explaining the emergence of the framework and its components. The methodology section describes the steps taken in the multiple regression analysis and presents the data used for this research. This will be followed by the results, presenting the findings of the regression models and a discussion that puts these findings into context. The paper will be rounded off with the limitation sector and the conclusion.

Literature review

Over the past 50 years, the role taken by entrepreneurship in the economy has undergone a significant transformation. Today, it is widely acknowledged as a catalyst for both social and economic development (Audretsch et al., 2006). Romano Prodi, the 10th president of the European Commission, stated in 2002 that: “The field of entrepreneurship needs to be taken seriously because there is mounting evidence that the key to economic growth and productivity improvements lies in the entrepreneurial capacity of an economy” (Audretsch et al., 2006). Only a few years prior, the macroeconomic tools of fiscal and monetary policy, on the one hand, and the size and scale economies generated by large corporations, on the other hand, had been the centre of the policy debate focused on growth and employment (Audretsch et al., 2006). After all, influential scholars like Joseph Schumpeter (1942) and Alfred Chandler (1977) influenced a generation of decision-makers to believe that large corporations are the primary source of value and efficiency, while small enterprises eventually fail due to their own inefficiency (Audretsch et

al., 2006). Small businesses were deemed disadvantaged, as large exporting enterprises,s, global markets, and global products control the world. Small businesses were considered less efficient than their bigger counterparts, with low employment compensation and little involvement in innovative activity (Audretsch & Thurik, 2004).

Despite this perception, small businesses began to re-emerge in North America and Europe in the 1970s, with the rate of company ownership increasing dramatically in various nations (Audretsch & Thurik, 2004). With this, empirical evidence on the upsurge of small businesses and their vital impact on economic growth and the creation of jobs started to accumulate (Birch 1981; Davis et al., 1996; Callagher & Stewart 1986; Storey & Johnson 1987), and scholars started to investigate the causes thereof to develop a theoretical foundation on the effects of SMEs on economic growth (Audretsch & Thurik, 2004). As the comparative advantage has changed to knowledge-based economic activity, Audretch and Thurik (2001) claim that entrepreneurship in the form of new and small businesses has gained a role of expanding importance. Entrepreneurship is a crucial mechanism by which knowledge created in one organisation becomes commercialised in a new enterprise, thereby contributing to economic growth, innovation, employment and the vitality of the overall economy (Audretsch & Thurik, 2004). With this shift, academics and policymakers attempted to conceptualise how entrepreneurship affects economic development and the implications of several variables influencing the prevalence of entrepreneurial activity (Leenderste et al., 2022). The field of economic geography contributed by showing significant regional variation in the incidence of entrepreneurship, with the main contributing factors being primarily spatial (Feldman, 2001; Kenney & Patton, 2005). The literature on the geography of entrepreneurship has shed light on the role that various components play in promoting the prevalence of entrepreneurship in

regions, giving rise to the widely used concept known as Entrepreneurial Ecosystems (Leenderste et al., 2022).

The Emergence of the Entrepreneurial Ecosystem

The concept of ecosystems has its roots in biology and refers to the natural environment and its components (Nicotra et al., 2018). Roy Clapham initially utilised the term in 1930 to denote the biological and physical elements of an environment that are viewed in relation to each other as a unit (Willis, 1997). This concept was first applied to an organisational business perspective by Moore in their influential article published in Harvard Business Review (Moore, 1933). The author claimed that "innovative businesses can't evolve in a vacuum" and suggested that a company must be considered a component of a business ecosystem that transcends different sectors rather than a member of a single industry (Moore, 1993). They further explain that for businesses to succeed in a competitive environment, they must be part of an inter-sectoral ecosystem that allows co-evolvement, development of new skills, and innovation. In this sense, "A business ecosystem, like its biological counterpart, gradually moves from a random collection of elements to a more structured community" (Moore, 1993). Iansiti and Levien (2004) extended Moore's concept by outlining the role of individual stakeholders in the business ecosystem and connecting these functions to the aggregate characteristics of the ecosystem (Nicotra et al., 2018). Today, the concept of Entrepreneurial Ecosystems is widely discussed and developed by different scholars, offering both theoretical (Stam, 2015) and practical perspectives (Saxenian, 1994, Cohen 2006) (Schwetzer et al., 2019).

Yet, Daniel Isenberg (2010, 2011) popularised the notion of Entrepreneurial Ecosystems by offering a particularly influential approach to systemising its components (Mason & Brown, 2014). The author proposed a framework consisting of various elements that can be categorised

into six domains: a supportive culture, facilitating policies and leadership, accessibility of dedicated finance, relevant human capital, venture-friendly markets for products and services, and a wide range of institutional and infrastructural support (Nicotra et al., 2018). Similar to Isenberg's approach, the most recent contribution made by Spigel (2017) claims that an Entrepreneurial Ecosystem consists of 11 Cultural, Social, and Material attributes that foster and encourage entrepreneurial activity (Spigel, 2017). Table 1 below shows an overview of the important literature that has contributed to defining the individual components of an Entrepreneurial Ecosystem.

Table 1. Components of an Entrepreneurial Ecosystem over time.

Author	**Components of an Entrepreneurial Ecosystem**
Neck et al. (2004) and Cohen (2006)	1. Informal network 2. Formal network 3. University 4. Government 5. Professional and support services 6. Capital services 7. Talent pool
Isenberg (2011)	1. A supportive culture 2. Facilitating policies and leadership 3. Availability of dedicated finance 4. Relevant human capital 5. A venture friendly market for products and

	services 6. A wide range of institutional and infrastructural support
Feld (2012)	Interaction between: 1. Strong group of Entrepreneurs 2. Mentors and advisors 3. Strong Network Access to relevant resources: 4. Talent 5. Services 6. Capital Enabling background: 7. Role of government
Spigel (2017)	Cultural attribute 1. Supportive culture 2. History of Entrepreneurship Social Attribute 3. Worker Talent 4. Investment capital 5. Networks 6. Mentors and role models Material attribute

	7. Policy and Governance 8. Universities 9. Support services 10. Physical Infrastructure 11. Open Markets

Next to its components, scholars collectively agree that Entrepreneurial Ecosystems involve a dynamic nature, encompassing multiple processes between stakeholders (Schwetzer et al., 2019). Yet, despite attempts, there is no universally agreed-upon definition for Entrepreneurial Ecosystems. Isenberg (2010) defines the Entrepreneurial Ecosystem as consisting of "a set of individual elements - such as leadership, culture, capital markets, and open-minded customers - that combine in complex ways" (Isenberg, 2010). Mason and Brown (2014) elaborated on this by defining the Entrepreneurial Ecosystem as "A set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organisations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, number of high growth firms, levels of 'blockbuster entrepreneurship', number of serial entrepreneurs, degree of sell-out mentality within firms and level of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment." (Mason & Brown, 2014). This research will adopt the definition by Stam and Spigel (2016), who define the Entrepreneurial Ecosystem as "A set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory." (Stam & Spigel, 2016). This definition was

chosen as the best suitable for this research, as this study uses the framework established by Spigel (2017), which will be further explained in the next section.

Components of the Entrepreneurial Ecosystem

The success of an Entrepreneurial Ecosystem depends on several corresponding components. These components emphasise the interaction between ecosystem participants to access relevant resources within an enabling governmental and cultural landscape (Stam, 2015). Scholars agree on components and their relevance (see Table 1). This study will draw on Spigel (2017), who found 11 attributes grouped into Cultural, Social, and Material attributes.

Cultural Attributes

The inherent attitudes and outlooks on entrepreneurship in a region are referred to as the cultural attributes of an Entrepreneurial Ecosystem (Spigel, 2017). Scholars have examined two key cultural characteristics - supportive culture and prominent history of entrepreneurial success - impacting the larger regional entrepreneurship process (Spigel, 2017). According to Saxenian (1994), cultural attitudes standardise regional perspectives on entrepreneurial activity, with different cultural perspectives on risk-taking and entrepreneurship leading to profoundly different economic entrepreneurial pathways. Thus, fostering regional entrepreneurial activity requires a culture that values risk-taking, creativity, and a positive outlook on failure (Feldman, 2001; Mason & Brown, 2014). Next to this, a region's prominent history of entrepreneurial success plays an important role. Spigel (2017) argues that young entrepreneurs may be motivated to pursue a similar path by the success stories of local enterprises that eventually grew into influential, international industry leaders. It has become evident that even one achievement may stimulate entrepreneurial activity by capturing the public's attention and motivating imitators.

Consequently, early, apparent success lowers the perception of entrepreneurial constraints and risks by highlighting the potential rewards (Isenberg, 2010).

Social Attributes

Social attributes in the context of an Entrepreneurial Ecosystem refer to the resources derived from and obtained through regional social networks. The value of social networks and capital to entrepreneurial ecosystems is well documented in the literature (Stam, 2015, Spigel, 2017). Networks act as a source of new knowledge, assist new venture creation by opening up access to finance, and positively impact entrepreneurial outlooks. For new ventures to gain from networks, it requires existing relationships among business owners, investors, and other entrepreneurial actors, as well as mutual trust that motivates the sharing of limited resources (Spigel, 2017).

Literature differentiates between four social attributes: networks, investment capital, mentors and role models, and worker talent (Spigel, 2017). Networks are crucial to encourage and assist new venture creation (Neck et al., 2004). According to Storper and Venables (2004), strong social networks within a region create a "buzz" that functions as " a superadditive form of information circulation, generating increasing returns for people who are in the buzz, and for the agglomeration in which they work" (Storper & Venables, 2004).

Another essential attribute of entrepreneurial activity is access to finance (Mason & Brown, 2014). Financial resources are a vital catalyst for new venture creation (Spigel, 2017). This can be through loans from banks, venture capitalists, business angel investors, or family and friends (Denis, 2004). For investors to find new businesses and minimise information asymmetry between the enterprise and investor, a significant share of startup investment is directed through tight social networks of investors (Spigel, 2017). In addition to the seed-capital, business angels

and venture capitalists can provide a supportive role within the firm (Denis, 2004). Business angels can provide an essential networking function and assist new firms in obtaining additional venture capital investment. Whereas venture capitalists actively provide mentoring, tactical counsel, and assistance in commercialising new ideas (Denis, 2004). Investors may rely on the trust established by strong social relationships. Thus, local investors closely linked to the regional entrepreneurial community are fundamental in fostering the growth of new enterprises (Spigel, 2017).

The third social attribute identified in the literature is mentors and dealmakers. This refers to a group of highly connected agents within the regional network (Spigel, 2017). The terminology “dealmakers" denotes an experienced actor deeply ingrained in regional networks which uses these ties to facilitate transactions (Senor & Singer, 2009; Kemeny et al., 2016). Other literature on the entrepreneurial ecosystem refers to this attribute as intermediaries (Feld, 2012) or Leadership (Mason & Brown, 2014; Stam, 2015). According to Mason and Brown (2014), these leaders must be open to participation from new enterprises and entrepreneurs. Additionally, they play an important role in information sharing, as they are strongly connected and trusted business agents that possess the expertise, know-how, and relationships with individuals and resources required to support young firms (Mason & Brown, 2014).

Lastly, the social attribute characterised as worker talent emphasises the importance of skilled labour. Substantial human capital is a crucial component of a new venture’s competitiveness and a prerequisite for success in the modern knowledge economy (Kenney & Patton, 2005; Spigel 2017). Worker talent refers to human capital composed of a broad and rich talent pool of individuals in all industries and fields of specialisation (Stam & Spigel, 2016).

Material Attributes

Material attributes refer to components with a tangible presence in a region (Spigel, 2017). These include universities, support services, policies and governance, infrastructure, and the availability of strong local markets (Spigel, 2017).

The paper written by Reichert (2019) argues that "the central role of knowledge creation in post-industrial economies and societies has given universities a pivotal role in society" (Reichet, 2019). They can provide Entrepreneurial Ecosystems with essential resources, including the knowledge produced in universities and graduates entering the labour market. The increased relevance of universities is intrinsically tied to their role as a facilitator of multi-actor innovation networks in the region (Reichert, 2019). As a result, the university's primary objective " of conducting research and educating future academics and professionals, leaders and innovators, are increasingly enacted in densely networked processes of knowledge creation" (Reichert, 2019).

Support services are an additional material attribute and refer to specialised assistance for early-stage enterprises (Spigel, 2017). This includes lawyers, accountants, recruitment agencies, and business consultants that tailor their services to small businesses and are familiar with the particular difficulties that new ventures may encounter (Mason & Brown, 2014, Spigel, 2017). Additionally, incubators and coworking areas provide new firms with scarce resources, guidance, and networking opportunities. They catalyse entrepreneurial activity and are frequently considered a focal point of the entrepreneurial ecosystem (Spigel, 2017).

Policies and governance are another material attribute (Spigel, 2017). This refers to laws and regulations contextualising the venture creation process through tax regimes, bureaucratic regulations, legislation and funds (Spigel, 2017). Thus, in supporting regional entrepreneurial

activity, policy and governance may entail reducing legal barriers to firm formation, developing effective tax regimes, or allocating public funds to assist entrepreneurship (Spigel, 2017). Literature shows that the institutional setting in which entrepreneurial activity occurs significantly impacts entrepreneurial activity (Rothstein et al., 2013). This stands to reason that greater levels of corruption or weak intellectual property rights can harm entrepreneurship. As a result, an environment conducive to business, where entrepreneurship is encouraged by institutions and a trusted governance structure, has a beneficial impact on entrepreneurship (Nicotra et al., 2018).

Further, the availability of open markets positively influences entrepreneurial activity (Spigel, 2017). This attribute refers to the prevalence of sufficient regional opportunities that support business formation and unrestricted access to international markets (Spigel, 2017). According to the World Economic Forum (2013), larger markets have been proven to encourage entrepreneurship due to the greater diversity of opportunities and increased demand.

Lastly, physical infrastructure is an important material supporting the entrepreneurial ecosystem. This refers to the availability of sufficient office space, telecommunication facilities and transportation infrastructure to foster venture establishment and expansion (Spigel, 2017). According to Audretsch et al. (2015) physical infrastructure can improve connectivity and linkages that assist in the recognition of entrepreneurial opportunities and the ability of entrepreneurs to take advantage of these opportunities.

Productive Entrepreneurship

As the components are established, a better understanding is needed about the purpose the elements of the system are intended to perform. As the definition implies, the entrepreneurial ecosystem is a “set of interdependent actors and factors coordinated in such a way that they

enable productive entrepreneurship within a particular territory" (Stam & Spigel, 2016). Entrepreneurial activity is the first observable output of the ecosystem and is considered the process by which individuals explore, evaluate, and exploit opportunities for creating new goods and services (Stam & Spigel, 2016; O'Connor et al., 2018). However, entrepreneurial activity is only seen as an intermediary output indicating progress towards the desired outcome of value created within an economic and social context (O'Connor et al., 2018) As a result, the outcome, often referred to as successful entrepreneurial activity is narrowed down to innovative, growth-oriented entrepreneurship, as this is claimed to be a source of regional productivity, growth and employment (Stam & Spigel, 2016). Thus, traditional statistical indicators of entrepreneurship, such as self-employment or small businesses, are by definition excluded when assessing the outcome of the entrepreneurial ecosystem (Stam & Spigel, 2016). The desired outcome is further, including this research, referred to as the concept of productive entrepreneurship (Stam, 2018). Productive entrepreneurship implies "any entrepreneurial activity that contributes directly or indirectly to the net output of the economy or to the capacity to produce additional output" (Baumol, 1993). Thus, productive entrepreneurship refers to establishing and expanding new enterprises that generate economic value by creating jobs, stimulating innovation, or enhancing productivity development (O'Connor et al., 2018).

A Gap in the Literature

The extensive body of literature on the entrepreneurial ecosystem offers a comprehensive framework, including the components, their relevance, and the desired outcome of productive entrepreneurship. Yet, there seems to be a gap in the literature providing empirical evidence, as the relationship between the components and the outcome remains inadequately studied. In many cases, single components have been empirically analysed. As an example, Sato et al. (2012)

assessed the effect of market accessibility on entrepreneurship, and Beugelsdijk (2007) investigated the relationship between regional cultures and economic activity. Nonetheless, an empirical analysis including all components has been conducted very few times, including relatively small sample sizes. One study having done so is by Stam (2018), who measured the entrepreneurial ecosystem within all regions throughout the Netherlands. Thus, the contribution of this study lies in extending the literature by measuring the effect of the distinctive ecosystem components on productive entrepreneurship, by looking at an enlarged sample size including different regions throughout the EU.

Methodology

To answer the research Question: How do the components of the Entrepreneurial Ecosystem affect productive entrepreneurship at the regional level, a multiple regression analysis was carried out. Multiple regression allows us to analyse the relationship between a single dependent variable defined in this research as productive entrepreneurship and the numerous independent variables resembling the individual components of an Entrepreneurial Ecosystem.

Fitting the Multiple Regression Model

$$y_i = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \beta_3 x_{i,3} + \ldots + \beta_k x_{i,k} + \varepsilon_i \quad (1)$$

Equation (1) above shows the multiple regression equation used for quantifying the economic relationship between the multiple independent variables (x) and the single dependent variable (y). The dataset used is cross-sectional, and within the model, the regional dimension is

denoted by i. Thus, y_i refers to the value y takes within the given region i. The intercept $\beta_{,0}$, further referred to as constant, is the predicted mean value of the dependent variable y in the case of all independent variables x being equal to zero. The estimated regression coefficient β represents the change in y due to a one-unit change in the respective independent variable, ceteris paribus. Lastly, ε denotes the stochastic (random) error term, which presents the difference between the observed value of the dependent variable and the conditional mean of the dependent variable derived from the model (Pedace, 2013).

As stated before, productive entrepreneurship is the dependent variable of my model. The different components of the Entrepreneurial Ecosystem are the independent variables. To address the possibility of reverse causality, a time lag between the dependent variable and independent variables has been applied. The dependent variable uses data from 2019, whereas the independent variables are measured in 2016, with a few exceptions due to limited data availability.

The multiple regression analysis has been carried out in different stages. To begin with, three multiple regressions have been executed, with the first one investigating the relationship between the dependent outcome variable and the independent variables classified under the cultural components of the Entrepreneurial Ecosystem. The second multiple regression analysis examined the relationship between the dependent outcome variable and the independent variables categorised as social attributes. Consequently, the third multiple regression analysis inspects the relationship between the dependent outcome variable and the independent variables defined as material attributes. Lastly, a fourth multiple regression analysis was carried out, incorporating all independent variables falling under the components of an Entrepreneurial

Ecosystem. This allows us to observe how each group of attributes affects the outcome variable and how this varies when all components are considered.

Data

The dependent and independent variables are measured at the NUTS2 regional level throughout the EU member states [1]. The cross-sectional dimension of regions followed the common NUTS (Nomenclature of territorial units for statistics) classification of economic territorial units for statistics (NUTS) established by Eurostat (Gouardères, 2022). The current NUTS classification is valid from 1 January 2021 and lists 242 regions at NUTS2 (Eurostat, 2022).

To measure the individual components of an Entrepreneurial Ecosystem, the following indicators have been used (A list of the indicators can be found in Table 2 below):

Cultural Attributes

Supportive Culture: Entrepreneurship culture resembles an informal institution and represents the extent to which society values entrepreneurship. A supportive culture refers to cultural attitudes that encourage and normalise entrepreneurial activities, risk-taking, and innovation (Stam, 2018). To quantify these characteristics, data from the eighth round of the European Social Survey (ESS), falling under the topic of "Welfare Attitudes, Attitudes to Climate Change", has been used (European Social Survey, n.d.). The ESS is a multi-country survey administered in over 30 countries at the NUTS2 and, or NUTS1 level (depending on the country) (European Social Survey, n.d.). The proxy variable chosen to measure the cultural

[1] Countries included: Austria, Bulgaria, Switzerland, Czech Republic, Denmark, Estonia, Spain, Finland, France, Croatia, Hungary, Italy, Lithuania, Latvia, Malta, Netherlands, Poland, Portugal, Romania, Sweden, Slovakia

attitudes is from 2016. It resembles the indicator classified as “Important to try new and different things in life” within the integrated data set of the ESS. In the ESS, this is indicated as an ordinal variable, where the participant was asked to what extent the following example resembles them: “She/he likes surprises and is always looking for new things to do” and “She/he thinks it is important to do lots of different things in life”. The participant was able to answer this question on the following scale:

- 1 = Very much like me
- 2 = Like me
- 3 = Somewhat like me
- 4 = A little like me
- 5 = Not like me
- 6 = Not like me at all

Within the Integrated dataset available at the Data Portal of the European Social Survey the results were given for every individual participant. Thus, for every NUTS2 region, all responses were collected and averaged to be applicable. After the responses were averaged, the distribution of the values included in the variable showed a minimum of 2 and a maximum of 4. Thus, none of the regions included in the dataset indicate a very much supportive culture towards entrepreneurial activity (1), nor a non-existing supportive culture towards entrepreneurial activity (5,6).

A second component under the cultural attributes pillar is Histories of entrepreneurship. Yet, there is no representative proxy variable available for this component at the NUTS2 regional level. Thus, the cultural components must be summarised by the attribute referred to as Supportive Culture.

Social Attributes

Worker Talent: Worker talent refers to the presence of skilled workers, thus the extensiveness of individuals with a high human capital. This is measured as the percentage of the population having attained tertiary education. This includes any type of education pursued beyond the High School level, encompassing diplomas, undergraduate, bachelor, master, and doctorate (Eurostat, n.d.a). This data is retrieved from Eurostat falling under the dataset name "Population by educational attainment level, sex and NUTS2 regions (%) (Eurostat, 2023). The data chosen is from 2016 and includes people of all gender between the ages of 20 till 64.

The indicator includes 174 observations in this dataset. Overall, there is a wide disparity across regions, with the highest region Warszawski stoleczny (Warsaw), the capital of Poland, with 53.3% having almost five times the percentage of the population having attained tertiary education compared to the lowest region Nord-Est, in the north of Romania, with 11.5%.

Network: Networks suggest the connectedness of enterprises for new value creation. Social networks facilitate expertise and skill sharing and link entrepreneurs, investors, advisors and workers (Stam, 2018). The data used to measure this component is from the Regional Innovation Scoreboard, established by the European Commission. The Regional Innovation Scoreboard (RIS), a regional extension of the European Innovation Scoreboard (EIS), evaluates the performance of Innovation in European regions based on a limited number of variables. The RIS 2021 offers a comparative evaluation of the effectiveness of innovation systems across 240 regions of 22 EU countries (European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, 2021). The indicator chosen from this dataset is called "Innovative SMEs collaborating with another " and measures Innovative SMEs collaborating as

a percentage of SMEs (European Commission, n.d.). Data for this indicator is solely available for the year 2021.

This variable includes 147 observations in the dataset. Again, there is a wide disparity in the network component between regions. The highest regions lie in Finland, where it is indicated that all innovative businesses collaborate with one another. Comparatively, none of the innovative enterprises appear to collaborate in Ciudad de Ceuta, Spain.

Excluded from this analysis must be the component of Investment Capital and Mentors and Role models. This is due to insufficient data applicable to the regional scale throughout the EU.[2]

Material Attributes

Policy and Governance: Institutions, both formal and informal, reflect the rules of the game in society and, thus, entrepreneurial activity (Stam, 2018). This analysis uses data from the European Quality of Governance Index 2017 to measure the component of Policy and Governance (University of Gothenburg, 2022). The index ranges from -3 to 3. It focuses on individuals' perceptions and experiences with public sector corruption and their judgements on how impartial and of good quality the public sector is at allocating resources to different services. The index is based on an extensive citizen survey covering all 27 EU member states (Charron et al., 2019).

This variable includes 163 observations. Overall, the Index shows a negative mean at -0.010 and varies significantly across all regions. The lowest Quality of Government Index is

[2] Investment capital can be very well measured at the national level with data provided by the European Central Bank, which conducted a survey on enterprises' access to finance nationally (European Central Bank, 2016).

recorded in Severozapaden, Bulgaria, with -2.158. On the other hand, the highest score can be seen in Aland, Finland, with 2.377.

Universities: Universities and higher education institutions train new entrepreneurs and produce new knowledge spillovers (Stam, 2018). The attribute of Universities will be measured as the percentage of Gross Domestic Product expenditure on Research and Development in higher education. The dataset can be found in Eurostat under the name "GERD by sector of performance and NUTS2 regions" (Eurostat, 2023b). This component is measured for the year 2016.

This variable includes 103 observations. Overall, across all regions, a tiny percentage of the GDP is spent on R&D within higher education, with the mean lying at 0.31 per cent. The smallest percentage is spent in Sud - Muntenia, Romania, with 0.01 per cent. Comparatively, Hovedstaden, the capital region of Denmark, has the largest expenditure on R&D in higher education, with 1.36 per cent.

Support Services: Support services resemble firms and organisations that provide ancillary services to new ventures, for example, patent lawyers, incubators, and accountancies. This attribute is measured as the percentage of the population employed working in services, including the finance and insurance sector. This variable is calculated using the absolute number of people employed and the absolute number of people employed in services, including finance and insurance. Both quantities can be found in the dataset "Employment by sex, age, economic activity and NUTS2 regions (NACE Rev. 2) (1000)" available on Eurostat (Eurostat, 2023c). The data used for this component is from 2016 and includes people of all gender between the age of 15 and 74.

This variable includes 175 observations with a mean value of 2.36. Again, there seems to be a large disparity between regions. The highest region, with 8.29 per cent of the population employed in services, including the finance and insurance sector, is Zürich, Switzerland.

Physical Infrastructure: This attribute captures the availability of transportation and digital infrastructure to enable venture creation and growth. This is measured by the "Infrastructure" pillar included in the European Regional Competitiveness Index 2016. The Regional Competitiveness Index (RCI), introduced and released every three years, enables regions (NUTS2) to track and evaluate their performance through time and in comparison to other regions (European Commission, n.d.b). The RCI comprises 11 pillars, each explaining a distinct facet of competitiveness (Annoni et al., 2017). The pillar defined as Infrastructure is measured on a score from 0 to 100 and encompasses the following indicators: Motorway potential accessibility, Railway potential accessibility, Number of passenger flights (accessible within 90'drive), and Intensity of high-speed railways (Annoni et al., 2017).

This variable includes 159 observations and has a mean value of 29.69. Again, there is a large disparity between the regions in the dataset. The highest score of 100 for this index is from the region Île de France in France.

Open Markets: The component of Open Markets refers to the presence of sufficient local opportunities and potential market demand enabling venture creation and unconstrained access to global markets. This is measured by the "Market size" pillar included in the European Regional Competitiveness Index 2016. Again, this is measured on a scale from 0 to 100 and includes the following indicators: Disposable income per capita, potential market size expressed in GDP, and Potential market size expressed in the population (Annoni et al., 2017).

This variable includes 159 observations and has a mean value of 26.58. Again, there is a large disparity across all regions. The highest score with 84.92, is again from the region Île de France in France. On the other hand, the lowest score 1.13 is from Severozapaden, Bulgaria.

Outcome

Productive Entrepreneurship: Productive entrepreneurship is proxied with the prevalence of High-growth enterprises within a region. This is measured as the percentage of high-growth enterprises (measured in employment) of active enterprises with at least 10 employees. The dataset "Business demography and high growth enterprise by NACE Rev. 2 and NUTS 3 regions" can be found in Eurostat. High-growth enterprises, in this case, is defined as an enterprise with average annualised growth in number of employees greater than 10 % per year over three years (t – 3 to t) and having at least 10 employees at the beginning of the growth (t – 3). The data retrieved is from 2019, and the statistical classification of economic activity used includes industry, construction and services, except activities of holding companies (Eurostat, 2023d).

This variable consists of 175 observations and has a mean value of 11.09. The region with the lowest prevalence of high-growth enterprises, thus productive entrepreneurship, is Centru, Romania, with 2.02 per cent. Comparatively, the highest prevalence is Helsinki-Uusimaa, Finland, with 16.93 per cent.

Below in Table 2, the components, their corresponding proxy variable and the data source are summarised.

Table 2. List of Indicators

Attribute	Description	Indicator	Unit of	Data Source

			measurement	
Cultural Attributes				
Supportive culture	Cultural values that encourage and endorse entrepreneurial activities, risk-taking and innovation.	Importance of trying new and different things in life.	Measured on a scale from 1 to 6. 1 = very much like me 6 = not like me at all	European Social Survey round 8 - 2016. Welfare attitudes, Attitudes to climate change (impdiff) (European Social Survey, n.d.)
Social Attributes				
Worker Talent	The presence of rich human capital.	Percentage of the population having attained tertiary education.	Percentage (%) of population (age: 20-64).	Eurostat (EDAT_LFSE_04) (Eurostat, 2023)

Networks	Social networks that facilitate expertise and skill sharing and link entrepreneurs, investors, advisors and workers.	Innovative SMEs collaborating with another.	Innovative SMEs collaborating with another as a percentage (%) of SMEs.	Regional Innovation Scoreboard, European Commission (European Commission, n.d.)
Material Attributes				
Policy and Governance	Laws and regulations that support entrepreneurship	European Quality of Government Index	Index (-3 - 3)	European Quality of Government Index (University of Gothenburg, 2022)
Universities	Universities training new talent and producing	Percentage of GDP spend on R&D in higher education sector	Percentage of GDP (%)	Eurostat (RD_E_GERDREG) (Eurostat, 2023b)

	knowledge spillovers			
Support Services	Firms and organizations that provide ancillary services to new ventures	Percentage of the population employed working in services including the finance and insurance sector	Percentage (%) of the population employed in services including the finance and insurance sector (age: 15-74)	Eurostat (LFST_R_LFE2EN2) (Eurostat, 2023c)
Physical Infrastructure	Availability of transportation and digital infrastructure to enable venture creation and growth	Infrastructure	Score from 0 - 100	Regional Competitiveness Index (European Commission, n.d.b)
Open Markets	Presence of sufficient local opportunities and potential	Market size	Score from 0 - 100	Regional Competitiveness Index (European Commission,

	market demand enabling venture creation and unconstrained access to global markets			n.d.b)
Outcome				
Productive Entrepreneurship	Enterprises that generate economic value	Prevalence of high-growth enterprises	Percentage (%) of high-growth enterprises (measured in employment) of active enterprises with at least 10 employees	Eurostat (BD_HGNACE 2_R3) (Eurostat, 2023d)

Results

The following section will present the four regression models and discuss the empirical findings.

VARIABLES	(1.Culture) Productive Entrepreneurship: High-growth enterprises	(2.Social) Productive Entrepreneurship: High-growth enterprises	(3.Material) Productive Entrepreneurship: High-growth enterprises	(4.Complete) Productive Entrepreneurship: High-growth enterprises
Supportive Culture = 3	-0.597			-0.0688
	(0.380)			(0.430)
Supportive Culture = 4	-2.077			-3.831**
	(2.148)			(1.508)
Worker Talent		0.0698***		0.143***
		(0.0242)		(0.0333)
Networks		2.091**		-0.490
		(1.035)		(1.104)
Policy and Governance			0.921**	-0.333
			(0.423)	(0.419)
Universities			1.929	4.027***
			(1.743)	(1.272)
Support Services			0.454	-0.105
			(0.391)	(0.290)
Physical Infrastructure			-0.00898	0.00422
			(0.0423)	(0.0250)
Open Markets			0.00780	-0.0330
			(0.0476)	(0.0308)
Constant	11.79***	8.398***	10.14***	8.485***
	(0.251)	(0.923)	(0.851)	(1.069)
Observations	129	146	99	61
R-squared	0.025	0.114	0.158	0.598

Level of statistical significance
*** p<0.01, ** p<0.05, * p<0.1

Multiple Regression Model 1: Cultural Attributes

The first regression includes the components classified under Cultural Attributes of the Entrepreneurial Ecosystem. In the scope of this study, this is summarised as Supportive Culture, measured by using data collected on Human Values by the European Social Survey. This regression includes 129 observations and is tested for the assumption of Homoscedasticity with the Breusch-Pagan test, which is found to be not violated. The regression model shows an R-squared value of 0.025. This implies that the independent variable can explain 2.5 per cent of

the variance in the dependent variable, defined as productive entrepreneurship and measured as the prevalence of High-growth enterprises. The Cultural Attribute classified as a Supportive Culture towards entrepreneurial activity is a categorical variable and proxied as the attitude towards trying new and different things in life. In this dataset, the range of this variable lies between 2 and 4, with the number 2 depicting a favourable attitude towards change and trying new and different things in life. Whereas the higher numbers, in this case, 3 and 4, show a decreased supportive culture towards change and trying new and different things in life and, thus, a decreased positive attitude towards entrepreneurial activity. The categorical variable classified as supportive culture was transformed into dummies. The dummy variable not included in the regression but used as a base category is a supportive culture equal to 2. The dummy variables Supportive Culture = 3 and Supportive Culture = 4, both depicting a decreased supportive culture towards entrepreneurial activity, were included in the regression. Yet, in this model, both coefficients are not considered statistically significant.

Multiple Regression Model 2: Social Attributes

The second multiple regression analysis incorporated all attributes classified under the Social Attributes of an Entrepreneurial Ecosystem. Based on the data available, this includes Worker Talent and Networks. This regression model encompasses 146 observations. It was checked whether the problem of Multicollinearity occurs by looking at the correlation matrix (see Appendix 3). All correlation coefficients were below the 0.8/0.9 threshold, thus, imposing no issue of Multicollinearity. Further, the regression model was tested for the assumption of Homoscedasticity, which was found to be violated and, thus, corrected for using robust standard errors. The regression model shows an R-squared value of 0.114, implying that the independent

variables can explain 11.4 per cent of the variance in the dependent variable. Both Work Talent and Networks are continuous variables measured in percentage. For Worker Talent, the coefficient is 0.0698. As such, a one percentage point increase in the population having attained tertiary education is associated with an increase of 0.0698 percentage points in the dependent variable, ceteris paribus. This coefficient is statistically significant at the one per cent level. In the case of Networks, which is measured as the percentage of Innovative SMEs collaborating with one another, this model shows a positive coefficient with a value of 2.091. Thus, a one percentage point increase in the share of Innovative businesses collaborating with each other leads to an increase of 2.091 percentage points for the prevalence of High-growth enterprises, ceteris paribus. This coefficient is significant at the five per cent level.

Multiple Regression Model 3: Material Attributes

The third regression model, as explained in the methodology section, entails all the attributes classified as a Material Attribute of the Entrepreneurial Ecosystem. This includes Policy and Governance, Universities, Support Services, Physical Infrastructure and Open Markets. Again, when conducting the regression analysis, it was checked for the assumption of Multicollinearity (see Appendix 4) and Homoscedasticity. In this model, both of the assumptions were met. The model includes 99 observations and shows an R-squared value of 0.158. This means that the independent variables can explain 15.8 per cent of the variance in the dependent variable, namely the prevalence of high-growth enterprises. Looking at the individual independent variables, there is one attribute whose coefficient is considered statistically significant, namely Policy and Governance, which the European Quality of Governance Index measures. The coefficient for this variable lies at 0.921 and is considered statistically significant at the five per cent level. For the remaining variables included in this model, the coefficients

showed no statistical significance. This includes Universities, measured as the percentage of Gross Domestic Product expenditure on Research and Development in higher education, which shows a positive coefficient of 1.929. Further, Support Services, measured as the percentage of the population employed working in services, including the finance and insurance sector, which shows a positive coefficient of 0.454. Open Markets, measured by the Regional Competitiveness Index, shows a positive coefficient with the value of 0.00780. Lastly, Physical Infrastructure, measured by the RCI, shows a negative coefficient equal to -0.00898.

AttributesRegression Model 4: Complete

As mentioned above, the final regression model incorporates all components of the Entrepreneurial Ecosystem. Within this model, there are 61 observations. Again, it was checked for Multicollinearity by looking at the correlation matrix (see Appendix 5). All correlation coefficients were below the 0.8/0.9 threshold, thus, imposing no issue of Multicollinearity. Further, it was checked for the assumption of Homoscedasticity, which was not found to be violated. The R-squared value for this model lies at 0.598. Thus, the independent variables can explain 59.8 per cent of the variance in the outcome variable, defined as productive entrepreneurship and measured as the prevalence of high-growth enterprises. This model shows three components whose impact on the dependent outcome variable is considered statistically significant and thus. The first one is Universities, measured as the percentage of Gross Domestic Product expenditure on Research and Development in higher education. In the third regression model, incorporating all Material Attributes, the impact of Universities on the dependent variable was not statistically significant, with a coefficient holding the positive value of 1.929. Yet, with all components included in the model, the impact of Universities is statistically significant at the

one per cent level. The coefficient for Universities within the fourth model lies at 4.027, implying that a one unit increase in the percentage of Gross Domestic Product expenditure on Research and Development in higher education leads to an increase of 4.027 percentage points in the prevalence of High-growth enterprises, ceteris paribus. Additionally, Worker Talent appears to be robustly significant, as its coefficient shows a statistical significance at the one per cent level within the second model (Social Attributes) and a statistical significance at the one per cent level in the fourth regression model (Complete Model). The coefficient in the complete regression model stemming from the independent variable of Worker Talent is positive and lies at 0.143. This implies that a one percentage point increase in the population having attained any level of tertiary education leads to an increase of 0.143 percentage points in the prevalence of high-growth enterprises, ceteris paribus. This is considered a larger effect on the dependent outcome variable compared to the second regression model, where the coefficient of the independent variable defined as Worker Talent is valued at 0.0698. Lastly, the coefficient for the dummy variable named “Supportive Culture = 4”, which indicates a regional culture supporting entrepreneurial activity “a little”, is considered statistically significant at the one per cent level and valued at -3.831 within the fourth complete regression model. This implies that productive entrepreneurship is 3.831 units lower, meaning the share of high-growth enterprises is 3.831 percentage points lower, in regions supporting entrepreneurial activity “a little”, compared to regions showing a favourable attitude towards trying new and different things in life (supportive culture = 2, the base category, ceteris paribus. Compared to the first regression model, incorporating the Cultural Attributes, this coefficient was valued at -2.077 and not considered statistically significant.

Additionally, the fourth model includes independent variables whose coefficients were shown to be statistically significant in prior models yet, not in the regression model that incorporates all the components of an Entrepreneurial Ecosystem. This includes Networks and Policy and Governance. In the second regression model that includes the Social Attributes, the impact of Networks was found to be statistically significant at the five per cent level with a positive coefficient of 2.091. However, the fourth model's coefficient for Networks has a negative value of -0.490. Similarly, the independent variable named Policy and Governance has a positive coefficient of 0.921 in the third model, which is statistically significant at the five per cent level, and a negative and insignificant coefficient valued at -0.333 in the fourth model.

Further, the fourth regression model includes independent variables whose impact on the dependent variable is not considered statistically significant throughout any of the prior models. This includes Physical Infrastructure with a positive coefficient of 0.00422, Support Service with a negative coefficient valued at -0.105, and Open Markets with a negative coefficient of -0.0330.

Discussion

This research examines how and to what extent the different components of the Entrepreneurial Ecosystem statistically account for variations in productive entrepreneurship, measured as the prevalence of high-growth enterprises, at the regional level. In order to investigate this, a multiple linear regression analysis including eight of the eleven identified components was executed. As explained in the methodology sector, this analysis is broken down into four regression models. The first three models include the individual attributes classified under either cultural, social, or material attributes, and the fourth model includes all components collectively. This allows us to observe how each group of attributes affects the outcome variable

and how this varies when all components are considered. Despite the rich literature providing theoretical evidence on the positive effects of all components on productive entrepreneurship, only a small number of indicators were found to influence the outcome variable on a statistically significant level. Some indicators even showed a negative coefficient. Yet, the lack of statistically significant relationships between predictor variables and productive entrepreneurial outcome does not imply that these components are not important, as there might be several factors explaining these results. A theoretical explanation argued by Stam (2018) implies that some values included in the measurement may already be above the required threshold for Europe. Due to data availability, the data included in this analysis frequently involves high income countries and regions, whose attributes are comparatively well established (Annoni & Dijkstra, 2013). Additionally, the indicators used to measure the individual components identified in the literature may negatively impact the results of the regression analysis. The chosen proxy variables might not accurately reflect the real world attributes and their process of influencing productive entrepreneurial activity. Lastly, the outcome of the model may be influenced by the sample size. As can be seen in the results, different components including Policy and Governance as well as Networks were thought to have a significant impact on the outcome variable within the second and third regression model. Yet, the results changed in the complete regression model that includes the smallest number of observations.

Nevertheless, the effect of regional worker talent on the prevalence of productive entrepreneurship showed statistical significance at the one percent level throughout the second and fourth regression model. This is consistent with the literature presented above. The impact, suggested by the coefficient, of having attained tertiary education on the outcome variable even

increased when all components were taken into account. In the second model, which includes all social attributes, the coefficient for worker talent is positively valued at 0.0698. In the fourth regression model this increases to 0.143, implying that a one percentage point increase in the population having attained any level of tertiary education leads to a positive increase in the prevalence of high-growth businesses by 0.143 percentage points. These findings are in line with the results by Stam (2018), whose model found higher education to be the only indicator significantly impacting the outcome. The results are further supported by literature and other empirical studies (Barro, 2013; Wang & Liu, 2016; Prasetyo, 2020). As an example, the study conducted by Glaeser et al. (1955) examined "the relationship between urban characteristics in 1960 and urban growth, measured in income and population, between 1960 and 1990. One of the paper's primary findings was the positive correlation between initial schooling and both growth types, including population growth and income (Gaeser et al.1955). Scholars argue that skilled labor is a crucial component for a new venture's competitiveness and a prerequisite for success in the modern knowledge economy (Kenney & Patton, 2005; Spigel 2017). Human capital essentially fosters technological transitions and increases the capacity for innovation, two phenomena closely intertwined and resulting from entrepreneurial activity (Tapia, 2014).

Further, in line with the literature presented above are the results attributed to the universities component. The indicator for universities is considered to have a significant impact at the one percent level on the outcome variable in the fourth regression model that incorporates all components of the Entrepreneurial Ecosystem. The impact, indicated by the coefficient, is relatively large. The model predicts a 4.027 percentage point increase in the prevalence of high-growth enterprises for every one percentage point increase in GDP spent on research and development in the higher education sector. As explained in the literature above, universities

have become a central actor in the knowledge-based economy as a result of their proactive support of technological development and innovation (Bramwell & Wolfe, 2008; Reichert, 2019). The knowledge produced in universities is transmitted into the local economy through a social and interactive procedure involving different stakeholders. According to Bramwell and Wolfe (2008), universities offer various important channels of knowledge exchange in addition to highly qualified researchers and commercially viable knowledge. Universities produce and draw talent, which increases the volume of tacit knowledge in the local economy and the size of the labour market (Betts & Lee, 2004). As a result, the presence of universities strengthens a region's appeal to skilled and creative entrepreneurs, scientists, and engineers (Betts & Lee, 2004). Further, universities offer ongoing, firm-based R&D activities with specialised expertise, facilities, and formal and informal technical guidance (Bramwell & Wolfe, 2008). They serve as a conduit, allowing enterprises to access knowledge from "global pipelines" and international research networks (Batheld & Malmberg, 2004). Thus, universities function as an essential players in fostering regional economic development and enterprise formation by facilitating the exchange of tacit knowledge among networks of innovative enterprises and operating as a creative hub sustaining the positive feedback loop of student recruitment and retention (Bramwell & Wolfe, 2008). The theoretical framework does not only align with the results of this research but is further supported by different empirical studies (Huggins & Johnston, 2009; Chandra, 2011).

In addition to universities, the results indicate that diminishing cultural support towards trying new and different things in life negatively impacts productive entrepreneurship, consequently, the emergence of high-growth enterprises on a statistically significant level of five per cent. The model shows that a regional culture only agreeing "a little" with trying new and

different things in life, proxied as attitudes towards entrepreneurial activity, negatively impacts the outcome variable by - 3.831 percentage points. These results align with the theoretical framework presented in the literature above and additional empirical studies investigating the impact of regional cultures on economic activity (Hayton & Cacciotti, 2013; Fritsch & Wyrwich, 2017). To provide one example, the study conducted by Beugelsdijk (2007) investigates the relationship between entrepreneurial culture and economic development within 54 European regions (NUTS1). The findings suggest that regions with higher economic growth rates and greater innovation levels can be characterised by an entrepreneurial culture (Beugelsdijk, 2007). As the influential scholar William Baumol explains it: "If we seek to explain the success of those economies that have managed to grow significantly, compared with those that have remained relatively stagnant, we find it difficult to do so without taking into consideration differences in the availability of entrepreneurial talent and the motivational mechanisms that drive them" (Baumol, 1993).

Lastly, Policy and Governance and networks were found to be statistically significant in the regression model incorporating either material attributes or social attributes. Yet, not in the fourth regression model, including all components of the Entrepreneurial Ecosystem. The role of government and policy in fostering socio-economic development at the regional level is frequently highlighted in the literature (Rothstein et al., 2013; Charron et al., 2014). Although EU and national policy objectives provide the initial impetus and establish an overarching framework of operations, regions and municipalities, play an important role in altering these visions into regional and local realities (Tapia, 2014). Additionally, the significance of social networks in regional economies has been discussed by different scholars (Huggins & Thompson, 2015; Makarem, 2016). Strong social networks are considered to be of value, as they facilitate

the formation of productive connections and the coordination of resources, which can aid the individual members in achieving their private and organisational objectives. Relationship networks further have a beneficial effect on the innovative and entrepreneurial spirit. They contribute to regional economic development, innovation, and resilience by fostering connections and leveraging network participants' collective resources and intellect of the network participants (Chen et al., 2018). In their research from 2018, Chen et al. (2018) assessed the impact of social networks and entrepreneurship on the economic development of Chinese regions. The empirical findings show that social networking and entrepreneurship both significantly support regional economic growth (Chen et al., 2018).

Despite the literature providing sufficient theoretical and empirical evidence on the importance of networks as well as policy and governance for a successful Entrepreneurial Ecosystem, their impact is not considered statistically significant when all components are included. The results might suggest an omitted variable bias in the first three regression models, as important components relevant for explaining the variance within the dependent variable are not considered. Excluding relevant components can lead to misleading coefficient estimates and false conclusions about the relationship between the independent variables and the dependent variable, the results suggest that the variance is best explained by and attributed to the components discussed prior. Yet, the final regression model might be of no exclusion to this error. Due to limited data availability, discussed in the methodology section, this study only includes eight out of the eleven components considered essential for an Entrepreneurial Ecosystem. The components of entrepreneurial history, mentors and role models, and capital investment are absent from the regression analysis. Three crucial elements that might significantly affect the outcome.

Limitations

This brings us to the limitations of this research. Next to the omitted variable bias discussed above, further shortcomings need to be carefully considered. The phenomenon of reversed causality is one of them. This refers to the issue where the assumed cause-and-effect relationship between the independent variable and the outcome variable is reversed, leading to false conclusions about the causal inference. In order to minimise the potential for reversed causality, this study employs a longitudinal study design, with the majority of the independent variables (dependent on the availability of data) being measured three years prior to the outcome variable. Yet, taking the component of Universities as an example, the study by Chandra (2011) examines the relationship between government expenditure on education and economic growth. The results of the empirical analysis suggest that government expenditure on education is affected by economic growth. Still, investment in education further tends to influence economic growth with a time lag (Chandra, 2011). Thus, further research requires a closer look at the underlying mechanisms in which the dependent variables interact with other components and factors of the region and how this affects the outcome to establish accurate pathways through which a cause leads to the effect. Further, the quality of data needs to be discussed as an additional possible limitation. The quality of data has an important bearing on the accuracy and reliability of the regression model. Thus, it is crucial that the proxy indicators chosen reflect the real-world component of the ecosystem as precisely as possible. The indicators used for this research were carefully chosen after a thorough analysis of the literature, which included measurement frameworks on the entrepreneurial ecosystem (Nicotra et al., 2018), potential indicators (Annoni et al., 2017; Nicotra et al., 2018), and previous empirical studies (Stam, 2018). Despite the effort to ensure the data's accuracy, completeness and reliability, there may

still be real-world factors and procedures influencing the outcome variable that the indicators are unable to capture. This may be more an issue for abstract components, including a supportive culture or networks, compared to tangible aspects, such as physical infrastructure. Furthermore, the indicators used to conduct this research are examined at a given point in time. Yet, the entrepreneurial ecosystem is dynamic in nature, evolving over time with the individual components interacting with one another. We are able to retrieve information on the effect of individual components by decomposing the entrepreneurial ecosystem into its distinctive elements and regressing them against the outcome, but this method does not provide a dynamic ecosystem analysis. This static approach to the Entrepreneurial Ecosystem at one given time cannot capture the interactive nature between individual components nor the process of resource flow of any given type. In light of this, Stam (2018) suggests an Entrepreneurial Ecosystem Index mapping the quality and complex nature of the ecosystem. Additionally, despite the simple fact that empirical analysis allows us to examine trends in the relationship between the many components and the outcome, every ecosystem is uniquely bound to the characteristics of its region. Thus, for the sake of policy, this research provides indicators of focus. Yet, regional interventions must carefully consider the characteristics distinctly shaping the region and its ecosystem.

Conclusion

This research has posed the question of how the components of the entrepreneurial ecosystem affect productive entrepreneurship at the regional level in light of the emerging framework on entrepreneurial ecosystems and its growingly acknowledged importance in the policy discussion on regional economic and social development. According to Stam and Spigel

(2016), an entrepreneurial ecosystem is "a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory" (Stam & Spigel, 2016). These actors and factors refer to a variety of components, such as the cultural attributes of a supportive culture and a history of entrepreneurship, the social attributes of worker talent, investment capital, networks, as well as mentors and role models and finally, the material attributes of policy and governance, universities, support services, physical infrastructure, and open markets. In order to investigate the impact these individual components have on the outcome, referred to as productive entrepreneurship, a multiple regression analysis, including a number of steps was carried out. According to Baumol (1993), productive entrepreneurship " is any entrepreneurial activity that contributes directly or indirectly to net output of the economy or the capacity to produce additional output" (Baumol, 1993). Thus, throughout this study, the outcome of productive entrepreneurship is measured as the prevalence of high-growth enterprises within a region. Yet, due to limited data availability, the three components of entrepreneurship history, investment capital, as well as mentors and role models were not included in this analysis. The findings revealed that, despite the abundance of theoretical evidence on the positive effect of all components on productive entrepreneurship, only a few attributes were shown to significantly impact the outcome variable. The components of worker talent, universities and a supportive culture proved a significant impact on the outcome variable within the fourth model investigating all components. These findings are supported by theoretical and empirical literature, indicating that these components are crucial elements for fostering productive entrepreneurship at the regional level. Although this study is not free of limitations, it provides valuable insights into the role of different components of the entrepreneurial ecosystem and their effect on the ultimate outcome of productive

entrepreneurship. This serves as a contribution by providing areas of focus for further research and policy discussion on the economic and social development of regions.

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Appendices

Appendix 1

Table showing the summary statistics of the variables included in the regression analysis.

Variable	Observations	Mean	SD	Minimum	Maximum
Cultural Attribute					
Supportive Culture	129		.	2	4
Social Attributes					
Worker Talent	174	28.71609	9.525917	11.5	53.3
Networks	147	0.4135211	0.2345283	0.0557549	1
Material Attributes					
Policy and Governance	163	-0.0102515	0.9929134	-2.158	2.377
Universities	103	0.3114563	0.2330085	0.01	1.36
Support Service	175	2.355002	1.309275	0	8.285277
Physical Infrastructure	159	29.68537	20.3393	0	100
Open Markets	159	26.58466	15.85663	1.134365	84.92451
Outcome					
Productive Entrepreneurship	175	11.0968	2.827775	2.02	16.93

Appendix 2

Table showing the summary statistics of the variables included in the separate regression models.

Variable	Observations	Mean	SD	Minimum	Maximum
Multiple Regression Model 1: Cultural Attributes					
Supportive Culture	129			2	4
Productive Entrepreneurship	129	11.51217	2.143399	6.75	16.93
Multiple Regression Model 2: Social Attributes					
Worker Talent	146	28.43904	10.18908	11.5	53.3
Networks	146	0.4117671	0.2343662	0	1
Productive Entrepreneurship	146	11.24274	2.952945	2.02	16.93
Multiple Regression Model 3: Material Attributes					
Policy and Government	99	-0.4107374	0.9040366	-2.089	2.377
Universities	99	0.3047475	0.2334626	0.01	1.36
Support Services	99	2.018545	1.080159	0	5.710391
Physical Infrastructure	99	21.77407	13.34825	0	59.23413
Open Markets	99	22.10135	12.71902	1.502617	60.83728
Productive Entrepreneurship	99	11.24737	3.346031	2.02	16.93
Multiple Regression Model 4: Complete					
Supportive Culture	61			2	4
Worker Talent	61	25.51803	9.798308	13.1	51.6

Networks	61	0.4414269	0.2523296	0.1095472	1
Policy and Governance	61	-0.3764262	0.8517547	-2.089	2.377
Universities	61	0..3234426	0..1793589	0.03	0.75
Support Services	61	2.10629	1.024431	0	5.710391
Physical Infrastructure	61	25.46876	13.03558	0	**59.23413**
Open Markets	61	25.66925	12.05206	8.818405	60.83728
Productive Entrepreneurship	61	12.29459	2.069456	7.86	16.93

Appendix 3

Correlation Table Regression Model 2: Cultural Attributes

	Productive Entrepreneurship	Worker Talent	Networks
Productive Entrepreneurship	1.0000		
Worker Talent	0.2991	1.0000	
Networks	0.2507	0.3517	1.0000

Apendix 4

Correlation Table Regression Model 3: Material Attributes

	Productive Entrepreneurship	Policy and Governance	Universities	Support Services	Physical Infrastructure	Open Markets
Productive Entrepreneurship	1.0000					
Policy and Governance	0.3370	1.0000				
Universities	0.3159	0.5491	1.0000			
Support Services	0.2168	0.1083	0.3269	1.0000		
Physical Infrastructure	0.1396	0.1260	0.2984	0.5432	1.0000	
Open Markets	0.1515	0.1003	0.2509	0.6307	0.8203	1.0000

Appendix 5

Correlation Table Regression Model 4: Complete

	Productive Entrepreneurship	Supportive Culture	Worker Talent	Networks	Policy and Governance	Universities	Support Services	Physical Infrastructure	Open Markets
Productive Entrepreneurship	1.0000								
Supportive Culture	-0.1227	1.0000							
Worker Talent	0.6520	0.0003	1.0000						
Networks	0.0341	0.0289	0.1343	1.0000					
Policy and Governance	0.3804	0.1849	0.6977	0.4429	1.0000				
Universities	0.4360	0.0241	0.3090	0.3810	0.2285	1.0000			
Support Services	0.0915	-0.1786	0.2835	0.1504	-0.0234	0.2169	1.0000		
Physical Infrastructure	-0.1504	-0.1368	-0.0222	0.2975	-0.1649	0.0462	0.5979	1.0000	
Open Markets	-0.1475	-0.0081	0.0666	0.3120	-0.0807	0.0346	0.6870	0.7970	1.0000