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The missing pillar: the creativity theory of knowledge spillover entrepreneurship

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Abstract Knowledge spillover theory of entrepreneurship and the prevailing theory of economic growth treat opportunities as endogenous and generally focus on opportunity recognition by entrepreneurs. New knowledge created endogenously results in knowledge spillovers enabling inventors and entrepreneurs to commercialize it. This article discusses that knowledge spillover entrepreneurship depends not only on ordinary human capital, but more importantly also on creativity embodied in creative individuals and diverse urban environments that attract creative classes. This might result in self-selection of creative individuals into entrepreneurship or enable entrepreneurs to recognize creativity and commercialize it. This creativity theory of knowledge spillover entrepreneurship is tested utilizing data on European cities.

Keywords Entrepreneurship · Creativity spillover · Human capital · European city

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1 Introduction

Where does new knowledge come from? This question has drawn attention in management, economic geography and strategic entrepreneurship literature. New knowledge is an outcome of the "learning by doing" process (Arrow 1962) or may fall as "manna from heaven" (Audretsch 1995; Audretsch and Keilbach 2007).

The knowledge production function (KPF) suggests that technological R&D is a source of innovations, new knowledge (Jaffe 1986; Griliches 1979; Klarl 2013) and new firm growth (Stam and Wennberg 2009). This argument has been extended by new growth theory (Romer 1990) incorporating various institutional settings. The process of new knowledge commercialization through knowledge spillover becomes a key determinant of innovation and growth in industries and regions (Acs et al. 2009; Audretsch et al. 2006; Audretsch and Keilbach 2007, 2008; Audretsch et al. 2012; Piergiovanni et al. 2012). This is why the availability of new knowledge through universities, entrepreneurs and network-based industrial systems (Saxenian 1994) is a major incentive for firms to cluster in a region and develop new high-tech industries there (Marshall 1920; Jaffe 1986; Krugman 1991; Audretsch and Feldman 1996; Stam 2007).

Unlike the existing KPF and new growth theory, which assume knowledge spillover can occur automatically, recent works by Audretsch (1995), Acs et al. (2004, 2009), Audretsch et al. (2006), Audretsch and Lehmann (2005), Audretsch and Keilbach (2007), Audretsch et al. (2013) and Braunerhjelm et al. (2010) identified an entrepreneur as a primary conduit of transmitting knowledge spillover. Although their knowledge spillover of entrepreneurship theory (KSTE) oversees new knowledge developed by universities, individuals or incumbent organizations, it does not distinguish between ordinary human capital (Zucker et al. 1998; Acs et al. 2009) and intellectual human capital, which is creative capital or simply creativity (Florida 2002, 2004, 2011; Lee et al. 2004; Boschma and Fritsch 2009). Creativity is an excludable knowledge element, primarily personalized (tacit) knowledge of individuals. Unlike ordinary human capital traditionally proxied by educational attainment, which is widely diffused knowledge and can earn a normal rate of return (Braunerhjelm et al. 2010), creativity is embodied in creative classes (Florida 2004) and can earn higher than normal rates of returns. This fact might self-select creative people in entrepreneurship, specifically in places to move in that are attractive to the creative class. Cities with a larger share of the creative class demonstrate diversity and cultural openness, an established high-tech base and cultural amenities (Acs and Megyesi 2009). Concerning the increasing focus on the importance of creativity for entrepreneurship and regional economic development, see Florida (2004), Agarwal et al. (2007), Boschma and Fritsch (2009) and Piergiovanni et al. (2012).

This article argues that the knowledge spillover theory of entrepreneurship misses the creativity–entrepreneurship relationship, and this does not exhibit a clear mechanism of creativity spillover. We extend Romer's KPF approach and the KSTE by assuming creativity rather than ordinary human capital as a source of entrepreneurial opportunities.

We synthesize the KSTE with institutional settings to account for the "thickness" of the knowledge filter. It considers regulatory barriers to entrepreneurship, bureaucratic constraints, taxes, social acceptance, entrepreneurial opportunities and culture (Parker 2004; Acs et al. 2009; Stenholm et al. 2013). The knowledge filter explains why some creative individuals might decide against starting up a business, even when in possession of creativity.

This article develops the basis of creativity theory of knowledge spillover entrepreneurship, supported by a simple empirical test utilizing multilevel modeling methods on a cross-country, cross-city data set during 1999-2010 (Eurostat 2012). It provides insights into the relationships between creativity and entrepreneurial opportunities and distinguishes between ordinary human capital and creativity embodied in people (Romer 1990; Acs et al. 2009). We also enrich Florida's (2002, 2004) theory of creative classes by measuring creativity by "industry affiliation" where the creative class works rather than utilizing occupational data as a proxy for the creative class (Florida 2004; Boschma and Fritsch 2009).

This research is primarily conceptual and enriches the literature by integrating entrepreneurship and creativity together. On the one hand, we advance the KSTE (Audretsch 1995; Acs et al. 2004, 2009) by introducing creativity as a critical source of knowledge-based entrepreneurial opportunities. On the other hand, we extend the application of creativity spillover and the importance of places that attract creative people self-selecting into entrepreneurship. It demonstrates that creativity spillover of entrepreneurship can be equally important for owners of creativity (i.e., inventors, idea-holders) and entrepreneurs who commercialize creativity in the market.

This article proceeds as follows. Section 2 reviews the KSTE, knowledge production function and new growth theory highlighting the creativity-entrepreneurship nexus. The concept of creativity as a source of entrepreneurial opportunities is developed and then tested in a simple empirical model. The last section concludes.

2 The creativity-entrepreneurship nexus: the knowledge spillover theory of entrepreneurship

The knowledge spillover theory of entrepreneurship (KSTE) was developed as a response to the missing points in the knowledge production function (KPF) and new growth theory (Audretsch and Lehmann

2005; Acs and Armington 2006; Audretsch et al. 2006; Acs et al. 2009). The major point of KSTE is that entrepreneurs commercialize new knowledge available through incumbent companies.

The KSTE uncovers an entrepreneur as a conduit of transmitting knowledge spillovers and further contributes to knowledge-driven economic growth. New knowledge and ideas are a source of entrepreneurial opportunities, and therefore a lack of entrepreneurship may lead to low returns of knowledge (Michelacci 2002; Audretsch and Lehmann 2005) and lower growth (Fritsch 2008). Along with knowledge generically perceived as human capital, intellectual human capital such as R&D activity might be important as scholars have found a positive impact of knowledge spillover on economic performance when accounting for the role of R&D activity (Michelacci 2002; Braunerhjelm et al. 2010). R&D creative efforts enable the exploitation of external knowledge stimulating new product development by high-tech firms (Stam and Wennberg 2009; Acs and Sanders 2012).

Acs and Qian (2013) make it clear the KSTE delivers two stories: "(1) knowledge constructs one source of entrepreneurial opportunities; and (2) entrepreneurial actions of appropriating the value of such opportunities involve the creation of new firms" (p 188).

While the KSTE has emphasized new knowledge and ideas as a source of entrepreneurial opportunities, there are ambiguities in the story as it does not distinguish knowledge from ordinary knowledge and rival knowledge (intellectual human capital) such as creativity. Despite numerous studies aiming to understand the mechanism of knowledge transfer and commercialization (Acs et al. 2004; Audretsch and Lehmann 2005; Audretsch and Keilbach 2007; Braunerhjelm et al. 2010), and the speed of knowledge creation and entrepreneurial absorptive capacity (Acs and Qian 2013), the source of new knowledge and creation of entrepreneurial opportunities remains ambiguous. Missing points in the KSTE are addressed by Acs and Armington (2006) in the section entitled "Knowledge as a source of entrepreneurial opportunities" (p. 55); Audretsch et al. (2006) supported it by analysis of variations in new firm startups underlying various knowledge contexts.

Inconsistencies in research on the KSTE have not made it clear whether it is human capital (Armington and Acs 2002; Acs and Armington 2006; Audretsch et al. 2006) or something else, such as skills, inspiration, talent or creativity embodied in people, that promotes the exchange of ideas and creates new knowledge (Lucas 2009), triggering new entrepreneurial opportunities and regional growth (Florida 2002, 2004; Fritsch 2008; Piergiovanni et al. 2012). Furthermore, Florida (2004) highlighted the role of regions rich in ideas and talented people as centers of global competitiveness. These regions make it easier for business to find non-trivial solutions and attract creative people from all over because of their diversity, tolerance and availability of cultural amenities. 'Creative cities' experience higher innovation and startup rates of new high-tech businesses (Florida 2011).

While the KSTE implies that new knowledge leads to entrepreneurship and entrepreneur's decisions that spill over (Audretsch and Lehmann 2005), new progress in knowledge and creativity research (Audretsch and Keilbach 2007; Agarwal et al. 2007; Boschma and Fritsch 2009) suggests that it is both human capital and creativity embodied in well-educated or skilled people as well as an environment rich in creativity and diversity that triggers entrepreneurial opportunities at both the regional and country levels (Florida 2004; Lee et al. 2004; Boschma and Fritsch 2009).

Florida (2002, 2004) suggested a different measure of intellectual human capital—the "creative class"—based on the individuals' occupations and the field in which they work, such as science, finance or management, arts and culture, entertainment, high- and low-tech engineering, or mining. At the same time, empirical analyses produced so far have missed "a serious measurement problem concerning the clear definition of the education and creativity components of human capital" (Marrocu and Paci 2012, p. 369). The authors attempted to disentangle this issue by advising a disaggregation of human capital into Bohemians, creative graduates and non-creative graduates to address Florida's (2004) argument.

According to the entrepreneurship literature and KSTE (Florida 2004; Audretsch and Keilbach 2007, 2008; Acs et al. 2008), a region with a higher concentration of new knowledge will generate more entrepreneurial opportunities. In contrast, a region with a paucity of new ideas and skills will generate

fewer entrepreneurial ideas and opportunities. The probability for a creative person, for example, an academic, artist, musician, writer, researcher, etc., to start a business is high because of greater returns to their "creativity" by starting new ventures instead of working in an incumbent firm. Creativity is a special skill that is not always desired in established firms that require following the rules and historically established business practice, hierarchy and ethics. Cities with a high potential of creativity (Florida 2004) attract creative people who are reluctant to work in hierarchies of large firms. As in the KSTE, creativity theory treats individual entrepreneurial opportunities as endogenous, and therefore creative people select entrepreneurship that includes creativity. Creative people are attracted by the climate of diversity and openness (Lee et al. 2004; Florida 2004, 2011; Link and Welsh 2013) and thus select attractive cities with a high creativity potential. Glaeser et al. (2010) highlighted that modern cities with rich cultural amenities grow faster, at least in terms of population and business startups. City diversity makes the life of the creative class more comfortable and therefore attracts even more educated and creative workers in a city who contribute to regional growth by working in incumbents or starting their own business. However, there will always be opportunity cost for creative people to select themselves into entrepreneurship, especially in large firms where they are generally very well paid (Acs and Qian 2013). When opportunity costs are relatively low and life in a city is pleasant (Piergiovanni et al. 2012), departing from an incumbent firm to start a business will be an option for the creative class. Although traditional firms such as GE, GM, Ford, Ely Lilly, Taco Bell and others will face difficulties in retaining creative talent, this does not mean that creativity is not important in firms located in creative sectors, such as Google, Facebook, Microsoft, Yahoo, Apple and others, who need creative people. Based on this argument, the KSTE slights entrepreneurs as a conduit of knowledge spillover, but entrepreneurs can help creative individuals to commercialize new knowledge as inventors. In this case, the creation of new knowledge is separated from the idea-holder.

We extend the KSTE, consistent with Acs et al. (2004, 2009), Agarwal et al. (2007) and Acs and Qian (2013), to endogenize the new knowledge production process with a leading role for inventor's skills and creativity as a special kind of human capital. This clarifies the mechanism by which creative people produce new knowledge, and entrepreneurial opportunities are therefore created. To show this explicitly, we can expand Romer's knowledge production function (KPF) (Romer 1990) as it simplifies a human capital model:

$$d(A) = f(H, C) \tag{1}$$

where new knowledge (A) is a function of ordinary human capital known as traditional knowledge, H, and creativity, C. First, human capital refers to knowledge embodied in people proxied by the level of education (Acs et al. 2009); creativity is the excludable knowledge element, primarily personalized (tacit) knowledge of individuals. It is the most relevant component in explaining production efficiency through the way education, talent, skills and experience is applied across occupations and places of work (Florida 2004; Boschma and Fritsch 2009; Marrocu and Paci 2012; Link and Welsh 2013).

This function captures not only the knowledge stock, but also creativity embodied in a creative class, both of which are input factors in Romer's KPF. Creativity is not only the predictor of new knowledge, but also a determinant of entrepreneurial opportunities (Stuetzer et al. 2013). We therefore hypothesize:

H1 Creativity is a source of entrepreneurial opportunities.

We have discussed one of the limitations of the KSTE: that it does not shed light on the process of creating new knowledge (Lee et al. 2004; Acs and Qian 2013). Another limitation is the KSTE highlights the almost primary role of an inventor who makes a career choice between being an employee and an entrepreneur. This is not always true as a creative individual might have a lack of skills and asymmetry of market information, and fear institutional barriers and bureaucracy when determining the best potential market for his/her ideas (Audretsch and Keilbach 2007, 2008).

Institutional barriers to knowledge and idea transfer, also known as knowledge filters, are important in the KSTE. Although a knowledge filter in particular appeals to commercializing ideas and creativity by an entrepreneur as a non-inventor, a process of new

knowledge commercialization by the entrepreneur-inventor will also hit a bureaucratic and cultural barrier, making the choice of entrepreneurship more challenging. The roles of institutions in the process of creating and commercializing new knowledge within the KSTE are well studied (Acs et al. 2004, 2009; Audretsch and Keilbach 2007; Stenholm et al. 2013).

The theoretical model developed by Acs et al. (2009) incorporates institutional barriers to entrepreneurship and the choice to start a business. It considers factors such as risk, traditions, financial constraints, normative rules and regulatory restrictions, entrepreneurship culture and social norms (Parker 2004). Applying the concept of a knowledge filter within the KSTE is important to control for the impact of institutions (Acs et. al. 2009; Stenholm et. al. 2013). This may explain why creative individuals as economic agents might decide against commercializing creativity, even when in possession of it.

Institutional characteristics are more challenging to identify than socioeconomic factors (Acs et. al., 2009). In this article, we include institutional controls described as the regulatory, normative and conducive pillars (Stenholm et. al., 2013) in addition to the creativity pillar as a proxy for creativity. Institutional characteristics can be expected to change the 'thickness' of the knowledge filter and therefore limit/foster new knowledge transfer between the agents (Braunerhjelm et al. 2010). Normative, regulatory and conducive pillars in this study are barriers to creativity commercialization and measure the 'thickness' of the filter (Acs et al. 2004; Audrestch and Keilbach 2007, 2008). Institutional controls are described in Table 1.

3 Methodology

3.1 Data

We construct the data set to test our hypotheses by merging city-level data from the Eurostat Urban Audit statistics (Eurostat 2012) and country-level data from the Global Entrepreneurship Monitor (GEM) (see Reynolds et al. 2004; GEM 2012), the Doing Business Report (World Bank 2012) and the Global Competitiveness Report 2008–2009 (Sala-I-Martin et al. 2009). Table 1 summarizes data sources and descriptive statistics for the variables used in the study. Our sample consists of variables for 143 European cities across 12 European countries covering 1999–2010. The list of cities is represented in Sect. 6. We use data on cities claiming urban environments are particularly conducive to entrepreneurial activities, innovation and knowledge spillovers (Jacobs 1969; Jaffe 1986; Krugman 1991; Audretsch and Feldman 1996).

Appendix illustrates the number of new firm startups, self-employed and SMEs and a proportion of creative professionals and Bohemians across European cities included in this study sorted in descending order. Differences in entrepreneurship rates and creative class distribution are remarkable within European cities. The city-level data are based on European Audit surveys, divided into three quadrennial periods, 1999–2002, 2003–2006 and 2007–2010, and the European Commission Cities report (The European Commission 2007). We obtain our samples after accounting for data discrepancies, data availability for the dependent variable and removing outliers. Lichtenstein and Austrian cities were dropped from both samples as only one city per country observation was available. Following Hoaglin et al. (1983), a lower and upper threshold for both samples of our dependent variables was identified and dropped (Eurostat 2012). The higher number of Eastern European and Italian cities in the self-employment and small and medium sample could be explained by economic cycle effects and particulars of employment and business registers in those countries (Acs et al. 2009; Belitski and Korosteleva 2010).

Our multilevel modeling approach includes explanatory and control variables at both the country and city level. This enables accounting for data clustering within country and city subsamples (Estrin et al. 2013). Multilevel models have the same assumptions as other major general linear models; however, some of the assumptions could be modified, accounting for the hierarchical nature of the design. The assumptions of homoscedasticity and independence of observations must be adapted to linear models. We use heteroscedasticity robust standard error clustered by country to address the first assumption. Observations within the same group (city) cannot cluster inter-temporarily because of cross-sectional data. We assume country groups to be independent of each other, but cities may experience interdependence within the same country.

Table 1 Variables and data sources

Dimension	Variable	Description	Data source	Obs.	Mean	SD
Regulatory	Starting procedure	Starting a business—number of procedures	WBDB	12	7.34	2.02
	Tax cost	Paying taxes—total tax rate (% profit)	WBDB	12	52.49	13.49
	Property cost	Registering property—cost (% of property value)	WBDB	12	4.22	2.12
Normative	Status	High status indicates the percentage of the adult population who agree with the statement that in their country people attach high status to successful entrepreneurs	GEM	12	62.00	7.99
	Media attention	Media attention measures the percentage of the adult population who agree with the statement that in their country they will often see stories in the public media about successful new businesses	GEM	12	49.66	8.29
Conducive	Density	Population density, logarithm	EUA	143	7.24	1.07
	Industrial intensity	Total number of establishments to city population	EUA	143	0.05	0.03
Creativity	Bohemians	Proportion of working population employed in culture and entertainment	EUA	143	2.38	1.30
	Professionals	Proportion of working population employed in finance, business intermediation, management	EUA	143	19.80	7.68
	Melting Pot Index	Proportion of non-EU residents to total population in city	EUA	143	6.09	3.86
Control variables	Human capital	Proportion of working age population qualified at level 5–6 ISCED (tertiary education)	EUA	143	22.26	7.07
	Technology	ICT laws measures the assessment of country's laws related to the use of information technology (e.g., electronic commerce)	GCI	12	26.99	18.82
	Opportunity perception	Opportunity perception indicates the percentage of the non-entrepreneurial adult population who see good opportunities for starting a business in the area in which they live	GEM	12	31.69	10.53
	Networks	Knows an entrepreneur indicates the percentage of the non-entrepreneurial adult population who knows an entrepreneur personally who started a business in the previous 2 years	GEM	12	44.61	7.97
	City type	Value 1 for each specific city type over 13 classified city types (otherwise zero)*	EC	143	–	–
Dependent variable	NB	Number of new businesses registered, logarithm	EUA	143	7.37	1.15
	SE	Number of self-employed, logarithm	EUA	143	9.45	1.08
	SME	Number of SMEs, logarithm	EUA	143	9.28	1.15

Twelve observations for country-level variables are available. Although we have 143 cities, country averages do not vary across cities within the same country

Source EUA European Urban Audit (core-city data) Eurostat (2012), *WBDB* World Bank's Doing Business (World Bank 2012), *GEM* Global Entrepreneurship Monitor (Stenholm et al. 2013; GEM 2012), *GCI* The Global Competitiveness Report (2008–2009) (Sala-I-Martin et al. 2009), *EC* European Commission Cities report (2007)

3.2 Cross-country and -city data related to our hypotheses

3.2.1 Dependent variables

Entrepreneurship is a heterogeneous phenomenon (Parker 2004, 2009; Acs et al. 2009; Minniti and Lévesque 2010; Stenholm et al. 2013). The variety of entrepreneurship stems from entrepreneurial processes, variations in the legal form of business organization, multidimensional institutional frameworks and heterogeneity in the entrepreneur's attitudes, orientation and aspirations (Zahra and Wright 2011).

Entrepreneurship is measured at a city level. Methodologically dependent variables, when utilizing multilevel analysis, should be on the lower grade (Rabe-Hesketh et al. 2005). Theoretically evidence exists that urban areas are conducive to entrepreneurship and business activity because of scale economies (Jacobs 1969; Krugman 1991; Acs et al. 1994).

New business startups are the most widely used indicator of entrepreneurship, referring to the number of ventures being created (or added to existing businesses or generated through the spin-off or buyout) by entrepreneurs (Zahra and Wright 2011). It has already been used in creativity and entrepreneurship studies (Boschma and Fritsch 2009; Piergiovanni et al. 2012). A popular approach employs the number of self-employed individuals, new business creation and the number of SMEs as a proxy for a quantity of entrepreneurial activity (Evans and Leighton 1989; Parker 2009; Acs et al. 2009). A new business entry (startup) is defined as the number of newly registered business units. The SME is defined as the number of companies with fewer than 250 employees. Self-employment is defined as an unincorporated business with zero employment, also known as sole proprietorship (Eurostat 2012). The number of SMEs as an indicator of entrepreneurship is out of date (Acs et al. 2009; Parker 2009); however, it is included as an additional control for entrepreneurship. The correlation between new business startup numbers and the number of self-employed is very strong (0.76), as with the number of SMEs (0.85). Similarly, the correlation between the number of self-employed and SMEs is very strong and positive (0.90).

3.2.2 *Explanatory variables and controls*

We employ multilevel modeling, and we control variables at both the country and city levels (Rabe-Hesketh et al. 2005; Estrin et al. 2013; Stuetzer et al. 2013). This approach enables us to capture country- and city-level characteristics to understand the association between creativity and entrepreneurship. To test our main hypothesis, we include a creativity pillar, which includes cultural diversity, the proportion of employed in cultural occupations (Bohemians) and other creative occupations (creative professionals) as an explanatory variable (Florida 2004; Lee et al. 2004; Audretsch and Keilbach 2007, 2008; Boschma and Fritsch 2009). We add regulatory, conducive and normative pillars as well as opportunity perception, and networks as control variables at a country level (Stenholm et al. 2013). We include human capital, population and industrial density at the city level (Acs et al. 1994).

3.2.2.1 The creativity pillar Unlike the approach of Florida (2002, 2004) and Boschma and Fritsch (2009) based on occupational data and of Piergiovanni et al. (2012) considering the number of firms in certain creative-specialized industries as well as a one-period lagged number of university faculties per resident population, we measure creativity based on a worker's industry affiliation. This is because industry provides a better description of what well-educated, talented and skilled people actually do and the way they exploit creativity (Lee et al. 2004; Markusen et al. 2008; Piergiovanni et al. 2012). It also enables capturing the indirect impact of intra-industry spillovers (Audretsch and Feldman 1996), which otherwise would have been underestimated using occupational data.

We utilize data on a share of creative professionals, Bohemians and a Melting Pot Index (MPI) calculated as the proportion of non-EU nationals (Boschma and Fritsch 2009) to capture creativity as a source of entrepreneurial opportunities in European cities. The MPI is broader than the share of legal immigrants per 1,000 residents used to measure migration processes in a region by Piergiovanni et al. (2012). We argue that diversity and openness to other cultures at both the regional and individual level increase a city's capacity to accept and absorb new knowledge, turning it into opportunities (Piergiovanni et al. 2012). Previous studies support the inclusion of the MPI as a proxy for diversity, cultural openness and tolerance (Reynolds et al. 1995; Florida 2004). Including the creativity proxy at a national level might lead to other effects than on the city level (Florida 2004). For example, the US might not be very open and cosmopolitan, but New York and San Francisco probably are, in contrast to Birmingham, Alabama. The European Union might not be cosmopolitan, but mega-cities such as Paris, London, Milan and

Amsterdam account for up to 40 % of foreign-born residents, in contrast to Nitra, Slovakia, or Lublin, Poland, with less than 1 percent foreign-born residents (Eurostat 2012).

The creativity pillar is used to test our research hypothesis. Human capital is included as a control variable for knowledge. We initially had a percentage of the adult population who believed that they had the skills required to start a business as a proxy for human capital relevant to entrepreneurship (GEM 2012). This indicator was multicollinear with the regulatory pillar. A share of the population with a tertiary education (Master or Bachelor degree) at a city level was found to be a better proxy (Eurostat 2012) for avoiding multicollinearity.

3.2.2.2 The regulatory pillar We use three country-level variables to capture the regulatory pillar (Stenholm et al. 2013): the number of procedures required to start a business, the tax burden on doing business and registering property proxied by the total tax rate (% of profit) and the cost of registering property (% of a property value). For instance, higher taxes and property costs may act as barriers to knowledge transfer and entrepreneurial activity (Desai et al. 2003). All three variables are drawn from the Doing Business Indicators (World Bank 2012).

3.2.2.3 The normative pillar The normative dimension is proxied by two variables at a country level from the GEM study: the percentage of the adult population who agreed to have people in their country who attach high status to successful entrepreneurs and the percentage of the adult population who agreed with the statement that in their country they will often see stories in the public media about successful new businesses. The normative pillar is used as a measure of entrepreneurial culture (Stenholm et al. 2013).

3.2.2.4 The conducive pillar "Information and business flows are denser in cities, where different competencies and financial resources are more accessible, and market proximity is obvious" (Acs et al. 2009, p 23). We therefore use population density (Reynolds et al. 1995; Boschma and Fritsch 2009) and industry intensity (Armington and Acs 2002; Acs and Armington 2006; Agarwal et al. 2007) to measure the opportune institutional arrangements and business flows in urban areas (Stam 2007). These variables also control for localized knowledge spillovers (Audretsch and Feldman 1996; Armington and Acs 2002; Dyer et al. 2008). Industrial intensity is measured by the total number of business establishments of all sizes in the city divided by the city's population.

3.2.2.5 Other control variables Other control variables are grouped as follows. The first group refers to 13 city typologies to capture heterogeneity in model fixed effects (European Commission 2007). This is unobserved in the model and would otherwise be included in the error term (Baltagi 2008). We include the 'reinvented capital' city dummy for Eastern European capitals to control for the socialist economic heritage. We include the de-industrialized city dummy representing major technological change in cities. Knowledge hubs and research center dummies serve as an additional control for human capital in a city.

The second group includes entrepreneurial opportunity perception (percentage of the non-entrepreneurial adult population who sees good opportunities for starting a business in the area in which they live) and networking (percentage of the non-entrepreneurial adult population who knows an entrepreneur personally who started a business in the previous 2 years) as argued in Stenholm et al. (2013).

The third group includes ICT laws as a proxy for a framework that enabled the transfer of knowledge and information within a country and serves as an additional control for the "thickness" of the filter.

3.3 Identification strategy

We combine the feasible generalized least squares (GLS) and robust approaches in our cross-country, cross-city model. It is reasonable to do the feasible GLS to obtain improvements in efficiency and then use robust standard errors to address the remaining heteroskedasticity. We address three limitations in our model.

First, a potential drawback is the missing observation of our dependent and explanatory variables

(Eurostat 2012) for several cities during 1999–2010. If this happens, one observation is left as a cross section; two or more observations are simply averaged over time (Eurostat 2012). It makes it more challenging to differentiate between a cause and effect. Although the cross-sectional averaged approach applied in this study enables us to determine prevalence and is useful at identifying associations, it is based on a sample accounting for randomly missing data on cities.

Second, we were unable to separate employees in the healthcare, education and real estate industries pulled together as a 'creative core' (Eurostat 2012). Not all of those industries classified in particular at the level of aggregation available in Eurostat (2012) are known as 'creative' (Florida 2002, 2004). Thus, we address this limitation by excluding a proportion of the creative core from the model, possibly underestimating the average impact of creativity on entrepreneurship.

Third, it is known that a certain proportion of Bohemians are self-employed or have their own SMEs. Thus, the number of Bohemians who are business owners should be excluded from the number of self-employed and a number of SMEs in a region. Data on the exact number or proportion of Bohemians who are self-employed or own a business do not exist (Eurostat 2012). Our attempt to exclude the number of Bohemians from the number of self-employed and SMEs resulted in 11 out of 143 cities having a negative number of self-employed and SMEs. For the rest of a sample, the number of self-employed and SMEs has significantly decreased (<65 %). This result illustrates that the number of Bohemians who are self-employed or own a business is tiny. Pearson's correlation coefficient between Bohemians and self-employed (SMEs) is not statistically significant, with values of 0.35 and 0.41, respectively. We therefore did not subtract the number of Bohemians from the number of self-employed and SMEs, assuming our dependent variable is not included in the proportion of Bohemians on the right-hand side.

To investigate multicollinearity issues, we measured variance inflation factors (VIFs) for all variables included in the model. Apart from the city types, we found no indication of multicollinearity. Hence, the VIFs for all other variables are ten (Estrin et al. 2013). We focus on pairwise correlations in the face of multicollinearity, accepting a cutoff point of more than 0.7 (for correlation matrix). This was applied to cut off a variable—the percentage of the adult population who believe that they have the skills required to start a business in a country that was correlated to regulatory pillar variables (>0.7). Our study is not subject to endogeneity because country-level institutional pillars and city characteristics are likely to affect the quantity and the type of entrepreneurship. It is however unlikely that the type and rate of entrepreneurship will affect the regulatory, conducive and normative institutional dimensions or the creativity capital in a city. We also alleviate any possible endogeneity by taking an average during the 2002–2010 period.

In addition to city fixed effects, by using model-fit indicators (F test, adjusted R square and residual sum of squares changes), we verified whether inclusion of city type dummies and other controls was justified. Our baseline city-type cross-sectional linear regression model is specified as:

$$E_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i + a_i + e_i \quad (2)$$

where $i = 1,\ldots, T$; E_i is urban entrepreneurial activity during 1999–2010. β_0 is a constant, and X_i is a vector of the creativity pillar at a city level treated as exogenous. The impact of the creativity pillar varies for each city i. Z_i is a vector of strictly exogenous country-level institutional variables and controls at both the city and country levels. Additionally, city typology a_i is included, and e_{it} is the error term.

4 Empirical results

Regression results are presented in Table 2. We report two specifications to indicate the robustness of our findings. First, we include the creativity pillar in a model (specifications 1–3) and then remove creative professionals and Bohemians (specifications 4–6), leaving the MPI to observe a change in regression outcome. The fit for both specifications is satisfactory with a slightly better fit in specifications 1–3. Specifications 1–3 capture between 63 and 76 % of the variation in entrepreneurship, while specifications 4–6 explain 69–73 %.

Table 2 Regression results for European cities

Measures of entrepreneurship specification		NB (1)	SE (2)	SME (3)	NB (4)	SE (5)	SME (6)
Regulatory	Start procedure	−0.22**	−0.03	−0.31***	−0.19**	−0.01	−0.29***
		(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
	Tax cost	−0.01	−0.01	0.01	−0.01	−0.01	0.01
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Property cost	−0.12*	−0.16***	−0.25***	−0.20***	−0.23***	−0.33***
		(0.06)	(0.06)	(0.05)	(0.07)	(0.06)	(0.06)
Normative	Media attention	0.01	−0.07***	−0.06***	0.01	−0.08***	−0.07***
		(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
	Status	−0.06	0.02	0.02	−0.02	0.06	0.05
		(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Conducive	Density	0.26***	0.23***	0.28***	0.44***	0.38***	0.44***
		(0.10)	(0.09)	(0.08)	(0.09)	(0.09)	(0.08)
	Industrial intensity	7.76	6.50	7.65*	13.48**	11.49**	12.68**
		(5.24)	(5.11)	(5.02)	(5.84)	(5.54)	(5.64)
Creativity	Diversity	0.07*	0.08**	0.08**	0.09***	0.10***	0.10***
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
	Creative professionals	0.04**	0.04**	0.03*			
		(0.02)	(0.02)	(0.02)			
	Bohemians	0.16*	.15*	0.17*			
		(0.09)	(0.08)	(0.09)			
Other control variables	Education	−0.01	−0.01	0.01	0.04**	0.03**	0.04***
		(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
	Technology	−0.02***	0.01	−0.01*	−0.02**	0.01	−0.01
		(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
	Opportunity perception	−0.03**	0.01	−0.01	−0.03**	−0.01	−0.02
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Networks	0.09***	0.01	0.06*	0.08**	−0.01	0.05*
		(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
	Knowledge city	0.01	0.08	0.03	0.19	0.23	0.18
		(0.16)	(0.15)	(0.16)	(0.19)	(0.18)	(0.19)
	De-industrialised city	0.24	0.25	0.32*	0.25	0.26	0.33*
		(0.20)	(0.21)	(0.19)	(0.24)	(0.23)	(0.21)
	Research city	−0.58***	−0.41**	−0.42**	−0.68***	−0.50***	−0.51***
		(0.18)	(0.17)	(0.17)	(0.20)	(0.18)	(0.18)
	Reinvented capitals	0.86***	0.78**	1.07***	0.94***	0.86***	1.14***
		(0.29)	(0.31)	(0.30)	(0.34)	(0.32)	(0.35)

Table 2 continued

Measures of entrepreneurship specification		NB (1)	SE (2)	SME (3)	NB (4)	SE (5)	SME (6)
Measures of fit	Constant	6.77***	9.05***	8.14***	4.04*	6.62***	5.69***
		(2.06)	(1.98)	(1.99)	(2.19)	(2.02)	(2.13)
	City typology and country controls	Yes	Yes	Yes	Yes	Yes	Yes
	Obs.	143	143	143	143	143	143
	R-square adj.	0.74	0.74	0.76	0.69	0.71	0.73
	RSS	47.20	41.70	43.15	55.49	48.06	49.53
	RMSE	0.64	0.60	0.61	0.69	0.64	0.65

Dependent variables are NB = number of new business startups; SE = number of self-employed; SME = number of small- and medium-size firms. Level of statistical significance is * 0.1 %, ** 0.05 % and *** 0.01 %. Standard errors clustered by country and robust for heteroskedasticity are in parentheses. To save space, four city-type dummies related to our research hypothesis are reported

The authors' calculation based on Eurostat (2012), World Bank's Doing Business (World Bank 2012), Global Entrepreneurship Monitor (Acs et al. 2011; GEM 2012), The Global Competitiveness Report (2008–2009) (Sala-I-Martin et al. 2009) and EU State of European Cities report (European Commission 2007)

The results support the KSTE with the creativity pillar exhibiting a positive effect on entrepreneurship. Increasing a share of creative professionals as a source of new knowledge by one percent is associated with a 3–4 % increase in urban entrepreneurship, while the impact of Bohemians is four times higher. This is not surprising as Bohemians provide cultural amenities in a location (Florida 2004), symbolizing a culture of tolerance, talent and diversity. They also play an important role in making a city more attractive to live in for other creative classes—well-educated, skilled and talented people (Florida 2004; Boschma and Fritsch 2009; Glaeser et al. 2010; Marrocu and Paci 2012; Piergiovanni et al. 2012). A strong correlation between tolerance and low barriers to immigration is well known, because "a tolerant atmosphere reduces the likelihood of potential social and cultural frictions" (Piergiovanni et al. 2012, p. 542). A high level of ordinary human capital and creativity in 'tolerant' regions ensures attracting the creative class, successfully turning creativity into new knowledge. Bohemians and other creative classes together may self-select into entrepreneurship. Not surprisingly, human capital has a positive impact on entrepreneurship (with a coefficient of 0.04) once the creative class proxy has been taken out distinguishing between ordinary human capital and creativity (specifications 4–6). This finding is consistent with Romer's (1990) KPF and highlights the leading role of creativity rather than a ordinary human capital proxied by educational attainment in the creation of entrepreneurial opportunities (Lee et al. 2004; Boschma and Fritsch, 2009; Acs et al. 2009; Acs and Qian 2013). Hypothesis one is therefore supported—creativity and a diverse cultural environment result in new entrepreneurial opportunities and increase overall entrepreneurship activity.

Our main finding is the strong and positive direct impact of creativity (both the proportion of creative workers and the diverse environment in city) on entrepreneurial activity in cities, providing evidence for creativity and talent embodied in a worker facilitating entrepreneurship and commercializing creativity. Such creativity is intellectual human capital that is neither publicly available nor perfectly protected (Zucker et al. 1998). The author distinguishes intellectual human capital from an ordinary capital proxied by educational attainment in our model. Human capital can be purchased as an input on a certain cost and provides a normal rate of return (Zucker et al. 1998). This argument is in line with Marlet and van Woerkens's (2004) and Markusen et al.'s (2008) criticism of Florida's better indicator for ordinary human capital. This article makes a distinction between intellectual human capital, which Florida

(2004, 2011) posits as creativity, and ordinary human capital. This is in line with the rival and non-rival knowledge argued by Romer (1990). Drawing on the extant literature (Arrow 1962; Romer 1990; Florida 2004; Acs et al. 2004, 2009; Marlet and van Woerkens's 2004; Piergiovanni et al. 2012), creativity is seen as a completely excludable knowledge and is a form of personalized (tacit) knowledge of a worker. As creativity is embodied in creative people and is unlikely to be endogenized by a third agent without a worker's will, the environment of openness and diversity becomes crucial in creating conditions under which agents pursue entrepreneurial activity (Florida 2004). This makes creativity or, as Romer (1990) puts it, 'non-rival capital,' exogenously available and easier to commercialize. In other words, we revealed the circumstances under which the creative class takes advantage of their intellectual human capital and creativity (Bhide 1994).

Numerous studies have already explored those conditions under which agents start up rival enterprises (Hellmann 2007; Lazear 2005; Lucas 2009), with a gap in the understanding of the role of cultural diversity and openness in creativity commercialization and new knowledge transfer. This study has also explicitly addressed this issue by incorporating a broader measure of diversity and tolerance (MPI) in the creativity context (Florida 2004; Boschma and Fritsch 2009).

Entrepreneurial opportunities do not appear to be exogenous in our study, but are also dependent on national institutions that determine how efficiently traditional knowledge and creativity are transformed into economic knowledge and innovation (Acs et al. 2004, 2009; Audretsch et al. 2006; Audretsch and Keilbach 2007, 2008). This implies that only a part of ordinary human capital (H) and creativity (C) introduced in the extended Romer (1990) KPF in Eq. 1 is converted into economically useful firm-specific new knowledge (A). Altogether the regulatory, normative and conducive pillars influence knowledge transfer mechanisms (Acs et al. 2004; Stenholm et al. 2013). As the negative statistically significant coefficients of the regulatory pillar suggest, entrepreneurial activity tends to be greater where lower property costs and fewer startup procedures are prevalent. Our empirical test measured the 'thickness' of the knowledge filter, which determines how efficiently the commercialization of knowledge takes place. A higher population rate and industrial density in cities are conducive to an exchange of ideas and core competencies, making financial resources more accessible, market proximity more obvious and networks denser (Armington and Acs 2002; Stam 2007; Acs et al. 2009). The conducive pillar eases the transfer of new knowledge between the agents through the filter.

Not surprisingly, media attention has a negative and significant impact on self-employment, and SMEs as successful stories in media motivate low-ambitious and low-quality business to consider other forms of occupation such as starting their own company. This phenomenon appeals to most Mediterranean and East European cities (Belitski and Korosteleva 2010; Manolova et al. 2008).

Note that the institutional pillars here are significant in all specifications (1–6), suggesting that limitations and barriers to knowledge exploitation by agents are negatively related to entrepreneurial activity. The thicker the filter is, the less efficient the exploitation of new knowledge and therefore the less new knowledge will be endogenized by an entrepreneur (Acs et al. 2004, 2009; Audretsch and Lehmann 2005; Audretsch and Keilbach 2007, 2008; Agarwal et al. 2007; Belitski and Korosteleva 2011; Estrin et al. 2013).

A possible reason for the low explanatory power of status and tax costs may be data limitations from using three quadrennial period averages. A model based on annual data may improve the explanatory power of our variables and should be considered for future research.

5 Discussion and conclusion

This article develops a creativity theory of the KSTE, distinguishing the captious role of creativity and a diverse cultural environment in building creativity-based entrepreneurial opportunities. The creativity context is built on knowledge spillover entrepreneurship theory, which sees the entrepreneur as a conduit for new knowledge and advances the theory by considering an entrepreneur as a mechanism for commercializing and spillover creativity. Creativity

as a source of knowledge spillover of entrepreneurship has not been adequately researched in the literature. Our theoretical extension of Romer's (1990) KPF is supported by empirical evidence from European cities over the 1999–2010 period and sheds light on the impact of creativity on entrepreneurship.

We advise policy makers to further exploit traditional human capital but also creativity embodied in the creative class, along with a climate of openness, tolerance and cultural diversity, which makes places friendlier and more attractive, encouraging the creative class to move in (Acs and Megyesi 2009). The creative class is self-selected into entrepreneurship because of higher than normal returns on creativity and the fact that creative people prefer to live in cities with rich cultural amenities, openness and diversity (Florida 2004; Glaeser et al. 2010).

Our article provides positive evidence that creativity embodied in an entrepreneur or inventor as well as the diverse environment where creative people work and live is critical in creating new business opportunities as most of the creative class is reluctant to be employed in traditional firms (Florida 2004). While the KSTE has been extensively investigated since Audretsch (1995), Acs et al. (2004) and Audretsch and Lehmann (2005), its applications to the context of creativity and Florida's 3T theory have been rare (Florida 2004; Lee et al. 2004; Boschma and Fritsch 2009). This has become a research frontier in the literature on economics, strategic entrepreneurship and management.

The primary limitations are the data availability and being an empirical exercise. The creativity theory of knowledge spillover entrepreneurship is still a missing link and needs additional empirical work. For example, we measure creativity utilizing worker's industrial affiliation and diverse cultural environments. Measuring creativity using occupational data as argued in Boschma and Fritsch (2009) and Florida (2011) or change in a number of firms in creative sectors (Piergiovanni et al. 2012) using the same sample could be useful for comparative reasons and testing on the consistency of results. While testing the creativity theory utilizing the individual data on creative individuals as the unit for analysis and entrepreneurs is the first best approach, obtaining such data is challenging. Incorporating works on the KSTE of Acs and Armington (2006), Audretsch and Lehmann (2005) and Acs et al. (2009), who used regional data, we employ city-level data as the unit for analysis, which is the lowest level of disaggregation available within this context. An annual survey of creative classes and entrepreneurs in European cities using national data may make a valuable contribution to new findings in the creativity and entrepreneurship theory. These efforts should be made in future research.

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Appendix

See Table 3.

Table 3 Entrepreneurship and employment in creative industries, 1999–2010 (sorted in descending order of new business startups)

Core city	NB	SE	SME	Creative professionals (%)	Bohemians (%)	Core city	NB	SE	SME	Creative professionals (%)	Bohemians (%)
Greater London	39,843	504,247	281,440	30.9	6.1	Darmstadt	1,367	7,638	7,503	22.8	3.4
Berlin	36,085	195,825	144,809	22.3	2.8	Mulheim ad Ruhr	1,358	6,876	7,165	17.4	0.9
Budapest	24,512	82,272	190,504	18.8	2.5	Nyiregyhaza	1,331	6,695	11,769	7.3	0.9
Inner London	21,778	201,303	147,605	38.4	8.0	Regensburg	1,284	7,190	7,411	17.3	1.3
Hamburg	17,924	103,775	95,228	26.3	3.6	Sheffield	1,283	24,373	11,585	17.6	1.5
Roma	17,587	218,166	232,527	27.9	5.3	Bradford	1,253	23,197	10,980	15.2	2.5
Kernel Stockholm	16,614	37,964	64,055	27.5	3.8	Tampere	1,210	5,985	9,666	15.3	3.2
Munich	15,655	86,829	90,544	29.7	3.8	Stavanger	1,189	2,289	3,106	15.1	3.7
Stockholm	11,631	21,657	41,209	61.6	4.8	Cagliari	1,128	13,822	17,341	27.3	2.0
Milano	11,184	138,398	168,861	40.4	3.7	Koblenz	1,081	5,900	6,152	19.9	1.6
Koln	10,908	46,482	53,118	26.2	4.0	Liverpool	1,049	14,898	8,610	18.5	2.0
Oslo	9,091	17,756	21,417	22.8	5.3	Las Palmas	1,011	16,967	4,060	11.3	2.5
Barcelona	8,545	106,306	62,030	14.5	3.5	Schwerin	1,010	3,808	4,091	19.0	3.1
Frankfurt am Main	7,930	40,056	37,426	38.9	2.5	Zilina	1,002	5,095	2,046	11.9	1.8
Brussels	7,848	60,615	24,067	26.0	2.5	Gottingen	1,002	4,790	4,820	16.7	1.6
Madrid	7,505	158,809	89,910	18.4	3.2	Turku	967	4,715	7,932	15.6	2.6
Bratislava	7,368	26,589	17,423	22.2	3.3	Banska Bystrica	966	4,410	2,029	12.7	2.3
Kernel Helsinki	7,199	28,882	64,132	21.9	4.0	Linkoping	965	2,457	4,426	18.3	1.0
Dusseldorf	6,838	32,242	36,425	30.8	2.0	Perugia	936	16,199	14,593	22.5	1.6
Leipzig	6,332	21,624	19,967	26.4	4.2	Presov	921	4,739	1,695	8.5	1.5
Torino	5,934	79,007	82,568	29.6	1.6	Coventry	918	11,100	6,360	19.1	0.9
Stuttgart	5,571	31,432	29,500	27.5	3.6	Orebro	911	2,469	4,497	13.3	1.6
Riga	5,440	23,325	33,397	16.1	4.3	Cardiff	878	14,641	7,975	20.4	4.2
Dresden	5,277	20,939	19,952	22.2	3.1	Nitra	868	4,189	1,589	9.8	1.3
Dortmund	5,265	21,646	20,716	23.8	1.8	Kristiansand	858	1,764	2,300	12.7	3.5
Essen	5,237	24,254	22,843	25.2	2.2	Trieste	833	18,872	13,932	28.4	1.2
Napoli	5,046	58,526	68,965	26.6	1.4	Jonkoping	816	2,046	4,286	11.5	1.2
Goteborg	4,996	10,084	18,757	20.7	2.3	Pescara	810	10,966	12,766	25.6	0.9
Helsinki	4,894	15,304	40,630	22.6	5.8	Moers	807	4,404	3,941	12.6	0.8
Nurnberg	4,833	29,165	25,364	27.7	2.1	Wirral	803	13,800	5,995	15.2	1.4

Table 3 continued

Core city	NB	SE	SME	Creative professionals (%)	Bohemians (%)	Core city	NB	SE	SME	Creative professionals (%)	Bohemians (%)
Murcia	4,277	26,727	7,795	9.8	1.5	Trier	790	4,489	5,043	12.6	1.2
Bremen	3,846	21,848	23,427	18.6	2.1	Nottingham	780	12,550	6,215	23.2	1.6
Hannover	3,788	22,304	–	24.4	2.1	Aberdeen	764	8,252	5,795	19.9	1.4
Genoa	3,151	53,299	48,253	23.1	1.1	Umea	743	1,359	3,489	11.6	2.0
Bochum	2,978	13,514	12,892	14.9	1.8	Taranto	734	9,823	10,573	19.7	0.7
Wiesbaden	2,948	14,889	14,360	27.1	2.4	Wolverhampton	705	9,650	5,235	13.7	1.4
Karlsruhe	2,810	13,744	13,350	24.9	2.6	Reggio Calabria	696	10,257	10,080	19.1	1.1
Bonn	2,750	15,207	14,547	20.4	2.8	Sassari	690	9,489	9,821	27.5	1.5
Birmingham	2,733	35,474	22,425	20.9	1.6	Maribor	667	5,500	4,646	17.3	2.3
Malmo	2,714	5,843	10,595	19.9	3.1	Weimar	665	2,555	2,380	17.7	5.7
Valencia	2,710	50,311	24,117	11.5	2.9	Belfast	647	8,607	7,955	18.7	3.0
Bielefeld	2,683	12,906	13,208	16.2	2.0	Trnava	645	3,723	828	11.5	1.1
Firenze	2,588	38,385	42,410	28.4	2.2	Newcastle	641	10,324	5,430	20.9	2.3
Palermo	2,555	36,190	36,434	25.8	1.8	Kingston-Hull	633	7,800	4,730	13.3	1.7
Monchengladbach	2,553	11,924	11,163	17.2	0.7	Stoke-on-trent	630	9,050	4,775	11.6	1.8
Augsburg	2,505	13,978	12,189	18.9	3.1	Trencin	628	3,466	1,390	11.1	0.6
Bergen	2,447	5,288	6,735	16.2	4.0	Frankfurt-Oder	604	2,742	2,235	17.2	2.2
Bologna	2,429	40,534	40,150	31.4	2.4	Trento	586	9,060	9,517	25.9	1.9
Erfurt	2,310	8,758	7,008	23.2	2.8	Tromso	579	1,876	1,721	11.6	2.6
Kiel	2,141	10,132	8,733	20.2	2.1	Sevilla	562	36,012	19,186	11.2	2.3
Magdeburg	2,131	7,985	8,379	17.6	0.9	St. Cruz Tenerife	560	10,409	3,165	9.9	2.5
Leeds	2,119	37,593	18,235	23.4	1.9	Ancona	548	9,586	9,048	23.4	1.1
Kosice	2,042	7,257	4,694	12.9	1.4	Caserta	522	5,126	6,146	27.0	1.2
Saarbrucken	2,016	7,371	–	26.6	2.5	Pamplona/Iruna	503	13,380	5,817	10.4	3.1
Halle an der Saale	1,946	7,586	7,318	16.6	1.9	Portsmouth	496	10,361	4,265	16.3	1.9
Ljubljana	1,923	12,000	16,838	19.3	4.5	Catanzaro	436	5,920	6,426	23.5	1.0
Mainz	1,802	8,389	10,063	20.9	6.5	Logrono	386	9,601	4,172	8.8	1.8
Pecs	1,755	7,318	14,089	13.0	1.9	Cremona	384	6,261	6,143	22.1	1.6
Catania	1,666	17,871	22,581	21.2	1.0	Cambridge	368	7,403	3,685	22.0	2.8
Miskolc	1,657	5,169	12,670	8.7	2.1	Potenza	334	4,768	5,286	29.8	0.9
Trondheim	1,651	3,086	4,442	17.4	4.3	Santander	326	10,149	5,335	9.8	1.8

Table 3 continued

Core city	NB	SE	SME	Creative professionals (%)	Bohemians (%)	Core city	NB	SE	SME	Creative professionals (%)	Bohemians (%)
Bari	1,649	22,463	24,892	28.4	1.0	Exeter	309	5,645	3,240	17.3	1.7
Glasgow	1,635	19,501	11,915	23.3	2.2	Badajoz	300	8,597	3,899	7.9	1.8
Manchester	1,613	15,513	10,510	26.8	3.0	Wrexham	275	6,530	3,275	7.7	2.2
Verona	1,609	26,082	23,704	27.1	3.0	Worcester	263	4,671	2,430	14.1	1.7
Uppsala	1,586	4,014	5,907	22.1	2.0	Stevenage	261	4,861	1,905	24.1	0.9
Malaga	1,544	28,720	14,492	10.7	2.3	Gravesham	261	5,730	2,325	11.7	1.9
Potsdam	1,486	7,072	6,350	23.7	5.8	Campobasso	256	4,165	4,176	22.1	1.3
Edinburgh	1,470	24,219	12,170	31.0	2.8	Toledo	231	4,098	3,030	6.7	1.6
Bristol	1,410	21,127	11,615	27.8	2.7	Aquila	230	5,434	4,764	22.1	1.0
Venezia	1,406	24,504	22,987	19.7	1.8	Lincoln	211	4,019	2,010	13.1	1.7
Leicester	1,374	9,965	7,315	15.7	1.5						

NB Number of new business start-ups, *SE* number of self-employed, *SME* number of small- and medium-size firms, *EUA* European Urban Audit (Eurostat 2012)

The table is ranked by new firm startup numbers

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