

The entrepreneur in the regional innovation system. A comparative study for high- and low-income regions

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ABSTRACT

This paper investigates the influence of entrepreneurs' characteristics on innovation in regions with different levels of development. By doing so, this work seeks to contribute to a better understanding of the role of entrepreneurs in the functioning and performance of regional innovation systems. The influence of entrepreneurs' personal characteristics and their perceptions of the business environment on firm innovation are investigated via a survey of companies carried out in six Spanish regions. The results allow the identifying of significant differences in the main determinants of innovation in the high-income regions and low-income regions studied.

Entrepreneurs' generalised trust stimulates innovation only in high-income regions, where necessity motivation has also a negative effect on innovation. Growth ambition seems to play a highly positive role only in the case of low-income regions. Human capital and infrastructure are perceived by the entrepreneurs as the main bottlenecks for innovation in low-income regions, whereas in the case of high-income regions the legal, fiscal and financial systems are considered the key institutional barriers. These differences in the entrepreneurial factor should be taken into account in order to design and implement policies to stimulate and foster innovation in different regional contexts.

JEL Codes: O31; R11; L26; M21.

Keywords: innovation, entrepreneur, regional innovation systems, Spain, business environment.

Introduction

The intensity of innovation varies across regions with different levels of development due to the economic, socio-cultural and institutional characteristics of the territories. In this respect, the 'innovation system' concept (Edquist 1997; Lundvall 1992; Nelson 1993) is a powerful conceptual tool for the spatial analysis of innovation (Asheim, Lawton, and Oughton 2011; Uyarra 2010). Soon this evolutionary approach was adapted from its original national level to the study of innovation at a regional level for the purpose of analysing the interactive and cumulative process of knowledge creation in a more homogeneous and specific context (Braczyk, Cooke, and Heidenreich 1996; Cooke, Gómez-Uranga and Etxebarria 1997). Research on Regional Innovation Systems (RIS) has contributed to a better understanding of the complexity of innovation at a regional level (Asheim, Lawton, and Oughton 2011; Doloreux and Porto-Gomez 2016). However, this

literature shows the existence of significant challenges, dilemmas and knowledge gaps (Doloreux 2002; Porto Gómez, Otegui Olaso, and Zabala-Iturriagagoitia 2016; Tödtling and Tripl 2005).

In this sense, some authors have pointed out the essential role of micro-agents in the performance of the innovation systems (Uyarra 2010), in line with the Schumpeterian theory that emphasises the role of the entrepreneur in the process of creation and dissemination of innovations (Schumpeter 1939). Innovation literature at the micro-level of analysis has shown how the entrepreneur's personal characteristics condition a firm's organisation and management (Koellinger 2008; Marvel and Lumpkin 2007; Romero and Martínez-Román 2012). Yet, the entrepreneur has been overshadowed by the influence of the institutional and regulatory framework in the dominant literature on innovation systems (Acs, Autio, and Szerb 2014).

New approaches have expanded the traditional view of the innovation process with a focus on institutions, emphasising the role of entrepreneurs in innovation systems. Recent contributions explore the systemic interactions between the entrepreneurial factor and the institutional context, often applying the concept of entrepreneurial ecosystem (Acs, Autio, and Szerb 2014; Stam 2015; Alvedalen and Boschma 2017).

The current paper aims at contributing to a better understanding of the functioning and performance of RIS exploring two main ideas. Firstly, it postulates that the personal characteristics of the entrepreneurs and their perceptions regarding the business environment influence innovation and condition the way in which the different actors (other entrepreneurs, companies and institutions) interact in RIS. For instance, necessity entrepreneurs who do not trust other people and are risk-adverse will rarely get engaged in

R&D projects with other companies in the region. Likewise, entrepreneurs with a negative perception of public administration will probably reject the possibility to collaborate with Universities, public research centres and public offices.

Secondly, the paper defends the idea that the same entrepreneurs' characteristics can produce different results in terms of innovation in regions with different structural characteristics. There are manifold possible criteria to classify regions in terms of their contextual conditions, but the level of development can capture many relevant dimensions of the economic and institutional structure of the regions. In general, high-developed regions present a better economic and institutional environment for innovation than less developed ones (human capital, financial resources, infrastructures, high quality public services and regulation, etc.). The previous literature has shown that the nature and characteristics of RIS and entrepreneurial activity vary based on the regional conditions and levels of development (Cooke, Gómez-Uranga, and Etxebarria 1997; Asheim, Lawton, and Oughton 2011; Tödtling and Trippl 2005; Fernández-Serrano and Romero 2013; Gumbau Albert 2017). The current paper postulates that the organisation and functioning of RIS in high-income regions differ from those in low-income regions. This work explores these differences, particularly regarding the role of entrepreneurs.

In order to test these ideas, the paper analyses the determinants of innovation in companies located in two groups of Spanish regions, which have very different levels of development. Spain is a moderate innovator with great regional disparities (European Commission 2017), ranking among the three most heterogeneous countries in Europe regarding regional innovative performance (European Commission 2009). The first group of regions considered in this study is made up of Andalusia, Extremadura and Murcia,

which are ranked among those regions with the lowest per capita income in Spain, while the other group is composed of the Basque Country, Madrid and Navarre, which are the three richest regions in the country. This dataset allows us to investigate and test the hypotheses proposed using regression analysis techniques.

The results show that the entrepreneurs' personal characteristics –such as their motivations, growth ambition, risk-taking propensity and trust– and their perceptions of the business environment influence firms' innovation results. The analysis also confirms that the influence of the entrepreneurs' characteristics presents particularities in regions with different levels of development. Furthermore, significant differences are observed in the way that entrepreneurs perceive the business environment in the high- and low-income regions, affecting the innovation activities of their companies.

The results of the analysis carried out have straightforward implications from a policy perspective. Policy makers should take regional particularities regarding the entrepreneurial factor into account in order to improve the effectiveness and efficiency of the actions implemented to stimulate and foster innovation in different regional contexts.

Literature review and theoretical framework

Regional Innovation Systems in different contexts

The RIS literature presents innovation as the result of a complex process of continuous interaction between private and public agents involved in the creation, dissemination and exploitation of new technological knowledge at the regional level. From a general perspective, an innovation system is formed by the interaction between the production system, composed of a wide range of companies, the science system –comprising

technology centres and research institutions– the education system –consisting of universities and official training centres– and workforce mediating institutions –such as official recruitment centres and other intermediaries between labour and companies (Autio 1998; Kaufmann and Tödtling 2001). The interactions between those systems and agents take place in a specific institutional-regulatory and socio-cultural environment and are shaped by the characteristics of this framework (see Figure 1). The specific characteristics of the institutional context greatly influence the economy, the companies and the individuals' entrepreneurial activity (Autio et al. 2015; Acs et al. 2016; Leyden 2016).

Previous studies have comparatively analyzed the RIS of European countries (Clarysse and Muldur 2001; Tödtling et al. 2013) and between regions of the same country (Blažek et al. 2013; Martin and Moodysson 2013), as in the case of Spain (González-Pernía et al. 2012; Gumbau Albert 2017). Empirical research has made it clear that there are significant structural differences between RIS in different contexts, especially in core and peripheral regions (Oughton, Landabaso, and Morgan 2002). Some authors emphasise the importance of economic issues (Tödtling and Trippel 2005), such as the sectoral structure and specialisation (Fritsch and Stephan 2005), in the formation and characterisation of RIS. Other research stresses the influence of socio-cultural characteristics in significant aspects, such as collective learning (Hauser, Tappeiner and Walde 2007), technological change (Dohse 2000), the level of cooperation (Fritsch and Lukas 2001) and the processes of creation and diffusion of technology and innovation (Leydesdorff and Fritsch 2006). Based on those differences, RIS typologies have been developed that classify the regions according to the innovation modes, types of learning and external knowledge linkages (Isaksen and Trippel 2017). Thus, core regions, traditional manufacturing regions and

peripheral regions constitute innovation contexts with differentiated economic, socio-cultural, scientific-technological and business characteristics (Brown, Gregson and Mason 2016; Isaksen and Trippel 2017; Tödtling et al. 2013) and specific barriers to innovation (Tödtling and Trippel 2005). High developed regions represent favourable environments for innovation due to their greater organisational and institutional thickness (Isaksen and Trippel 2017), while the innovative activity faces greater obstacles in less developed regions (Doloreux and Dionne 2008; Kuştepli, Gülcan and Akgüngör 2013). In this respect, the current paper postulates that the characteristics of the process through which entrepreneurs and companies pursue and achieve innovation can differ in different environments.

Insert Figure 1 around here

The role of entrepreneurs in Regional Innovation Systems

Entrepreneurship is considered today an essential element of a competitive and sustainable RIS in the global economy. The traditional top-down view, focused on the creation and exploitation of new technologies from the close cooperation between large industrial enterprises and R&D centres (Cooke and Leydesdorff 2006), has evolved into a bottom-up perspective. According to this view, the role of entrepreneurs, small businesses and entrepreneurial culture (Beugelsdijk 2007; Fernández-Serrano and Romero 2013; Yoon et al. 2015) is becoming increasingly recognised. Entrepreneurs are at the origin of the formation of clusters and the exploitation of local resources (Feldman, Francis and Bercovitz 2005), their collaboration with local authorities being vital in the development of

sustainable innovation policies (Gasbarro et al. 2017) or in the diversification and reactivation of RIS based on traditional industries (Brown et al. 2016), among other situations.

The study of innovation systems at the micro level (Kaufmann and Tödting 2001, 2002; Martínez-Román et al. 2011) leads the researcher's attention to the influence of the entrepreneur's personal characteristics on the management of innovation (Koellinger 2008; Marvel and Lumpkin 2007), as Figure 2 illustrates. However, the entrepreneurs' personal characteristics and the characteristics of companies are conditioned by the institutions and economic environment in each region. The regional entrepreneurial culture (Beugelsdijk 2007, Gonzalez-Loureiro, Sousa, and Pinto 2017), the institutional setting (Yoon et al. 2015) and the regional economic structure (Fritsch and Stephan 2005) thus interact in shaping the RIS's functioning and performance.

As a result, the possibility of combining the varied range of knowledge available in core regions reduces the uncertainty of entrepreneurs and facilitates their entry into new industries (Isaksen and Trippel 2017). The thick and diversified RIS of those regions offer the entrepreneur a wide range of resources (high labour mobility, knowledge spillovers, business networks, university-business cooperation and spin-offs) to exploit business opportunities and introduce radical innovations. On the contrary, in old, less developed industrial regions, there is a lack of complementary knowledge to be sought outside the region (Isaksen and Trippel 2017). In peripheral regions, the entrepreneur faces unfavourable conditions, which are characteristics of thin RIS and hinder interactive learning and innovation, especially those of small companies (Doloreux and Dionne 2008; Dubois 2016, Isaksen and Trippel 2017). In these contexts, entrepreneurs should strive to

strengthen extra-regional knowledge links (Dubois 2016, Isaksen and Trippel 2017) and links with large foreign companies located in the region (Salamonsen 2015) to increase their capacity for technological absorption.

The previous considerations have led to the developing of a comprehensive systemic vision of entrepreneurship, innovation, the institutional context and their influences on economic performance (Acs, Autio and Szerb 2014; Acs et al. 2016). From this perspective, entrepreneurship is a systemic phenomenon in which institutional and environmental variables interact and have a moderating effect on the entrepreneur's decision-making (Acs, Autio and Szerb 2014, Autio et al. 2015). The entrepreneur emerges therefore as a key actor in the creation and development of entrepreneurial ecosystems (Alvedalen and Boschma 2017; Stam 2015).

Insert Figure 2 around here

Hypotheses development

The previous literature has related the personal characteristics of entrepreneurs to several key organisational aspects in the innovation process. The entrepreneur's personal characteristics influence the identification of business opportunities and the company's vigilance of the market (Renko, Shrader, and Simon 2012; Wright et al. 2007). The entrepreneur's growth ambition conditions the size of the company (Morrison, Breen, and Shameem 2003; Stam and Wennberg 2009) and the influence of firm size on innovative activity has been very often shown in the literature (Amara et al. 2008; Martínez-Román

and Romero 2017). Firm growth increases the availability of financial resources for innovation (Vaona and Pianta 2008) and rigour in planning and control. Similarly, some works have shown that when entrepreneurs have a high propensity to take risks (Baron and Tang 2011) and great interpersonal trust (Tsay and Goshal 1998), they find it easier to innovate. Flexible organisations with high risk tolerance (Forsman 2011), which support training activities and internal learning (Martínez-Román, Gamero, and Tamayo 2011) and intensively cooperate with other agents in the value chain (clients and suppliers) (Rondé and Hussler 2005; Ar and Baki 2011) and in the regional science system (Kaufmann and Tödtling 2002; Romero and Martínez-Román 2013) are more innovative as well, according to previous works.

The very decision to start a new business is associated with the entrepreneur's personal motivations, whose effects on innovation have been considered in the literature (Marvel et al. 2007). Thus, the entrepreneurs' intrinsic motivation, based on their desire for personal and professional achievement, is a factor that usually favours innovation in the company (Martínez-Román and Romero 2017). By contrast, entrepreneurs basically driven by extrinsic motivations, such as the profit motive (Guzmán and Santos 2001), or urged by material necessity, unemployment or professional dissatisfaction (Block and Sandner 2009) have been observed to less likely promote innovation in their companies.

From this perspective, the entrepreneur's personal characteristics permeate the firm's organisation and management of innovation. Notwithstanding, the underlying economic and institutional conditions can modify the way in which those personal characteristics favour or hinder innovation. As has been previously point out, the channels for innovation in regions with different levels of development can be partially different, as

are the resources available for achieving innovation. In this respect, the current paper postulates the following hypothesis:

Hypothesis 1 (H1): The entrepreneurs' personal characteristics – motivations, risk-taking, ambition and trust - influence business innovation in a different manner in high- and low-income regions.

Entrepreneurs' perceptions play an important role in the interaction between the micro-agents' decision processes and the characteristics of the regional contexts. Those perceptions represent the filter through which entrepreneurs dialogue with their peers and the rest of the elements of the RIS (see Figure 2). In general, the business environment in high-income regions is 'objectively' better than in low-income ones. However, entrepreneurs can 'subjectively' perceive the socio-economic and institutional environment in a different manner depending on their personal characteristics and the characteristics of their businesses. Consequently, the entrepreneurial culture in each area can shape those perceptions (Beugelsdijk 2007; Fernández-Serrano and Romero 2014). Moreover, firm organization and management influence the needs and aspirations of the companies, affecting the way in which they perceive opportunities and obstacles in the environment (Varis and Littunen 2012). Those companies that are more entrepreneurial can feel particularly constrained by certain barriers in their business environment. The different characteristics of the companies in high- and low-income regions (Fernández-Serrano and Romero 2013) can thereby condition the perceptions on the business environment in each type of context.

In turn, entrepreneurs' perceptions can influence the organisation and management of companies in general, and their innovation activities, in particular. The key determinant

of entrepreneurs' decisions in this sense is not actually the objective situation of the business environment, but the way in which they perceive this environment. When entrepreneurs perceive that the resources necessary to innovate (human resources, funding or public support) are not available, they can change the initial entrepreneurial intentions (Koellinger 2008). Other studies have demonstrated the influence of perceptions about the external environment on organisational learning and innovation performances in companies (Wang and Ellinger 2011). Furthermore, an entrepreneur's values and regulatory barriers to start-up have been observed to have an interactive influence on entrepreneurial activity (Fernández-Serrano and Romero 2014). Finally, Varis and Littunen (2012) show that the entrepreneurs' perceptions in relation to the quality and availability of human resources, funding and public support in the case of innovative companies may differ from that of business owners who run companies that do not innovate.

In this respect, the current paper postulates the following hypothesis:

Hypothesis 2 (H2): The entrepreneurs' perception of the business environment – infrastructure, labour resources, tax, financial and administrative systems- influences business innovation in a different manner in high- and low-income regions.

If the entrepreneurs in a region do not generally trust others and believe that agreements are not often complied with within their society, they will be reluctant to cooperate with other companies and institutions (Cooke and Wills 1999). Trust is often the result of information obtained from social interactions, leading to the formation of positive expectations regarding the behaviour of particular others (Rus and Igluc 2005). In addition, actors usually base their expectations regarding the behaviour of others whom they do not know on the quality of the institutional system (Rus and Igluc 2005). Therefore,

entrepreneurs' social capital and their perception of the institutional arrangements condition cooperation with the rest of the agents (other companies, Universities, administrations, etc.) in the RIS. The impact of those cooperation relationships on innovation in areas with diverse entrepreneurial cultures and institutional frameworks can also differ. In this respect, the following hypothesis is proposed in this paper:

Hypothesis 3 (H3): The cooperation relationships with other actors in the regional innovation system (other companies, clients, suppliers and Universities) influence business innovation in a different manner in high- and low-income regions.

Data and methodology

This paper defends the idea that the same entrepreneurs' characteristics can produce different results in terms of innovation in regions with different levels of development. In order to check this core hypothesis, representative samples of business populations in different regions were needed. The regions included in the analysis had to be classified according to their level of development to make a comparison possible.

Hence, data for this study come from a survey conducted in six Spanish regions: Andalusia, Extremadura, Murcia, the Basque Country, Madrid and Navarre (see Figure 3). The regions included in the survey were selected in order to create two clearly different groups. Thus, the first three regions are ranked among those regions with the lowest per capita income in Spain (76% of national GDP per capita as an average), while the last three are the three richest regions in the country (130% of national GDP as an average). The

regional level of development is used as a proxy to capture different characteristics of the economic and institutional structure.

Insert Figure 3 around here

Table 1 shows some basic economic indicators of these regions. The average unemployment rate in the low-income regions doubles the levels in the high-income ones. In fact, Andalusia showed the highest regional unemployment rate in Spain, while the Basque Country and Navarre had the lowest ones. Likewise, the importance of the shadow economy is higher in the low-income regions.

The low-income regions tend to be characterised by smaller industrial sectors and larger agricultural and construction sectors. However, among the high-income regions, Madrid has a very small industrial sector, being essentially a tertiary economy, and Navarre has a relevant agriculture activity (without exceeding the importance of this sector in the low-income regions). A significant gap favourable to the high-income regions also exists regarding business density (13 per cent points of difference as an average) or employment in high technology sectors indicators (8.5 per cent points of difference).

The territorial distribution of R&D and innovation activities in Spain is very heterogeneous. Hence, the high-income regions considered in this analysis invested 2.1% of their regional GDP on R&D (public and private expenditure), doubling the average effort of

the low-income regions. The gap remained basically the same when exclusively considering the business R&D activities.

Finally, there are also significant disparities in terms of human capital between the regions selected. The low-income regions are characterised by greater illiterate and no schooling rates (three times higher than the average in high-income regions), greater early school leavers rate (doubling the rate of high-income regions) and lower tertiary education rates (almost 14 per cent points of difference).

Table 1. Some economic indicators (2011)

	Madr id	Basq ue Coun try	Nav arre	High - Inco meR egio ns	Extrem adura	Murc ia	Anda lusia	Low - Inco meR egio ns	SPAI N
Population (number of inhabitants)	6,394,239	2,183,134	637,099		1,102,300	1,459,076	8,332,087		46,667,175
Population (Spain=100)	13.7	4.7	1.4		2.4	3.1	17.9		100
GDP per capita (euros)	31,041	29,842	28,533	29,805	15,916	18,646	17,318	17,293	22,903
GDP per capita (Spain=100)	135.5	130.3	124.60	130.0	69.5	81.4	75.6	76.0	100.0
Shadow economy (over GDP)*	14.9	18.6	17.5	17.0	29.8	29.4	33.2	30.8	24.4
Agriculture (over GDP)	0.1	0.7	3	1.3	6	3.7	4.9	4.9	2.6
Industry (over GDP)	9.6	25	27.8	20.8	11.7	15.9	11.4	13.0	17.2
Construction (over GDP)	6.2	8.1	7.7	7.3	10.9	9.6	9.3	9.9	8.8
Services (over GDP)	84.1	66.2	61.5	70.6	71.4	70.8	74.4	72.2	71.4
Number of enterprises (including self-employed without workers)	501,669	165,496	41,541		65,103	90,856	492,341		3,250,576
Number of enterprises (per 1,000 inhabitants)	78.5	75.8	65.2	73.2	59.1	62.3	59.1	60.2	69.7
Employment in high and medium-high-technology sectors (% of total employment)	9.9	12.5	11.5	11.3	2.3	3	3.2	2.8	6.6
Total R&D expenditure (over GDP)	2	2.2	2.1	2.1	0.9	0.9	1.2	1.0	1.4
Business R&D expenditure (over GDP)	1.1	1.6	1.5	1.4	0.2	0.3	0.4	0.3	0.7
Public R&D expenditure (over total R&D)	45.0	27.3	28.6	33.3	77.8	66.7	66.7	70.0	50.0
Population aged 16 years old and over literate/no schooling (% population)	8	3.1	3.2	4.8	17.4	15.4	15	15.9	10.6
Population (16 years old and over) with tertiary education	33.3	34.8	30.6	32.9	17.8	19.6	20.3	19.2	24.3
Early school leavers ratio	19.8	13	12	14.9	29.6	30.7	34.7	31.7	28.4

Source: Calculated from data of the National Institute of Statistics (<http://www.ine.es>) * González-Fernández and González-Velasco (2015).

The survey was conducted in the last quarter of 2010. All types of companies were included in the study with the exception of self-employed people without employees. The survey was addressed to the person having the role of entrepreneur. The entrepreneur was defined as any business owner (or co-owner) who also carried out managerial functions within the firm. The stratified sample –with quotas for firm size groups and sectors– was representative of the business population of every region included in the study with an error of $\pm 6.0\%$ at a confidence level of 95.5 percent. Ten pilot interviews were done before starting the fieldwork to test the questionnaire and detect possible mistakes. The companies participating in this survey were randomly selected using public information from the Spanish Official Company Register. The surveying technique used was that of computer-assisted telephone interviewing (CATI). A response rate of 20.8 percent was obtained in the fieldwork. The final dataset is made up of 1,595 observations –797 cases in high-income regions and 798 in low-income ones. No bias was detected between respondents and non-respondents.

The questionnaire used in this research included queries about the innovative activities of the businesses and about different possible explanatory variables for them, considering the entrepreneurs' personal characteristics and perceptions and the characteristics of the firm's management.

Dependent variable: Innovativeness

The business owners/managers were asked whether in the previous three years they had introduced four different types of innovation and, if so, they were asked to assess the level of innovativeness of these developments using a 7-item Likert scale. Value 0 was assigned to those companies that had not carried out the innovation activities and value 7 to those

companies that had introduced the most ambitious developments in each area. The four types of innovation activities were the following:

- a) Introduction of new products (prod_innov).
- b) Introduction of new production processes (proc_innov).
- c) Entrance into new markets (mark_innov).
- d) Changes in internal organisation (org_innov).

Table 2. Descriptive indicators for innovation variables

		High-income regions		Low-income regions	
		Value*	S. D.	Value*	S. D.
Innovation	prod_innov	2.59	2.71	2.40	2.71
	proc_innov	1.27	2.28	1.25	2.28
	mark_innov	1.14	2.22	1.20	2.22
	org_innov	1.39	2.45	1.53	2.45

(*) Value = average value. S.D. = Standard Deviation.

Table 2 shows some descriptive indicators for these innovation variables. A significant correlation exists between these innovation indicators. Hence, the principal component analysis technique was employed in order to capture the latent dimensions associated with the innovation variables. This methodological approach has often been used in previous research on innovation (Gatignon et al. 2002; Martínez-Román and Romero 2017). The first principal component accounts for 56.15% per cent of the total variance.

Appendix 1 presents the variable-factor correlations, the communalities and other details of this analysis. The econometric model presented in the following section seeks to explain this first principal component (innovation), capturing the companies' level of innovativeness, using different explanatory variables with a linear regression specification.

Explanatory variables

The following *control variables*, regarding general characteristics of the companies, were included in the econometric models:

- Number of employees (emp) as an indicator of firm size.
- Two sectorial dummies for manufacturing industry (ind) and services (serv).

Furthermore, a set of variables related to internal business practices favouring innovation were also considered as controls:

- Innovation expenditure (inn_exp). This dummy variable takes value 1 for those businesses that made some expenditure in innovation-oriented activities in the previous three years and 0 in the negative case.
- Training activities for workers (train). The entrepreneurs were asked whether they regularly carried out training activities in their businesses in order to improve the capabilities of their workers and develop new skills. The answers were coded using a binary variable.
- Formal business planning of the different management areas (finance, marketing, logistics, human resources, etc.) (plan). This dummy variable takes value 1 for the companies which undertook formal business planning on a regular basis, and 0 in the negative case.

- Alertness and identification of new markets and business opportunities (alert). This dummy variable takes value 1 for the companies which developed specific activities oriented at identifying new markets and business opportunities and 0 in the negative case.

Three groups of variables were included in the model to test the hypotheses proposed in the previous section. The first group of variables captures *entrepreneurs' personal characteristics* as follows:¹

- Intrinsic entrepreneurial motivation (int_mot). The entrepreneurs interviewed were asked about their level of agreement with the following statement: "I became an entrepreneur because this was the best option for my personal and professional development". The answers were coded as ordinal variables which take values from 1 to 7 –7 meaning full agreement and 1 complete disagreement.

- Necessity entrepreneurial motivation (nec_mot): The following statement was proposed to capture necessity motivation: "I became a self-employed person because I did not have another option (I was unemployed)". The answers were coded as in the previous variable.

- Ambition for growth (ambition): The entrepreneurs interviewed were asked about their level of agreement with the following statement: "The idea that my business grows is very attractive to me"(7-item Likert scale).

- Risk taking (risk): The entrepreneurs interviewed were asked about their level of agreement with the following statement: "In general, a tendency to undertake highly-risky projects exists in my business" (7-item Likert scale).

- Trust (trust): The entrepreneurs were asked about their perception on the level of compliance with informal agreements in the local environment (7-item Likert scale).

Secondly, a set of variables approaching the entrepreneurs' perceptions on the business environment was considered. The managers/business owners were asked to assess the importance of the following obstacles (7-item Likert scale):

- Tax burden (tax)
- Difficulty in finding qualified workers (qual_work)
- Administrative and legal obstacles (adm_leg)
- Difficulty in getting funding (funding)
- Poor infrastructures (infrast)

Finally, four variables were also considered to capture *the access of external information and knowledge* that can favour innovation activities as a result of interactions within the different agents participating in the RIS:

- R&D cooperation with other companies (coop_bus). The managers/business owners interviewed were asked to assess the intensity of the R&D cooperation activities (if any) with other companies, using a 4-item scale (from no cooperation to intense cooperation).
- R&D cooperation with universities and research centres (coop_univ). The managers/business owners interviewed were asked the same question but regarding their possible collaboration with universities or other technological centres (4-item scale).
- Suggestions or petitions from clients (client). The entrepreneurs interviewed were asked whether the suggestions or petitions from their clients were used in their businesses as sources to increase their knowledge or information. The answers were coded using a binary variable.

Table 3. Descriptive indicators for the explanatory variables.

		High-income regions		Low-income regions	
		Value*	S. D.	Value*	S. D.
Organisation general characteristics	emp	9.97 ^a	0.44	9.04 ^a	0.37
	ind	11.2 ^b	0.32	10.4 ^b	0.31
	serv	50.2 ^b	0.50	44.9 ^b	0.50
	inn_exp	69.4 ^b	0.46	62.5 ^b	0.48
Organisation internal factors	plan	44.9 ^b	0.50	43.7 ^b	0.50
	train	70.0 ^b	0.46	72.4 ^b	0.45
	alert	66.2 ^b	0.47	64.4 ^b	0.48
Entrepreneurs' personal characteristics	int_mot	4.28 ^a	2.43	4.39 ^a	2.37
	nec_mot	3.02 ^a	2.45	3.19 ^a	2.51
	ambition	5.05 ^a	2.08	5.66 ^a	1.87
	risk	3.13 ^a	1.83	3.22 ^a	1.95
	trust	5.34 ^a	1.69	4.80 ^a	1.92
Entrepreneurs' perception of the business environment	tax	5.00 ^a	2.19	5.42 ^a	2.01
	qual_work	3.66 ^a	2.37	3.52 ^a	2.38
	adm_leg	3.84 ^a	2.36	4.10 ^a	2.35
	funding	3.87 ^a	2.45	4.32 ^a	2.52
	infrastr	2.40 ^a	1.90	2.64 ^a	2.02
Companies' relationships with other actors	coop_bus	1.38 ^a	0.81	1.40 ^a	0.85
	coop_univ	1.22 ^a	0.60	1.23 ^a	0.64
	client	50.4 ^b	0.50	50.3 ^b	0.50
	supply	45.2 ^b	0.50	49.1 ^b	0.50

(*) Value = (a) average value (b) percentage of 1 –in the case of binary variables.

S.D. = Standard deviation.

- Suggestions or petitions from suppliers (supply): The entrepreneurs were asked the same previous question but regarding their suppliers (dummy).

Some descriptive indicators for the independent variables in the analysis are presented in Table 3. Next, the effect of the independent variables in the innovativeness variable derived from the principal component analysis was observed by means of estimating linear regressions. For this analysis, companies were grouped depending on the level of development of the regions in which they were settled. Thus, separated regressions were estimated for high-income and low-income regions. The condition indices are lower than 20 and the variance inflation factors are around 1. Therefore there is not a serious problem of multicollinearity in the analysis.

Results and Discussion

The econometric results for high- and low-income regions are presented in Table 4. Regarding the control variables, firstly, industry (ind) is statistically significant, with a positive sign in both types of regions. This indicates that the level of innovativeness is higher in the industry sector, as could be expected. In contrast, the sign of the coefficient for services (serv) –though it is not significant– is negative. In the case of firm size (emp), the variable is not statistically significant and the sign of the coefficient is uncertain (around zero).

Table 4. Regression results. Dependent variable = Innovation.

		High-income regions				Low-income regions			
		B	S.E.	St.B	Sig.	B	S.E.	St.B	Sig.
	constant	-2.010	.166		***	-1.700	.197		***
Organization	emp	.000	.001	.007		.000	.001	.012	
general	ind	.418	.009	.132	***	.295	.111	.089	***
characteristics	serv	-.019	.063	-.010		-.032	.069	-.016	
	inn_exp	.405	.067	.188	***	.443	.069	.213	***
Organisation	plan	.327	.064	.164	***	.194	.068	.096	***
internal factors	train	.057	.068	.026		.162	.075	.072	**
	alert	.303	.065	.144	***	.163	.071	.077	**
	int_mot	.009	.012	.021		.022	.014	.052	
Entrepreneurs'	nec_mot	-.024	.012	-.060	**	-.005	.013	-.012	
personal	ambition	.021	.015	.043		.040	.018	.074	**
characteristics	risk	.056	.016	.102	***	.039	.017	.076	**
	trust	.035	.017	.060	**	.009	.017	.018	
Entrepreneurs'	tax	.027	.014	.060	**	<i>.031</i>	.017	<i>.061</i>	*
perception of	qual_work	<i>.024</i>	.013	<i>.058</i>	*	.053	.014	.124	***
the business	adm_leg	.028	.013	.065	**	<i>-.030</i>	<i>.015</i>	<i>-.069</i>	*
environment	funding	.026	.013	.064	**	-.013	.014	-.033	
	infrastr	-.021	.016	-.040		.042	.017	.084	**
Companies'	coop_bus	.212	.041	.173	***	.055	.042	.046	
relationships	coop_univ	.068	.054	.040		.108	.056	<i>.069</i>	*
with	client	.088	.066	.044		.244	.073	.121	***
other actors	supply	.149	.064	.074	**	.004	.073	.002	

Note: S.E.= Standard Error. St. B = Standard coefficient.

* Significant at the 0.10 level. **Significant at the 0.05 level. ***Significant at the 0.01 level.

$N = 798$ in the case of high-income regions and 797 in the case of low-income regions.

R^2 adjusted = 0.355 in the case of high-income regions and 0.205 in the case of low-income regions. Both models are significant at the 0.000 level.

Regarding the organisations' internal factors, all the variables are significant in both types of regions with the unique exception of the training variable (train) in the case of high-income regions. This result can be explained by the more advanced education system in this type of regions, as can be seen in the indicators reported in Table 1. This could imply that the activities for improving the skills within the companies are not so relevant for innovation in the case of the high-income regions. On the contrary, in the case of low-income regions, the deficiencies in the skills of the human resources can represent a severe constraint. Therefore, the investment in training programmes in low-income regions has a significant return in terms of innovation.

It is also worth noting that the size of the standardised coefficients for planning (plan) and alertness (alert) is larger in the case of the high-income regions, suggesting that these factors play a more significant role in these regions than in the low-income ones. This could be due to the different approaches towards innovation in high- and low-income regions which have often been pointed out in the previous literature (Oughton, Landabaso and Morgan 2002; Tödting and Trippel 2005). In high-income regions, the role of R&D and formal innovation processes targeting radical innovations is more important, requiring rigorous planning, alertness and proactivity regarding potential innovation opportunities. In the case of the low-income regions, firms focus more often on non-R&D investments, incremental innovations or activities for mere technology adoption. Those innovations could be attained through more informal processes and require more knowledge absorption

capabilities than alertness skills. On the contrary, the innovation expenditure (*inn_exp*) seems to have a greater effectiveness for stimulating innovation in low-income regions. Given the lower expenditure on innovation in low-income regions compared to high-income ones (as can be seen in Table 1), this could imply the existence of decreasing returns of scale of innovation expenditure. This is in line with the neoclassical view and other approaches, and contradicts the Schumpeterian assumption of increasing returns of investment in R&D (Rodríguez-Pose 2001; Acs et al. 2009).

When considering the entrepreneurs' personal characteristics, in the case of high-income regions, necessity motivation (*nec_mot*) has a negative statistically significant effect and trust (*trust*) and risk-taking propensity (*risk*) have positive significant effects. The positive effect of risk-taking propensity (*risk*) can also be observed in the case of low-income regions. However, in low-income regions the entrepreneur's ambition for growth (*ambition*) has a significant positive effect on firm innovativeness, while necessity motivation (*nec_mot*) and trust (*trust*) are not observed to be significant factors. In the case of these low-income regions, which are characterised by high unemployment rates (see Table 1), necessity is a more frequent motivation pushing people towards self-employment. Yet, this fact does not signal the entrepreneurs in a negative way. Therefore, in low-income regions, the important issue is not whether entrepreneurs are motivated for opportunity or necessity reasons, but the level of ambition that they show in their business activity. Notwithstanding, in the case of high-income regions, where people have greater economic opportunities, the fact of being motivated for necessity reasons could be associated with low skills or negative attitudes. These results recommend researchers and policy makers to be cautious when classifying individuals or territories according to the necessity and

opportunity entrepreneurial motivations as the significance of these two types of entrepreneurship is mediated by the context (see also Rosa, Kodithuwakku, and Balunywa 2006).

Furthermore, in high-income regions trust seems to have an important role favouring innovation in business (which is not the case in low-income regions). As shown in the descriptive results in Table 3, the overall level of trust is higher in the high-income regions than in the low-income ones. Both facts could be revealing a higher relevance of cooperation and social capital in the innovation systems of high-income regions as a factor favouring innovation. This is in line with Yoon, Yun, and Phillips (2015) who observed that entrepreneurial RIS present particular requirements in terms of (structural, relational and cognitive) social capital.

Consequently, the results presented here support H1 regarding motivations, ambition and trust, but not with regards to risk-taking (which has basically the same effect on innovation in the two types of regions).

Table 4 also shows the results for the entrepreneurs' perceptions regarding their business environment. The interpretation of the results in this respect has to be different than in the case of 'objective' indicators of these business obstacles being included in the model. In that alternative case, negative coefficients should be expected for the measurement variables in the model (higher obstacles being associated with less innovation). Nevertheless, in the analysis presented here –based on the entrepreneur's perceptions– positive coefficients are generally observed in Table 4. This is indicating that, in general, those entrepreneurs who are more sensitive regarding the obstacles in their institutional environment are also more innovative. This is in line with the results of Varis

and Littunen (2012) in a study for Finland. The innovative entrepreneurs and companies are more proactive, ambitious and challenge the institutional environment when trying to carry out their business projects. On the contrary, the conservative business owners/managers who are only concerned about the survival of their companies are less demanding regarding the conditions of the business environment and may not feel constrained by the existing obstacles for their businesses.

Important differences can be observed between high- and low-income regions regarding this aspect as well. In high-income regions, the legal/administrative (adm_leg), financial (funding) and tax (tax) obstacles are the most severe constraints for innovation in the view of the managers/business owners. The workers' qualification (qual_work) is also marginally significant in the model. Nonetheless, in the case of low-income regions, the workers' qualification (qual_work) and infrastructures (infrastr) are observed to be the main constraints for innovative firms. Tax and legal/administrative burdens (tax and adm_leg) are only marginally significant. In addition the coefficient for the latter is, interestingly, negative.

So, contrary to the result noted for high-income regions, high innovative firms in low-income regions are not concerned about the regulatory and administrative conditions. This fact could be connected with a larger presence of an informal economy and a less rigid application of norms and administrative procedures in low-income regions. As La Porta and Shleifer (2014) have stated, strong evidence supports that informality declines with development. Therefore, the administrative burdens represent a critical point in more rigid institutional frameworks that would comparatively characterise the high-income regions.

However, they are not so relevant in the context of the low-income regions, where the degree of effective fulfilment of regulations is lower.

On the contrary, the financial and tax conditions are more critical for the companies in high-income regions. This is coherent with previous considerations. Companies in high-income regions are more often involved in R&D projects which are more demanding in terms of financial resources. Moreover, the size of the shadow economy in the low-income regions studied is much higher than in the high-income ones (González-Fernández and González-Velasco 2015), as can be seen in Table 1. So companies in high-income regions might be more sensitive to tax burdens than those in low-income regions due to the lower levels of tax fraud in the former ones.

The results presented in Table 4 also confirm the differences in the availability of human capital and infrastructures in high- and low-income regions, which have often been pointed out for Spain (i.e., Gumbau Albert 2017). Companies in high-income regions usually benefit from better environmental conditions that favour their innovation activities while companies in low-income regions are limited by deficiencies in these aspects.

In this respect, the results of this paper support H2, since the entrepreneurs' perceptions of the business environment condition business innovation in a markedly different manner in high- and low-income regions.

Finally, regarding the organisation links with other agents in the RIS, relevant differences in the patterns favouring innovativeness can also be observed when comparing high- and low-income regions. On the one hand, in the case of the high-income regions, cooperation with other companies in R&D activities (*coop_bus*) and the communication

and collaboration with suppliers (supply) are significant factors stimulating firm innovativeness. On the other hand, in low-income regions, the collaboration and suggestions of clients (client) is the only clearly significant factor fostering innovativeness. The R&D cooperation with Universities and technological centres (coop_univ) is marginally significant in these regions as well, while it has not a significant effect in high-income regions, against what might be expected (Isaksen and Trippel 2017; Rondé and Hussler 2005).

These results point out to two main interpretations. Firstly, the pattern of insertion in value chains could differ between companies in high- and low-income regions and this fact could have consequences for the most frequent sources of innovation (downwards or upwards in the value chains). The existence of regional differences in the patterns of the SMEs' insertion in national and global value chains has been observed in the previous literature for Spain (Fernández-Serrano and Romero 2013). Secondly, in high-income regions, a more dense, efficient and dynamic private sector exists which enables a fruitful collaboration between companies in R&D and innovation issues. This contrasts with the "organisational thinness" that characterises peripheral regions (Tödtling and Trippel 2005; Isaksen and Trippel 2017). In the case of low-income regions, even though innovative companies exist, there is not a critical mass of them to form a dynamic cluster (Tödtling and Trippel 2005). The regional differences on R&D cooperation have also been associated with regional differences in firm size or industrial specialization (Fritsch and Lukas 2001; Forsman 2011). In the context of low-income regions, characterised by low innovation capabilities in the private business sector, the role of public agents is especially important (Doloreux and Dionne 2008), as the proportion of public expenditure in the overall regional

R&D expenditure suggests (see Table 1). However, the R&D initiatives, through Universities and research centres, frequently encounter difficulties in reaching companies in both high- and low-income regions and this fact restricts their effective impact on innovation (Melançon and Doloreux 2013).

Overall, the results presented support H3, since interaction with other agents in the RIS influences innovation in a clearly different way in high- and low-income regions.

Conclusion

This paper studies the role of the entrepreneurial factor in RIS inspired by two main ideas: Firstly, the article defends the idea that the characteristics of entrepreneurs crucially influence the organisation and performance of the RIS. Entrepreneurs' personal characteristics condition the decisions that shape firm organisation and management in a direct way, and also in an indirect one, via their perceptions of the business environment. Those entrepreneurs' perceptions influence the relationships between companies and other agents in the territory (regional administration and public agencies, universities and technological centres, the financial system, etc.), conditioning the socio-economic interactions within the RIS.

Secondly, the paper assumes that RIS in areas with different levels of development have specificities regarding entrepreneurial cultures and other economic, social and institutional conditions. Hence, the functioning of RIS in high and low-income regions can respond to different parameters and rationales, in particular, regarding the role of the entrepreneurial factor. The entrepreneur –and his/her characteristics – interacts with the

framework conditions in the RIS and therefore the entrepreneurial profiles that can better foster (or hinder) innovation in different contexts may differ.

This paper provides evidence of these considerations based on firm-level data for six Spanish regions, three of them high-income regions and three of them low-income ones. In this respect, the paper shows that the entrepreneurs' personal characteristics – motivations, risk-taking, ambition and trust - influence business innovation in a different manner in high- and low-income regions (first hypothesis). In the case of the high-income regions included in the analysis, the necessity motivation of entrepreneurs limits business innovation, while trust favours it and growth ambition has no apparent effect. On the contrary, in the low-income regions analysed, the entrepreneur's ambition for growth stimulates firm innovativeness, while necessity motivation and trust do not affect business innovation.

The paper also shows that the entrepreneurs' perception of the business environment –infrastructure, labour resources, tax, financial and administrative systems- influences business innovation in a different manner in the high- and low-income regions (second hypothesis). Particularly, in the high-income regions considered, the legal/administrative, financial and tax obstacles are perceived as the most severe constraints for innovation from the perspective of the managers/business owners. However, in the case of low-income regions, the workers' qualification and infrastructures are observed to be the main constraints for innovative firms.

In addition, the characteristics and perceptions of entrepreneurs influence their relationships with other agents in their RIS. In this respect, the paper shows that the cooperation relationships with other agents influence business innovation in a different

manner in high- and low-income regions (third hypothesis). In the case of the high-income regions, cooperation with other companies in R&D activities and communication and collaboration with suppliers stimulate firm innovativeness, whereas in low-income regions the relationships with clients and with Universities and technological centres are the key channels that foster innovativeness. Thus, in low-income regions, characterised by lower levels of trust and a less entrepreneurial private sector, public support seems to have a more relevant role for innovation. Nonetheless, in high-income regions the inter-firm relationships in clusters are the main source of innovation.

These results indicate that the most effective mechanisms and actions to support innovation in low-income regions can partially differ with respect to the ones that are effective in high-income regions. From this perspective, it is not possible to replicate in low-income areas the organisation and functioning of RIS in high-income areas. Policy makers should adapt their programmes to the characteristics of the RIS and the business environment in each type of region, paying particular attention to the entrepreneurial culture in the area.

Innovation policy should take into account in its design and implementation that in high-income regions cooperation between companies is an effective mechanism to support innovation and, in this sense, it is better to target those entrepreneurs with high levels of generalised trust who can more frequently develop cooperative behaviours. On the contrary, innovation policy should avoid locating resources for necessity entrepreneurs, since they are observed to be less innovative.

Yet, these necessity entrepreneurs should not be relegated from the perspective of public incentives in low-income regions, since they are not associated with worse results in

terms of innovation in this specific context. Nevertheless, policy action in low-income regions should focus on ambitious entrepreneurs with growth aspirations (regardless of their entrepreneurship motivations) in order to achieve better results in terms of innovation. Regarding the conditions of the business environment, in high-income regions, the legal/administrative, financial and tax obstacles should be the priority aspects to be improved in order to stimulate firm innovation. On the contrary, in the case of low-income regions, the workers' qualification and infrastructures should be attended as a priority.

This paper focuses on a set of Spanish regions and therefore its results cannot be directly generalised. Yet, the considerations presented in the analysis could be relevant for other regions. In this respect, further comparative research in other regions and countries is needed in order to confirm the findings of this paper. Furthermore, the comparison between high- and low-income regions is a simplified approach that could be enriched with other criteria and considerations. The results presented in this paper indicate the existence of different patterns of insertion into value chains for companies in high- and low-income regions, which could be related to firm innovativeness. The data for this study have not allowed delving into this interesting issue that would deserve more attention in future research.

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Notes

1. Entrepreneurs' education was also considered as an explanatory factor, but it turned out to be non-significant in the econometric models. This does not mean entrepreneurs' education has no effect on innovation, but its effect comes through other variables in the model, as suggested by Romero and Martínez-Román (2012).

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