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Exploring entrepreneurial genetic code of Smart Cities

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Abstract

Smart Cities are key players in the Digital Economy; their essence is to transformation living, housing and consuming in a sustainable way. The aim of this paper is to explore the entrepreneurial genetic code of Smart Cities. In this way, Smart Cities are born to Smart Entrepreneurships which means that the origin of this smart universe, its genetic code, is Smart Entrepreneurship. Using a sample of 48 Spanish cities obtained from databases such as the National Statistics Institute (NSI) and the Iberian Balance Analysis System between 2015 and 2019, we analyse the differences between smart habitat. Some demographic, economic and social variables are used for identifying smart universe understood as Smart Entrepreneurship and City. Logit modelling is used to identify the significant variables to explain Smart Cities. Some of these variables are ICT entrepreneurship, university level and median age of citizens and represent the core genetic code of Smart Cities. This paper concludes that Smart Entrepreneurship has a unique entrepreneurial genetic code which can create differences between Smart Cities. Entrepreneurship and City are the power couple to develop better smart ecosystems.

Key words: Smart City, Entrepreneurship.

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1. INTRODUCTION

The Smart Cities market will reach a global business volume close to 2.4 trillion dollars in 2025, with a significant increase and acceleration in recent years (Frost and Sullivan, 2020). Moreover, the European Union will be the area with the largest number of Smart Cities and entrepreneurial investment around the world. In this sense, the policies and initiatives promoted by the European Commission – with specific investment lines – are crucial in this forecasting.

Smart City and Entrepreneurship are two sides of the same coin. From one side, entrepreneurs discover technological opportunities, create businesses, and help to develop Smart Cities at the same time (Kummitha, 2019; Van den Buuse and Kolk, 2019; Paroutis et al., 2014). And for the other side, Smart Cities discover new technological opportunities for improving the community's way of living and focus on new entrepreneurial opportunities at the same time. In this sense, the title of the paper about the genetic code of Smart Cities tries to highlight the development of the Smart Cities as the origin of Smart Entrepreneurships. Thus, it is possible to identify a particular genetic code (variables related to demographic aspects, social conditions, economic elements, surface and land use, as well as elements of training and education) of smart habitat where cities and entrepreneurs goes together.

The United Nations entitle one of the Sustainable Development Goals (SDGs) "Sustainable cities and communities" (number 11) and it is not only an international requirement. It is understood as a right of all urban communities around the world. Nowadays, urban life represents more than half of us and in 2050, it will comprise two-thirds of all humanity. Urban spaces are being transformed into sustainable models as green public spaces, inclusive services and transport and safe and affordable housing. This sustainable development requires tools for technology management (big data) and is triggering new opportunities for sustainable entrepreneurship. This bidirectional relationship between Smart City and Entrepreneurship is growing fast in line with the requirements of communities and economies.

Smart Cities are part of this transition to a digital economy. Those urban aspects of living that can be smart will be smart through technology management. The

Digital Economy Report 2019 of UNCTAD forecasts digital scenarios of growing. By 2022, Global Internet Protocol IP traffic (a proxy for data flows) is projected to reach 150,700 GB per second, considering that global IP traffic grew from about 100 gigabytes (GB) per day in 1992 and more than 45,000 GB per second in 2017.

Digital platforms are new tools for creating new synergies between traditional and digital businesses. The data are definitive: "The combined value of the platform companies with a market capitalization of more than $100 million was estimated at more than $7 trillion in 2017 – 67 per cent higher than in 2015" (UNCTAD, 2019: p. XVII). For example, Walmart has partnered with Google Assistant and Ford and Daimler have joined Baidu in its Apollo platform (UNCTAD, 2019: p. XVII). E-commerce platforms are another bridge for transforming traditional companies as, for example, in the educational and health sectors. Smart Cities are the focus of this digital storm and their essence is to transform living, housing and consuming. In this sense, the genetic code of Smart Cities is to create sustainable value and entrepreneurs are the agents of these changes. For that reason, the title of this paper is "Exploring the genetic code of Smart Cities" through entrepreneurship.

Given this context, we propose to start answering three main questions: What are the core variables which explain the genetic code of a Smart City? What is the role of entrepreneurship in Smart City development? What is the role of entrepreneurship based on services in Smart City development?

Firstly, our Smart City concept is proposed following the entrepreneurial ecosystem that, in this case, is characterized as digital and managing technological tools. According to the complex and dynamic agents involved in these urban communities, our discussion follows those authors who emphasize these interlinkages between interdependent actors (Oh et al., 2016). These complex linkages allow faster and deeper growth, transforming traditional urban spaces into digital and sustainable urban spaces. Innovation, productivity and employment are possible in cities thanks to entrepreneurial ecosystems and this is highlighted in the case of Smart Cities (Kriz et al., 2016).

Secondly, this paper presents the entrepreneurial Smart City approach as promoting competitiveness in a context of sustainable innovation (Santos, 2017). In this sense, small and medium-sized enterprises (SMEs) take an important role in local context as well as large corporations because all of them are service providers of different sectors involved in a city (Kitchin, 2014; Vanolo, 2014; Angelidou, 2014).

Thirdly, our link between Smart City and Smart Entrepreneurship is tested in a country – Spain – and its 52 cities distinguishing between smart and not smart. This difference is proposed using several indexes which are explained in the following sections. Also, total entrepreneurship rates are analyzed in the period post-crisis (2015–2019), which also coincides with the Sustainable Development Goal related to sustainable cities and communities (SDG 11) is proposed by the United Nations. The proposed model uses the following variables: Entrepreneurship (number per thousand inhabitants), Average of entrepreneurship in Information Systems (%), Average of entrepreneurship in Other Services (%), Population density (persons per square kilometer), Average Size of households (persons), Average Size of households (persons), Activity rate (%), Proportion of employment in services (%), Average rent per household (Euros) and Persons aged 25–64 with high level of education (%).

Finally, after the methodology section, results, discussion and conclusions are developed and analyzed clarifying the limitations of our research and future proposals.

2. LITERATURE ON THE SMART UNIVERSE

2.1. The Smart City concept

The term Smart City has been used by several authors over the two past decades and it is possible to distinguish two different aspects: on the one hand, the urban places composed of everyware (Greenfield, 2010): connecting up, integrating and analysing information to provide a more cohesive, smart and sustainable city (Kitchin, 2014; Hancke et al. 2013; Townsend 2013); on the other hand, the term 'Smart City' refers to the development of a new knowledge economy driven by innovation, creativity and entrepreneurship (Kourtit et al. 2012). In this sense, Information and Communication Technology (ICT) is presented as crucial in Smart Entrepreneurship in a Smart City.

Some authors argue that technological firms develop and promote technologies for transforming cities into Smart Cities as a consequence of their corporate strategy (Kummitha, 2019; Van den Buuse and Kolk, 2019; Paroutisetal, 2014). In this way, Smart Cities are born to Smart Entrepreneurships which means that the origin of this smart universe, its genetic code, is Smart Entrepreneurship.

Kummitha and Crutzen (2017) analyse the concept of inclusive Smart Cities adopting a quadruple-helix model through four key players: (a) the government, (b) corporate firms by offering technological expertise and knowledge (corporate entrepreneurship), (c) small and medium enterprises (SMEs), and (d) citizens playing responsible roles on a sustainable basis. In this sense, all these agents play an active role in Smart Cities encouraging and promoting social and economic sustainable benefit for their urban community (Pisano et al., 2007).

Other authors, such as Giffinger et al. (2007), conceptualize the Smart City in a sustainable way: smart people, smart governance and smart economy, smart mobility, smart environment, and smart living (Meijer and Bolívar, 2016). This whole smart universe is the essence of the Sustainable Development Goals (SDGs) which are specified across three dimensions: society, environment, and economy. The SDGs (2012) are a set of seventeen goals on poverty, environment, social equality, and prosperity and 169 goals that the member states of the United Nations (UN) have committed to achieve by 2030. The eleventh goal refers to "Sustainable cities and communities" and the smart universe – understood as Smart City and Smart Entrepreneurship – which is the consequence of this commitment.

2.2. Smart Entrepreneurship

Smart Cities are born to Smart Entrepreneurships. Some of these entrepreneurships are born to Smart Corporate Strategy and others are born to

SMEs which operate using e-commerce platforms; some of them are born to Smart Public Governance and others are born to citizens' demands. Summarizing, two dimensions could be distinguished: transformation of traditional good and services' entrepreneurships and new digital entrepreneurships created as a new opportunity. The Knowledge Economy concept introduced by Peter Drucker in 1967 and the Digital Economy concept proposed by Don Tapscott in 1996 are two sides of the same coin. The key point is not to choose between knowledge or data but to join knowledge and data as a power and sustainable couple in the smart universe.

The Sustainable Development Goals (SDGs) are the inspiration for many types of entrepreneurship (Hekkert and Negro, 2009). Some authors define sustainable entrepreneurship as a model of economic and social behavior (Ploum, Blok, Lans and Omta, 2018; Muñoz and Cohen, 2018; Espina, Phan and Markman, 2018; Belz and Binder, 2017). Others define sustainable entrepreneurship as a kind of spin-off from sustainable development both of which create social and economic value in a sustainable way (Gladwin et al.,1995; McDonough et al., 2002)

Dirks and Keeling (2009) propose the urban innovator term to describe the traditional entrepreneur who improves his business using his legitimate expertise in the local area where he works (Santos, 2017). In this sense, Smart City supports the urban innovator and helps to improve his local actions. Doing that, urban communities explore sustainable solutions to their requirements and Smart Cities build strong entrepreneurial ecosystems where society, environment and economy grow in a smart way. In this sense, Santos holds – in his paper titled "Mind the gap: Smart Cities and entrepreneurship policies" – that "each city has its own unique characteristics and strengths" (2017; p. 2). This means that Smart Entrepreneurship has a unique entrepreneurial genetic code which can create differences between Smart Cities. The same ICT do not develop the same smart universe, so entrepreneurship and city are the basis to develop better smart ecosystems.

Through these analyses, the proposed hypotheses are:

H1 Smart Cities need new entrepreneurial initiatives for their development in the fields of technologies and basic services for citizens.

H2 The demographic conditions of cities, such as the proportion of young people and their educational level, are related to the creation of companies in smart cities.

Finally, the study proposes to investigate the effects of these variables in the 52 largest cities in Spain.

3. METHODOLOGY

3.1. Sample

This paper proposes to analyze the Spanish smart universe. We use a sample of 52 Spanish cities of which 21 have been selected due to their highest smart level, based on its appearance and/or evaluation in at least two of the main studies or rankings on Smart City in recent years. In this sense, it is possible to identify Smart Governments which develop any kind of strategy, initiatives or projects following the Smart parameters harmonized.

The analysis is done using the studies of the European Smart Cities initiative of the Vienna University of Technology, which developed the European Smart City Model through a series of indicators that allow comparison of the Smart degree achieved in medium-sized European cities. These comparisons have been made at various levels and sizes of city since the first study in 2007 for cities between 100,000 and 500,000 inhabitants, which it was replicated in 2013 and 2014; and in 2005 for cities between 300,000 and 1 million inhabitants. These studies analyze a total of 11 Spanish cities that are provincial capitals. The Spanish cities that appear in the evaluation of four of the main rankings around the world study the Smart City through the analysis of a large group of indicators have been incorporated into the previous studies – considering the last year of publication of all of them (2009). These four rankings are the following:

a) “Cities in Motion Index”, carried out by the IESE Business School through its Globalization and Strategy Center since 2014 and annually. The indicators used for its elaboration, a total of 90 in the year 2019, are grouped into topics related to human capital, social cohesion, the economy, governance, the environment, mobility and transport, urban planning, international projection and technology. A total of 174 cities around the world are analyzed.

b) “Global Cities Index”, carried out by ATKearney Global Cities that manages a total of 27 indicators grouped into five dimensions: business activity, human capital, information exchange, cultural experience and political engagement that have been studied in 130 cities around the world.

c) “Global Power City Index 2019”, carried out by the Institute for Urban Strategies of The Mori Memorial Foundation, annually since 2008, assesses the level or ability of cities to attract people, capital and business out of 48 cities studied worldwide. The 70 indicators used are structured in six main functions: economy, research and development, cultural interaction, habitability, environment and accessibility.

d) “Innovation Cities Index: Global”, carried out by 2Thinkknow of Global Innovation Agency, benchmarks a total of 525 cities around the world annually using 162 indicators. These indicators cover aspects related to the economy, industry and social functions of a city necessary to enable or encourage innovation.

Additionally, the study carried out by International Data Corporation (IDC) in 2011, titled “Analysis of Smart Cities in Spain”, analyzes the degree of maturity reached of a Smart City in the country according to cities with more than 100,000 inhabitants and using a total of 94 indicators. It classifies cities based on the results obtained in "top", "contenders", "players" and "followers". The analysis carried out, on the one hand, handles smart dimensions (in which the indicators are structured), smart government, smart buildings, smart mobility, smart energy and the environment, and smart services; and on the other hand, the facilitating forces, which include people, the economy, and information and communication technology.

21 cities are considered as Smart Cities and 31 do not meet the requirements and indicators used by these rankings (Table 1). These 31 cities will act as a control group. Among the cities considered Smart are Madrid, Barcelona, Santander, Valencia, A Coruna or Palma de Mallorca. However, four of the cities in the control group have been excluded because there is not enough data on the variables to be used for the study (Huesca, Segovia, Soria and Teruel).

3.2. Variables

Three relevant Spanish sources of information have been used to obtain the information:

a) National Statistics Institute (NSI) of Spain: statistics about the quality of life of the main European cities. Some of its variables are used for considering a city as smart and they can be defined into demographic aspects, social conditions, economic elements, surface and land use, as well as elements of training and education. The variables are the following:

1. Population density (persons per square kilometre) (Pop).
2. Median population age in each city (Age).
3. Average size of households (House).
4. Activity rate (%) (RA).
5. Average rent per household (annual and in Euros) (Earn).
6. Proportion of employment in services (%) (Serv).
7. Persons aged 25–64 with high level of education (%) (Edu).

b) Memories of the Central Mercantile Registry. These reports are prepared with the information that the Provincial Commercial Registers provides to the Central Commercial Registry. Data relating to corporate acts are recorded, such as the creation of companies, mergers, corporate extinction, etc. This source is accessed because it allows access to data disaggregated by municipalities.

8. The variable related to the creation of companies has been obtained from this source of information. This variable has been related to the resident population in each municipality to obtain a new variable that reports on the number of companies that are created per thousand inhabitants. This variable approximates the rate of entrepreneurial activity in the region (Entr).

c) Information from the Iberian Balance Analysis System (SABI) database. This private database contains economic-financial data from according to the geographical and territorial composition of the companies. Specifically, the sectoral distribution of the new incorporated companies has been considered.

9. Sectoral distribution of the companies constituted of technological services (EmpInf). The percentage of companies in the Information-communications sector and professional, scientific and techniques with respect to the total of companies incorporated in the period is also considered in the study. In this way, companies related to telecommunications (National Classification of Economic Activity-CNAE61), information services (CNAE 63), technical architectural and engineering services (CNAE 71, Research and Development (CNAE 72) as well as other scientific and techniques (CNAE 74) are incorporated.

10. Sectoral distribution of companies constituted of services for citizenship (EmpCit). The percentage of companies constituted with respect to the total number of entrepreneurial initiatives in the following sectors is also provided: Public administration and defense (CNAE 84), Education (CNAE 85), Health and social services activities (CNAE 86, 87 and 88) and artistic, recreational and entertainment activities (CNE 91 and 94).

In order to obtain comparable data, a geographical criterion (NUT3 level) to be the capital of the province is established. The analysis of the period analyzed is between the end of the last economic crisis (2015) to the last available year of data (2019). This period also coincides with the phase in which the Sustainable Development Goals set the goal of achieving an objective related to sustainable cities and communities (SDG 11). It is not considered a panel study since not all the information is available for all the variables throughout the entire period considered. Our priority is to know the level of progress of a Smart City in the proposed period (2015–2019).

Using these variables, the study proposes to analyze the descriptive results distinguishing two samples (Smart and non-Smart Cities). Applying the Kruskal Wallis non-parametric contrast to both samples of cities – following a significance level of 5% – statistically significant differences will be identified.

After that, a correlation analysis will determine and eliminate the possible presence of autocorrelation. For those variables that present a high level of correlation, the information will be complemented with a graphic analysis by city according to its classification as Smart. These graphs will allow to identify behavior patterns between the different samples analyzed.

3.3. Logit Model

Finally, a Logit model is proposed to determine which variables make it more likely to classify a city as Smart. This model uses a dichotomous dependent variable which adopts the value of one when the city is considered Smart and adopts the value of zero when the city is not considered Smart according to the rankings used. The dependent variables consider: the creation of companies and the demographic, economic and educational variables of the city. Two models are proposed: for the initial period and another for the final period, in order to determine which variables have become determining factors to be considered Smart in the period analyzed.

$$Smart_{,201x} = \alpha + \beta_1 \cdot Entr_{,201x} + \beta_2 \cdot Pop_{201x} + \beta_3 \cdot Age_{201x} + \beta_3 \cdot House_{201x} + \beta_3 \cdot RA_{201x} + \beta_3 \cdot Earn_{201x} + \beta_3 \cdot Edu_{201x} + \beta_3 \cdot Serv_{201x} + \beta_3 \cdot EmpInf_{201x} + \beta_3 \cdot EmpCit_{201x} + \mu_{201x}$$

4. RESULTS AND DISCUSSION

The classification used in the study is indicated as follows:

- Smart Cities: Alicante, Barcelona, Bilbao, Córdoba, A Coruna, San Sebastián, Granada, Madrid, Málaga, Murcia, Oviedo, Palma, Pamplona, Santa Cruz de Tenerife, Santander, Seville, Valencia, Valladolid, Zaragoza, Las Palmas and Vitoria-Gasteiz.
- Non-Smart Cities: Albacete, Almeria, Ávila, Badajoz, Burgos, Cáceres, Cádiz, Castellón, Ceuta, Ciudad Real, Cuenca, Girona, Guadalajara, Huelva, Jaen, León, Lleida, Logroño, Lugo, Melilla, Ourense, Palencia, Pontevedra, Salamanca, Tarragona, Toledo and Zamora.

If we consider its main descriptive statistics (see Table 2), Smart Cities maintain a business creation rate of 2.38 companies for every thousand residents at the end of the period, compared to 1.49 companies for every thousand inhabitants of non-Smart Cities. Over time, there has been a decrease in this density of new ventures per inhabitant, although the reduction is much more adjusted in non-Smart Cities (reduction of 7.47%). Thus, in 2019 the cities classified as Smart have slightly less than twice the entrepreneurial activity in sectors related to information technology and telecommunications than non-Smart Cities. This situation has remained significant over time. Furthermore, the percentage of ventures related to social services, such as health services, education and public administration services, is one of the variables significant over time.

According to demographic variables, the population density per square meter is the only variable that presents statistically significant differences: the number of inhabitants per square kilometer is more than doubling in Smart Cities (3,800 inhabitants on average compared to 1,650). For its part, the median age of residents is close to 45 years and in the case of the inhabitants of Smart Cities the median age is higher (although this variable is just only significant at the beginning of the period). At an economic level, the activity rate of the regions is not a differentiating element of the regions (close to 57%). There are differences in the percentage of jobs of the active population in the service sector (significance of 10%), as well as in the average income of households (with higher value in both variables in the case of Smart Cities).

Finally, the variable that considers education and training intensifies over the years and becomes significant at the end of the period. In Smart Cities, slightly less than one in two residents between 25 and 65 years old have higher education compared to just over 40% in non-Smart Cities. University cities require the latter to provide greater services.

Table 2 presents the level of correlation between different explanatory variables of a Smart City as well as its statistical significance. The positive relationship between the creation of companies, the activity ratio, the percentage of employment within the service sector and the average household income is highlighted. When the level of entrepreneurial activity of a region is higher, the number of created jobs and the need of services for citizens are greater.

All this activity increases the purchasing power of families. It also highlights the relationship between the average level of income of families and educational level, obtaining higher educational level of citizens. However, there is a negative relationship between the activity ratio of a region and its educational level. It could be explained by various reasons: overqualification of part of the population or the need for unskilled personnel in other business sectors that can act as the hub of the region, such as industry or commerce. Finally, there is significant relationship between higher educational level and higher percentage of ICT businesses creation (see Table 3).

According to Graphic 1 (2019), the relationship between entrepreneurship and the most technological sectors is analyzed by cities' category, as well as the connectivity between business sectors most related to Smart City development (corporate entrepreneurship). There is a direct relationship between the business creation rate – per thousand inhabitants – and the percentage of startups that occur in the ICT sectors, highlighting the cities of Madrid, Barcelona and Bilbao. Graphic 1 shows how the cities identified as Smart are at the top. These Smart Cities highlight the driving force of the ICT sector, and their entrepreneurship which can turn cities into transformational agents of change.

On the other hand, the relationship between ICT entrepreneurships and social entrepreneurships – as health and educational services – is analyzed. Once again, it can be seen how most of the cities classified as Smart are located again in the upper-right part of the graph (see Graphic 1). That means that ICT entrepreneurships are coupled to well-being and sustainable entrepreneurships. In average terms, for every two entrepreneurial initiatives in the ICT sector, an entrepreneurial initiative arises in the other services. This direct relationship highlights that the city's connectivity allows new entrepreneurial opportunities (such as the cities of Madrid and La Coruna which stand out positively).

Finally, the results of the Logit model are presented (see Table 4). Thus, during the year 2015 the significant variables are: the rate of businesses creation in the period and the percentage of startups related to ICT. This relationship is positive: greater ICT entrepreneurship develops greater probability of being a Smart City.

However, over time this probability increases with respect to entrepreneurial activity and two new variables are added that are significant, specifically, the median age and educational level of the residents. This relationship is also positive when the average age, the business creation rate and the educational qualifications of the residents are higher; then the probability of being a Smart City is higher too.

Therefore, ICT entrepreneurships are not considered statistically significant over time. This is because the percentage of these entrepreneurships in non-Smart Cities has been increasing and converging to Smart Cities. The Odds Ratio confirms the greater probability that these variables occur. Thus, for example, in 2015, an ICT entrepreneurship tripled the probability of being in the presence of a Smart City. In 2019, when the percentage of the population with university studies is higher, the possibility of being a Smart City is 1.5 times higher.

5. CONCLUSIONS AND LIMITATIONS

Innovation (which is part of one of the main initiatives of the Europe 2020 Strategy) and entrepreneurship are the essence of the Smart City ecosystem and provide smart synergies of all kinds between the different community's dimensions (social, economic and environmental) and the provision of urban services.

Cities are a strong force in the digital economy and represent around 80% of world GDP and concentrate a large part of employment, talent and knowledge. Their potential for changing and transforming living, housing and well-being towards Smart levels is a dynamic competitive advantage between Smart Cities around the world. This paper is an approach to identify the variables which explain the entrepreneurial genetic code of Smart Cities, a code based on knowledge, data, technology, and public policies, which grow with mutual feedback.

The results of the paper show a positive relationship between entrepreneurship and Smart Cities. In this way, a sustainable city is defined as entrepreneurial motor of value creation through business projects in different competitive areas (energy, organic food, mental and body well-being, or technology). On the other hand, the demographic aspects such as the presence of young people with university profile, urban population density, and income´s level are explicative factors of this smart entrepreneurship.

Furthermore, governments and private and public institutions have begun to invest in this sustainable and smart awareness, developing opportunities for new entrepreneurship. New policies for creating and/or investing on sustainable business projects are being developed by institutional agents and decision-makers trying to reply to the smart habitat.

Regarding the limitations of the study, this paper presents the absence of a complete sequence of data for all cities during the study period. Large cities have more complete statistics but working with cities of different sizes implies a loss of data. Another limitation of the study is the availability of more specific data from cities related to land use, availability of means of transportation, as well as variables related to the energy and environmental efficiency of cities. Again, data could be obtained from large cities, but the study would lose the global vision of the set of cities in a country.

One of our future lines of research is to extend this study to all European cities. This will allow us to understand if these variables are significant when configuring a city as Smart or, on the contrary, if the regional characteristics and the environment where the cities are located establish other circumstances.

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Table 1. Analysis of different rankings about Spanish Smart Cities (Source: own work).

City	**Smart City (Yes=1, no=0)**	**Rankings or studies where this city appears. Año 2019**	
		Number of times it appears	**Study or Index (level and assessment).**
Madrid	1	5	"Cities in Motion Index" (level: 24, assessment: 73,02), "Global Cities Index" (level: 15), "Global Power City Index" (level: 13, assessment: 1125), "Innovation Cities Index" (level: 28, assessment: 49), Analysis IDC (level: Top 5).
Barcelona	1	5	"Cities in Motion Index" (level: 28, assessment: 72,25), "Global Cities Index" (level: 23), "Global Power City Index" (level: 22, assessment: 1076,80), "Innovation Cities Index" (level: 21, assessment: 50), Analysis IDC (level: "Top 5").
Málaga	1	4	European Smart Cities (2015), "Cities in Motion Index" (level: 80, assessment: 57,59), "Innovation Cities Index" (level: 260, assessment: 38), Analysis IDC (level: "Top 5").
Sevilla	1	4	European Smart Cities (2015), "Cities in Motion Index" (level: 76, assessment: 58,57), "Innovation Cities Index" (level: 248, assessment: 39), Analysis IDC (level: "Players").
Bilbao	1	4	European Smart Cities (2015), "Cities in Motion Index" (level: 107, assessment: 50,14), "Innovation Cities Index" (level: 141, assessment: 41), Analysis IDC (level: "Contenders").
Valencia	1	4	European Smart Cities (2015), "Cities in Motion Index" (level: 61, assessment: 61,52), "Innovation Cities Index" (level: 124, assessment: 42), Analysis IDC (level: "Players").
Palma de Mallorca	1	3	European Smart Cities (2015), "Cities in Motion Index" (level: 88, assessment: 55,57), Analysis IDC (level: "Players").
Zaragoza	1	3	European Smart Cities (2015), "Cities in Motion Index" (level: 107, assessment: 50,14), "Innovation Cities Index" (level: 141, assessment: 41), Analysis IDC (level: "Contenders").
Valladolid	1	3	European Smart Cities (2007/2013/2014), European Smart Cities (2015), Análisis IDC (level: "Players").
Murcia	1	3	European Smart Cities (2015), "Cities in Motion Index" (level: 105, assessment: 51,19), Analysis IDC (level: "Players").
Pamplona	1	3	European Smart Cities (2007/2013/2014), "Innovation Cities Index" (level: 334, assessment: 36), Analysis IDC (level: "Contenders").

Table 2. Descriptive Analysis of Smart and non-Smart Cities (2015–2019)
(Source: own work)

2019	*Smart City*		*No Smart*		*Significance*
	Mean	*Desv.*	*Mean*	*Desv.*	
Entrepreneurship (number per thousand of inhabitants)	*2.38*	*0.93*	*1.49*	0.4	***0.000***
Average of entrepreneurship in Information Systems (%)	*8.84*	*2.71*	*5.22*	4.07	***0.000***
Average of entrepreneurship in Other Services (%)	*4.78*	*1.28*	*3.47*	2.34	***0.000***
Population density (persons per square kilometer)	*3851.78*	*3732.17*	*1665.17*	2204.86	***0.004***
Median population age in each city	*45.01*	*2.22*	*43.97*	3.49	*0.190*
Average Size of households (persons)	*2.49*	*0.15*	*2.53*	0.25	*0.811*
Activity rate (%)	*57.24*	*2.59*	*57.11*	3.42	*0.876*
Proportion of employment in services (%)	*86.97*	*4.28*	*84.39*	5.26	***0.069***
Average rent per household (Euros)	*32482.42*	*3709.4*	*30644.48*	2761.73	***0.066***
Persons aged 25–64 with high level of education (%)	*46.08*	*7.44*	*42.58*	5.81	***0.011***
2015	*Smart City*		*No Smart*		*Significance*
	Mean	*Desv.*	*Mean*	*Desv.*	
Entrepreneurship (number per thousand of inhabitants)	2.38	0.83	1.63	0.43	***0.000***
Average of entrepreneurship in Information Systems (%)	8.28	1.69	6.51	1.56	***0.000***
Average of entrepreneurship in Other Services (%)	6.67	1.03	6.38	1.88	*0.232*
Population density (persons per square kilometer)	3804	3666.25	1675.51	2249.63	**0.004**
Median population age in each city	43.58	2.23	42.13	3.34	**0.060**
Average Size of households (persons)	2.55	0.15	2.57	0.24	*0.967*
Activity rate (%)	57.26	3.16	57.83	3.04	*0.284*
Proportion of employment in services (%)	86.72	4.17	85.36	4.67	*0.135*
Average rent per household (Euros)	31298.37	3850.86	29413.97	2733.97	***0.069***
Persons aged 25–64 with high level of education (%)	43.16	7.38	40.34	5.66	*0.170*

Table 3. Correlations between explicative variables in 2019.
(*) Significance 0.01. (**) Significance 0.05 (Source: own work)

	Entr	Pop	Age	House	RA	Serv	Earn	Edu	EmpCit	EmpInf
Entr	1.00	**0.464****	-0.11	-0.01	**0.322***	**0.344***	**0.372****	0.17	0.27	**0.513****
Pop		1.00	0.07	0.02	-0.15	**0.500****	**0.475****	0.27	0.22	**0.321***
Age			1.00	**-0.897****	**-0.783****	-0.03	-0.22	**0.589****	0.19	**0.362***
House				1.00	**0.609****	0.09	0.20	**-0.686****	-0.10	**-0.330***
RA					1.00	-0.04	0.28	**-0.475****	-0.11	-0.10
Serv						1.00	**0.411****	0.20	0.21	0.25
Earn							1.00	**0.358***	0.11	0.19
Edu								1.00	0.14	**0.363***
EmpCit									1.00	**0.289***

Graphic 1. Representation of Spanish Smart and non-Smart Cities 2019. (Source: own work).

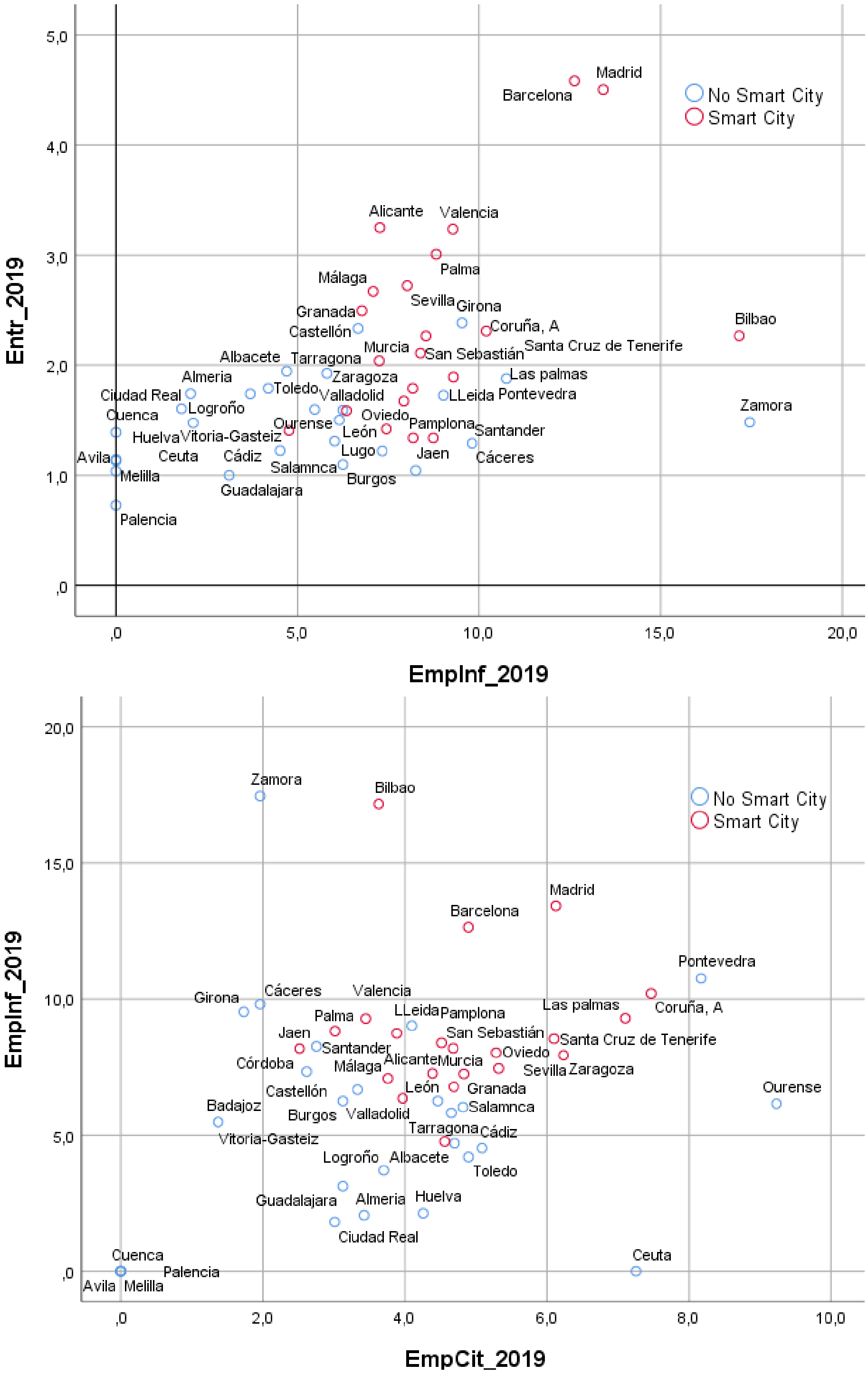

Table 4. Logit Model (Source: own work).

	Year 2019					Year 2015			
Smart	Coef.	Std. Err.	P>[z]	Odds Ratio	Smart	Coef.	Std. Err.	P>[z]	Odds Ratio
Entr	5.4961	1.7739	***0.002****	24.7600	Entr	11.7079	4.7858	***0.014****	10.1700
Pop	0.0000	0.0002	0.945	1.0000	Pop	-0.0002	0.0003	0.565	0.9997
Age	2.1610	1.0776	***0.045****	8.6799	Age	2.5073	1.3204	0.058	5.0615
House	22.1790	11.5138	0.054	0.0000	House	16.8969	9.3123	0.070	0.0000
RA	0.6622	0.5517	0.230	1.9391	RA	0.2660	0.5593	0.634	1.2091
Serv	-0.1340	0.0003	0.221	0.8745	Serv	-0.3057	0.1696	0.072	0.8832
Earn	0.0000	0.2065	0.786	1.0000	Earn	0.0009	0.0005	0.105	1.0002
Edu	0.4159	0.3384	***0.044****	1.5157	Edu	-0.0578	0.1995	0.772	0.9819
EmpInf	0.0696	0.1692	0.680	1.1009	EmpInf	1.1229	0.4328	***0.009****	3.0738
EmpCit	0.0961	0.3384	0.776	1.0721	EmpCit	1.9694	1.0006	0.049	7.1670
Wald Chaid(10):10,69 / Pseudo R2: 0.5783					Wald Chaid(10): 27.70 / Pseudo R2: 0.6785				