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Entrepreneurship Capital Spillovers at the Local Level

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Abstract: The paper analyses three underexplored issues in the entrepreneurship capital spillover literature, namely, its local nature, the generators and the receptors of such spillovers. For that purpose, we take advantage of the Ecuadorian census of establishments. Unlike previous evidence, we can estimate the spillovers at the establishment level, compute the entrepreneurship capital at the local level, and compare different permissiveness levels in the application of registration and tax legislation to businesses (i.e., the relative importance of the informal economy). In general, we find entrepreneurship capital spillovers at the local level. The spillover effects are lower when the entrepreneurship capital has been accumulated in informal businesses. By contrast, informal, large and more technologically developed establishments benefit more from these spillover effects. The paper discusses the implications of those findings for the design of public policies for promoting entrepreneurship.

Key words: Entrepreneurship Capital, Production Spillovers, Cities, Informal Economy.

JEL: R11, L26, O4

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1. Introduction

Public policies that promote entrepreneurship have been justified by its positive spillovers on the productivity of the other firms in the region (Acs et al. 2016). Although there is extensive evidence of entrepreneurship capital spillovers[1], much less evidence is available on how the spillovers are produced, and therefore there is a lack of insights about how the public policies have to be developed (Acs et al. 2008). Theoretical arguments justifying the existence of entrepreneurship capital spillovers, like the Knowledge Spillover Theory of Entrepreneurship, KSTE (Audretsch and Keilbach 2005; 2007; Acs et al. 2009; Audretsch and Lehmann 2017), do not specify its geographical extension nor exclude its heterogeneity among firms and industries. We use a unique database containing information for the 445,490 establishments in Ecuador in the year 2010 in order to analyse the presence of entrepreneurship capital spillovers at the local level and explore whether are differences in the generation and reception of such spillovers between different types of firms. Those questions and evidence are crucial for policy makers and are appealing for theoretical debate.

At the time the data were collected, Ecuador was administratively organized in 24 provinces, among which 224 cantons were distributed (see Table 1 and Graph 1 for more detailed information). The governments of the country, provinces and cantons were all elected by their inhabitants. The presence of entrepreneurship capital spillovers at the level of Eurostat[2] NUTS-3 regions or are even more aggregated (NUTS2) is well documented. However, as far we know, there is no evidence of such spillovers at the local level (formerly NUTS-5 or new LAU2). We provide evidence that establishments in cantons with more entrepreneurship capital than the other cantons of the same province are on average more productive. This evidence seems quite relevant for the justification of the local development of public policies for promoting entrepreneurship beyond those developed at superior administrative levels, in the case of Ecuador provincial or country governments.

This study analyses the spillover effects of local entrepreneurship capital in a Latin American country. A distinctive feature of Latin American countries from European or North American

[1] Audretsch and Keilbach (2004a,b,c, 2005; 2008); Mueller (2006, 2007); Böente et al. (2008); Cravo et al. (2010); Stough et al. (2008); Chang (2011); Hafer (2013); Laborda et al. (2011); Mendonça and Grimpe (2015); Massón-Guerra and Ortín-Ángel (2017a).

[2] For further information, see [http://ec.europa.eu/eurostat/web/nuts/history].

ones (the previously most analysed countries) is the weight of the informal economy, those economic activities partially or fully outside of government regulation and taxation. Based on our data, the informal economy represented 34.96% of the establishments in 2010. These figures are similar to estimates for other Latin American countries from previous studies (Scneider and Enste 2000 or Laporta and Shleifer 2008). From a theoretical perspective, it has been suggested that the level of the informal economy is in part a consequence of political decisions (Acs et al. 2008). Therefore, in order to develop public policies, it is important to know the role and weight of the informal economy in entrepreneurship capital spillovers. Public policies for promoting specific types of entrepreneurs are justified when those entrepreneurs have been identified among the main generators of spillovers. Although some efforts have been made to identify those generators of spillovers (Audretsch and Keilbach, 2004a, b, c, 2008), those efforts are mostly focused on the technological capabilities of the entrepreneurs.

The data is taken from the census of establishments in Ecuador. Data at the establishment level let us analyse the main receptors of spillovers. Those analyses open challenges in the way that public policies have to be supported. Public policies are expensive. Therefore, it can be argued that it is fair that those establishments or firms that benefit the most from entrepreneurship capital spillovers provide a higher financial support to those policies. The paper provides the first steps in the identification of entrepreneurship capital receptors. This research line is academically appealing as a way to develop theoretical arguments for explaining these differences. This paper provides a tentative explanation that combines the arguments from the KSTE and the absorptive capacity theory (Cohen and Levinthal 1990; Qian and Acs 2013). Information at the establishment level has been unusual in the previous literature. Massón-Guerra and Ortín-Ángel (2017b) argued that data at the regional level does not allow researchers to clearly distinguish when the relationship between regional GDP and entrepreneurship capital is due to spillovers or technologies with decreasing returns to scale. Therefore, data at the establishment level provides a better estimation of the entrepreneurship capital spillover than data aggregated at the regional level.

The paper is organized as follows. In Section 2, we discuss the related literature and state the hypotheses. Section 3 presents the data. Section 4 presents the production functions estimated at the establishment level. Section 5 discusses the implications and concludes the paper.

2. Related literature

There is a stream of literature (Audretsch and Keilbach 2004a, b, c, 2005, 2008; Mueller 2006, 2007) that estimates the impacts of regional entrepreneurship capital on the production of a given region. In those studies, the regions vary from countries (Cravo et al. 2010; Stough et al. 2008; Chang 2011; Hafer 2013; Laborda et al. 2011; Mendonça and Grimpe 2015) to regions equivalent to a NUTS-3 level according to the Eurostat classification (Salas-Fumás and Sánchez-Asín 2008, 2010, 2013a,b). As far we know, there are no studies based on the local level, equivalent to cantons, with data aggregated at the establishment level.

We adapt the methodology that is usually employed in the cited literature to the available data. In fact, the main contribution of this literature is to introduce measures of entrepreneurship capital in production functions that have been extensively estimated in other contexts (see Syverson 2011 for a further methodological discussion). Therefore, we propose the estimation of a Cobb-Douglas (1928) function where establishment *j*'s output ($Y_{j,i}$) is obtained as a combination of the inputs purchased by the establishment and other public inputs of the region *i* where it is placed:

$$\ln Y_{j,i} = \beta \ln L_{j,i} + \alpha \ln K_{j,i} + \phi \ln I_{j,i} + \rho \ln Z_{j,i} + \mu \ln R_i + \delta \ln E_i + \varepsilon_{j,i} \qquad (1)$$

Then, the inputs considered at the establishment level are labour ($L_{j,i}$), (physical) capital ($K_{j,i}$), intermediate goods ($I_{j,i}$), and private knowledge ($Z_{j,i}$), while inputs at the regional level are regional knowledge (R_i), regional entrepreneurship capital (E_i), and $\varepsilon_{j,i}$, which captures the usual error term. The parameters to be estimated are the production elasticities with respect to labour (β), capital (α), intermediate goods (ϕ), private knowledge (ρ), public regional knowledge (μ) and regional entrepreneurship capital (δ) or entrepreneurship capital spillovers, which in previous studies have usually been positive and statistically significant. The existence of such positive spillovers has been interpreted as a call to arms (Acs et al. 2016) for the development of public policies to promote entrepreneurship. However, less consensus exists on how those policies should be developed.

Acs et al. (2008) emphasize that entrepreneurship is a local phenomenon. Policies developed by local authorities can enhance the probability that clusters of entrepreneurs favouring the economic development of the zone appear. Those entrepreneurs can help each other and stimulate the economic growth of the place (Feldman, 2014). In accordance with the KSTE, entrepreneurship

facilitates the dissemination of knowledge among entrepreneurs. Therefore, public policies enhancing the generation of knowledge, the attractiveness of the place and the communication infrastructures can aid this purpose (Acs et al. 2016). In this sense, it has been argued that big cities have better conditions than more rural areas for the generation of such entrepreneurial clusters (Acs, et al. 2011). Furthermore, there is some evidence that entrepreneurship capital spillovers are higher in more urban regions (Audretsch and Keilbach 2005). Although some empirical evidence exists about the determinants of the level of entrepreneurial activity at the city level (Audretsch and Belitski 2017; Bosma and Sternberg 2014; Barreneche 2014), there is no evidence on the entrepreneurship capital spillovers at the city or similar local levels, which is the main justification for such policies. We can provide such evidence for the case of Ecuadorian cantons by controlling for provincial dummy variables. Therefore, those spillovers are beyond those produced by other provincial inputs, thus justifying the intervention of local governments.

Hypothesis 1: The production is higher in establishments placed in cantons with more entrepreneurship capital than other cantons of the same province.

A second important issue for the development of public policies is whether they are more efficient when they foster specific kinds of entrepreneurs. For that purpose, some previous studies (Audretsch and Keilbach 2004a, b, c, 2008) sought to identify the type of entrepreneurship capital that generates more spillover effects. For example, Audretsch and Keilbach (2004a, b, c, 2008) classified entrepreneurship capital on the basis of the technological intensity of the sectors (high technology, ICTs, and other sectors). The theoretical argument behind this classification is that the newness of the knowledge used in these sectors is different. Therefore, in accordance with the KSTE, one would expect higher spillovers in regions with a higher relative presence of technological entrepreneurs. The evidence is mixed. Higher relative weights of technological sectors generated more spillover effects in Audretsch and Keilbach (2004c), while they generated less spillover effects in Audretsch and Keilbach (2004a, b, c, 2008).

Acs et al. (2008) highlight legal infrastructure as an important part of the public policies for promoting entrepreneurship. In their words, "State and local regulations can also affect entrepreneurship, as they do for other businesses activities. For decades, economists have argued that many forms of regulation help large businesses that can pay the fixed costs of meeting those regulations, but harm smaller firms. (...) States and localities also may wish to consider exempting smaller businesses from certain regulation" (p.20). The informal economy is the usual term for

identifying businesses exempted from government taxes and regulation. The data available allow us to distinguish between formal and informal entrepreneurship capital. Although several theories have been proposed for explaining the transition from informal to formal businesses (see, for example, Bennett 2010), the empirical evidence (La Porta and Shleifer 2008; Bruhn 2011, 2013) suggests that there is not much mobility between informal and formal businesses. The informal economy is mainly composed of entrepreneurs with very low human capital that engage in small businesses with low value added and are in the less innovative sectors (La Porta and Shleifer 2008). Therefore, one would expect less knowledge spillovers from informal establishments.

From the discussion above, we propose to test whether the entrepreneurship capital spillovers are higher in those cantons with a higher weight of technological establishments and a lower weight of informal ones.

Hypothesis 2: The effect of regional entrepreneurship capital is a) higher when it is accumulated in technological sectors and b) lower when it is accumulated in informal establishments.

A third important issue related to public policies is who provides the financial support. Some taxpayers can support the government policies without benefitting from the spillovers. Therefore, it is interesting to identify whether some sort of established business receives systematically higher entrepreneurship capital spillovers. Theoretical arguments justifying such spillover differences can be built based on the KSTE and the absorptive capacity theory. From the KSTE perspective, entrepreneurship is a facilitator of knowledge dissemination. From the absorptive capacity theory, established businesses have different levels of knowledge and capacity to accumulate further knowledge or absorptive capacities. Therefore, entrepreneurship capital spillover effects are expected to be higher in those establishments with lower current levels of knowledge and/or higher absorptive capacities. From Cohen and Levinthal (1990), several authors have related the technological intensity of the firms with their absorptive capacities. Tentatively, we postulate that large establishments have more resources and can learn faster, while the establishments of the same size that remain informal have accumulated lower levels of knowledge and thus have more to learn. Data at the establishment level allow us to estimate the elasticities of production with respect to entrepreneurship capital for each different group of establishments. The next hypothesis summarizes the expected results:

Hypothesis 3: The benefits from entrepreneurship capital spillover effects (a) increase with the size of the establishment, (b) increase with its technological intensity, and (c) and increase with the level of informality.

Finnaly, Audretsch and Keilbach (2004a, c, 2008) suggest that the entrepreneurship capital may be correlated with the production function error term in Equation (1). Therefore, the estimation of the entrepreneurship capital spillovers can suffer from an endogeneity problem. This seems quite reasonable when it is estimated with aggregated data. Those regions with higher production can also be the ones producing more entrepreneurs. Data at the establishment level seems to alleviate these problems. Nonetheless, we provide simultaneous estimations of the determinants of the establishments' production, Equation (1), and the determinants of the cities' entrepreneurial capital, Equation (2):

$$\ln E_i = \sum_x \theta_x X_x + e_i \qquad (2)$$

where e_i are the usual error terms and θ_x are the parameters to be estimated. As much as possible, we consider x similar determinants X_x than the ones highlighted by the previous literature that analysed the determinants of the cities' entrepreneurial capital. Consistent with previous findings, we expect positive relationships between the city's entrepreneurship capital, the city's agglomeration and its public resources. Using different measures related with the population density of the cities, Acs et al (2011), Bosma and Sternberg (2014) and Barreneche (2014) find evidence of a positive relationship between a city's agglomeration and its entrepreneurship capital. Acs et al. (2011) and Audretsch and Belitski (2017) highlighted and provided evidence of the importance of a city's amenities and infrastructures for stimulating the entrepreneurship capital of the city. Finally, we also include variables related to the economic situation in the city, namely, its GDP per capita. In accordance with Audretsch and Belitski (2017), previous literature has made ambiguous predictions about the relationship between the variables related to the economic situation and the cities' entrepreneurship capital. All the determinants of the entrepreneurship capital of a city are going to be lagged one year.

3. Data

We use data from the *Censo Nacional Económico*[3] (CENEC). This is a census of the

[3] For further details about the census, see [http://www.ecuadorencifras.gob.ec/censo-nacional-economico].

establishments in all 224 cantons of Ecuador from between September and November of 2010. The objective was to identify and collect information about all (visible) establishments where economic activity is conducted out and is physically separated from a home. Therefore, the census includes formal and informal establishments. Due to that, it is not based on the fulfilment of any regulations or tax payments. For this study, we excluded public and government establishments (10.310) and mining and oil extraction establishments (87). The census does not include those establishments that have a head office in the same canton. However, we have identified and omitted some establishments in which this is the case (55.278). We ended up with 445.490 establishments.

We identify the canton (*i*) and province where the establishments are placed, and therefore introduce fixed effects for provinces and cantons. Due to the lack of establishments, two cantons were omitted (El Piedrero y Las Golondrinas), leaving 222 cantons in the sample (see Table 1 for further details).

We use the following information regarding each establishment.

The establishment's annual production (*Output*, $Y_{j,i}$) measured by sales volume, the number of employees engaged in production activities (*Labour*, $L_{j,i}$), the fixed assets of the establishment (*Capital*, $K_{j,i}$), the current assets of the establishment (*Intermediate Goods*, $I_{j,i}$) and the investment in R&D activities and training (establishment's *Knowledge*, $Z_{j,i}$). All the monetary variables are in US dollars, the currency in Ecuador in 2010.

The CENEC provides information about the economic activities of the establishments (two-digit NACE codes). Following the Organization for Economic Cooperation and Development (OECD) and EUROSTAT[4], we identify a set of NACE two-digit sectors as technological businesses. See Table 2 for further details. The dummy variable $D_{Tech\,j,i}$ takes a value of 1 when the establishment belongs to a technological sector.

The CENEC also indicates whether the establishment is included in the *Registro Único de Contribuyentes*[5] (in other words, whether or not it pays taxes). In fact, the Ecuadorian

[4] Further details and references can be found in [https://www.oecd.org/sti/ind/48350231.pdf].
[5] For further details, see the Servicio de Rentas Internas [http://www.ecuadorencifras.gob.ec/institucional/home].

governmental statistical office[6] (INEC) considers an establishment as an informal one when it is not included in the *Registro Único de Contribuyentes* and has fewer than 100 workers. Using these criteria, we classify each establishment as either formal or informal. The dummy variable $D_{Informal\ j,i}$ takes a value of 1 when the establishment belongs to the informal economy.

For each canton (i = 1,…, 222), we have collected the following information.

The cantons' knowledge is measured by the investments in R&D activities and training. We differentiate among the *Regional Public Knowledge* (accumulated by public and government establishments[7], R_{PUBi}) from the *Regional Private Knowledge* (accumulated by the rest of establishments, R_{PRIVi}). Following Acs et al. (2012), *entrepreneurship capital* is measured by the ratio between the number of establishments and the canton's population[8], $E_i = n_i/P_i$. Graph 2 shows its distribution among the different cantons. The measurement of entrepreneurship capital is open to discussion (Erikson 2002; Audretsch and Keilbach 2004a; Bönte et al. 2008). Several authors use start-ups instead of the stock of establishments. In Appendix 2, we reproduce the main analyses using the average of the last three years of the start-ups per inhabitant ratio in each canton following the method established in Audretsch and Keilbach (2004a, b, 2008). The main conclusions do not depend on the measure of entrepreneurship capital used. In each canton, we can compute the number of establishments in technological sectors, *Knowledge-based Entrepreneurship Capital* (KE_i), and its relative importance over the regional entrepreneurship capital (KE_i/E_i). In a similar way, we can compute the number of establishments in the informal economy, *informal entrepreneurship capital* (IE_i), and its relative importance (IE_i/E_i).

Regarding the determinants of entrepreneurship capital, the cantons' agglomeration ($DEN_{i,t-1}$) is measured by its population density, which is the number of inhabitants per square kilometre. As a proxy of the cantons' public resources ($TAX_{i,t-1}$), we have collected information about the ratio of total taxes paid by the establishments over the GDP (in thousands of dollars). Related to the economic situation of the canton, we have collected information about the GDP (in thousands of dollars) per capita for each region ($y_{i,t-1}$). We collected this information from the INEC. These

[6] More concretely, the *Instituto Ecuatoriano de Estadísticas y Censos*. For further details, see [http://www.ecuadorencifras.gob.ec/institucional/home].
[7] We use information related to the 10.310 establishments not included in the sample.
[8] The cantons' poulation is obtained from the *Censo de Población y Vivienda* (CPV) [http://www.ecuadorencifras.gob.ec/censo-de-poblacion-y-vivienda, 2010].

variables have been included in the logarithms and are one period lagged. Therefore, they refer to 2009.

The descriptive statistics are presented in Table 3. The correlations between variables are in Table 4.

4. Results

Table 5 shows different estimations of Equation (1). The differences between the columns or models are the additional variables included. In the best case, the increase in the explanatory power of the model R^2 is 0.0236. As an indicator of the collinearity magnitude, we use the variance inflator factor (VIF). In all cases, the values are below 10, which is the usual maximum acceptable level.

Model 1 is the basic model. Much of the coefficients are output elasticities that indicate the percentage change of the production associated with a 1% increase in the input amount. The elasticity of production with respect to labour (β) is 0.7376, the elasticity with respect to capital (α) is 0.1656, the elasticity with respect to current capital (ϕ) is 0.2190, the elasticity of production with respect to private knowledge (ρ) is 0.0587. All of these coefficients are statistically significant at the 1% level. The values of those elasticities are quite stable among the different Models, except when interactions are included, see Model 4. Model 1 also includes Provincial fixed effects (i.e., we control for all the public inputs at the province level). The inclusion of these 24 dummies is associated with an R^2 increase of 0.0054.

Model 2 is estimated for testing Hypotheses 1 and 2. In this case, we present a three-stage simultaneous estimation of Equations (1) and (2). Regarding Equation (1), we add the basic variables related to the KTSE theory, the regional knowledge, the entrepreneurship capital and its composition. The coefficient associated with the regional entrepreneurship capital is 0.1937, which is positive and statistically significant at the 1% level, which supports Hypothesis 1. There are entrepreneurship capital spillovers at the cantonal level after controlling for the public inputs at the provincial level. We also find that the elasticity of production with respect to the cities' knowledge generated by public institutions is 0.0017, while knowledge generated by private institutions is 0.0026; both elasticities are positive and statistically significant at the usual levels. With respect to Hypothesis 2, we find that the establishments in cantons with higher weights of informal and technological establishments have lower production. The estimated elasticities are

respectively -0.0549 and -0.0261, and only the first one is statistically significant. Therefore, we only find support for Hypothesis 2b; informal businesses generate fewer spillovers.

Regarding the determinants of entrepreneurship capital, we find that all the estimated elasticities in Equation (2) are positive and statistically significant. Therefore, ceteris paribus, those cantons that are wealthier, have denser populations and have higher tax pressures have higher levels of entrepreneurship capital.

Model 3 includes in Equation (1) cantons' fixed effects. This implies an increase of 0.0036 in the R^2, which can be interpreted as the importance of the omitted cantonal inputs. For testing Hypothesis 3, we add interaction terms between the entrepreneurship capital and the establishments' size, its technological intensity, and its formalization level. The results are presented in Model 4. The elasticity of production with respect to the entrepreneurship capital is 0.1282 and 0.0814 points higher in technological and formal establishments than in non-technological and informal ones, respectively. Take note that in this specification, the elasticity of production with respect to labour depends on the entrepreneurship capital of the canton. For example, when this is evaluated at the average value of the entrepreneurship capital (-3.4060), the elasticity is 0.7080, being 0.8257 when there is an increase of one standard deviation (0.3515) in the entrepreneurship capital. All the coefficients are statistically significant at the 1% level. These results support Hypothesis 3; larger, more technological and more informal establishments benefit more from the spillover effects of regional entrepreneurship capital. Furthermore, ceteris paribus, low technological and informal establishments have on average 25.84% and 20.81% less production than technological and formal establishments, respectively.

5. Conclusions

This paper provides evidence related to the local existence of entrepreneurship capital spillovers and the characteristics of entrepreneurs that generate and benefit more from those spillovers. These are important issues for the design and development of public policies to promote entrepreneurship.

Data about the entrepreneurship capital of 222 Ecuadorian cantons show that the spillovers are a local phenomenon. The evidence seems consistent with the KSTE arguments. Personal contacts between the staffs of different firms help to disseminate knowledge and those contacts are mostly

produced at the local level. Therefore, important spillovers are produced at the local level. Our evidence confirms this, but we need further evidence to extend the results to other geographic areas and for a better understanding of their determinants. Meanwhile, the evidence provided in this study suggests that the development and implementation of public policies to promote entrepreneurship is in part a responsibility of the local authorities.

A second piece of evidence is related to the kind of establishments that generate more spillovers. The evidence comes from a Latin American country, an institutional environment scarcely analysed until now, in which the informal economy plays an important role. It has been argued (Acs et al. 2008) that the laxity in business regulation is a political decision. Therefore, it is important to know its implications. The evidence shows that in those cantons with higher weights of informal establishments, the entrepreneurship capital spillovers are lower. The kind of businesses developed by the informal economy seem to be those that generate lower spillovers. Further evidence is needed to confirm those results in other contexts. Furthermore, we also test whether the relative importance of technological firms in a canton increases or decreases the entrepreneurship capital spillovers. Although we found a negative effect, it is not statistically significant. Therefore, the debate about the importance of technological firms as a higher source of spillovers remains open.

Finally, the use of data at the establishment also provided a third piece of evidence related to the type of firms that benefited the most from the entrepreneurship capital spillover effects. From our analyses, we detect that technological, large and informal establishments receive the most benefits from such spillover effects. The evidence can be interpreted to mean that technological and large firms have, on average, higher absorptive capacities (Cohen and Levinthal 1990; Qian and Acs 2013), while informal firms have more to learn. Further studies using data at the establishment level are needed to confirm such relationships and identify whether some type of firms systematically benefit from entrepreneurship capital spillovers.

This research has limitations. This study uses cross-sectional data, which makes it difficult to address endogeneity and causality problems. The data come from a specific country and institutional setting, so we cannot guarantee its generality. The data do not allow for the determination of how these spillover effects are produced and consequently the sources of such spillover effects. Further evidence could help to overcome these limitations.

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Table 1. The Ecuadorian administrative organization

Province	*Cantons*	*Inhabitants*	*km²*	*Province*	*Cantons*	*Inhabitants*	*km²*
Azuay	Cuenca	505.585	3.191	Esmeraldas	San Lorenzo	42.486	3.051
Azuay	Girón	12.607	354	Esmeraldas	Atacames	41.526	509
Azuay	Gualaceo	42.709	350	Esmeraldas	Rioverde	26.869	1.508
Azuay	Nabon	15.892	633	Esmeraldas	La Concordia	42.924	323
Azuay	Paute	25.494	271	Guayas	Guayaquil	2.350.915	4.196
Azuay	Pucara	10.052	585	Guayas	Alfredo Baquerizo Moreno	25.179	219
Azuay	San Fernando	3.993	139	Guayas	Balao	20.523	410
Azuay	Santa Isabel	18.393	605	Guayas	Balzar	53.937	1.186
Azuay	Sigsig	26.910	659	Guayas	Colimes	23.423	758
Azuay	Oña	3.583	293	Guayas	Daule	120.326	462
Azuay	Chordeleg	12.577	105	Guayas	Durán	235.769	300
Azuay	El Pan	3.036	132	Guayas	El Empalme	74.451	716
Azuay	Sevilla De Oro	5.889	315	Guayas	El Triunfo	44.778	395
Azuay	Guachapala	3.409	40	Guayas	Milagro	166.634	405
Azuay	Camilo Ponce Enríquez	21.998	639	Guayas	Naranjal	69.012	1.740
Bolivar	Guaranda	91.877	1.892	Guayas	Naranjito	37.186	225
Bolivar	Chillanes	17.406	663	Guayas	Palestina	16.065	194
Bolivar	Chimbo	15.779	261	Guayas	Pedro Carbo	43.436	935
Bolivar	Echeandia	12.114	230	Guayas	Samborondón	67.590	368
Bolivar	San Miguel	27.244	574	Guayas	Santa Lucía	38.923	358
Bolivar	Caluma	13.129	177	Guayas	Salitre (Urbina Jado)	57.402	393
Bolivar	Las Naves	6.092	149	Guayas	San Jacinto De Yaguachi	60.958	510
Cañar	Azogues	70.064	611	Guayas	Playas	41.935	273
Cañar	Biblian	20.817	227	Guayas	Simón Bolívar	25.483	292
Cañar	Cañar	59.323	1.798	Guayas	Marcelino Maridueña	12.033	254
Cañar	La Troncal	54.389	320	Guayas	Lomas De Sargentillo	18.413	67
Cañar	El Tambo	9.475	64	Guayas	Nobol	19.600	135
Cañar	Deleg	6.100	76	Guayas	General Antonio Elizalde	10.642	154
Cañar	Suscal	5.016	50	Guayas	Isidro Ayora	10.870	487
Carchi	Tulcán	86.498	1.828	Imbabura	Ibarra	181.175	1.093
Carchi	Bolívar	14.347	359	Imbabura	Antonio Ante	43.518	82
Carchi	Espejo	13.364	554	Imbabura	Cotacachi	40.036	1.687
Carchi	Mira	12.180	587	Imbabura	Otavalo	104.874	490
Carchi	Montufar	30.511	383	Imbabura	Pimampiro	12.970	449
Carchi	San Pedro De Huaca	7.624	69	Imbabura	San Miguel De Urcuqui	15.671	785
Cotopaxi	Latacunga	170.489	1.386	Loja	Loja	214.855	1.895
Cotopaxi	La Mana	42.216	656	Loja	Calvas	28.185	841
Cotopaxi	Pangua	21.965	722	Loja	Catamayo	30.638	652
Cotopaxi	Pujilí	69.055	1.302	Loja	Celica	14.468	521
Cotopaxi	Salcedo	58.216	486	Loja	Chaguarpamba	7.161	313
Cotopaxi	Saquisilí	25.320	205	Loja	Espindola	14.799	516
Cotopaxi	Sigchos	21.944	1.352	Loja	Gonzanama	12.716	698
Chimborazo	Riobamba	225.741	983	Loja	Macará	19.018	576
Chimborazo	Alausí	44.089	1.657	Loja	Paltas	23.801	1.155
Chimborazo	Colta	44.971	836	Loja	Puyango	15.513	638
Chimborazo	Chambo	11.885	164	Loja	Saraguro	30.183	1.083
Chimborazo	Chunchi	12.686	273	Loja	Sozoranga	7.465	411
Chimborazo	Guamote	45.153	1.222	Loja	Zapotillo	12.312	1.213
Chimborazo	Guano	42.851	460	Loja	Pindal	8.645	202
Chimborazo	Pallatanga	11.544	379	Loja	Quilanga	4.337	237
Chimborazo	Penipe	6.739	367	Loja	Olmedo	4.870	113
Chimborazo	Cumandá	12.922	159	Los Ríos	Babahoyo	153.776	1.087
El Oro	Machala	245.972	330	Los Ríos	Baba	39.681	517
El Oro	Arenillas	26.844	808	Los Ríos	Montalvo	24.164	363
El Oro	Atahualpa	5.833	278	Los Ríos	Puebloviejo	36.477	336
El Oro	Balsas	6.861	70	Los Ríos	Quevedo	173.575	305
El Oro	Chilla	2.484	332	Los Ríos	Urdaneta	29.263	378
El Oro	El Guabo	50.009	607	Los Ríos	Ventanas	66.551	815
El Oro	Huaquillas	48.285	64	Los Ríos	Vinces	71.736	697
El Oro	Marcabeli	5.450	149	Los Ríos	Palenque	22.320	580
El Oro	Pasaje	72.806	456	Los Ríos	Buena Fe	63.148	581
El Oro	Piñas	25.988	617	Los Ríos	Valencia	42.556	978
El Oro	Portovelo	12.200	288	Los Ríos	Mocache	38.392	568
El Oro	Santa Rosa	69.036	822	Los Ríos	Quinsaloma	16.476	280
El Oro	Zaruma	24.097	649	Manabí	Portoviejo	280.029	961
El Oro	Las Lajas	4.794	298	Manabí	Bolívar	40.735	538
Esmeraldas	Esmeraldas	189.504	1.350	Manabí	Chone	126.491	3.037
Esmeraldas	Eloy Alfaro	39.739	4.273	Manabí	El Carmen	89.021	1.261
Esmeraldas	Muisne	28.474	1.243	Manabí	Flavio Alfaro	25.004	1.347
Esmeraldas	Quinindé	122.570	3.875	Manabí	Jipijapa	71.083	1.467

Manabí	Junín	18.942	246	Pichincha	Rumiñahui	85.852	136
Manabí	Manta	226.477	303	Pichincha	San Miguel De Los Bancos	17.573	850
Manabí	Montecristi	70.294	739	Pichincha	Pedro Vicente Maldonado	12.924	624
Manabí	Pajan	37.073	1.088	Pichincha	Puerto Quito	20.445	695
Manabí	Pichincha	30.244	1.075	Tungurahua	Ambato	329.856	1.018
Manabí	Rocafuerte	33.469	280	Tungurahua	Baños De Agua Santa	20.018	1.066
Manabí	Santa Ana	47.385	1.025	Tungurahua	Cevallos	8.163	19
Manabí	Sucre	57.159	694	Tungurahua	Mocha	6.777	86
Manabí	Tosagua	38.341	375	Tungurahua	Patate	13.497	316
Manabí	24 De Mayo	28.846	526	Tungurahua	Quero	19.205	174
Manabí	Pedernales	55.128	1.907	Tungurahua	San Pedro De Pelileo	56.573	202
Manabí	Olmedo	9.844	254	Tungurahua	Santiago De Pillaro	38.357	447
Manabí	Puerto López	20.451	429	Tungurahua	Tisaleo	12.137	59
Manabí	Jama	23.253	579	Zamora	Zamora	25.510	1.898
Manabí	Jaramijó	18.486	97	Zamora	Chinchipe	9.119	1.156
Manabí	San Vicente	22.025	709	Zamora	Nangaritza	5.196	2.023
Morona Santiago	Morona	41.155	4.657	Zamora	Yacuambi	5.835	1.254
Morona Santiago	Gualaquiza	17.162	2.208	Zamora	Yantzaza	18.675	1.014
Morona Santiago	Limón Indanza	9.722	1.821	Zamora	El Pangui	8.619	631
Morona Santiago	Palora	6.936	1.455	Zamora	Centinela Del Condor	6.479	262
Morona Santiago	Santiago	9.295	1.405	Zamora	Palanda	8.089	1.991
Morona Santiago	Sucua	18.318	893	Zamora	Paquisha	3.854	354
Morona Santiago	Huamboya	8.466	664	Galápagos	San Cristobal	7.475	849
Morona Santiago	San Juan Bosco	3.908	1.055	Galápagos	Isabela	2.256	5.368
Morona Santiago	Taisha	18.437	6.170	Galápagos	Santa Cruz	15.393	1.794
Morona Santiago	Logroño	5.723	1.171	Sucumbíos	Lago Agrio	91.744	3.143
Morona Santiago	Pablo Sexto	1.823	1.390	Sucumbíos	Gonzalo Pizarro	8.599	2.229
Morona Santiago	Tiwintza	6.995	1.170	Sucumbíos	Putumayo	10.174	3.575
Napo	Tena	60.880	3.922	Sucumbíos	Shushufindi	44.328	2.470
Napo	Archidona	24.969	3.029	Sucumbíos	Sucumbios	3.390	1.511
Napo	El Chaco	7.960	3.500	Sucumbíos	Cascales	11.104	1.250
Napo	Quijos	6.224	1.589	Sucumbíos	Cuyabeno	7.133	3.906
Napo	Carlos Julio Arosemena	3.664	502	Orellana	Orellana	72.795	7.079
Pastaza	Pastaza	62.016	19.930	Orellana	Aguarico	4.847	11.260
Pastaza	Mera	11.861	528	Orellana	La Joya De Los Sachas	37.591	1.202
Pastaza	Santa Clara	3.565	314	Orellana	Loreto	21.163	2.151
Pastaza	Arajuno	6.491	8.869	Sto. Dom. de	Santo Domingo	368.013	3.447
Pichincha	Quito	2.239.191	4.218	Santa Elena	Santa Elena	144.076	3.597
Pichincha	Cayambe	85.795	1.191	Santa Elena	La Libertad	95.942	25
Pichincha	Mejia	81.335	1.485	Santa Elena	Salinas	68.675	68
Pichincha	Pedro Moncayo	33.172	338	Manabí*	Manga Del Cura	20.758	487
				Imbabura**	Las Golondrinas	6.329	127
				Guayas**	El Piedrero	5.302	170

Source: National Institute of Statistics and Censuses, INEC, 2010.

(*) Manga del Cura was incorporated in 2017 into the province of Manabí. Originally it was not assigned to a concrete province. In the analyses, it is considered as a canton of Manabí.

(**) In the case of Las Golondrinas and El Piedrero, there is no information about establishments. Therefore, they are excluded from the analyses.

Table 2. Technological sectors.

NACE Code	Sector description
J58	Publishing activities
J59	Motion picture, video and television programme production, sound recording and music publishing activities
J60	Programming and broadcasting activities
J61	Telecommunications
J62	Computer programming, consultancy and related activities
J63	Information service activities
M69	Legal and accounting activities
M70	Activities of head offices; Management consultancy activities
M71	Architectural and engineering activities; technical testing and analyses
M72	Scientific research and development
M73	Advertising and market research
M74	Other professional, scientific and technical activities
P85	Education
R91	Libraries, archives, museums and other cultural activities

Source: National Institute of Statistics and Censuses, INEC, 2010.

Table 3. Descriptive statistics

Establishments	*Mean*	*Standard Deviation*
$\ln Y_{j,i}$	9.2404	1.6141
$\ln I_{j,i}$	5,6803	2,4177
$\ln K_{j,i}$	7.3621	1.8953
$\ln L_{j,i}$	0.4981	0.6668
$\ln Z_{j,i}$	0.0255	0.4556
$\ln R_{PUBj,i}$	13.1216	5.2355
$\ln R_{PRIVj,i}$	11.0444	6.2526
$\ln E_{j,i}$	-3.4060	0.3515
$\ln(IE_{j,i}/E_{j,i})$	-1.1005	0.3283
$\ln(KE_{j,i}/E_{j,i})$	-2.5117	0.2295
$D_{Inform\ j,i}$	0.3496	0.4769
$D_{Tech\ j,i}$	0.0831	0.2760
$\ln y_{j,i,t-1}$	1.3314	0.4677
$\ln DEN_{j,i,t-1}$	5.3861	1.2129
$\ln TAX_{j,i,t-1}$	2.6093	1.3963

Observations: 445.490

Table 4. Correlation Matrix

	$\ln Y_{j,i}$	$\ln K_{j,i}$	$\ln I_{j,i}$	$\ln L_{j,i}$	$\ln Z_{j,i}$	$\ln Rpub_{j,i}$	$\ln Rpriv_{j,i}$	$\ln E_{j,i}$	$\ln(IE_{j,i}/E_{j,i})$	$\ln(KE_i/E_i)$	$\ln y_{j,i,t-1}$	$DEN_{j,i,t-1}$
$\ln K_{j,i}$	0.4067 ***											
	[0.000]											
$\ln I_{j,i}$	0.4275 ***	0.2325 ***										
	[0.000]	[0.000]										
$\ln L_{j,i}$	0.4484 ***	0.4291 ***	0.1677 ***									
	[0.000]	[0.000]	[0.000]									
$\ln Z_{j,i}$	0.0803 ***	0.0889 ***	0.0300 ***	0.1183 ***								
	[0.000]	[0.000]	[0.000]	[0.000]								
$\ln Rpub_{j,i}$	0.0749 ***	0.0565 ***	0.0315 ***	0.0516 ***	0.0210							
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]							
$\ln Rpriv_{j,i}$	0.0934 ***	0.0702 ***	0.0267 ***	0.0665 ***	0.0240 ***	0.7423 ***						
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]						
$\ln E_{i,i}$	0.0414 ***	0.0361 ***	0.0263 ***	0.0054 ***	0.0143 ***	0.4415 ***	0.5171 ***					
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]					
$\ln(IE_{j,i}/E_{j,i})$	-0.0068 ***	-0.0537 ***	-0.0379 ***	0.0361 ***	-0.0174 ***	-0.2454 ***	-0.1355 ***	-0.4541 ***				
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]				
$\ln(K_{j,i}/E_{j,i})$	0.0402 ***	0.0586 ***	0.0292 ***	0.0021	0.0265 ***	0.5236 ***	0.6203 ***	0.4739 ***	-0.4850 ***			
	[0.000]	[0.000]	[0.000]	[0.163]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]			
$\ln y_{j,i,t-1}$	0.1000 ***	0.0865 ***	0.0366 ***	0.0557 ***	0.0167 ***	0.5302 ***	0.6859 ***	0.4351 ***	-0.2362 ***	0.3888 ***		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
$\ln DEN_{j,i,t-1}$	0.0672 ***	0.0344 ***	0.0085 ***	0.0680 ***	0.0133 ***	0.4464 ***	0.7066 ***	0.3845 ***	0.2092 ***	0.3408 ***	0.4320 ***	
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	
$\ln TAX_{j,i,t-1}$	0.0761 ***	0.0602 ***	0.0260 ***	0.0458 ***	0.0200 ***	0.6677 ***	0.7472 ***	0.6559 ***	-0.2305 ***	0.5668 ***	0.4569 ***	0.6252 ***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

*: Significant at the 0.10 level. **: Significant at the 0.05 level. ***: Significant at the 0.01 level. p-values are in brackets.

Table 5. Hypotheses Tests

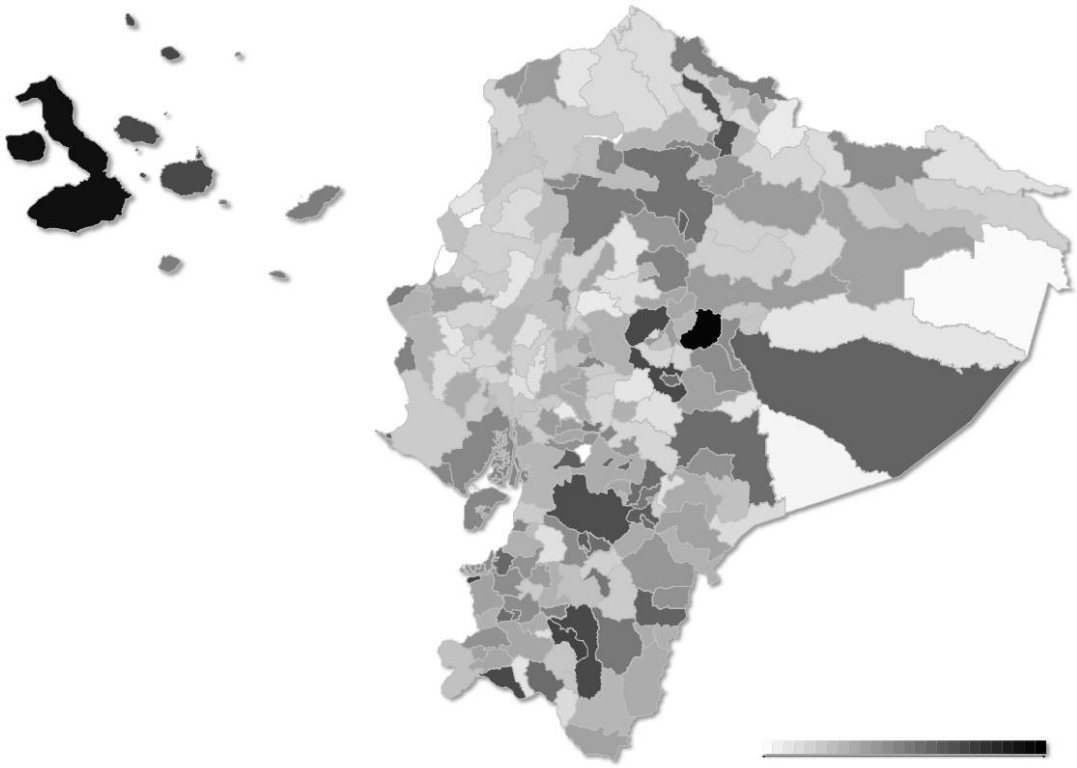
		Equation [1] Dependent Variable: $\ln Y_{j.i}$			
	Model	1	2	3	4
Independent Variable	*Coefficient*				
Constant		6.3644 ***	6.7851 ***	6.3857 ***	6.7959 ***
		[0.016]	[0.095]	[0.016]	[0.017]
$\ln K_{j.i}$	α	0.1656 ***	0.1645 ***	0.1655 ***	0.1359 ***
		[0.002]	[0.001]	[0.002]	[0.002]
$\ln I_{j.i}$	ϕ	0.2190 ***	0.2188 ***	0.2194 ***	0.1998 ***
		[0.001]	[0.001]	[0.001]	[0.001]
$\ln L_{j.i}$	β	0.7376 ***	0.7352 ***	0.7339 ***	1.8471 ***
		[0.005]	[0.003]	[0.005]	[0.051]
$\ln Z_{j.i}$	ρ	0.0587 ***	0.0583 ***	0.0580 ***	0.0593 ***
		[0.005]	[0.004]	[0.005]	[0.005]
Province	*Dummies*	Yes	Yes	No	No
$\ln Rpub_i$	μ_{pub}		0.0017 ***		
			[0.001]		
$\ln Rpriv_i$	μ_{priv}		0.0026 **		
			[0.001]		
$\ln E_i$	δ		0.1937 ***		
			[0.017]		
$\ln(KE_i/E_i)$	δ_{KE}		-0.0549 ***		
			[0.018]		
$\ln(IE_i/E_i)$	δ_{IE}		-0.0261		
			[0.017]		
$\ln E_i * \ln L_j$	δ_S				0.3344 ***
					[0.015]
$D_{Tech\ j.i}$	d_T				0.2584 ***
					[0.084]
$\ln E_i * D_{Tech\ j.i}$	δ_T				0.1282 ***
					[0.025]
$D_{Inform\ j.i}$	d_I				-0.2082 ***
					[0.049]
$\ln E_i * D_{Inform\ j.i}$	δ_I				0.0814 ***
					[0.014]
Canton	*Dummies*			Yes	Yes
R^2		0.3653	0.3662	0.3698	0.3889
Observations	445.490				
Independent Variable	*Coefficient*	Equation [2] Dependent Variable: $\ln E_i$			
Constant			-4.2159 ***		
			[0.002]		
$\ln y_{j.i.t-1}$	θ_1		0.2735 ***		
			[0.001]		
$\ln DEN_{j.i.t-1}$	θ_2		0.1076 ***		
			[0.001]		
$\ln TAX_{j.i.t-1}$	θ_3		0.0689 ***		
			[0.000]		
Province	*Dummies*		Yes		
R^2			0.7477		
Observations	445.490				

*: Significant at the 0.10 level. **: Significant at the 0.05 level. ***: Significant at the 0.01 level. Robust standard errors are in brackets.

Graph 1. Map of Ecuadorian Provinces

Source: National Institute of Statistics and Censuses. INEC. 2010.

Graph 2. Entrepreneurship Capital Density



Source: Own elaboration, using CENEC data.

Appendix 1. Entrepreneurship capital measured by city start-ups.

In the table below, the entrepreneurship capital is measured by the average of the last three year's ratios between the start-ups per inhabitant of each city.

Table A.1. Hypothesis Test (Entrepreneurship Capital: Start-Ups).

		Equation [1] Dependent Variable: $\ln Y_{j.i}$			
Model		1	2	3	4
Independent Variable	*Coefficient*				
Constant		6.3644 ***	7.1993 ***	6.3857 ***	6.8058 ***
		[0.016]	[0.121]	[0.016]	[0.017]
$\ln K_{j.i}$	α	0.1656 ***	0.1645 ***	0.1655 ***	0.1359 ***
		[0.002]	[0.001]	[0.002]	[0.002]
$\ln I_{j.i}$	ϕ	0.2190 ***	0.2188 ***	0.2194 ***	0.1998 ***
		[0.001]	[0.001]	[0.001]	[0.001]
$\ln L_{j.i}$	β	0.7376 ***	0.7352 ***	0.7339 ***	2.6456 ***
		[0.005]	[0.003]	[0.005]	[0.082]
$\ln Z_{j.i}$	ρ	0.0587 ***	0.0583 ***	0.0580 ***	0.0583 ***
		[0.005]	[0.004]	[0.005]	[0.005]
Province	*Dummies*	Yes	Yes	No	No
$\ln Rpub_i$	μ_{pub}		0.0019 ***		
			[0.001]		
$\ln Rpriv_i$	μ_{priv}		0.0027 ***		
			[0.001]		
$\ln E_i$	δ		0.2032 ***		
			[0.017]		
$\ln(KE_i/E_i)$	δ_{KE}		-0.0616 ***		
			[0.017]		
$\ln(IE_i/E_i)$	δ_{IE}		-0.0304 *		
			[0.016]		
$\ln E_i * \ln L_j$	δ_S				0.3608 ***
					[0.016]
$D_{Tech\ j.i}$	d_T				0.6240 ***
					[0.136]
$\ln E_i * D_{Tech\ j.i}$	δ_T				0.1495 ***
					[0.026]
$D_{Inform\ j.i}$	d_I				-0.1284 *
					[0.077]
$\ln E_i * D_{Inform\ j.i}$	δ_I				0.0666 ***
					[0.014]
Canton	*Dummies*			Yes	Yes
R^2		0.3653	0.3660	0.3698	0.3892
Observations	445.490				

*: Significant at the 0.10 level. **: Significant at the 0.05 level. ***: Significant at the 0.01 level. Robust standard errors are in brackets.

Table A.1. (Cont.) Hypothesis Test (Entrepreneurship Capital: Start-Ups).

Independent Variable	*Coefficient*	Equation [2] Dependent Variable: $\ln E_{j,i}$
Constant		-6.1872 ***
		[0.002]
$\ln y_{j.i.t-1}$	θ_1	0.2377 ***
		[0.001]
$\ln DEN_{j.i.t-1}$	θ_2	0.1198 ***
		[0.001]
$\ln TAX_{j.i.t-1}$	θ_3	0.0534 ***
		[0.000]
Province	*Dummies*	Yes
R^2		0.7212
Observations	445.490	

*: Significant at the 0.10 level. **: Significant at the 0.05 level. ***: Significant at the 0.01 level. Robust standard errors are in brackets.