HIGH-GROWTH ENTREPRENEURSHIP IN A DEVELOPING COUNTRY: REGIONAL SYSTEMS OR STOCHASTIC PROCESS?

BRUNO FISCHER
School of Applied Sciences, University of Campinas, Brazil
bruno.fischer@fca.unicamp.br

PAOLA RÜCKER SCHAEFFER
Department of Science and Technology Policy, University of Campinas, Brazil
paolaschaeffer@ige.unicamp.br

SÉRGIO QUEIROZ
Department of Science and Technology Policy, University of Campinas, Brazil
squeiroz@ige.unicamp.br

ABSTRACT

High-growth entrepreneurship represents a key socioeconomic phenomenon that is expected to spur aggregate levels of innovation, competitiveness and economic growth. Nonetheless, its impacts are mainly felt at the regional level, making a case for investigating the dynamics of Regional Systems of Entrepreneurship. While several approaches have dealt with this issue in the context of developed economies, approaches to developing nations are still scarce and they suggest that the underlying conditions can be significantly distinct to those observed in advanced countries. This research addresses this situation by investigating the determinants of entrepreneurial activity in Brazilian states. Two main explanatory dimensions are created (markets and knowledge infrastructure) to predict entrepreneurial activity (absolute numbers, density, and specialization). Econometric estimations comprehend data from gazelle firms in Brazilian states throughout the period 2008-2014. Findings allow identifying the existence of relevant agglomeration diseconomies and an overall lack of connection between the knowledge infrastructure and entrepreneurship. These conditions suggest that high-growth entrepreneurship in Brazil has a strong stochastic character – or embryonic Regional Systems of Entrepreneurship. Thus, the geographic dynamics of entrepreneurial activity in this country is remarkably different from what has been observed in developed countries in general. This might indicate the inadequacy of entrepreneurship policy in developing countries that emulates initiatives undertaken in leading innovation systems: building functional systems of entrepreneurship can be a challenge that goes beyond subsidies allocated to new ventures.

Keywords: High Growth Entrepreneurship; Regional Systems of Entrepreneurship; Geography of Innovation; Gazelles.

JEL codes: L26; R58

1 INTRODUCTION

High-growth entrepreneurship (HGE) stands for a key socioeconomic phenomenon that spurs aggregate levels of innovation, competitiveness and economic growth (Audretsch et al., 2006; Saxenian, 1994). These impacts are originated from entrepreneurial capabilities to translate available knowledge into products and services, reducing inefficiencies in the markets where they operate (Braunerhjelm et al., 2010). Also, these new ventures generate substantial levels of multiplier effects for the environment in which they are embedded (Stangler & Bell-

Masterson, 2015). Increasingly, these propositions find their way into policymaking processes, drawing attention to the dynamics of entrepreneurial quality (not just quantity) for development (Stam, 2015; Henrekson & Sanandaji, 2014).

Nonetheless, knowledge is susceptible to increasing returns to scale, which can be attributed to agglomeration economies and complex socioeconomic environments that promote a heterogeneous pattern of innovation distribution in space (Krugman, 1998). Hence impacts of entrepreneurial[1] activity can be mainly felt at the regional level (Ács & Armington, 2004), putting concepts such as Regional Systems of Entrepreneurship (RSE) and Entrepreneurial Ecosystems as matters of rising interest for public policy (Borissenko & Boschma, 2016).

However, entrepreneurship has received scant attention as an aggregate phenomenon in the field of innovation systems (Ács et al., 2014). As a consequence, there is a lack of empirical understanding on the location determinants of high-growth entrepreneurship (Audretsch, 2012). This situation reduces the ability of policymakers to formulate well-guided initiatives that make efficient use of public resources. A particular gap of knowledge persists for developing economies, which end up relying on conclusions drawn from the context of leading innovation systems. The problem is these countries seem to present marked differences in respect to the spatial dynamics of innovation systems in developed economies (Calá et al., 2014; Crescenzi & Rodríguez-Pose, 2012; Fischer et al., 2015).

In order to contribute to this body of knowledge, *this research addresses the socioeconomic determinants behind the formation of Regional Systems of Entrepreneurship in the context of a developing country*, using detailed information relevant to the regional geography of high-growth entrepreneurship in Brazil in the period 2008-2014. Three econometric models are developed in order to understand the dynamics of HGE occurrence, density and specialization at the regional level. Two broad dimensions of Regional Systems of Entrepreneurship are assessed as potential determinants of entrepreneurial activity: regional markets and knowledge infrastructure.

Results indicate signs of relevant agglomeration diseconomies in the Brazilian context. Market traits appear to have a very distinct behavior to what has been observed in the context of developed countries. More importantly, the lack of significance in the Knowledge Infrastructure dimension suggests that Regional Systems of Entrepreneurship in Brazil may be in an embryonic stage and that high-growth entrepreneurship seems to be more closely connected to stochastic processes than to expected systemic predictors.

The article is structured in six sections. Aside from this introduction we develop a literature review on Regional Systems of Entrepreneurship and its determinants. General models are developed in Section 3. Section 4 describes the data and method of estimation. Results can be found in Section 5. We conclude with final remarks and implications.

2 REGIONAL SYSTEMS OF ENTREPRENEURSHIP IN PERSPECTIVE

Recent efforts in the field of innovation management and economics has contributed substantially to the literature on the role of entrepreneurial activity within the realm of regional systems of innovation (e.g. Ács et al., 2014; Ács et al., 2015; Szerb et al., 2015). This geographic scope of analysis offers an important contribution to nation-wide, macroeconomic analysis, particularly for the case of large nations (Cooke et al., 1997). This is of special interest for the assessment of high-growth entrepreneurship. These activities rely on learning processes for innovation that are localized in space (Cooke et al., 1997), generating concentrated areas of entrepreneurship itself (Cooke, 2016; Stam, 2009; Feldman, 2001). As a result, HGE plays an

[1] After the initial conceptual claims, the terms "high-growth entrepreneurship", "HGE" and "entrepreneurship" are used interchangeably.

active role in shaping long-term development paths, but these impacts are restricted to the region in which they operate (Duranton, 2007).

Thus, the concept of Regional Systems of Entrepreneurship[2] has risen to deal with the specific dynamics of entrepreneurial activity within innovation systems. This literature incorporates several conceptual aspects from the Regional Systems of Innovation literature, using dimensions of interest such as market structures, interactions, entrepreneurial culture, local presence of research institutions and universities, supportive services, and qualitative aspects of the available workforce (Fritsch, 2002; Iammarino, 2005; Isenberg, 2010; Qian et al., 2013; Saxenian, 1994; Stam, 2009; Stam, 2015).

It follows that the combination of these factors of interest is what drives the aggregate patterns of firm-level competitiveness in RSEs (Radosevic & Yoruk, 2013; Szerb et al., 2015). Because of its own nature, these systems involve multiple agents and the context in which they are embedded, whereas their productivity is affected by the performance of any of its components (Ács et al., 2014; Szerb et al., 2015). Based on these introductory concepts of Regional Systems of Entrepreneurship and its rationale, we address two broad dimensions that cover the constructs of interest pointed out by literature: markets and knowledge infrastructure.

2.1 Markets

A first issue related to regional market dynamics that we pay attention to concerns its (uneven) distribution in space. The regional dynamics of economic growth are usually related to the existence of agglomeration economies (Delgado, Porter & Stern, 2010). Puga (2010) summarizes the main arguments behind the benefits of agglomeration in three categories: i) a larger market facilitates sharing of local infrastructure, suppliers and labor pool; ii) better matching between firms and employees, demand and supply, and among business partners; and iii) more efficient learning processes between agents. Hence, regions that contain large metropolitan areas are expected to have a relative advantage in terms of innovative activity because of their capacity of providing access to markets, business and social networks, and ideas (Glaeser, 2011; Stam, 2009).

Correspondingly, regional economic agglomerations tend to generate higher rates of entrepreneurial activity (Audretsch & Fritsch, 1994). Armington and Ács (2002) and Spilling (1996) use similar arguments to those of Puga (2010), arguing that these greater levels of new firm formation can be attributed to industrial density, larger populations and income levels. These dynamics create heterogeneous geographic distributions of high-tech entrepreneurship (Dorfman, 1983; Feldman, 2001). Nonetheless, the scant literature on Regional Systems of Entrepreneurship in developing countries has yielded contradictory outcomes, demonstrating weak significance of agglomeration economies for entrepreneurial activity (e.g. Calá et al., 2014; Fischer et al., 2015).

A second market trait of interest – and closely related to the first one – concerns relative geographic position of Regional Systems of Entrepreneurship. In this regard, proximity to large economic centers seems to matter. Peripheral regions suffer from reduced capabilities in terms of business activity and innovation (Fritsch, 2002; Iammarino, 2005). We can relate this situation to lower levels of interconnectedness with key innovation networks and lack of exposure to knowledge spillovers from central areas (Crescenzi & Rodríguez-Pose, 2012). This perception seems to hold for start-up formation, where core-periphery structures have been identified (Spilling, 1996).

Another issue that deserves attention involves the dynamics of localization and urbanization economies. While the Marshallian argument defends the hypothesis of local specialization (urbanization economies), later work developed by Jacobs states that diversity is key for

[2] A closely related concept to that of Regional Systems of Entrepreneurship is that of Entrepreneurial Ecosystems (Isenberg, 2010).

localized innovation (localization economies) (Beaudry & Schiffauerova, 2009). Empirical work concerning regional and urban systems of innovation in this respect is mixed (Qian et al., 2013), even though positive effects in terms of entrepreneurship are more strongly connected to Jacobs' propositions (Beaudry & Schiffauerova, 2009). This is a function of the evidence presenting that excessive industrial specialization can be detrimental to long-run growth (Antonelli et al., 2016; Beaudry & Schiffauerova, 2009; Stangler & Bell-Masterson, 2015).

This can be attributed to the strategic relevance of complementary economic activities and the significant contributions they offer for start-ups (Cooke, 2016; Delgado et al., 2010; Glaeser & Kerr, 2009). In similar vein, some authors have put emphasis on "entrepreneurial support networks", i.e., business agents that offer complementary services to the activity of entrepreneurial ventures (Bresnahan et al., 2001; Kenney & Patton, 2005). From these theoretical and empirical expositions it can be gathered that the existence of a complementary economic structure can exert desirable effects on regional entrepreneurial propensity. On the other hand, this relationship is not linear, as excessive dispersion may provide little contribution for aggregate innovative capabilities (Boschma et al., 2014).

A fourth specificity of markets is associated to the level of development in a RSE and its endogenous relationship to local wealth and demand characteristics. In its turn, entrepreneurial capabilities can be related to levels of income (Radosevic & Yoruk, 2013), as this indicator functions as a proxy for purchasing power (market attractiveness) and productivity. Also, demand size is associated to positive incentives for entrepreneurial activity (Kangasharju, 2000).

2.2 Knowledge Infrastructure

Knowledge is an essential part of Regional Systems of Entrepreneurship. As argued by Qian et al. (2013), it not only represents a key source for entrepreneurial opportunities, but it also feeds entrepreneurs with higher levels of absorptive capacity. When it comes to the knowledge infrastructure a first aspect to be addressed concerns the institutional framework that is embedded in Regional Systems of Entrepreneurship. This is so because this knowledge pool can be translated into technological advancements, which affect the performance of new technology-based firms (Qian et al., 2013). Furthermore, local innovation potential can supply the Regional System of Entrepreneurship with valuable inputs, knowledge spillovers and learning effects (Puga, 2010).

It is intuitive to refer to the impacts originated from the presence of academic institutions. These agents can act as support entities for the evolutionary processes of entrepreneurial ecosystems, functioning as sources of ideas, manpower, and entrepreneurs themselves (Dorfman, 1983; Etzkowitz, 1998). That helps explaining why regional presence of universities offers access to technical expertise for high impact entrepreneurial activity (Etzkowitz, 1998; Fini et al., 2011; Stam, 2009). Nonetheless, these effects appear to be restricted to prominent institutions (Di Gregorio & Shane, 2003).

Universities can also perform the role of poles of attraction for high skilled labor, thus leveraging the regional pool of potential high-growth entrepreneurs (Glaeser et al., 2010; Florida et al., 2012). This is relevant for RSEs, since availability of human capital is a fundamental condition for the creation of entrepreneurial hubs (Bresnahan et al., 2001; Dorfman, 1983; Okamuro & Kobayashi, 2006).

A complementary perspective is offered through the analysis of knowledge stock as an ingredient of innovative activities in regions. Antonelli et al. (2016) verify that patent data can supply a valuable indicator in predicting innovation throughout regions in Europe. This is because patents – and their representation of available knowledge – functions as an external source of available knowledge and localized specialization for firms and individuals (Antonelli & Colombelli, 2015).

3 GENERAL MODELS

Reference models are developed as an exploratory entrepreneurial propensity function. This follows Radosevic and Yoruk (2013) who propose that the "entrepreneurial propensity" of innovation systems signals their capacity to spawn innovation-driven opportunities. A simple exploratory model is introduced in Equation 1:

$$\boldsymbol{E_{it} = \alpha + E_{it-1} + \sum i\, M_{it}^{\alpha} + \sum i\, K_{it}^{\beta} + \varepsilon_{it}} \qquad \textbf{Equation 1}$$

Where $\boldsymbol{E}$ corresponds to total high-growth entrepreneurial activity. This outcome is defined according to the two broad dimensions explored in this article: Market ($\boldsymbol{M}$) effects with elasticity $\boldsymbol{\alpha}$; and Knowledge Infrastructure ($\boldsymbol{K}$) effects with elasticity $\boldsymbol{\beta}$. A lagged term of the dependent variable ($\boldsymbol{E_{it-1}}$) is introduced to control for persistent patterns of entrepreneurship over time (Glaeser & Kerr, 2009; O'Shea et al., 2005). This structure represents the need to make each dimension operational via an adequate set of predictors (see section 4 for a description). $\boldsymbol{\alpha}$ is the constant of the model. $\boldsymbol{\varepsilon}$ comprehends aspects that are not within the scope of our analytical framework and that may help shaping the dynamics of Regional Systems of Entrepreneurship (unobserved effects)[3]. Since the empirical part of this research deals with panel data, this error term comprehends both a unit-specific and a time-invariant component.

An additional assessment of entrepreneurial activity concerns the relative weight of HGE within the regional productive structure. This is an aspect of particular interest in the evaluation of entrepreneurial ecosystems (Ács et al., 2014). The second model is a simple derivation from Equation 1:

$$\boldsymbol{\frac{E_{it}}{F_{it}} = \alpha + \left(\frac{E_{it-1}}{F_{it-1}}\right) + \sum i\, M_{it}^{\alpha} + \sum i\, K_{it}^{\beta} + \varepsilon_{it}} \qquad \textbf{Equation 2}$$

Where $\boldsymbol{F_{it}}$ represents the total number of firms in region "i", period "t". The remainder of the model is analogous to the structure depicted in Equation 1.

Lastly, we use a vector of "entrepreneurial specialization" as the dependent construct. In this alternative structure, the total number of entrepreneurial firms is substituted by the location quotient of high-growth entrepreneurship ($\boldsymbol{E^*}$) in region "**i**", period "**t**". The quotient is given by:

$$\boldsymbol{E_{it}^{*} = \frac{\frac{E_{it}}{F_{it}}}{\frac{E_{Ct}}{F_{Ct}}}} \qquad \textbf{Equation 3}$$

$\boldsymbol{E^*}$ is corresponds to high-growth entrepreneurial activity (HGE). $\boldsymbol{F}$ is a measure of total firms. Subscripts correspond to the regional level ("**i**"), country level ("**C**") and specific periods in time ("**t**"). $\boldsymbol{E^*}$ weighs the relevance of HGE in any given region compared to the national profile. The third general model takes the following form:

$$\boldsymbol{E_{it}^{*} = \alpha + E_{it-1}^{*} + \sum i\, M_{it}^{\alpha} + \sum i\, K_{it}^{\beta} + \varepsilon_{it}} \qquad \textbf{Equation 3.1}$$

The use of the approaches as defined in Equations 1 (absolute numbers of HGE), 2 (entrepreneurial density) and 3.1 (entrepreneurial specialization) can offer a deeper

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[3] In this regard, the case of entrepreneurial culture is noteworthy (see Feldman, 2001; Isenberg, 2010; Lambooy & Boschma, 2001). This dimension lies beyond the scope of this research due to the lack of suitable indicators, particularly within the sub-national scope of Brazil.

understanding of the dynamics of Regional Systems of Entrepreneurship than either assessment by itself. As expressed in the literature review, each of the two dimensions approached by the general models presented in this section is composed by a set of operational variables. A specific parameter is assigned to each variable in the estimations that follow.

4 DATA AND ESTIMATION METHOD

Data for the estimation of the general models focus on regional units of the Brazilian economy, represented by 26 states and the Federal District observed throughout the period 2008-2014. The adoption of state-level analysis for Regional Systems of Entrepreneurship has been conceptually proposed in Qian et al. (2013), and empirically tested for the case of European regions (Ács et al., 2015; Szerb et al., 2015). We address fundamentally simultaneous effects from the Market and Knowledge Infrastructure dimensions. We follow the basic analytical structure of Qian et al. (2013), not neglecting the issues that this approach might involve. Nonetheless, there is a lack of clarity in terms of the adequate lags for the set of variables.

The operational definition of high-growth entrepreneurship is given by gazelles. This subset of high-growth firms consists in those companies with 10 or more employees (in t-3) that achieved an average employment growth of at least 20%/year from t-3 to t[4]. What approximates gazelles to the classification of entrepreneurial firms is the fact that they are up to 8 years old. These companies are recognized by the literature on entrepreneurship as adequate proxies for "Schumpeterian entrepreneurship", altering technological regimes and replacing incumbents (e.g. Bos & Stam, 2014; Fritsch & Schroeter, 2009). Nonetheless, we recognize that it is an imperfect definition of innovation-driven entrepreneurship. First, it neglects companies that have less than 10 employees, potentially disregarding technology start-ups that are not labor-intensive. Complementarily, the focus on employment growth may not comprehend companies that are scaling up in terms of revenue without increases in the workforce. Thus, although gazelles stand for a useful indicator of innovative, high-growth entrepreneurship, it encompasses some caveats that should be taken into account when analyzing empirical results.

The complete group of analytical variables is depicted in Table 1. The Market dimension comprehends six vectors: GDP, Population Density, Regional Specialization, KIBS, MNEs and Trade Openness. These variables are related to the aspects of interest highlighted in the literature review and they largely represent indicators of interest found in previous empirical research (e.g. Ács & Armington, 2004; Ács et al., 2014; Andersson & Koster, 2011; Bresnahan et al., 2001; Qian et al., 2013; Stangler & Bell-Masterson, 2015). Specifically, GDP and Population Density also serve the function of controlling for economic and population sizes of Brazilian states.

The Knowledge Infrastructure dimension is represented by five variables: Patents, Human Capital, Universities, Infrastructure[5] and Gross Expenditures in R&D. We take the variable Patents as a measure of knowledge stock, more than of innovative potential, which explains the interest in patent deposits rather than in grants. The use of national-level data is justified by the fact that Brazil has a low propensity of generating international patents. This can be problematic for the very small numbers involved in the state-level analysis (including a substantial amount of zeros), particularly for the North, Northeast and Mid-West regions. Human Capital is approximated by tertiary enrollment per thousand inhabitants. Our measure of universities accounts for faculty per thousand inhabitants (as in Qian et al., 2013). These indicators are also derived from our literature review and a set of empirical investigations (e.g. Colombo & Grilli, 2005; Fini et al., 2011; Qian et al., 2013; Rosenthal & Strange, 2001; Spilling, 1996).

[4] According to the definition used by the Brazilian Office of Statistics.
[5] Following Hymel (2009) we introduce a vector of physical infrastructure.

Estimations are carried out via Fixed-Effects (FE) models for panel data with heteroscedasticity and autocorrelation-consistent standard errors (HAC). The use of FE models is warranted by statistical merit (Hausman tests) and operational reasons related to states' unobserved characteristics that might influence entrepreneurial dynamics. Robustness tests are undertaken with the exclusion of the states of São Paulo and Rio de Janeiro. We do so in order to identify if the presence of two metropolitan areas with international reach, as well as the two most important economies of the country, may bias econometric findings. We apply natural logs to analytical variables so statistical relationships can be interpreted as elasticities.

Table 1. *Analytical variables.*

Dimension	Variable	Definition	Source
Dependent	Gazelles(total)	Total number of gazelles.	Brazilian Office of Statistics
	Gazelles(density)	Share of gazelle firms among the population of firms.	
	Location Quotient (Gazelles)	Location quotient of gazelle firms.	
Market	GDP	State-level Gross Domestic Product in thousands (local currency).	
	Population Density	Population (thousand inhabitants) per squared kilometer.	
	Regional Specialization	Herfindahl-Hirschman Index of economic activity (NACE 2-digit Rev.2).	Brazilian Ministry of Labor
	KIBS	Share of selected Knowledge-Intensive Business Services[6] among the population of firms.	
	MNEs	Share of wholly-owned foreign subsidiaries among the population of firms.	
	Trade Openness	Exports plus Imports as a share of the regional GDP.	Brazilian Ministry of Industry and Trade/Brazilian Office of Statistics
Knowledge Infrastructure	Patents	Domestic patent deposits (invention and utility models) per capita.	Brazilian Patent Office
	Human Capital	Individuals enrolled in tertiary education per thousand inhabitants.	Ministry of Education/
	Universities	Faculty in Higher Education Institutions per thousand inhabitants.	
	Infrastructure	Share of highways rated as "excellent" and "good".	Brazilian Transport Confederation
	GERD	Gross Expenditures in R&D as a share of regional GDP.	Ministry of Science, Technology and Innovation

[6] Real estate, hardware and software consultancy, data processing and computer related activities, R&D, legal services, accounting, financial services, engineering, advertising and business activities.

5 RESULTS

Descriptive statistics of the analytical variables in their original structure can be found in Table 2. A preliminary observation of the sample highlights the strong heterogeneity in terms of regional entrepreneurship in the country for absolute numbers, density and specialization. Marked differences can also be noted for economic size (GDP), Population Density, Trade Openness, Patent activity (per capita), Human Capital, Universities, Infrastructure and GERD. These socioeconomic traits are an example of the strong regional asymmetries found in the Brazilian economy.

Table 2. *Descriptive statistics.*

Variable	Mean	Min.	Max	Within Std. Dev.	Between Std. Dev.
Gazelles (Total)	823.53	29	7118	111.67	1260.2
Gazelles (Density)	.009	.005	.022	.001	.002
Location Quotient (Gazelles)	1.115	.680	2.273	.119	.240
GDP	$ 162.070.000,00	$ 4.841.900,00	$ 1.858.200.000,00	$ 69.274.000,00	$ 281.980.000,00
Population Density	.070	.001	.495	.004	.109
Regional Specialization	.220	.174	.298	.006	.032
KIBS	.092	.057	.141	.005	.016
MNEs	.0002	.0000	.0009	.0001	.0001
Trade Openness	.039	.001	.224	.009	.040
Patents	.023	.000	.104	.004	.024
Human Capital	28.945	11.117	64.834	2.971	8.975
Universities	1.793	0.593	3.362	.120	.531
Infrastructure	.466	.000	.868	.090	.181
GERD	.004	.0001	.0412	.0014	.0074

Note: Descriptive statistics are provided for data in their original structures.

Results for the econometric estimations are presented in Table 3. The lagged term of the dependent variable is statistically significant for the total number of Gazelles and for Gazelles' density, although only slightly for the latter case. Hence, for the second and third models, persistence of the dependent variable over time does not seem to be remarkably present.

Table 3. *Fixed-Effects estimations (HAC).*

Dimension	Predictor	Equation 1 LnGazelles (Total)	Equation 2 LnGazelles (Density)	Equation 3.1 LnLocation Quotient (Gazelles)
	const.	-6.074***[2.147]	-10.574***[2.193]	-7.295***[2.474]
	Dependent variable (t-1)	.256***[.092]	.197*[.098]	.124[.098]
Market	LnGDP	.291**[.112]	.028[.113]	.109[.125]
	LnPopulation Density	-1.125***[.382]	-1.350***[.373]	-1.105***[.332]
	LnRegional Specialization	.393[.688]	.049[.629]	-.273[.673]
	LnKIBS	-.662**[.308]	-.738**[.324]	-.419[.347]
	LnMNEs	-.046***[.017]	-.042**[.016]	.001[.015]
	LnTrade Openness	.083*[.043]	.073*[.041]	.037[.047]
Knowledge Infrastructure	LnPatents	.112***[.033]	.107***[.030]	.076***[.026]
	LnHuman Capital	.386[.247]	.199[.266]	.233[.271]
	LnUniversities	-.582***[.180]	-.538***[.177]	-.378*[.192]
	LnInfrastructure	.049[.048]	.031[.051]	.014[.050]
	LnGERD	.007[.015]	.006[.014]	-.005[.013]
	Valid N	145	145	145
	LSDV R sq.	.995	.880	.890
	Within R sq.	.485	.413	.173

Std. Errors in brackets *sig. at 10%; **sig. at 5%; ***sig. at 1%

For the Market construct, most outcomes for individual variables are contrary to previous expectations drawn from the literature dedicated to developed economies. GDP seems to serve better as a control for economic size than as an indication of stronger entrepreneurial ecosystems. Its results are only significant for predicting the total number of gazelles, but they are not related to HGE density and specialization.

In its turn, Population Density exerts significant and strong negative impacts on all measures of high-growth entrepreneurship. Even though this finding is in conflict with the dominant literature (Glaeser, 2011; Stam, 2009), it provides a hint in favor of recent developments that deal with developing nations (Fischer et al., 2015; Calá et al., 2014). What has been noticed for the environment of less advanced socioeconomic systems is that regional agglomerations can suffer from decreasing levels of quality of life, social cohesion and industrial competitiveness.

Concerning the variables related to the complementary economic structure, expectations derived from developed countries are also challenged. One would expect Regional Specialization to have a positive and significant influence on entrepreneurial activity if Jacobs' localization economies were in place – or the opposite situation to identify the presence of Marshallian economies. From the lack of significance of this variable, neither hypothesis can be confirmed. Multinational companies are negatively related to a thriving entrepreneurial ecosystem, which can be linked to the relatively low levels of absorptive capacity in the country under scrutiny. In this case, positive externalities arising from the presence of FDI are hampered and they may damage indigenous productive systems (Fischer & Queiroz, 2016). More puzzling is the negative behavior of KIBS in the first and second models. This is an issue that deserves further attention in future assessments, but it can be related to the identification of agglomeration diseconomies – as a complement to conclusions drawn from Population Density.

The last vector of the Market dimension concerns openness to trade and this indicator is positively related to the emergence of Gazelles (total and density). This is an aspect of interest for the Brazilian case, provided this country has a low level of trade as a share of GDP – possibly hurting aggregate levels of entrepreneurship.

For the case of the Knowledge Infrastructure dimension, patents per capita is consistently associated to more active Regional Systems of Entrepreneurship, but the remaining variables do not perform the expected roles. What is more interesting is that the density of universities in states wield lower levels of entrepreneurial activity. If we combine the analysis of this variable with our proxy for Human Capital, one can notice the absolute lack of integration between the academic environment and the generation of entrepreneurship in Brazil. A possible explanation resides on the strong institutional heterogeneity in terms of academic entrepreneurial propensity observed in universities (Di Gregorio & Shane, 2003), an aspect that is not captured in the specification of our variables. Moreover, these results may be a reflex of existing inequalities in technological, scientific, and innovative activities at the regional level in Brazil, particularly within the academic context (Albuquerque, 2003; Suzigan & Albuquerque, 2011).

Regional involvement in R&D has no significant impacts on HGE activity, even though one might consider that its impacts may be of an indirect order via generation of knowledge stocks (patents, for instance). The proxy for physical infrastructure also does not seem to be an adequate predictor of entrepreneurial ecosystems.

Observations resist to robustness tests with the exclusion of the states of São Paulo and Rio de Janeiro (Table 4) – combined, these two federal units account for 30% of the population and over 40% of national GDP. Also, they contain the most important metropolitan areas in the country (together their capitals form a world level-megalopolis). As per our empirical evaluation, they do not seem to bias the outcomes of econometric estimations, and the observations of Market and Knowledge Infrastructure dimensions hold for our sub-sample of regions. We provide a further discussion on these findings and their respective implications in the closing section.

Table 4. *Robustness tests for Fixed-Effects estimations (HAC): exclusion of the states of São Paulo and Rio de Janeiro.*

Dimension	Predictor	Equation 1 LnGazelles (Total) W/O Rio de Janeiro and São Paulo	Equation 2 LnGazelles (Density) W/O Rio de Janeiro and São Paulo	Equation 3.1 LnLocation Quotient (Gazelles) W/O Rio de Janeiro and São Paulo
	const.	-5.617**[2.468]	-10.037***[2.384]	-5.783**[2.323]
	Dependent variable (t-1)	.246**[.096]	.183*[.101]	.093[.099]
Market	LnGDP	.254*[.126]	-.018[.127]	.030[.126]
	LnPopulation Density	-1.062**[.402]	-1.285***[.392]	-.970***[.344]
	LnRegional Specialization	.300[.708]	-.047[.651]	-.358[.712]
	LnKIBS	-.633*[.312]	-.709**[.327]	-.354[.354]
	LnMNEs	-.043**[.017]	-.039**[.016]	.002[.015]
	LnTrade Openness	.081*[.044]	.072*[.042]	.040[.047]
Knowledge Infrastructure	LnPatents	.109***[.032]	.104***[.030]	.073**[.026]
	LnHuman Capital	.427[.256]	.245[.272]	.308[.274]
	LnUniversities	-.562***[.185]	-.514***[.181]	-.335[.197]
	LnInfrastructure	.047[.049]	.029[.052]	.010[.051]
	LnGERD	.008[.015]	.007[.014]	-.003[.013]
	Valid N	133	133	133
	LSDV R sq.	.993	.878	.889
	Within R sq.	.469	.406	.164

Std. Errors in brackets *sig. at 10%; **sig. at 5%; ***sig. at 1%

6 CONCLUDING REMARKS

This article has addressed the determinants of Regional Systems of Entrepreneurship in the context of a developing country. Our empirical assessment emphasizes the need for further studies in this field by supplying evidences that are in conflict with the regional dynamics observed in advanced economies. We have organized our analysis in two broad dimensions: Markets and Knowledge Infrastructure. Based on the application of econometric models for Brazilian states, some startling findings have come to our attention. First, most variables in the Markets dimension have an opposite effect on the measures of RSEs than expected. Hints of agglomeration diseconomies can be perceived, confirming recent results obtained for entrepreneurial activity in Brazil at the city level (Fischer et al., 2015). On the one hand, this might indicate a prevalence of regional convergence in respect to high-growth entrepreneurship. If it is so, then this can be a step towards the reduction of regional economic asymmetries that hamper development in peripheral regions (Andersson & Koster, 2011).

On the other hand, these findings may be representative of socioeconomic barriers to the formation of entrepreneurial hubs, and the consequent rise of a critical mass of innovation-driven new ventures. This is the most likely explanation for the sample under analysis and it may cast serious doubts on the use of the term Regional *Systems* of Entrepreneurship for the evaluation of developing countries. To substantiate this hypothesis some further arguments are necessary. First, our empirical evidence on the influence of the Knowledge Infrastructure is weak and concentrated on one (imperfect) measure of knowledge stock. This is not enough information to warrant that a true system of entrepreneurship is at work, where a stronger interplay among the variables of interest would be expected. Connecting this finding to the scarce levels of innovation-driven entrepreneurship in Latin America (Lederman et al., 2014), we may assert that Brazil has - at best - embryonic RSEs. In other words, stochastic processes seem to dominate the generation of HGE in the context under analysis.

Accordingly, applying policy rationales drawn from the experience of advanced nations may render initiatives in catching-up countries ineffective. For instance, the governmental role associated with the promotion of entrepreneurial ecosystems is often directed towards direct support to specific locations. However, several aspects related to a wide range of infrastructure, regulatory frameworks and institutional efficiency are not properly addressed (Chatterji et al., 2014). In other words, building functional systems of entrepreneurship can be a challenge that goes beyond subsidies allocated to new ventures.

Further investigations are needed to validate these propositions - not only in the Brazilian context, but in other developing countries as well. High-growth entrepreneurship is an important source of economic development and technological upgrading, thus making a case of interest. Alternative constructions of econometric models, use of different variables and time lags, are fundamental to verify if these conclusions stand. Also, different geographic scopes should be assessed, since federative units often display strong internal heterogeneities. From this perspective, perhaps systems of entrepreneurship present highly localized patterns which cannot be assessed in an evaluation such as ours.

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