

The geographical distribution of Portuguese business incubators: An empirical approach

Gonçalo Rodrigues Brás^{1,*} • Miguel Torres Preto²

¹*Faculty of Economics, University of Coimbra, Coimbra, Portugal*

²*Instituto Superior Técnico, IN+, Center for Innovation, Technology and Policy Research, Universidade de Lisboa, Lisbon, Portugal*

Received: 8 December 2018

Revised: 27 March 2019

Accepted: 3 April 2019

Abstract

This study attempts to develop an ordered logit regression model to identify the determinants of the geographical distribution of business incubators (BIs) in Portuguese regions in 2015. The results show that Portuguese BIs are more likely to be geographically concentrated in regions where the number of patent applications is higher, usually in the larger regions (particularly in metropolitan areas), and mostly in regions with a university. The study clearly demonstrates the importance of Portuguese universities to the location of BIs.

Keywords: business incubators; universities; entrepreneurial ecosystems; Portuguese regions; ordered logit model

JEL Classification Codes: L26, L24, M13, O31

1. Introduction

BIs fall into what Mason and Brown (2014) term entrepreneurial ecosystems, which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment. According to the academic, policy, and business literature, entrepreneurial ecosystems are a critical tool for creating resilient economies based on entrepreneurial innovation (Spigel, 2017). Thus, the role of BIs and science parks should be highlighted due to their increasing relevance in recent years (Barbero, Casillas, Wright, & Garcia, 2014); moreover, science parks may integrate BIs within their campuses (Squicciarini, 2008).

BIs are organizations that create value through the provision of spaces and/or utilitarian services for start-ups and companies to assure their sustainable development (Tötterman & Sten, 2005); they can make a significant contribution to regional development, as demonstrated in south-eastern Spain (Mas-Verdú, Ribeiro-Soriano, & Roig-Tierno, 2015).

* Corresponding author. E-mail: goncalo.nr.bras@gmail.com.

Citation: Rodrigues Bras, G., and Torres Prieto, M. (2019) The geographical distribution of Portuguese business incubators: An empirical approach, *Economics and Business Letters*, 8(3), 147-155.

DOI: 10.17811/eb1.8.3.2019.147-155

In the framework of entrepreneurial ecosystems, the importance of the role played by BIs makes it relevant to explore geographically bounded factors that may influence their location or concentration in some Portuguese regions. This research adds to the scarce literature on the topic due to its novelty in Portugal; moreover, it responds to the need for studies that shed light on the dispersion of BIs across Portugal. Despite the growing number of studies on business incubators as a formal mechanism for business creation (Schwartz & Hornych, 2010), these rarely address the factors influencing their location. Exceptions to this are the studies by Qian, Haynes, and Riggle (2011) and by Yu, Middleton, and Jackson (2010) which focus on BI clusters in USA and explore significant variables to explain the location of BIs; they are therefore of relevance to our specific topic. However, the research on BIs typically examines topics such as their success factors (Grimaldi & Grandi, 2005; Lee & Osteryoung, 2004; Mian, 1996; O'Neal, 2005), the various impacts of their screening processes (Aerts, Matthyssens, & Vandembemt, 2007; Lumpkin & Ireland, 1988), the consequences of BI specialization (Schwartz & Hornych, 2010; Vanderstraeten, van Witteloostuijn, Matthyssens, & Andreassi, 2016), the link between BIs and innovation (Thierstein & Willhelm, 2001; Xiao & North, 2017) and the cooperation between universities and BIs (McAdam & McAdam, 2008; Mian, 1996).

This gap in the literature led to exploratory research aimed at exploring some variables related to Portuguese regions, namely in relation to their area, population, innovation and the presence of universities that might influence BIs' location in Portuguese districts. Due to the lack of official information from the business incubation activity in Portugal, this essay serves merely as the starting point for further research. Rather than studying the hypothetical contribution of BIs to the development of Portuguese regions based on available information, we address their spatial distribution in Portugal, notably with the aim of understanding the “asymmetrical distribution of BIs across Portuguese districts and the mismatch between the number of BIs and the number of new firms” (Brás & Preto, 2018, p. 275).

The overall aim of this exploratory research is to understand which variables are related to or can influence the location and concentration of BIs in Portuguese districts. Rubin and Babbie (2010: 166) note that “exploratory and descriptive studies, for example, do not test hypotheses”, and this research seeks to accomplish the above-mentioned objective rather than to establish and confirm specific hypotheses. Spatial economics has been studied extensively since von Thünen (1826), Krugman (1991) and other more recent works; however, this exploratory rather than confirmatory research is justified by the lack of a solid theoretical framework on the location of BIs. Nevertheless, this does not stop us from addressing some theoretical topics to support this empirical and exploratory research.

Stokan, Thompson, and Mahu (2015) show that BIs lead to firm growth partly through access to services within and external to the incubator. Besides providing infrastructures and business services to tenant firms, BIs stimulate their network opportunities (Bergek & Norrman, 2008; Bøllingtoft, 2012), particularly with suppliers, customers, competitors, financial institutions, consultants, investors, among other stakeholders. As such, this might be critical for the selection of a specific geographical location and could explain the creation of business clusters (Peña, 2004); therefore, Henderson, Kuncoro, and Turner (1995) also point out that start-ups might have benefits from both location and urbanization economies.

On the one hand, it is known that major cities act as innovation and creativity ecosystems (Krätke, 2012) and data from USA show that new patents are granted in larger urban centres (Bettencourt, Lobo, & Strumsky, 2007). Thus, patent data is often used as a proxy due to the difficulty of measure regional innovation (Ejermeo, 2009). On the other hand, urbanization is usually measured by population density (Gössling & Rutten, 2007).

Tamásy (2007, p. 470) argue that “regions need to have a sufficient population to reach agglomeration economies, and possess a strong university (or other research-oriented organisation) to serve as a good host for an incubator”. However, it should be underlined that

BIs are only one part of the knowledge transfer outcomes in a university, and although BIs play an important role in this domain (Rothaermel & Thursby, 2005), this is not always the case (Berbegal-Mirabent, Lafuente, & Solé, 2013). Furthermore, taking into account the knowledge transfer in universities, the density and size of a region are linked to the innovative activity (Varga, 1998) and possibly to BIs.

To sum up, it is expected that BIs might be concentrated in regions with a university, a high population density, in bigger region areas and with an effective innovation environment (measured by number of patents).

2. Data and methods

The Brás and Preto (2018) database was used to identify the location of Portuguese BIs at the district level. A total of 171 BIs with known addresses were identified in the 20 Portuguese districts. This study uses quartiles to determine the maximum and minimum concentration of BIs in groups of four districts by each quartile – Table 1 and Table 2.

The ordered (by quartiles) and discrete dependent variable ranges from one (1st category – low concentration of BIs) to four (4th category – high concentration of BIs). Moreover, demographic, social, and economic variables drawn from publicly available data were tested at the Portuguese district level to explain BI concentration in these specific regions. This exploratory research seeks to estimate the likelihood of BIs being concentrated in some districts due to the presence of a university through a dummy variable (taking the value 0 or 1 to indicate the absence or presence of a university), based on the number of patent applications or even the population density and area of the districts.

Table 1. Geographical distribution of Portuguese BIs in 2015 and presence/absence of a public university.

<i>Portuguese districts</i>	<i>Number of BIs</i>	<i>Presence of at least one public university¹</i>
<i>Bragança</i>	2	No
<i>Guarda</i>	2	No
<i>Madeira</i>	2	Yes
<i>Vila Real</i>	2	Yes
<i>Santarém</i>	3	No
<i>Viana do Castelo</i>	3	No
<i>Viseu</i>	3	No
<i>Azores</i>	4	Yes
<i>Évora</i>	5	Yes
<i>Faro</i>	5	Yes
<i>Leiria</i>	5	No
<i>Portalegre</i>	6	No
<i>Beja</i>	7	No
<i>Castelo Branco</i>	7	Yes
<i>Coimbra</i>	9	Yes
<i>Setúbal</i>	9	No
<i>Braga</i>	10	Yes
<i>Aveiro</i>	19	Yes
<i>Porto</i>	26	Yes
<i>Lisbon</i>	42	Yes

Source. Brás and Preto (2018).

¹ Only the public university's (or universities') main location of was considered, and not decentralized faculties or departments.

Table 2. Distribution of BIs by each group of Portuguese districts.

Categories	Frequency	Proportion	Characteristics
1 st (Quartile) – low concentration of BIs	17	9.9%	Districts with average or low number of specialized BIs
2 nd (Quartile) – average/low concentration of BIs	19	11.1%	Districts with average number of specialized BIs
3 rd (Quartile) – average/high concentration of BIs	38	22.2%	A mix of districts with high number of specialized BIs with districts with low number of specialized BIs
4 th (Quartile) – high concentration of BIs	97	56.7%	Districts with high number of specialized BIs; Two metropolitan areas

Moreover, logit models have been applied to geographical and spatial analysis (Bhat & Sener, 2009) as well as to regional contexts (Yung, Ho, & Chan, 2017; Zhou & Yu, 2017). The Maximum Likelihood method can be used to estimate parameters in ordinal logit regressions. This method can be employed if the observations are assumed to be independent (Hosmer, Lemeshow, & Sturdivant, 2013). The robustness of results was tested by estimating an ordered logit model. This model assumes that there is a natural ranking in the possible values of the dependent variable - BIs concentration (BIS_C): a low concentration of BIs (value = 1), average/low concentration of BIs (value = 2), average/high concentration of BIs (value = 3) and high concentration of BIs (value = 4). This means that BIS_C can be represented simply as:

$$BIS_{C_i} = \sum_{k=1}^K \beta_k X_{ik} + \varepsilon_i, \quad (1)$$

where BIS_{C_i} is a linear function of K explanatory variables for each BI (i), whose values are X_{ik} and where β_k represents the coefficients associated to those explanatory variables, namely: (i) number of patent applications, (ii) regional area, (iii) presence/absence of a university (dummy variable) and (iv) population density; ε_i is the error term².

This ordered logit model for an ordinal response BIS_{C_i} with C categories can be represented as an underlying continuous response with a set of $C - 1$ cut points α_c^* such that $BIS_{C_i} = BIS_{C_c}$ if and only if $\alpha_{c-1}^* < BIS_{C_i} \leq \alpha_c^*$ through the cumulative logistic function³.

The endogeneity hypothesis of the explanatory variables was tested for the use of instrumental variables (IV), such as Population level, R&D firms, Higher Institutions related to science and technology, Number of higher education courses and Regional area under logarithm form. Hence, the Durbin-Wu-Hausman Test (Durbin, 1954; Hausman, 1978; Wu, 1973) was performed:

$$H = [\hat{b}_{IV} - \hat{b}_{OLS}] [Var(\hat{b}_{IV}) - Var(\hat{b}_{OLS})]^{-1} [\hat{b}_{IV} - \hat{b}_{OLS}] \sim \chi_k^2 \quad (2)$$

Using Durbin-Wu-Hausman Test, with a 5% significance level, it is concluded that all explanatory variables are exogenous since they have a p -value > 0.05 ⁴.

² The error term has a variance $\sigma_0^2 \sigma_i^{*2}$, where $\sigma_i^{*2} = h(\alpha_0^* + z_i' \alpha^*)$; h is a given function, z_i is a vector of explanatory variables, α_0^* is normalized such that $h(\alpha_0^*) = 1$, and σ_0^2 is determined by F in its logistic cumulative distribution function (ordered logit model).

³ $F(\alpha_i + X_n' \beta) = 1 / (1 + \exp[-\alpha_i - X_n' \beta])$

⁴ Number of patent applications (p -value = 0.110123); Regional area (p -value = 0.948803); Presence/Absence of university (p -value = 0.522046); Population density (p -value = 0.445131).

3. Results

Considering the BIs concentration as the outcome variable, Table 3 shows the estimation results and the robustness indicators.

Table 3. Estimation results.

Explanatory variables	Ordered Logit		
	Coef.	Std. Err.	z P> z
Number of patent applications	.1063	.0144	7.38 0.000
Regional area	.0006	.0001	4.88 0.000
Presence/absence of university (dummy)	2.0228	.6534	3.10 0.000
Population density	.0056	.0042	1.32 0.185
_cut1	5.6054	1.2926	
_cut2	7.5068	1.4648	
_cut3	11.9427	1.7156	
Robustness			
Wald test	Wald chi2(4) = 76.61; Prob > chi2 = 0.0000		
Pseudo R2	0.6516		

There is no standard way of interpreting the coefficients of a logit regression: However, the positive signs of all coefficients and the absence of statistical significance of population density should not be ignored when explaining BIs' concentration. The Wald tests confirm the global consistency of the specified models, given that all the coefficients in the models are different than zero. In relation to pseudo R-squared value, the model has an excellent fit based on the thresholds defined by McFadden (1973).

However, following Hamilton (2012), the scores (S) can be stated a linear function of the explanatory variables:

$$S_{logit} = 0.1063PA + 0.0006A + 2.0228D \quad (3)$$

According to Greene (2003), given the cut points, it is possible to predict probabilities for the ordered logit model. These refer to the cut points used to differentiate the adjacent levels of the BIs concentration and indicates the probability of a BI belong from a low to a high concentration area of BIs when values of the independent variables are evaluated at zero⁵:

It is important not only to predict probabilities, but also to interpret the marginal effects, that is, the extent to which the (conditional) probability of the outcome variable changes when there is a change in the value of a regressor, *ceteris paribus*. In this case, the marginal effects show the change in probability for each BI concentration category (outcome variable) when the predictor or independent variable increases by one unit – Table 4.

Table 4 shows that the university dummy variable has a positive marginal effect for the last two categories of BI concentration, but a negative effect on the two first categories. This indicates there is more likely to be a higher BI concentration in Portuguese districts with universities.

⁵ P(y_ordinal = “low concentration of BIs”) = P(S_logit+ u ≤ _cut1) = P(S_logit + u ≤ 5.6054)

P(y_ordinal = “average/low concentration of BIs”) = P(_cut1 < S_logit+ u ≤ _cut2) = P(5.6054 < S_logit + u ≤ 7.5068)

P(y_ordinal = “average/high concentration of BIs”) = P(_cut2 < S_logit+ u ≤ _cut3) = P(7.5068 < S_logit + u ≤ 11.9427)

P(y_ordinal = “high concentration of BIs”) = P(_cut4 < S_logit + u) = P(11.9427 < S_logit + u)

Table 4. Average marginal effects.

<i>Explanatory variables</i>	Ordered logit (categories)			
	1st	2nd	3rd	4th
<i>Number of patent applications</i>	-.00502	-.00169	.00452	.00220
<i>Regional area</i>	-.00003	-.00001	.00003	.00001
<i>Presence/absence of university (dummy)</i>	-.09560	-.03213	.08589	.04185
<i>Population density</i>	-.00026	-.00009	.00023	.00012

Note. All coefficients except 'population density' are statistically significant at the 1% level of significance.

Similarly, the marginal effect of the other continuous variables is negative for the two lowest categories of BI concentration, but positive for the two highest categories.

When the concentration of BIs is low or average/low, the district area decreases the probability of having a concentration of BIs. In Portuguese districts with a high concentration of BIs, the district area increases the probability of having a concentration of BIs.

In the same vein, when the concentration of BIs is low or average/low, the number of patent applications reduces the probability of having a concentration of BIs. In Portuguese districts with a higher concentration of BIs, the number of patent applications raises the probability of having a concentration of BIs. Population density did not show statistical significance to explain concentration of BIs at the Portuguese district level.

4. Concluding remarks

The results indicate there is more likely to be a strong concentration of BIs in Portuguese districts with one or more universities in the vicinity, where the number of patent applications is higher and in the largest areas. Taking into account the value-added contributions of university technology business incubators to tenant firms, the geographical proximity between Portuguese BIs and universities is in line with the findings of Mian (1996). A Portuguese entrepreneurial university may positively influence its regional development (Ferreira, Leitão, & Raposo, 2006), but little is known about the role of the knowledge transfer among all Portuguese universities and BIs. Despite this, the research presented here seeks to raise policy makers' awareness of the relevance of a desirable holistic approach to the distribution of Portuguese BIs, as advocated by Spigel (2016) in Scotland.

The confirmed prominence of a university near BIs implies a holistic reflexion from Portuguese policymakers about the entrepreneurial ecosystem. Therefore, additional global policies are required with the capacity to engage BIs, universities and regional clusters, as opposed to the current "go with the flow" policy that prevails in Portugal in this domain.

Although the empirical knowledge on how the business incubator and the university relate to each other is still very limited (Rothschild & Darr, 2005), Gstraunthaler (2010, p. 400) argued that "business incubators are often seen as part of a resource transfer to enable firms to develop the inventions made in the university environment", this also helps explain the probability of a strong concentration of BIs where the number of patent applications is higher. In this vein, a strong concentration of BIs is more likely to be found in Portuguese districts that have a larger number of specialized BIs. Squicciarini (2008) notes that science park tenants have a higher number of patent applications, which indirectly confirms the link between the concentration of BIs and the number of patent applications (in Portuguese districts with specialized BIs). However, the influence of patents should be viewed with caution because knowledge transfer depends on regional factors related to technological development and entrepreneurial culture (Berbegal-Mirabent et al., 2013).

The district area decreases the probability of having a strong concentration of BIs because the larger Portuguese districts are in rural areas. However, after an inflection point, in the two last

categories (average/high and high number of BIs), the district area increases the probability of having a strong concentration of BIs, as they belong to metropolitan areas; this is similar to the findings of Qian et al. (2011).

Nevertheless, the relevance of population density to explain the location of BIs was not confirmed; this is in contrast to findings for the USA (Qian et al., 2011). This might be explained by the regional idiosyncrasies in Portugal; for instance, some Portuguese districts have a low concentration of BIs and high population density (*Madeira*), while others have average/high concentration of BIs and low population density (*Beja, Portalegre* and *Castelo Branco*).

Due to the lack of official information about BIs and their location in Portugal, this cross-sectional work is limited to 2015. Longitudinal data would consolidate our findings but would exist consistent, harmonized, systematic and comparable data provided by a Portuguese institution. This would allow us to specify a panel data model or even a dynamic panel data model that sheds light on the long and short run effects on BIs concentration.

Acknowledgments

Article financed by Faculty of Economics University of Coimbra (project FEUC/IE) and by FEDER—Fundo Europeu de Desenvolvimento Regional funds through the COMPETE 2020—Operacional Programme for Competitiveness and Internationalisation (POCI), and by Portuguese funds through FCT—Fundação para a Ciência e a Tecnologia in the framework of the project PTDC/IVC PEC/5514/2014. Both authors would like to thank the anonymous reviewers for their valuable comments and suggestions to improve the paper.

References

- Aerts, K., Matthyssens, P., and Vandenbempt, K. (2007) Critical role and screening practices of European business incubators, *Technovation*, 27(5), 254-267.
- Barbero, J. L., Casillas, J. C., Wright, M., and Garcia, A. R. (2014) Do different types of incubators produce different types of innovations?, *Journal of Technology Transfer*, 39(2), 151-168.
- Berbegal-Mirabent, J., Lafuente, E., and Solé, F. (2013) The pursuit of knowledge transfer activities: An efficiency analysis of Spanish universities, *Journal of Business Research*, 66(10), 2051-2059.
- Bergek, A., and Norrman, C. (2008) Incubator best practice: A framework, *Technovation*, 28(1/2), 20-28.
- Bettencourt, L. M. A., Lobo, J., and Strumsky, D. (2007) Invention in the city: Increasing returns to patenting as a scaling function of metropolitan size, *Research Policy*, 36(1), 107-120.
- Bhat, C. R., and Sener, I. N. (2009) A copula-based closed-form binary logit choice model for accommodating spatial correlation across observational units, *Journal of Geographical Systems*, 11(3), 243-272.
- Bøllingtoft, A. (2012) The bottom-up business incubator: Leverage to networking and cooperation practices in a self-generated, entrepreneurial-enabled environment, *Technovation*, 32(5), 304-315.
- Brás, G. R., and Preto, M. (2018) Business incubators, tenant firms and new companies: evidence from Portugal. In L. Carvalho, C. Rego, M. Lucas, M. Sánchez-Hernández, & A. Noronha (Eds): *Entrepreneurship and Structural Change in Dynamic Territories - Contributions from Developed and Developing Countries*. Switzerland: Springer, 275-295.
- Durbin, J. (1954) Errors in Variables, *Revue de l'Institut International de Statistique / Review of the International Statistical Institute*, 22(1/3), 23-32.

- Ejermo, O. (2009) Regional Innovation Measured by Patent Data—Does Quality Matter?, *Industry and Innovation*, 16(2), 141-165.
- Ferreira, J., Leitão, J., and Raposo, M. (2006). The role of Entrepreneurial Universities in interfacing Competitive Advantages: The Case of Beira Interior region (Portugal) *Munich Personal RePEc Archive* (Vol. 486). Munich: University Library of Munich, Germany.
- Gössling, T., and Rutten, R. (2007) Innovation in Regions, *European Planning Studies*, 15(2), 253-270.
- Greene, W. H. (2003) *Econometrics Analysis*, New Jersey: Prentice Hall.
- Grimaldi, R., and Grandi, A. (2005) Business incubators and new venture creation: an assessment of incubating models, *Technovation*, 25(2), 111-121.
- Gstraunthaler, T. (2010) The business of business incubators, *Baltic Journal of Management*, 5(3), 397-421.
- Hamilton, L. C. (2012) *Statistics with STATA: Version 12*, Belmont, CA: Cengage Learning.
- Hausman, J. A. (1978) Specification Tests in Econometrics, *Econometrica*, 46(6), 1251-1271.
- Henderson, V., Kuncoro, A., and Turner, M. (1995) Industrial development in cities, *Journal of Political Economy*, 103(5), 1067-1090.
- Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013) *Applied Logistic Regression*, New Jersey: Wiley.
- Krätke, S. (2012) *The creative capital of cities: Interactive knowledge creation and the urbanization economies of innovation*: New Jersey: Wiley.
- Krugman, P. (1991) Increasing Returns and Economic Geography, *Journal of Political Economy*, 99(3), 483-499.
- Lee, S. S., and Osteryoung, J. S. (2004) A Comparison of Critical Success Factors for Effective Operations of University Business Incubators in the United States and Korea, *Journal of Small Business Management*, 42(4), 418-426.
- Lumpkin, J. R., and Ireland, R. D. (1988) Screening Practices of New Business Incubators: The Evaluation of Critical Success Factors, *American Journal of Small Business*, 12(4), 59-81.
- Mas-Verdú, F., Ribeiro-Soriano, D., and Roig-Tierno, N. (2015) Firm survival: The role of incubators and business characteristics, *Journal of Business Research*, 68(4), 793-796.
- Mason, C., & Brown, R. (2014). *Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship* Paper presented at the Workshop organised by the OECD LEED Programme and the Dutch Ministry of Economic Affairs, The Hague, Netherlands.
- McAdam, M., and McAdam, R. (2008) High tech start-ups in University Science Park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources, *Technovation*, 28(5), 277-290.
- McFadden, D. (1973) Conditional Logit Analysis of Qualitative Choice Behavior. In P. Zarembka (Ed.), *Frontiers in Econometrics*. New York: Wiley.
- Mian, S. A. (1996) Assessing value-added contributions of university technology business incubators to tenant firms, *Research Policy*, 25(3), 325-335.
- O'Neal, T. (2005) Evolving a Successful University-Based Incubator: Lessons Learned From the UCF Technology Incubator, *Engineering Management Journal*, 17(3), 11-25.
- Peña, I. (2004) Business Incubation Centers and New Firm Growth in the Basque Country, *Small Business Economics*, 22(3), 223-236.
- Qian, H., Haynes, K. E., and Riggie, J. D. (2011) Incubation Push or Business Pull? Investigating the Geography of U.S. Business Incubators, *Economic Development Quarterly*, 25(1), 79-90.
- Rothaermel, F. T., and Thursby, M. (2005) University-incubator firm knowledge flows: assessing their impact on incubator firm performance, *Research Policy*, 34(3), 305-320.

- Rothschild, L., and Darr, A. (2005) Technological incubators and the social construction of innovation networks: an Israeli case study, *Technovation*, 25(1), 59-67.
- Rubin, A., and Babbie, E. (2010) *Research Methods for Social Work*, Belmont, CA: Cengage Learning.
- Schwartz, M., and Hornych, C. (2010) Cooperation patterns of incubator firms and the impact of incubator specialization: Empirical evidence from Germany, *Technovation*, 30(9), 485-495.
- Spigel, B. (2016) Developing and governing entrepreneurial ecosystems: the structure of entrepreneurial support programs in Edinburgh, Scotland, *International Journal of Innovation and Regional Development*, 7(2), 141-160. doi: 10.1504/IJIRD.2016.077889
- Spigel, B. (2017) The Relational Organization of Entrepreneurial Ecosystems, *Entrepreneurship: Theory & Practice*, 41(1), 49-72.
- Squicciarini, M. (2008) Science Parks' tenants versus out-of-Park firms: who innovates more? A duration model, *The Journal of Technology Transfer*, 33(1), 45-71.
- Stokan, E., Thompson, L., and Mahu, R. J. (2015) Testing the Differential Effect of Business Incubators on Firm Growth, *Economic Development Quarterly*, 29(4), 317-327.
- Tamásy, C. (2007) Rethinking Technology-Oriented Business Incubators: Developing a Robust Policy Instrument for Entrepreneurship, Innovation, and Regional Development?, *Growth and Change*, 38(3), 460-473.
- Thierstein, A., and Willhelm, B. (2001) Incubator, technology, and innovation centres in Switzerland: features and policy implications, *Entrepreneurship & Regional Development*, 13(4), 315-331.
- Tötterman, H., and Sten, J. (2005) Start-ups: business incubation and social capital, *International Small Business Journal*, 23(5), 487-512.
- Vanderstraeten, J., van Witteloostuijn, A., Matthyssens, P., and Andreassi, T. (2016) Being flexible through customization – The impact of incubator focus and customization strategies on incubatee survival and growth, *Journal of Engineering and Technology Management*, 41, 45-64.
- Varga, A. (1998) *University research and regional innovation: a spatial econometric analysis of academic technology transfers*. New York: Springer Science & Business Media.
- von Thünen, J. H. (1826) *Isolated State*, London: Pergamon Press.
- Wu, D.-M. (1973) Alternative Tests of Independence between Stochastic Regressors and Disturbances, *Econometrica*, 41(4), 733-750.
- Xiao, L., and North, D. (2017) The role of Technological Business Incubators in supporting business innovation in China: a case of regional adaptability?, *Entrepreneurship and Regional Development*, 30(1-2), 29-57.
- Yu, J., Middleton, M., and Jackson, R. (2010). *Toward the Geography of Business Incubator Formation in the United States*. Paper presented at the 56th North American Regional Science Association International (RSAI) Conference San Francisco.
- Yung, E. H. K., Ho, W. K. O., and Chan, E. H. W. (2017) Elderly satisfaction with planning and design of public parks in high density old districts: An ordered logit model, *Landscape and Urban Planning*, 165, 39-53.
- Zhou, S., and Yu, X. (2017) Regional Heterogeneity of Life Satisfaction in Urban China: Evidence from Hierarchical Ordered Logit Analysis, *Social Indicators Research*, 132(1), 25-45.