REGIONAL DETERMINANTS OF FOREIGN DIRECT INVESTMENTS IN ROMANIA. A SPATIAL ERROR MODEL

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Abstract

Considering the well documented significance of investments for the regional economic development, this paper explores the underlying factors that drive FDIs' behaviour in Romania, at county level, in the year 2014. The empirical analysis employed a variety of statistical methods, focusing on the detection of the potential spatial dependence among counties and subsequent use of spatial econometric models able to account for such autocorrelation. The analysis revealed that well developed counties, having large innovative potential, stronger entrepreneurial spirit, better human capital and a higher degree of specialization are the most attractive locations for new foreign direct investments.

Keywords: *FDI determinants, spatial model, county, Romania.*

JEL Classification: R19, J21, J64

1. Introduction

Economic theory and empirical research credit foreign direct investments (FDIs) as an essential driver of technological progress, creator of new jobs, source of larger trade flows, and provider of new business opportunities, all translating into increased economic growth. Under these circumstances, it is obvious that all countries and regions make efforts to stimulate the investment inflows. In Romania, despite some temporary downward fluctuations in the context of the recent economic crisis, the overall volume of foreign direct investment stock grew constantly over the past two decades. However, only few regions and even fewer local firms benefited substantially from such FDIs flows. From a territorial perspective, the Romanian FDIs picture is very unbalanced, with Bucharest-Ilfov Region getting above half of these investment stocks.

There is already a wealth of empirical literature on regional determinants and effects of FDIs in Romania (e.g., Danciu et al, 2010, 2011, 2012a and 2012b; Constantin et al, 2012; Nistor, 2012; Popescu, 2012; Goschin et al., 2013; Popa and Gavril, 2014; Dornean and Oanea, 2015; Radulescu et al, 2016, etc.) using various statistical indicators and methods such as multidimensional regional rankings, OLS regressions models, panel data models, etc.

Since empirical investigations on this topic require statistical methods adapted to the regional scale of the analysis, I seek to substantiate the regional picture of FDIs in Romania by using more appropriate spatial analysis tools. Consequently, this paper brings two elements of novelty. Firstly, it captures the post-crisis economic context, which could reveal new factors of influence on the FDIs, given that not all counties have entirely recovered from the economic downfall. Secondly, the empirical analysis is undertaken by means of specific spatial analysis techniques, such as spatial autocorrelation measures and spatial econometric models, never used in previous research on regional investments in Romania.

The rationale for this research is the need to explore the current situation of territorial variation of FDIs in Romania, marked by incomplete recovery of economic activity after crisis, in order to provide new data for policy-makers. By reaching a spatial insight into this actual topic, I fill a gap in the existing literature on regional dimension of FDIs in Romania.

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2. Literature review

Extensive empirical research on FDIs found a large range of determinants, from macroeconomic factors (exchange rates, taxes and tariffs, market size, country risk, trade flows, etc.), knowledge-capital factors (human capital, R&D expenditure and performance, patents), public goods (such as infrastructure, institutions well-functioning and corruption), to location factors such as geographic distance or cultural differences (Blonigen, 2005; Reschenhofer et al, 2012). Research focused on transition economies in CEECs indicated low wages and skilled workforce as main attraction factors, while also pointing to economic reforms, macroeconomic stability, R&D, privatization and trade liberalization as likely determinants (Lansbury et al., 1996; Riker and Brainard, 1997; Garibaldi et al., 2001).

Benacek et al (2000) suggested that market size and growth potential are the primary determinants, while labour costs in a certain country relative to other transition economies are significant when choosing the precise location within the CEEC region. Many studies point to regional market size as a significant factor for the FDI decision because it reflects the local demand (Taylor, 2000; Benacek et al, 2000; Chakrabarti, 2003; Reschenhofer et al, 2012). Most empirical studies are currently using GDP per capita as proxy for market size, a common alternative being population (Bagchi-sen and Wheeler, 1989). The regional enterprise and population density, as proxies of agglomeration economies (He, 2002) represent another potential attraction factor to both domestic and foreign investments (Driffield and Munday, 2000) given the positive externalities and production facilities associated with spatial concentration of economic activities. As expected, profitability is dependent on the existence of a good infrastructure, another significant factor to be considered in the investment decision (Blonigen, 2005; Bagchi-sen and Wheeler, 1989). R&D potential and performance weight heavily in the locational decision of knowledge-seeking foreign investor (Lansbury et al, 1996; Jensen, 2004). R&D indicators are also relevant for the human capital in a region, another important factor of influence for FDI flows.

As regional inequalities became increasingly visible in Romania, studies on the causes, effects and magnitude of the economic disparities begun to emerge, followed relatively recently by empirical research identifying the highly regionally uneven FDIs as one of the main determinants. FDIs territorial distribution in Romania faces the problem of severe imbalance. For instance, Danciu et al (2011) ranked the Romanian regions according to their FDI stocks, showing the domination of the Bucharest-Ilfov region, placed on the first position, followed at a long distance by the West and North East regions. The authors stressed that the highly unbalanced regional development, the economic decline of most small and medium size towns, as well as the severe negative impact of economic restructuring upon mono-industrial areas lead to even bigger disparities inside the regions. Moreover, FDI seems to deepen the regional development gaps in Romania (Nistor, 2012; Goschin et al., 2013).

Empirical evidence in Romania suggests that investment incentives such as low labor costs, large human capital, good education and high skills, as well as low income corporate tax may have a powerful influence in attracting FDI inflows (Danciu et al, 2010, 2011, 2012a and 2012b; Constantin et al, 2012; Nistor, 2012; Goschin et al., 2013). Some studies also highlighted factors that hinder investments, such as the low quality of the infrastructure (Radulescu et al, 2016).

Using a panel data analysis at regional level, over a period of constant economic growth (2001-2008), Goschin et al. (2013) showed that the regions that reached a critical investments mass are able to further attract more investments, benefiting from agglomeration economies. In addition, higher market size (measured by GDP/capita), agglomeration (population density) and the technological level of production (proxied by employment in knowledge-intensive services and R&D expenditure of business enterprise sector) are significant factors of attraction for bigger new regional investments in Romania.

Dornean and Oanea (2015) found that human capital and economic stability has had the highest impact on regional FDIs over the period 2006-2012, while Danciu et al. (2010) indicated that the unfolding of privatization process, the economic growth cycle, labor cost, education and infrastructure are the main determinants of regional FDI distribution. Moreover, the minimum level of FDI is recorded in regions where agriculture is predominant.

Several studies pointed to economic growth as a factor bearing strong positive influence on the FDIs level in Romania (Pauna and Dumitrescu 2005; Pelinescu and Rădulescu 2009; Dornean et al., 2012). In the same register, scholars analyzed the downward impact of the recent economic crisis on FDIs inflows in Romania (e.g., Popescu, 2012; Popa and Gavril, 2014).

In sum, past studies on regional FDI patterns in Romania confronted questions of investment incentives, territorial distribution, economic growth effects and decline during the recent economic and financial crisis. This paper aims at bringing new insights on these issues in the post-crisis economic framework.

3.Methodology, variables and data

This paper undertakes a county-level research on FDI stocks in Romania, using specific methods of spatial analysis, in addition to descriptive statistics and classic regression models.

Firstly, a classic regression model is employed for estimating the influence of various likely determinants of regional FDI in Romania (see Table 1 for the list of variables), as follows:

$$FDI_i = a + \sum_k b_k X_{ki} + \varepsilon_i \quad (1)$$

where X_k are the regressors and ε is the error term.

Considering that neighbor regions often tend to share common characteristics, I will test for spatial dependence in FDIs location by employing Moran's *I* indicator (Anselin and Rey, 1991):

$$MI = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{(\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij})\sum_{i=1}^{n}(x_i - \bar{x})^2}, \quad (2)$$

where x_i and x_j represent the FDIs stock per capita in the regions i and j respectivelly, $\bar{x}$ is the average FDIs stock per capita, and w_{ij} represent spatial weights capturing the "spatial influence" between county j and county i. The spatial matrix used in this paper is a first-order queen contiguity matrix, i.e. $w_{ij} = 1$ if regions *i* and *j* are neighbours and $w_{ij} = 0$ otherwise. Moran's *I* ranges from −1 (perfect dissimilarity among neighbours) to +1 (perfect similarity), while the null value corresponds to random spatial distribution of values. The permutation test will be further applied to validate the statistic significance of the Moran's *I* (Anselin and Rey, 1991).

If spatial dependence is confirmed, it should be corrected using the appropriate spatial model (Anselin, 2005; LeSage and Pace, 2009). To this aim two main types of spatial models are going to be tested: The spatial autoregressive model is including the

spatial lag of the dependent variable ($\rho \sum_j w_{ij} FDI_j$) in the previous classic model specification:

$$FDI_i = a + \sum_k b_k X_{ki} + \rho \sum_j w_{ij} FDI_j + \varepsilon_i \quad (3)$$

while the spatial error model accounts for spatial dependence in the error term, as follows:

$$FDI_i = a + \sum_k b_k X_{ki} + (\lambda \sum_j w_{ij} \varepsilon_j + v_i). \quad (4)$$

I will finally choose the appropriate model for our data according to the value of Lagrange multiplier test.

The selection of the variables is based on theoretical considerations and empirical studies, balancing data requirements with data availability. Since regional official statistics are scarce, the list of regressors is limited to GDP, R&D, Entrepreneurship, Human capital, specialization, urbanization and industrialization rates (see Table 1 for description of the variables). Unfortunately, the last two variables, namely urbanization rate (the share of urban population) and the industrialization rate (employment in industry relative to total employment) didn't provide valid estimations and consequently have been rejected from the final specification of the model. The county FDIs stock, rather than FDIs inflows, has been preferred as dependent variable of the model, based on empirical studies showing that it has a more stable relationship with the investment determinants (Reschenhofer et al, 2012).

Table 1. The variables in the FDIs determinants models

Variable name	Description	Data source
FDIs	The foreign direct investments stock per capita (Euro)	The National Trade Register Office and own computations
GDP	Gross Domestic Product per inhabitant (Euro)	Eurostat database
R&D	Number of R&D employees (full time equivalent) per 1000 inhabitants	Eurostat database and own computations
Entrepreneurship	Number of private entrepreneurs per 1000 inhabitants	National Institute of Statistics and own computations
Human capital	Number of tertiary education graduates per 1000 inhabitants	National Institute of Statistics and own computations
Specialization	Herfindahl index of specialization[1] based on NACE activities, for each county	National Institute of Statistics and own computations

[1] Herfindahl index is an absolute measure of specialisation, computed as $H_i^S = \sum_{j=1}^{m} (\frac{X_{ij}}{\sum_{j=1}^{m} X_{ij}})^2$, where X_{ij} is the employment in NACE activity j in county i. The

GDP per capita was included in the model as the appropriate proxy for regional market size and level of development. Well developed counties tend to attract more investments, both domestic and foreign, and I expect a positive influence of this variable. Moreover, the evolution of FDI is believed to be closely interconnected with GDP dynamics.

A potentially major factor in the FDI decision is the knowledge economy, captured by variables such as research and development employees and expenditures. Such factors can be particularly important for the firms activating in high and medium high-tech sectors. I use the variable "R&D employee per 1000 inhabitants" to reflect the innovative potential of a region and its human capital. It is expected to have a plus sign in the model.

The entrepreneurial spirit, captured by the number of private entrepreneurs per 1000 inhabitants, should have a positive impact on the FDI flows into a county.

The human capital is an important catalyst of economic performance and new investments need skilled workforce to function efficiently, therefore the variable "Number of tertiary education graduates per 1000 inhabitants" is introduced in the model as a proxy for human capital.

Finally, the Herfindahl index is used to capture the degree of economic specialization of a county. Since a more specialized county provides the appropriate workforce and capital, the business infrastructure and the production experience for certain industries, it is a more attractive destination for new investments in similar activities.

The analysis of FDIs determinants in this paper relies on newest data accessible, i.e. data for the year 2014, except for GDP for which only 2013 official statistics at regional level are currently available. Data for the analysis come from the Romanian Institute of National Statistics (TEMPO database), Eurostat database and National Trade Register Office, and own computations of per capita values of the variables (for better comparability among counties).

4. Results and discussion

The empirical analysis of the regional determinants of FDIs was preceded by a diagnostic for spatial dependence (Moran index) that indicates if a spatial model is appropriate for our data or not. The results in Table 2 clearly show that all variables, except for Human capital, exhibit significant spatial dependence, i.e. similarity among neighbours, therefore classic regression models are inappropriate and should be replaced by spatial models that allow for spatial autocorrelation to be explicitly included in their specifications.

Table 2. Diagnostics for spatial dependence of FDIs and its potential determinants (Moran index)

Variable	Moran's I			
	Index (pseudo p-value)	Mean	S.D.	Z-Value
FDIs	0.5171 (0.0010)	-0.0222	0.0775	6.9586
GDP	0.2216 (0.0070)	-0.0236	0.0852	2.8768
R&D	0.2999 (0.0070)	-0.0246	0.0897	3.6197
Entrepreneurship	0.3494 (0.0020)	-0.0244	0.0907	4.1028
Human capital	0.0813 (0.2690)	-0.0193	0.0945	-0.6554
Specialisation	0.1389 (0.0460)	-0.0295	0.0962	1.7498

Source: author's computations in Open Geoda

Herfindahl index is increasing with the degree of specialization, reaching its upper limit of 1 if the county i is specialized in only one activity.

In the same register, the map in Figure 2 illustrate the values of FDIs by county, in 2014, confirming that low / high values of this indicator tend to cluster. This territorial pattern is specific for positive spatial dependence (neighborhood similarity). The map also reveal strong inequalities between the Bucharest-Ilfov Region, which concentrates the highest FDIs stocks, and the rest of the county. Such disparities exist for other economic indicators as well: R&D, human capita, earnings, etc., reflecting an old economic and social development divide. Empirical research revealed that FDI inflows tend to be considerably higher in the capital city regions of other countries in Central and Eastern Europe as well, driven by the lower factor prices and skilled labour force that compensated for transportation costs and loss of accessibility (Constantin et al, 2012).

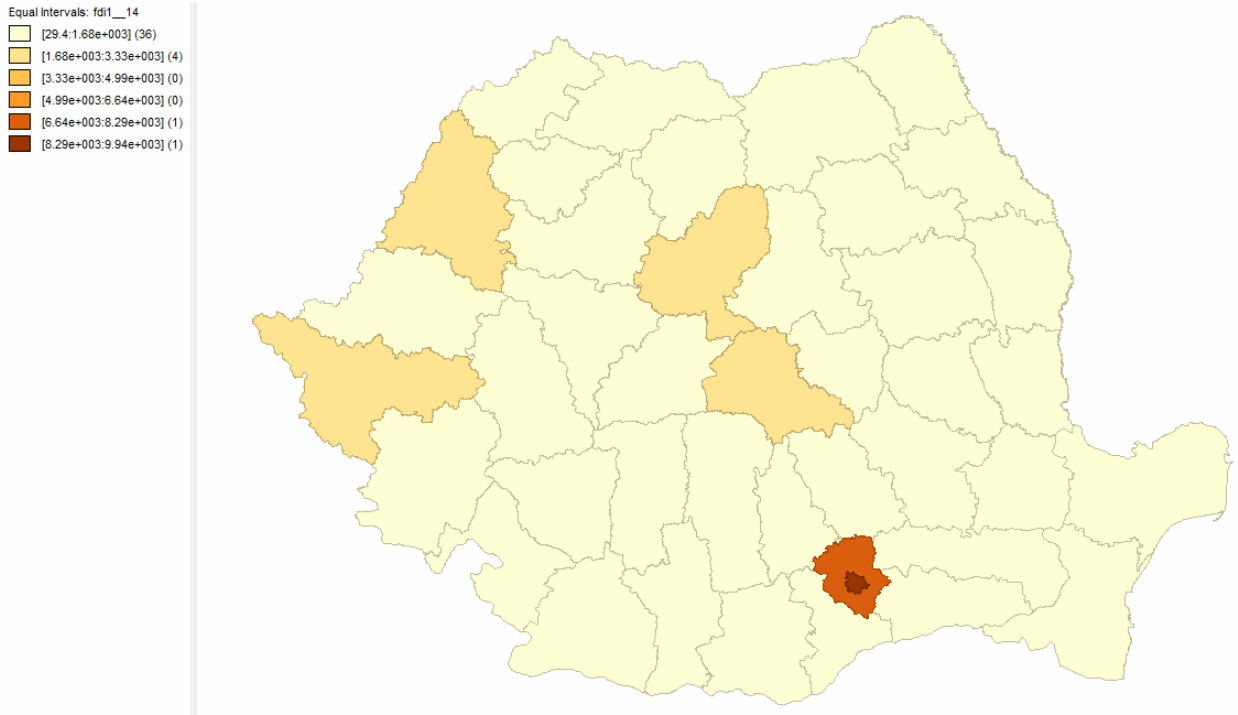

Figure 2. FDIs per capita by county, 2014
Source: own processing in Open Geoda

Most counties (36) belong to the lowest FDIs group (up to 1680 Euro per inhabitant FDIs stock), while a few (Timis, Bihor, Brasov, Mures) own between 1681 and 3330 Euro per inhabitant, compared to 9940 in Bucharest Municipality. These development gaps are the result of systematic deindustrialization in Romania and consequent decline of many small towns depending on a single industry (often relying on a single big company), lost of human capital following internal migration of the population (from rural to urban, from small to big towns) and, especially, external migration. Since investments continue to be attracted particularly to most favorable locations for business, supporting their future rapid development and thus increasing the gaps with less privileged areas, the foreseeable long-run effect is a steady increase in regional development gaps.

The cartogram of FDIs stock per capita in Appendix reinforces the idea of high spatial disparities by displaying the counties as circles sized proportional to their investments. This picture makes more clearly visible and puts into national perspective the high proportion of FDIs in the Bucharest-Ilfov Region.

The results from the regression models on the determinants of FDI stock per capita are largely in accordance with the mainstream empirical literature and our expectations. GDP per capita, proxy for the county's development, has a positive sign in all models and

is highly significant in the classic and spatial error model, supporting the hypothesis that developed counties do attract more investments, taking advantage from their better human and tangible capital. The innovative potential of the county (R&D employee per 1000 inhabitants) also bears a plus sign and is highly significant in all models. This finding confirms previous research indicating that R&D potential and performance weight heavily in the locational decision of knowledge-seeking foreign investor (e.g. Lansbury et al, 1996; Jensen, 2004).

The entrepreneurial spirit, captured by the number of private entrepreneurs per 1000 inhabitants, is positive and statistically significant (except for a lower significance level in the classic model) suggesting that it might be an additional attraction factor for the FDI flows into a county. The human capital has the expected positive sign in all models, but is statistically significant only in the spatial error model, which is the best specification. The new foreign direct investments seem to be drawn more strongly to counties having better educated workforce

Finally, the degree of economic specialization of a county (the Herfindahl index) is significant both in the classic and spatial error model, suggesting that previous production experience makes a county more attractive destination for new investments in similar activities. This finding is supporting previous studies such as Popescu (2012) that found FDIs driven towards Romanian regions having specialized and renowned industries and products.

Table 3. The results from the regression models (dependent variable – FDI stock per capita)

Variables	**Classic model***		**Spatial lag model****		**Spatial error model****	
	Coeff.	**Prob.**	**Coeff.**	**Prob.**	**Coeff.**	**Prob.**
W_FDIs			0.50272	0.0000		
Constant	954.916	0.3263	-422.927	0.5947	1173.834	0.1014
GDP	5.1670	0.0005	1.5139	0.2273	4.8496	0.0007
R&D	268.415	0.0168	261.7633	0.0018	392.992	0.0000
Entrepreneurship	0.0629	0.0870	0.71366	0.0110	0.05783	0.0190
Human capital	153.410	0.1202	100.877	0.1863	221.222	0.0027
Specialisation	1768.498	0.0425	503.508	0.4743	1566.882	0.0297
LAMBDA					-0.74781	0.0010
Statistics	**Value**	**Prob**	**Value**	**Prob**	**Value**	**Prob**
R-squared	0.8407		0.8702		0.8861	
Log likelihood			-333.9031		-330.166	
F-statistic	38.0135	0.0000				
Spatial dependence: Likelihood Ratio Test			3.9882	0.0458	11.4623	0.0007

**OLS estimation*

*** Maximum likelihood estimation*

In accordance with the significant spatial dependence revealed by Moran's I, spatial regression proved to be a better fit for the data, compared to classic regression. Based on the spatial dependence diagnosis (Likelihood Ratio Test) the spatial error model is the best specification for this empirical research on county determinants of FDIs. The spatial error model is statistically valid and the independent variables explain a high part (88.61%) of the spatial variation in the dependent variable.

5. Conclusions

The territorial determinants of FDIs in Romania have been explored in this paper, in the post-crisis economic context, by means of appropriate spatial analysis techniques. In accordance with the literature, the regression models showed that well developed counties, having large innovative potential, stronger entrepreneurial spirit, better human capital and a higher degree of specialization are the most attractive locations for new foreign direct investments. Spatial autocorrelation tests showed a significant spatial dependence in FDIs and its main determinants and the spatial error model proved to be a better fit for the data, compared to the classic OLS regression model.

Since investments are systematically drawn to business favorable locations, supporting their more rapid development and thus increasing the gaps with less privileged areas, a foreseeable long-run effect of this phenomenon is the steady increase in regional development gaps. This negative process should be countered by regional development strategies specially designed to support local initiative, entrepreneurship, and capitalization of local resources in order to boost the economy using domestic capital, instead of the foreign one. Such a development strategy should foster local growth and consequently increase the investment attractiveness, which in turn might bring more FDI inflows in the future.

As the ongoing developments in the economic environment are constantly bringing new challenges, further research will be needed to assess the stability of the FDIs determinants after the complete recovery of all county economies from the recent economic crisis.

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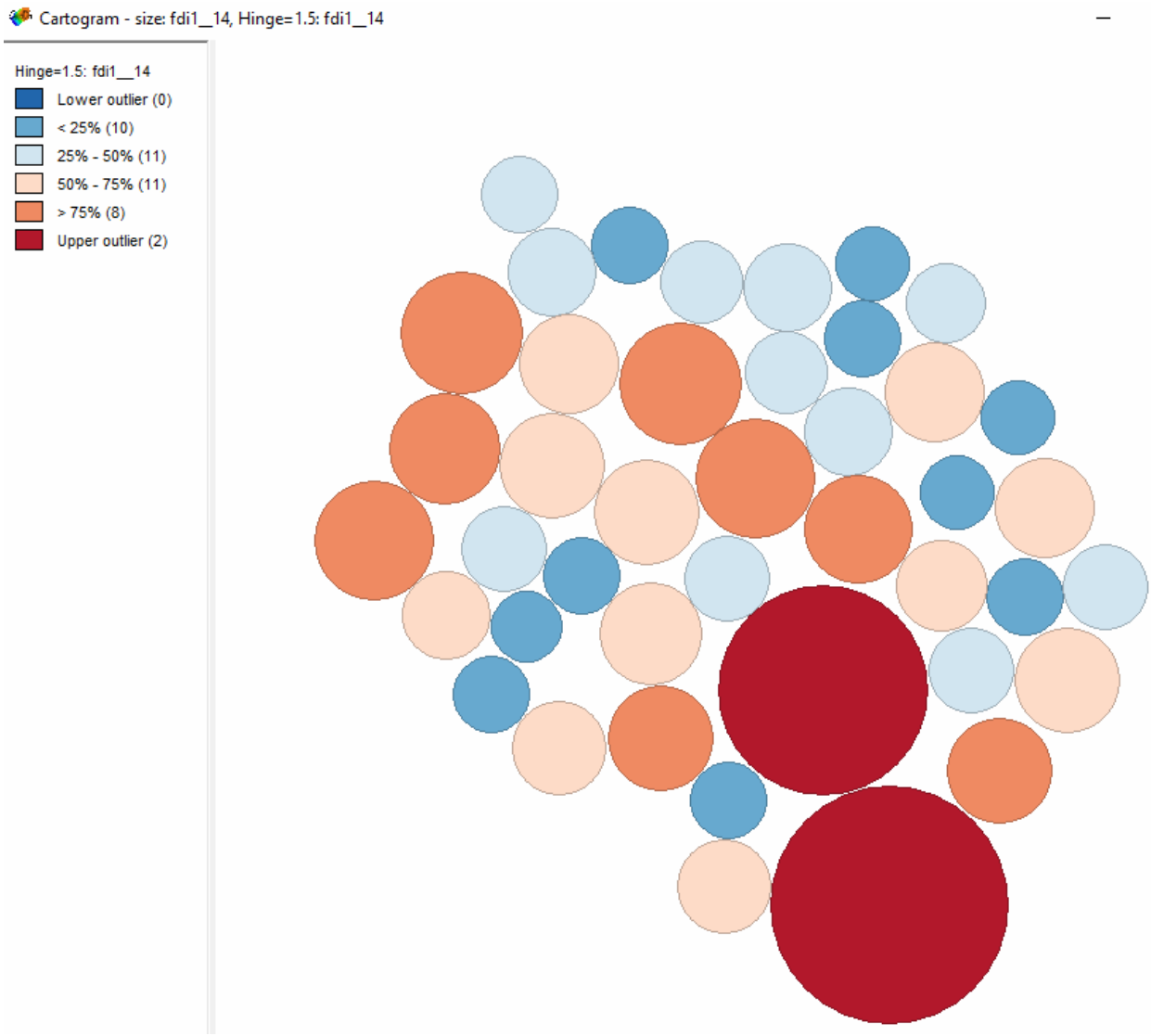
Appendix. Cartogram of FDIs stock per capita, 2014



Source: own processing in Open Geoda