Artículo de investigación

Spatial patterns of profitable firms' location: empirical evidence from Russia

Пространственные схемы размещения рентабельных фирм: эмпирические данные из России

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Abstract

Our study examines the variance of the profitable firms in 330 municipalities within 7 constituent entities of the Russian Federation, based on range of data from 2010 to 2017. The methods of spatial and hierarchical linear analysis were involved to identify horizontal and hierarchical ties. Our findings highlighted existence spatial autocorrelation of municipalities concerning firms' profitability with high-high and low-low areas stable throughout the determined period. The interregional variance was evaluated, applied hierarchical linear modeling showed that region determined to 25.2% of the variance of the share profitable enterprises in municipalities. Our findings provide essential empirical evidence required policy initiatives at regional level for creation sustainable effective enterprises in the emerging economies.

Keywords: Spatial effects, hierarchical linear analysis, regional administration, share of profitable enterprises.

Аннотация

Целью данной работы является изучение дисперсии доли прибыльных организаций в 330 муниципалитетах в 7 субъектах Российской Федерации с использованием набора данных за 2010 по 2017 года. Для достижения этой цели использовались методы пространственного и иерархического линейного анализа. Результаты выявили существование зон положительной и отрицательной пространственной автокорреляции муниципальных районов и городских округов по доле прибыльных организаций, стабильных в течение рассматриваемого периода. Оценка межрегиональной дисперсии методами иерархического моделирования, показала, что в регионе до 25,2% вариации муниципальных образований по доле прибыльных предприятий определяется регионами. Наши результаты дают существенные эмпирические доказательства необходимости политических инициатив на региональном уровне для устойчивого эффективного развития предприятий в странах с развивающейся экономикой.

Ключевые слова: пространственные эффекты, иерархический анализ, региональное управление, доля прибыльных предприятий.

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Introduction

The fall of Soviet Union led to dramatic changes in spatial structure of Russian Federation caused by break-up of economic ties between regions. It explains the degrading quality of economic space accompanied by strengthening spatial heterogeneity and a decrease in living standards. The issues of sustainable spatial development in transitional economies are widely discussed in academic and political circles (Peilei et al., 2015; Li et al., 2019; Wieczorek, 2018). To compensate negative consequences of administrative economy modern scientists propose a lot of various tools adapted to regional characteristics and stakeholders' needs. However, most of them are based on firms' interaction within the given territory. The firm an initial local unit of management is considered as an engine of territorial development and competiveness.

The research hypothesis is that there are many factors, including location determinants affecting the end enterprise outcomes. Thus, within exploratory analysis we should research both the horizontal and hierarchical ties, which can be estimated by spatial and hierarchy modeling. Hierarchy modeling makes enable the assessments of differences between territories at municipal and cross-region scales. In the research we examine the share of profitable enterprises in 330 municipalities of 7 constituent entities to determine whether there is any link between municipalities attributing to firms' profitability and how region effects explain variance in firms' profitability.

The results may be useful for politicians to account for the spatial hierarchy effect on functioning of firms and therefore to delegate authority of each level within the regional development programs.

Theoretical framework

The issues of spatial effects referring to cross-country and cross-region differences in firms' profitability have been widely studied since the end of last century. The accelerated development of spatial analysis methods yielded expanding theoretical background and contributing empirical evidence related to spatial dependence of firms (Moran, 1948; Geary, 1954; Anselin, 1990).

For example, Plummer L. investigates spatial dependence referring to entrepreneurship research using global and local Moran's indexes. His findings prove that return on assets exhibits positive spatial correlation (Plumer, 2009). Ragoubi H. and El Harbi S. use a spatial panel data analysis to provide an empirical support concerning effects of income inequalities on the entrepreneurial activity (Ragoubi & El Harbi, 2017). The results show the existence of an inverted U-shaped relationship between entrepreneurship and income inequality. Zhang L. examines spatial characteristics of operating performance in Chinese photovoltaic industry (Zhang et al., 2016). The application of spatial analysis tools made possible to identify regions with high и low comprehensive technical efficiency.

O'Donoghue C. explores spatial patterns of market income within agricultural firms. His research reveals patterns of areas requiring rural development initiatives (O'Donoghue, 2017).

Sparking interest in spatial dimension concerning to profitability variance has been emerged recently due to development spatial analysis tools. The earlier studies considered internal factors affecting profit (Banerji, 1978; Goddard et al., 2005) and reasons determined profitability variations across regions and countries (Li et al., 2017; Carney et al., 2018; Danilova et al., 2016; Ivanov, 2015; Klimova, 2018; Davidson, Mariev, 2015). For instance, Carney M. examined firms in more than 130 countries and proved influence of distinctive trajectories on firms' performance (Carney et al., 2018).

Li X., Sun L. argued that restrictions at sub-national scale made negative effects on profitability foreign firms (Li, Sun, 2017).

Ivanov P. considers financial security of municipal unit through the definition «financial potential of the territory» (Ivanov, 2015). Klimova N. uses share of profitable enterprises as the threshold value for stages of the territory life cycle (Klimova, 2018).

Worthy note the early studies were focused directly on factors driven the variance profitability. By now the emphasis has been turned to role of territorial hierarchy, which takes into account nested character of data. The development of hierarchical linear modeling (HLM) Goldstein H., Garson D. made possible multilevel investigation of cross-country variance in firm profitability by decomposing the variance inter and

intraregional components (Goldstein, 2010; Garson, 2013). The first researches devoted to hierarchical linear modeling traced back to Chan C.M. (Chan et al., 2010) and Molina-Azorin J.F. (Molina-Azorin et al., 2010). They studied effects referred to regional level. Later Ma X. (Ma et al., 2012) и Stavropoulos S., Skuras D. (Stavropoulos, Skuras, 2015) identified these effects too. Stavropoulos S., Skuras D. added region and country as hierarchical territorial units into consideration using data of 37 European countries.

Furthermore, studies on inter-countries disparities without using regional hierarchy are also of interest. Salah W. conducts exploratory analysis of scale-dependent factors on firm's performance (Salah, 2018). His evidences proved significant influence of firm level on financial performance. Kristiansen G. tested hypothesis whether firm effects more pronounced in determining firm profitability than industry effects, covering data sample of eleven development economies. Major findings show that firm effects constitute 88,93% of firm profitability, industry effects make up 9,48% and country effects 1,60% (Kristiansen, 2018).

To provide deep understanding factors determined regional variance scientists modify variables.

Thus, Zouaghi F., Hirsch S. examined multilevel regional effects across agricultural Spanish sector and proved firms' specific effects on the profitability variance (Zouaghi et.al., 2017).

The recent empirical studies demonstrated different influence on firms' profitability attributed to regional and country level (Goldszmidt et al., 2011; Ketelhöhn et al., 2012; Hirsch et al., 2014; Bamiatzi et al., 2015; Salah, 2018; Kristiansen, 2018).

For example, Chan C.M. proved 17,7% variance of profitability related to region for the return on sales in China (Chan et al., 2010). Stavropoulos S., Skuras D. argued that regional characteristics did not determine a essential portion of the total variance in firm profitability and labour efficiency (Stavropoulos, Skuras, 2015).
Salah W. considers these significant differences to be possible because of restrictions of analysis methods (Salah, 2018). Stavropoulos S. assume that high values variance attributed to regional effects may be result of data sparseness (Stavropoulos et al., 2015).

It should be noticed that there are few articles devoted to this scope of study in Russian regional studies.

For instance, Yusupov K. considered the portion of variance volume of social payments and taxable money incomes related to regional level (Yusupov et al., 2018).

We add to existing literature by supporting a research relating to the effects of region-specific identities on firm's profitability in Russian Federation.

Methodology

Study area

This study attempts to analyze the spatial structure and variance in firms' profitability, taking horizontal and vertical links into account, and more precisely to evaluate (i) location correlation and find out regional specificities in detected clusters; (ii) existing regional differences in variance of firms' profitability; (iii) role of the regional level in variance profitability using HLM. Our study differs because putting emphasis both on spatial and hierarchical effects.

This study analyses the share of profitable organizations in the total number of organizations in percentage in 330 municipalities within 7 constituent entities of the Russian Federation using the data set from 2010 to 2017. The case study areas are on the conditional border between the European and Asian parts of the country and contain 14,9% per cent of the country's total population. The main source of data set is official website Rosstat. Among these constituent entities the Republic of Tatarstan and Sverdlovsk region are in the top twenty of most economically developed regions in the country. The analysis does not include municipalities with lacking data.

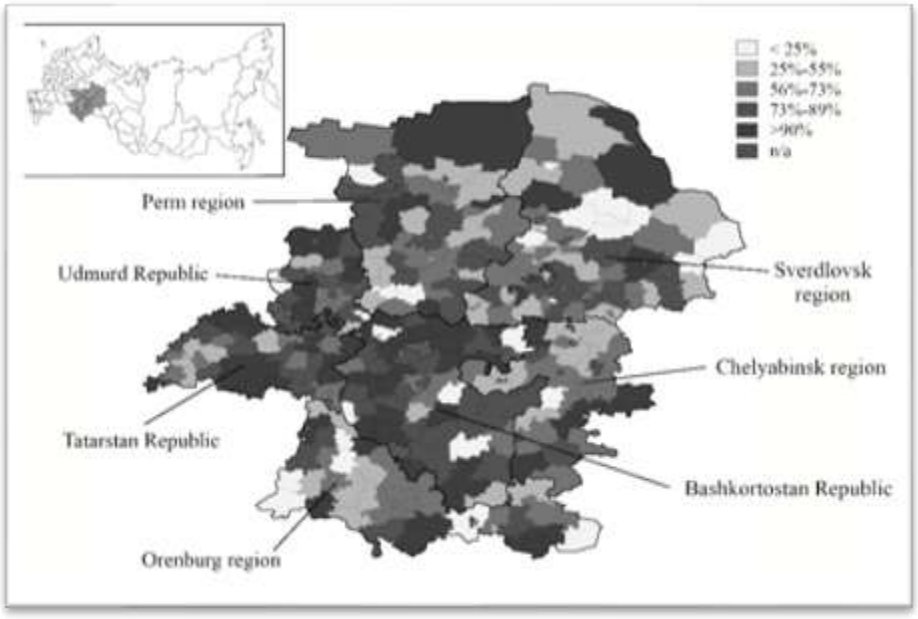

Figure 1. The share of profitable firms within municipalities in 2017
Source: Rosstat statistics (own elaboration)

There was a significant share of profitable firms in 2017; only 7.5% of the total number of municipalities are characterized by the portion of profitable enterprises less than 25%. To the west the share of profitable enterprise is higher. These territories are also characterized by the higher density population. In 2010-2017 the lower values are observed in the most southern region (Orenburg region) located on the border of Kazakhstan and the northeastern regions (Sverdlovsk and Chelyabinsk regions) separated from the rest by the Ural Mountains. Analysis of average values in the context of 7 regions indicated the presence of interregional differences.

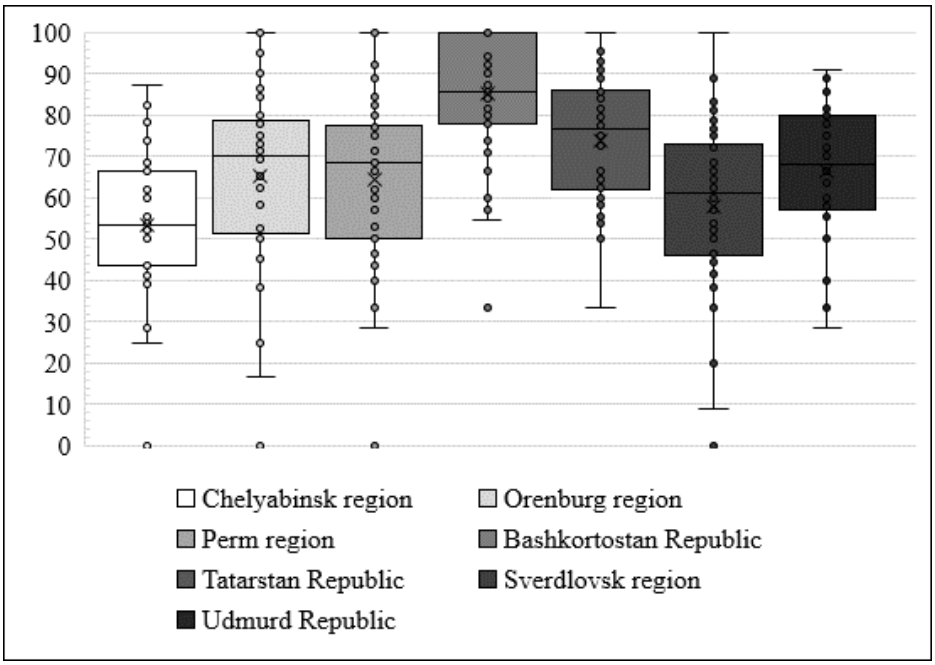

Figure 2. Boxplots of the municipalities according the share of profitable enterprises in 2010
Source: Rosstat statistics (own elaboration)

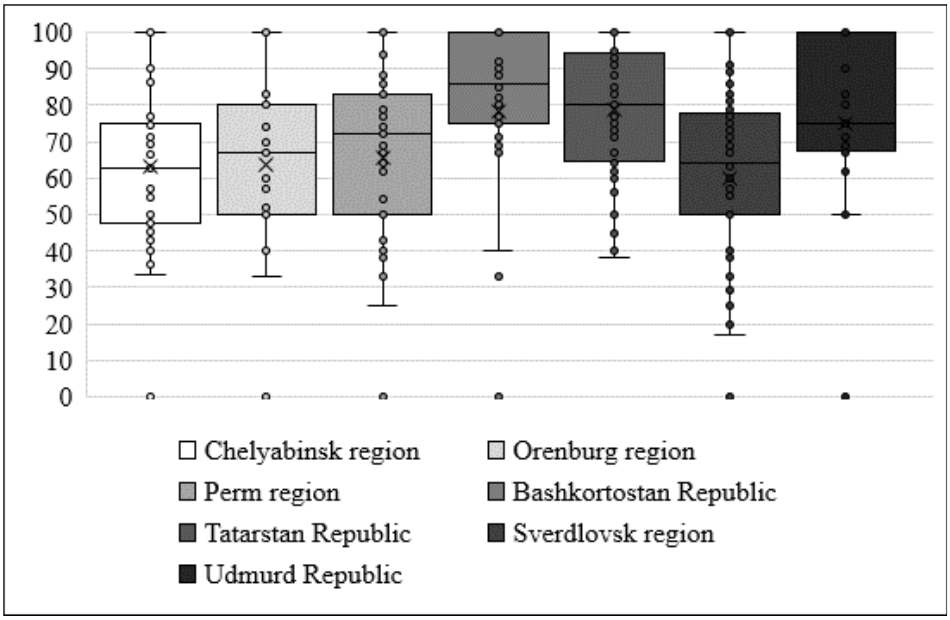

Figure 3. Boxplots of the municipalities according the share of profitable enterprises in 2017.
Source: Rosstat statistics (own elaboration)

Under examined period we observed average values below median in 2010 and 2017 that shows a predominance municipalities with low share of loss-making enterprises. Chelyabinsk, Orenburg and Sverdlovsk regions didn't have significant changes in economic context, Udmurt Republic showed much improved situation in 2017.

Spatial analysis municipalities according the share of profitable enterprises

Spatial analysis allows testing hypothesis about correlation between neighboring municipalities. This technique is actively used in studies devoted to regional disparities in the activities of enterprises (Ragoubi and Harbi, 2017; Davidson and Mariev, 2015; Plummer, 2009). The assessment of the spatial aspect in territorial development was based on the theory of spatial econometrics (Moran, 1948; Geary, 1954; Anselin, 1990). Moran's global autocorrelation index gives an idea how the clusters of share profitable enterprises are spatially organized (eq.1).

$$Im = \frac{N}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij} \left(dp_i - \overline{dp}\right)\left(dp_j - \overline{dp}\right)}{\sum_i \left(dp_i - \overline{dp}\right)^2}, \quad (1)$$

Where N – quantity of municipalities;

$\overline{dp_ı}$ – average portion of profitable organizations in the total number of ones, percent;
w_{ij} – elements of the distance-based spatial weights matrix between the i-th and j-th municipalities

The value of the Moran index is compared with the expected value E (Im) = - 1 / (n-1).

If Im > E (Im) we observe positive spatial autocorrelation due to similarity values of shares profitable firms in the neighboring municipalities. When Im <E (Im) it indicates on existence negative spatial autocorrelation; the examined values significantly vary from location to location At last Im= E (Im), it shows spatially randomised values of share profitable firms.

The contiguity matrix of municipalities was used in the calculations (eq.2):

$$w = \begin{cases} 1, \text{if municipalities i and p have common border;} \\ 0, \text{if i} = \text{j;} \\ 0, \text{if municipalities i and p do not have common border} \end{cases} \quad (2)$$

Next, we determined local Index Spatial Autocorrelation (LISA) to identify local clusters and local spatial outliers (eq 3);

$$L_{Imi} = N\frac{(dp_i - \overline{dp})\sum_i \sum_j w_{ij}(dp_i - \overline{dp})}{\sum_i (dp_i - \overline{dp})^2}, \quad (3)$$

If $L_{Imi} < 0$, there is a negative autocorrelation for the municipality, this territory differs significantly from the neighboring territories (outlier) by this value. If $L_{Imi} > 0$, the autocorrelation is positive, the given territory is similar in value to the neighboring territories (cluster).

Cores of a clusters and local spatial outliers based on the values of the Moran Local Index and their significance were identified among the municipalities. The territories fall into next four groups according the type of spatial autocorrelation.

1. High-high – the municipalities having relatively high values of the analyzed indicator are surrounded by the neighboring locations with similar values. Autocorrelation is positive.
2. Low-Low – the municipalities having relatively low values of the analyzed indicator are surrounded by the neighboring locations with similar values. Autocorrelation is positive.
3. High – Low territories having relatively high values of the analyzed indicator are surrounded by neighboring locations with dissimilar values. Autocorrelation is negative.
4. Low – High territories having relatively low values of the analyzed indicator are surrounded by neighboring locations with dissimilar values. Autocorrelation is negative.

This technique allows us to reveal areas with particularly high levels of spatial dependence (i.e., hot spots) drawing attention to their location and identifying regional identities.

Hierarchical linear modeling (HLM)

Hierarchical linear modelings (HLM) are applied to assess the regions' (upper level) impact on municipalities' development (lower level). Said method initially was adopted in the social sciences Goldstein H. (2010), Garson D. (2009).

By now they are widespread across economical studies including analysis of regional and cross-country differences to reveal intergroup differentiation. Our case deals with regional differences in firms' profitability within municipalities located on their territory. High interregional differentiation indicates significant portion of variance in firm profitability related to region.
The existence of interregional differentiation and hierarchical (two-level, nested) nature of data allow us build multilevel regression model (eq. 4,5,6).

Level 1 (lower):

$$dp_{ij} = \beta_{0j} + r_{ij} \quad (4)$$

Level 2 (upper):

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad (5)$$

Substituting equation (5) into equation (4) yields the well-known two-level mixed model without predictors (null two-level model):

$$dp_{ij} = \gamma_{00} + u_{0j} + r_{ij} \quad (6)$$

where dp_{ij} - the percentage of profitable organizations to the total number in the i-th municipality attributing to j-th region.

β_{0j} – function of a general intercept (γ_{00}) for all municipalities, and error of interregional variance (u_{0j}) that characterize variations across regions due to values of indices belonging to their municipalities;
r_{ij}- error of intraregional variance (intermunicipal), it represents the error in evaluating the indicator within regions.

Hierarchical linear modeling (HLM) requires certain requirements have to be complied with. Firstly, the hierarchy must be fully nested, so the municipality can belong to only one constituent entity. Secondly, for each municipality, the branches in the hierarchy must have the same length. To assess the extent to which municipalities in different regions affects the profitability of enterprises an intraclass correlation coefficient (ICC) was used:

$$\mathrm{ICC} = \frac{\sigma_{00}^2}{\sigma_{00}^2 + \sigma_j^2} \quad (7)$$

Where σ_{00} – interregional variance;
σ_j - intra-regional (inter-municipal) variance.

The coefficient value varies in the range from +1, where variance is determined directly by the difference between groups in the absence of variance within the groups, to$\frac{1}{(n-1)}$, where variance is predominantly intra-group (where n – number of municipalities).

The higher the value of ICC is, the more significant the variance within municipalities as opposed to variance within regions is and vice versa.

The coefficient value near zero shows that upper level of the management hierarchy does not make effects on development municipalities. If ICC smaller than 5% it makes analysis for grouped data senseless (Bliese, 2000).

Case study

To test hypothesis whether there was a relationship between municipalities we calculated values of global Moran's indexes related to a share of profitable enterprises (per cent, beginning of year). During the period under review the indicator remains positive, although the substantial drop in 2017 in comparison with 2010-2016. Increased standard deviation displays increasing differentiation in municipalities.

Further analysis drawing on LISAs showed spatial heterogeneity in the strength of the spatial autocorrelation. However, the selected subset shows a very different degree of dependence the data set as a whole. For example, global Moran's indexes in Tatarstan and Bashkortostan were higher than in the Perm and the Sverdlovsk regions in 2010-2013, 2016 (table 1).

Table 1. Global Moran's indexes

Year	Average	Standard deviation	Moran's statistic	Number of the municipalities belonging to High-high cluster (located in Bashkortostan and Tatarstan)	Number of the municipalities belonging to Low-Low cluster (Located in Perm and Sverdlovsk regions)
2010	66,75	22,26	0.23	32 (29)	15 (11)
2011	69,73	20,93	0,23	43 (41)	24 (15)
2012	71,78	20,26	0,19	26 (24)	17 (16)
2013	69,59	20,89	0,2	37 (34)	17 (16)
2014	68	21,05	0,21	26 (24)	20 (15)

2015	69,29	22,32	0,27	26 (25)	19 (9)
2016	70,71	21,06	0,18	21 (18)	10 (7)
2017	68,06	27,31	0,09	19 (19)	15 (11)

Source: own elaboration

When LISAs were established we identified cores of a clusters and local spatial outliers (fig.4). In 2010 г. 32 locations identified as significant high-high cluster centers, they are shown in red color on the map, 24 locations recognized as significant low-low cluster centers, they are highlight in dark blue on the map. At last we highlight by light red the high-low spatial outliers' centers (5 locations) on the map, by light blue the low-high spatial outliers centers (5 locations). In 2017 the number of clusters decreased, we observed 19 high-high cluster centers, 10 low-low cluster centers, 7 high-low spatial outliers centers and 8 low-high spatial outliers centers.

Having conducted analysis cores location, we revealed predominant locations of cores (high-high cluster centers) in the Tatarstan and Bashkortostan Republics. Furthermore, the low-low cluster centers are situated in the Sverdlovsk and Perm regions.

Thus, there is a regional differentiation in terms of firms' profitability, i.e. intergroup differences are observed. It makes possible the construction of hierarchical linear models for each year. All built models are statistically significant. The lowest reliability estimate is 0.795, p-value <0.001 (table 2).

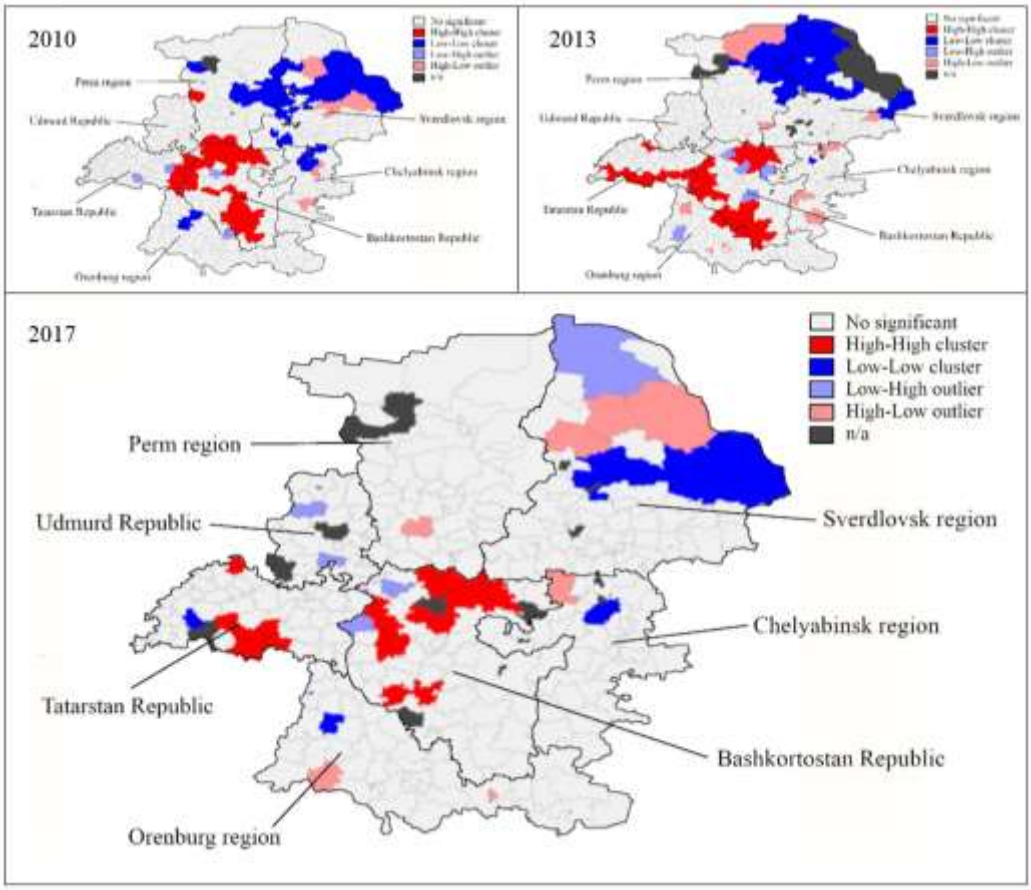

Figure 4. Share of profitable firms: LISA cluster map (p<0.05).
Source: Rosstat statistics (own elaboration)

Table 2. Variance decomposition results

Year	2010	2011	2012	2013	2014	2015	2016	2017
Interregional variance, u_{0j}	111.87	110.78	76.51	99.15	112.56	121.507	90.17	60.59
Intraregional variance, r_{ij}	383.87	337.50	339.83	339.08	334.35	383.59	359.93	690.35
ICC	22.6	24.7	18.4	22.6	25.2	24.1	20.0	8.1
Reliability estimate	0.928	0.936	0.909	0.927	0.934	0.928	0.909	0.795
$\chi 2$	101.9	104.3	74.4	98.1	104.8	94.8	74.1	32.1
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Source: own elaboration

Variance component demostrates intraregional (intermunicipal) differences to be are higher than interregional; it grew increasingly in 2017 within to the municipalities at the same time reducing at the region level. Therefore regional disparities decreased due to the influence of common regional processes took place.

At last we determined intraclass correlation coefficient (ICC) using variance component. Results showed that decomposed municipal variance in 2010 explained both by interregional (22.6%) and intraregional components (77.4%).

The variance attributed to the regional level remains significant during the entire period but it much dropped in 2017. Keeping in mind extensive changes in LISAs and ICC in 2017 the detailed factors should be considered to shed light on this field. So, from 2010 to 2016 we observe high level of spatial autocorrelation with well defined cores low-low in Sverdlovsk and Perm region and high-high in Bashkortostan and Tatarstan accompanied by regional differentiation in terms of firms' profitability.

Discussion

Our study deals with the influence of neighboring territories and spatial hierarchy on the share of profitable firms in municipalities, applying two-step technique. To assess neighboring territories impact on firms' profitability we used Moran's indexes (local and global). Finally, we used the hierarchical modeling due to the nesting of firms into locations to study portion of variance attributed to regional and municipal level. Our findings could be useful in several ways.

First, this research provides empirical support for the key provision of the existing body business literature that firm performance in developing countries depends on regional factors. Specifically, this study finds that region of country determines from 8,1 to 25,2% of the decomposed variance under examined period. The findings support the hypothesis of Chan C.M. that the sub national regions have an explanatory power greater in developing economies than in global ones (Chan et al., 2010).

Secondly, our work shows existence both spatial and hierarchical relations between firms' profitability within municipalities. According the analysis there is a positive spatial autocorrelation, despite its reduction in 2017 in comparison with 2010-2016. Given spatial patterns of firms' location we can conclude that profitability should be regarded as independently forming within regions and that possible spatial and hierarchical effects have to be taken into consideration.

Thirdly, our highlights demonstrate a very different degree of dependence the data set as a whole.

Predominantly high-high cluster centers are located in Bashkortostan and Tatarstan. It can be largely explained by established regional economic structure based on such dynamic industries as mining

and the oil industry, chemical industry and petrochemicals. Additionally, these regions have advanced public support schemes aiming at entrepreneurs and favorable institutional environment as well positively affecting on the economic performance of enterprises. At the same time low-low cluster centers are situated in north regions - Sverdlovsk and Perm with harsh climatic conditions negatively affecting on production costs. It determines regional specificities and as a result lead to interregional variance.

These findings lend support to the importance of addressing firms profitability with regard to regional conditions including region-level regulatory, cognitive, and normative institutions and extent access to finance as well. Recent studies proved that the institutional context influences the nature, pace of development of entrepreneurship and extent of firms (Krasniqi, Desai, 2016). Therefore, researchers should draw attention to spatial and regional ties, defining the location of new firm and how aggressively and efficiently it will strive for growth (Acs Z. et al., 2016).

Taking into account regional disparities and spatial connectivity territorial governments might contribute to the formation effective and sustainable enterprises in developing countries.

We acknowledge that this study is not without limitations.

First, we used the data come from Rosstat official website, its methodology aims on collecting data referring to large and medium-sized enterprises. So, in some municipalities the indicators could be overestimated. There are some ways to improve situation: changing source of data, extracting data primarily from enterprises, using qualitative interviews with entrepreneurs.
Second, we tried to study the influence of region on firms' profitability. On our opinion, further researches should take into account relationship between firms performance and region sectoral structure because there are many differences in industry profitability. For example, most researchers noted the region influence is insignificant in developed countries. But it is not like that for emerging economies or for individual industries. For example, Molina-Azorin J.F. argued importance of location effects (17.7%) in explaining firm profitability in Spanish service firms (Molina-Azorin et al., 2010).

Third, this study does not include possible micro- and macro-level conditions that may be of importance for firm profitable. These factors embedded in research design could expand theoretical background and improve understanding field of study.

Conclusions

Profitability in a broad sense represents an effectiveness of business units at micro level. Referring to municipal scale it should be considered as the key growth driver determining the level of population income and consumption patterns. We have conducted analysis referring to firms' profitability by means of Moran' indexes and hierarchical linear modeling. The resulting global Moran' index shows existence spatial autocorrelation. We revealed existence of predominantly cores (high-high cluster centers) in the Tatarstan and Bashkortostan Republics, but the low-low cluster centers are situated in the Sverdlovsk and Perm regions. Thus, we observe a regional differentiation in terms of firms' profitability.

This finding is confirmed by results of hierarchical linear modeling (HLM) which enable to assess the regions (upper level) impact on municipalities' development (lower level). Under examined period calculated ICC has demonstrated changing of variance owing to regional scale from 22.6% in 2010 to 8.1% in 2017 reaching a high point of 25.4 in 2014. Given regional heterogeneity and spatial cohesion regional administrations might promote the sustainable effective clusters of enterprises in emerging countries. Thereby the entrepreneurship development should be considered in close relation to local and regional identities and programs, schemes aimed on increasing economic activity required regional ties to be taken into consideration. Further studies must be targeted to deeping and confirmation of the hypothesis in two ways.

Firstly, there is a strong need of accumulation empirical evidences regarding the relationships between neighboring municipalities in terms of firms' profitability. Taking this approach we assume that separate municipality is seen as an interdependent participant in the process of spatial planning and in the field of forming sub regional clusters and entrepreneurial systems.

Secondly, it is necessary to research the impact of the regional (municipal) conditions on the entrepreneurship development in general and the economic efficiency of enterprises in details. Our research does not address to potential macro- and micro- level conditions which may be relevant to profitability. The including of additional explanatory variables in subsequent studies will significantly expand the understanding of factors affecting the profitability of enterprises.

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