



Comparison of Investment Activity of the Russian and Foreign Manufacturers: Case from Manufacturing of Transportation Vehicles

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ABSTRACT

The purpose of this paper is to study the indices of investment activity of subsection DM “manufacturing of transportation vehicles and equipment” enterprises under Russian, foreign and joint ownership (JO). Multivariate statistical analysis of the investment activity was performed at the Russian regional level. Using analysis of variance we identified statistically significant differences of the investment to shipped products ratio and investment structure in fixed capital between Russian, foreign and JO enterprises. Using methods of hierarchical classification, two models of clustering of regions were performed for each form of ownership. The clustering demonstrated that during the years of 2010-2013 the process of intensive creation of enterprises under foreign ownership in certain regions of Russia continued. In regions with enterprises under Russian and JO a low intensity of investment processes was identified. Some region clusters with enterprises under JO have high share of investment into foreign machinery and equipment.

Keywords: Domestic and Foreign and Joint Enterprises, Manufacturing of Transportation Vehicles, Investments, Multivariate Statistical Analysis
JEL Classifications: C100, G310, L620, O140

1. INTRODUCTION

The relevance of this paper is based on the intensive change of the subsection DM “manufacture of transportation vehicles and equipment” production structure in the Russian economy and significant increase of enterprises under foreign and joint ownership (JO). Intensive processes of establishing enterprises in certain sectors of industry under foreign and JO take place starting from 2006 in the Russian economy. These processes are especially extensive in subsection DM “manufacture of transportation vehicles and equipment” of the processing industry of Russia. Production volumes of enterprises under foreign and JO in this subsection reached 42% in 2013 and became comparable to that of enterprises under Russian ownership (RO). New territorial production centers are being created with enterprises under

foreign and JO. Involvement of these enterprises is intended for production of higher quality products on the territory of Russian and gradual mastery of advanced foreign technologies. However, these enterprises are directed primarily at the Russian market, compete with enterprises under RO and can negatively impact their development and technological safety of the country. It should be pointed out that the enterprises established under foreign and JO have their advantages and disadvantages compared to the Russian enterprises. They manufacture higher quality products using advanced foreign technology, however, many of them have assembly operation with low level employment and low integration into Russian production and innovation networks. It is therefore necessary to have joint development of Russian enterprises and enterprises under foreign and JO, at the same time it is important for the country to master advanced foreign technologies. How

are the enterprises of subsection DM broken down into forms of ownership being developed in post-crisis period, and what type of consistent trends can be identified for the purposes of state regulation? To answer this question it is necessary to perform a comparative analysis of subsection DM enterprises broken down into forms of ownership, indices and regions of Russia.

The purpose of this paper is to study the indices of investment activity of subsection DM enterprises broken down by forms of ownership and determination and economic assessment of differences in indices of enterprises under Russian, foreign and JO. As part of this study using methods of multivariate statistical analysis we will test the hypotheses regarding higher investments at enterprises under foreign and JO and greater amount of funds, allocated by these enterprises, for buying foreign machinery and equipment. Regions of Russia with enterprises under Russian, foreign and JO will be clustered to identify the growth points (territories with high investment activity) and territories where enterprises actively purchase foreign machinery and equipment. The conducted analysis will help to identify the differences in investment activity of subsection DM enterprises and certain territories that would be reasonable to use in state regulation in order to ensure corresponding and balanced development of enterprises broken down into forms of ownership according to the goals of the Russian economy.

1.1. Object of Study

Enterprises under Russian, foreign and JO of the subsection DM “Manufacture of transportation vehicles and equipment.” Subsection DM of the Russian classification of the types of economic activity corresponds to C29 manufacture of motor vehicles, trailers and semi-trailers and C30 manufacture of other transport equipment Statistical Classification of Economic Activities in the European Community (NACE Rev. 2). Study period - 2010-2013. Data base for analysis - Statistical data on enterprises of subsection DM broken down into forms of ownership (Russian - RO, foreign ownership [FO], joint - JO) at the level of Russia and its regions, obtained at the website of UISS (Unified Interagency Informational Statistical System, 2015) and upon special requests to Rosstat (Federal Service of State Statistics). Database created in such a manner was used further in the package Statistica for multivariate statistical analysis of data according to the methodology (Hill and Lewicki, 2007; StatSoft, 2013).

It should be noted that differences in the behavior and development of enterprises broken down into forms of ownership (domestic manufacturers and enterprises under FO) are of interest for Russia as well as for foreign countries, in particular, the EU countries. Notably, Eurostat in section “structural business statistics” has data related to the whole sample of enterprises as well as a separate subsection “Foreign controlled EU enterprises” (Eurostat, 2015). This data enables us to compare the indices of enterprises under national ownership and enterprises controlled by the foreigners. However, Eurostat has a limited set of data regarding foreign controlled enterprises. In terms of sectors of industry, indices related to the number of personnel, performance, added value are available, however, indices on investment activity, investments in buildings and equipment are lacking (Eurostat, 2015).

In international practice the peculiarities of the development of enterprises broken down into forms of ownership (national and foreign) have been studied in sufficient detail and continue to be studied. The problems of foreign owned enterprises’ and direct foreign investment’s influence on the development of national companies are being considered. Differences in the performance rate of enterprises broken down into forms of ownership are being studied in the following ways:

- Influence of foreign direct investment (FDI) on the investment and capital structure of domestic firms and economic growth (Anwar and Sun, 2015; You and Solomon, 2015; Chayawisan, 2015; Szkorupová, 2015; Sun et al., 2015).
- Comparative analysis of personnel qualification, labor productivity and salary at foreign and domestic enterprises taking into account direct foreign investments (Chen, 2011; Chen et al., 2011, Dachs and Peters, 2014).
- Innovation activity of domestic and foreign manufacturers, the role of the latter in the import of high technologies to the domestic market (Dachs and Peters, 2014; Girma et al., 2009; Murakami, 2007).

Analysis of the recent studies dedicated to the identification of the influence pattern of foreign firms and their investments on the operation of the national market allows us to make several general conclusions:

1. Previously proposed hypothesis about the beneficial impact of investment and production activity of foreign firms on the state of domestic market is being questioned, with statistical data, presented by many scientists of the developing countries, in whole (Murakami, 2007; Girma et al., 2009), as well as in separate sectors of the economy (Basti et al., 2015; Buckley et al., 2007, Szkorupová, 2015). At the same time positive effects of FDI on investment of domestic firms found in some countries and industries (Chayawisan, 2015; You and Solomon, 2015).
2. Based on the opinion of the aforementioned scientists (Buckley et al., 2007; Girma et al., 2009) greater beneficial effect can be generally attributed to investments of foreign firms operating in monopolized sectors as well as high-tech sectors of the industry (Chayawisan, 2015; You and Solomon, 2015). Such scientists as Anwar and Sun (2015) express their opinions regarding the change in the attitude of the Chinese government authorities to stimulation of foreign firms operating in labor-intensive industries. Villarreal and Sakamoto (2011) believe that foreign investments in human capital are more preferential in labor-intensive industries.
3. The main part of the study is based on the examination and comparison of the performance rates of separate firms. Mathematical and statistical methods of data analysis are used at the level of individual firms.

The characteristic property of our research is the examination of the activity of the subsection DM enterprises broken down into forms of ownership at the regional level based on the aggregate reporting of individual enterprises at the regional level. The object of the study is the investment activity of enterprises broken down into forms of ownership, its intensity and composition of investment, differences in investment processes between enterprises by their forms of ownership.

Study of the automobile industry in Russia was performed in the paper of Bareev (2014). The author examines the problem of the Russian automobile industry clustering: Considers and systematizes approaches to clustering, describes main industrial clusters of Russia (North-Western, Central, Kumskiy and Povolzhskiy clusters), demonstrates the presence of Russian as well as foreign and joint enterprises in each cluster. In this paper clustering is performed based on the territorial characteristic to a large extent taking into account absolute measures. In our study clustering will be performed based on mathematical methods, moreover, the emphasis will be made on relative indicators of the investment activity of the territories.

2. METHODOLOGY OF THE STUDY

Study methods. Methods of multivariate statistical analysis are used in this study. We applied these methods in the paper (Spitsin et al., 2016). Correlation analysis and construction of the factorial economic area allowed to identify the correlation of indices, based on them form factorial independent indices and determine the differences in their values between the enterprises under Russian, foreign and JO. Cluster analysis allowed the formation of typical regional clusters by forms of ownership and comparison of their factorial indicators.

The following regional samples are formed in order to analyze the investment activity of enterprises broken down into forms of ownership:

- 59 regions with enterprises under RO
- 12 regions with enterprises under FO
- 14 regions with enterprises under JO.

The criterion for inclusion of the region in the study was the average annual volume of shipped products, based on the relative form of ownership, over 1 billion RUB for a period between 2010 and 2013. Moreover, individual regions with atypical behavior of enterprises were excluded from the study.

In order to analyze the investment activity of enterprises at the regional level the following absolute and relative indicators were used (Table 1).

Average values for 2010-2013 were used for four absolute indices. Other indices were calculated based on average values of these indices.

3. RESULTS OF VARIANCE ANALYSIS OF FORMS OF OWNERSHIP

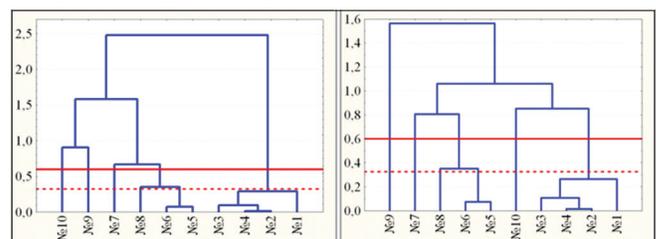
3.1. Correlation-cluster Analysis of Indices

A dendrogram, which allows to identify various groups of indices that have correlation association depending on the selected distance of association d (Figure 1), was built based on the correlation analysis of a system of 10 initial indices. For example, $d_1 = 0.6$ (solid horizontal line in Figure 1 on the left and on the right) conforms to the group of 5 indices that have correlation association, and $d_2 = 0.325$ (dotted horizontal line in Figure 1 on the left and on the right) conforms to the group of 6 indices that have correlation

Table 1: Indices for study by forms of ownership of the enterprises

| No | Line of research | Formula for calculating relative indices |
|----|---|--|
| 1 | Absolute indices | Shipped products, billion RUB |
| 2 | | Investments in fixed capital - total, billion RUB |
| 3 | | Investments in buildings (except for residential) and structures, billion RUB |
| 4 | | Investments in machinery and equipment, billion RUB |
| 5 | Ratio of investments to shipped products | Investments in fixed capital/shipped products, % |
| 6 | | Investments in machinery and equipment/shipped products, % |
| 7 | | Investments in buildings/shipped products, % |
| 8 | | Investments in foreign machinery and equipment/shipped products, % |
| 9 | Composition of investments in fixed capital | Investments in machinery and equipment/investments in fixed capital, % |
| 10 | | Investments in foreign machinery and equipment/investments in machinery and equipment, % |

Figure 1: Vertical dendrogram of the correlation matrix of indices (horizontally - indices, vertically - distance of association)



association, stable in regards to the variation of cluster consolidation rules (Ward's method - to the left, complete linkage - to the right). Since the correlation analysis of the initial indices demonstrated significant correlation associations of various pairs of indices, then during their clustering it was reasonable to use correlation distance (1-r Pearson) as a means of proximity of indices.

3.2. Construction of the Factorial Economic Area

Presence of the correlation dependence of initial indices allows for the use of the factor analysis. The main objectives of the factor analysis are to decrease the amount of indices (data reduction) and to determine the structure of correlations between the indices, i.e., classification of indices. Factor analysis as a method of classification is based on the assessments of correlation (factor loadings) between the initial indices and factors (or "new" indices) under the selected factor model and allows to understand the significance of factors. The purpose is to reproduce the majority of variance of indices using a relatively small number of factors.

By means of the principal components method of the factor analysis the following 5 factor model of indices (Table 2) was built, which fully conforms to Figure 1 (solid horizontal line).

Table 2: Matrix of a 5 factor structure of indices

| Indices | Factor 1 (F1) | Factor 2 (F2) | Factor 3 (F3) | Factor 4 (F4) | Factor 5 (F5) |
|---------------------------|---------------|---------------|---------------|---------------|---------------|
| No. 1 | 0.906 | -0.124 | -0.044 | 0.013 | -0.230 |
| No. 2 | 0.973 | 0.161 | -0.056 | 0.082 | 0.075 |
| No. 3 | 0.920 | 0.103 | -0.177 | 0.103 | 0.203 |
| No. 4 | 0.961 | 0.196 | 0.028 | 0.080 | 0.012 |
| No. 5 | 0.117 | 0.933 | -0.190 | -0.014 | 0.263 |
| No. 6 | 0.086 | 0.980 | 0.085 | 0.046 | 0.028 |
| No. 7 | 0.122 | 0.532 | -0.567 | -0.101 | 0.582 |
| No. 8 | 0.114 | 0.793 | 0.143 | 0.497 | -0.200 |
| No. 9 | -0.091 | 0.050 | 0.987 | 0.050 | -0.051 |
| No. 10 | 0.129 | 0.094 | 0.049 | 0.978 | -0.009 |
| Percent of total variance | 0.361 | 0.285 | 0.140 | 0.124 | 0.055 |

The most significant (main) reversed factor loadings (partial correlation coefficients) of indices on factors are presented in bold in Table 2, which allows for interpretation of the corresponding factors based on the aggregate of these indices, ascribing to them the most relevant traits of the significant indices. Percentages of variance of initial indices, explained by this factor, otherwise stated as weighted coefficients of factors, are mentioned in the bottom line. Accumulated variance of the first 5 factors is $\approx 96.5\%$.

According to Table 2 and Figure 1, high factor loadings of indices were distributed based on factors that had the highest weight, the following way:

F1 - Is the most important (≈ 0.361), characterized by positive correlation relationship with all absolute indicators No. 1-No. 4 and is interpreted as the factor of absolute measures.

F2 - Less important (≈ 0.285), characterized by positive correlation relationship with investment relative indicators (No. 5, No. 6, No. 8) and is interpreted as the factor of investments to shipped products ratio.

The rest F3 (No. 9), F4 (No. 10), F5 (No. 7) - the least important ($\approx 0.140-0.055$), characterized by positive correlation relationship mostly with one of the relative indicators, interpreted as the factor of the corresponding relative indicator.

Considering the economic interpretation and methodological importance of the indicator No. 8 (investments in foreign machinery and equipment/shipped products, %) below it is designated as a separate factor F6 (No. 8). Thus, further we consider a 6 factor model of indicators of industrial developments of the regions of Russia.

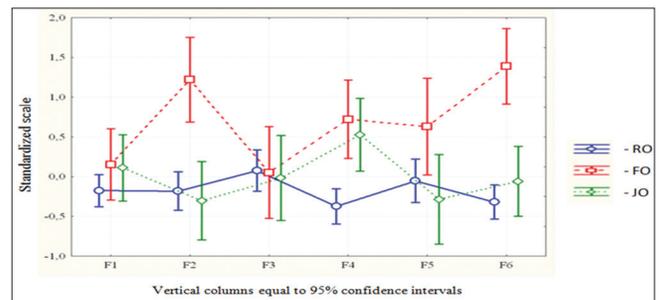
3.3. Variance Analysis of Forms of Ownership

Based on the identified 6-factor indices within the analysis of variance, a comparison of forms of ownership RO, FO, JO of the DM industry development was performed (Figure 2).

In the case at hand (Figure 2) F-test demonstrates highly significant (at the level $0.0005 > P \approx 0.0004$) differences of the total forms of ownership and factors due to:

1. In the case of F2 and F6 highly significant (at the level of $0.0005 > P$) difference of FO from others

Figure 2: Diagrams of standardized average values of Russian ownership, Foreign ownership and Joint ownership based on 6 factorial indices



2. In the case of F4 strongly significant (at the level of $0.005 > P \approx 0.003 > 0.0005$) difference of RO from JO, FO
3. In the case of F5 statistically significant (at the level of $0.05 > P \approx 0.04 > 0.005$) difference of FO from JO, RO.

The small sample size of FO and JO presupposes control of obtained results using Kraskel-Wallis rank test which mitigates the differences in cases of F2, F6 and F4 to statistically significant (at the level of $0.05 > P > 0.005$) and in the case of F5 to slightly insignificant (at the level of $P \approx 0.15 > 0.10$).

So we receive the next results:

- Enterprises under FO have a higher ratio of investments (into fixed capital, machinery and equipment, foreign machinery and equipment) to shipped products compared to the enterprises under Russian and JO. That is, investment processes at these enterprises are more intensive, and they have fewer limitations on financial resources needed for development (Factors 2 and 6).
- Enterprises under FO, JO direct a higher percentage of investments in machinery and equipment on purchase of foreign machinery and equipment, as compared to the enterprises under RO (F4).

4. CLUSTER ANALYSIS OF REGIONS

Clustering of regions was performed based on the key factors that characterize innovation-investment-driven development of enterprises. For this purpose the following factors were selected:

- F2 and F5 - The first clustering version - Reflects the intensity of investments in the region (total investments and

Table 3: Average values of factorial indices of DM region clusters

| Cluster | F2 | F5 | Number of regions | Examples of regions |
|---------|-------|-------|-------------------|---|
| RO1 | 0.62 | 1.91 | 3 | Tulskay oblast, Stavropolskiykrai, Primorskiykrai |
| RO2 | 0.80 | -0.32 | 2 | Voronezhskay oblast, Republic of Dagestan |
| RO3 | 2.26 | 4.12 | 1 | Omskaya oblast |
| RO4 | 0.57 | 4.26 | 1 | Republic of Khakassia |
| RO5 | -0.42 | -0.45 | 46 | Nizhegorodskaya oblast, Moscow, Moskovskaya oblast, St. Petersburg, Republic of Tatarstan, etc. |
| RO6 | 1.31 | 0.64 | 1 | Yaroslavskeya oblast |
| RO7 | 0.19 | 0.65 | 5 | Leningradskaya oblast, Novgorodskaya oblast, Archangelskaya oblast and other |
| FO4 | -0.14 | -0.16 | 7 | St. Petersburg, Republic of Tatarstan, Samarskaya oblast, Moskovskaya oblast, Rostovskaya oblast etc. |
| FO5 | 1.51 | 2.24 | 2 | Kaluzhskaya oblast, Sverdlovskaya oblast |
| FO1 | 6.06 | 4.59 | 1 | Leningradskaya oblast |
| FO3 | 4.61 | -0.61 | 1 | Nizhegorodskaya oblast |
| FO2 | 1.93 | 0.27 | 1 | Krasnoyarskiykrai |
| JO1 | 0.25 | 0.27 | 2 | Samarskaya oblast, Khabarovskiykrai |
| JO3 | -0.55 | -0.56 | 6 | Republic of Tatarstan, Moscow and others |
| JO2 | -0.40 | 0.04 | 4 | St. Petersburg, Moskovskaya oblast and others |
| JO4 | 0.07 | -0.66 | 2 | Sverdlovskaya oblast, Tverskaya oblast |

RO: Russian ownership, FO: Foreign ownership, JO: Joint ownership

investments in buildings) as it relates to the shipped products and allows to identify the regions where new enterprises are being established and the old ones are expanding.

- F4 and F6 - The second clustering version - Reflects the percentage and the intensity of investments into foreign machinery and equipment and allows to identify the regions and forms of ownership that have active import of advanced foreign technologies and equipment.

Please also note, that the attempt to cluster the regions based on all 6 factors turned out to be unsuccessful, because as a result of this, regions similar in production volumes but fundamentally different in investment indicators were united into one cluster.

4.1. Clustering based on F2 and F5

Clustering of Regions (test of homogeneity) was performed based on each form of ownership using methods of K-average and hierarchical classification. Various methods of clustering demonstrated similar results at the level of a 7 cluster model of 59 DM regions for RO, 5 cluster model of 12 DM regions for FO and 4 cluster model of 14 DM regions for JO (Table 3).

The quality of constructed cluster models of regions was assessed using analysis-of-variance tests (parametric F-test and Kruskal-Wallis rank test). According to F-test differences between average cluster values of regions are highly significant (at the level of $p_F < 0.0005$) for each form of ownership in the case of F2, as well as F5 (Table 4). The small sample size of clusters presupposes control of obtained results using Kruskal-Wallis rank test which confirms the conclusions of the F-test for RO and mitigates them in the cases of FO to slightly significant (at the level of $0.10 > p_{K-W} > 0.05$) and in the case of JO to statistically significant (at the level of $0.05 > p_{K-W} > 0.005$) (Table 4).

Thus, distribution of regions in the case of each form of ownership is significantly inhomogeneous based on all factorial indicators (Table 4 and Figure 3).

Table 4: The results of the analysis of variance of the quality of regions clustering

| Factor | RO | | FO | | JO | |
|--------|--------|-----------|--------|-----------|--------|-----------|
| | P_F | P_{K-W} | P_F | P_{K-W} | P_F | P_{K-W} |
| F2 | 0.0000 | 0.0001 | 0.0000 | 0.066 | 0.0002 | 0.026 |
| F5 | 0.0000 | 0.0001 | 0.0002 | 0.082 | 0.0000 | 0.012 |

RO: Russian ownership, FO: Foreign ownership, JO: Joint ownership

Taking into account divergence of the results of parametric and non-parametric analysis of variance due to the small sample size and infringement of the condition of normalcy of distribution, results of the non-parametric analysis of variance that mitigate the significance levels of differences between average cluster values of regions as in the case of FO and JO are considered to be more accurate.

Economic interpretation of the obtained results of regions clustering.

Summary of clusters obtained during the study based on F2 and F5 is presented on Figure 3. Factors F2 and F5 are of the most interest because they characterize the intensity of investments into creating new and expanding old enterprises. Clustering visually illustrates differences in investment processes at the subsection DM enterprises, broken down by forms of ownership.

In 2010-2013 investments were actively made at enterprises under FO (clusters FO1, FO3, FO5). They were most actively made in Leningradskaya oblast (FO1), which is a leader, based on F2, as well as F5. Here establishment of new foreign enterprises "from the ground up" is evident. Cluster FO3 (Nizhegorodskaya oblast) is developing in another way. It has high values based on F2, but low values based on F5. Here the emphasis is made on the investments into machinery and equipment, but not into the construction of buildings (possible development at the premises of Russian enterprises or already finished infrastructure). Cluster FO5 should be noted separately. This is a cluster of regions - Large

subsection DM production centers under FO and despite that regions in this cluster demonstrate a high intensity of investments. We do not emphasize cluster FO2 (Krasnodarskiykrai) here due to a small production volume. In general, 4 regions out of 12 under FO demonstrate a high intensity of investments.

Enterprises under RO have low investment activity. 46 regions out of 59 (78%) are included in cluster RO5 that shows very low indices of investments. Notably, among these regions are the largest regions - Manufacturers of transportation vehicles (Nizhegorodskaya oblast, Moscow, Moskovskaya oblast, St. Petersburg and others). Only Omskaya oblast (RO3) has high indices, and Yaroslavskaia oblast's (RO6) indices are higher than average. These two regions are of interest. Clusters RO1 and RO4 demonstrate a high percentage of investments into buildings but not investments in general. Notably, Republic of Khakassia (RO4) has low production volumes and is hardly of interest.

Investment activity of enterprises under JO is even worse. It is not possible to identify regions-leaders among them. Possibly, establishment of joint enterprises allows to save on investments as infrastructure of the Russian partner is used. Enterprises under JO are expected to have high investments into foreign machinery and equipment (transfer of advanced foreign technologies).

4.2. Clustering based on F4 and F6

Clustering of regions (test of homogeneity) was performed based on each form of ownership using methods of K-average and hierarchical classification. Various methods of clustering demonstrated similar results at the level of a 6 cluster model of 59 DM regions for RO, 8 cluster model of 12 DM regions for FO and 5 cluster model of 14 DM regions for JO (Table 5).

The quality of constructed cluster models of regions was assessed using analysis-of-variance tests (parametric F-test and Kruskal-Wallis rank test). According to F-test differences between average cluster values of regions are highly significant (at the level of $p_f < 0.0005$) for RO, JO and strongly significant (at the

level of $0.005 > p_{k-w} > 0.0005$) for FO in the case of F4, as well as in the case of F6 (Table 4). The small sample size of clusters presupposes control of obtained results using Kruskal-Wallis rank test which confirms the conclusions of the F-test for RO and mitigates them in the cases of FO to slightly significant (at the level of $0.10 > p_{k-w} > 0.05$) and in the case of JO to statistically significant (at the level of $0.05 > p_{k-w} > 0.005$) (Table 6).

Thus, distribution of regions in the case of each form of ownership is significantly inhomogeneous based on all factorial indicators (Table 6 and Figure 4).

Figure 3: Scatter plot of cluster standardized average values based on factorial indicators F2 and F5

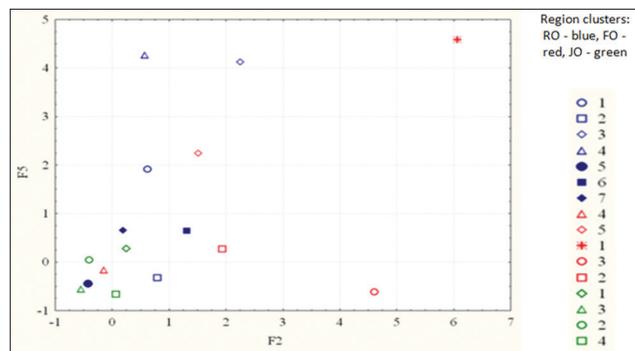


Figure 4: Scatter plot of cluster standardized average values based on factorial indicators F4 and F6

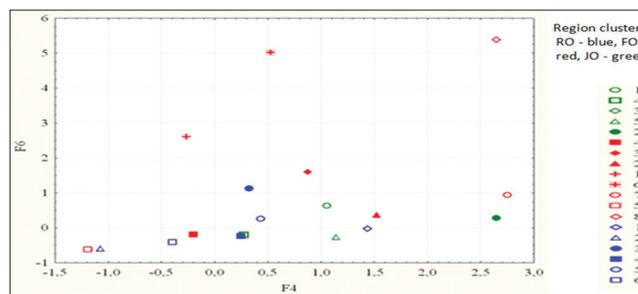


Table 5: Average values of factorial indices of DM region clusters

| Cluster | F4 | F6 | Number of regions | Examples of regions |
|---------|--------|--------|-------------------|---|
| FO1 | -0.265 | 2.606 | 1 | Leningradskaya oblast |
| FO2 | 1.524 | 0.371 | 2 | Rostovskaya oblast, Republic of Tatarstan |
| FO3 | 0.875 | 1.593 | 2 | Kaluzhskaya oblast, Sverdlovskaya oblast |
| FO4 | -0.201 | -0.189 | 3 | St. Petersburg, Samarskaya oblast, Krasnodarskiykrai |
| FO5 | -1.191 | -0.624 | 1 | Amurskaya oblast |
| FO6 | 0.526 | 5.021 | 1 | Nizhegorodskaya oblast |
| FO7 | 2.750 | 0.935 | 1 | Moskovskaya oblast |
| FO8 | 2.648 | 5.376 | 1 | Krasnoyarskiykrai |
| RO1 | 1.438 | -0.033 | 2 | Kemerovskaya oblast, Republic of Karachaevo-Cherkessia |
| RO2 | -1.073 | -0.597 | 25 | Moscow, Sverdlovskaya oblast and others |
| RO3 | 0.322 | 1.126 | 1 | Yaroslavskaia oblast |
| RO4 | 0.250 | -0.233 | 10 | St. Petersburg, Republic of Tatarstan, Moscow and others |
| RO5 | 0.435 | 0.255 | 9 | Nizhegorodskaya oblast, Ulyanovskaya oblast, etc. |
| RO6 | -0.398 | -0.410 | 12 | Moskovskaya oblast, Saratovskaya oblast and others |
| JO1 | 1.056 | 0.626 | 3 | Samarskaya oblast, Sverdlovskaya oblast, Tverskaya oblast |
| JO2 | 2.646 | 0.283 | 1 | St. Petersburg |
| JO3 | -1.188 | -0.623 | 2 | Moscow, Chelyabinskaya oblast |
| JO4 | 0.273 | -0.203 | 6 | Leningradskaya oblast, Nizhegorodskaya oblast, etc. |
| JO5 | 1.144 | -0.270 | 2 | Primorskiykrai, Moskovskaya oblast |

RO: Russian ownership, FO: Foreign ownership, JO: Joint ownership

Table 6: The results of the analysis of variance of the quality of regions clustering

| Factor | RO | | FO | | JO | |
|--------|----------------|------------------|----------------|------------------|----------------|------------------|
| | P _F | P _{K-W} | P _F | P _{K-W} | P _F | P _{K-W} |
| F4 | 0.0000 | 0.0000 | 0.0008 | 0.087 | 0.0000 | 0.022 |
| F6 | 0.0000 | 0.0000 | 0.0049 | 0.096 | 0.0001 | 0.033 |

RO: Russian ownership, FO: Foreign ownership, JO: Joint ownership

Taking into account divergence of the results of parametric and non-parametric analysis of variance due to the small sample size and infringement of the condition of normalcy of distribution, results of the non-parametric analysis of variance that mitigate the significance levels of differences between average cluster values of regions as in the case of FO and JO are considered to be more accurate.

Economic interpretation of the obtained results of regions clustering.

Summary of clusters obtained during the study based on F4 and F6 is presented on Figure 4. Factors F4 and F6 are of interest because they characterize the import of foreign technologies and equipment for manufacturing transportation vehicles. Clustering visually illustrates differences in investment processes at the subsection DM enterprises, broken down by forms of ownership.

Leaders are again enterprises under FO (FO8, FO7, FO2, FO3, FO6). Among them is the cluster of regions - Large subsection DM production centers under FO (FO3). However, these enterprises are under FO and it is unlikely to expect from them transfer of technologies to the Russian manufacturers.

Enterprises under RO are not aimed at foreign machinery and equipment, except for clusters RO1 (Kemerovskaya oblast, Republic of Karachaevo-Cherkessia) and RO3 (Yaroslavl'skaya oblast)/However, 3 regions out of 59 is a very small amount.

Enterprises under JO have very good values based on F4, but low values based on F6. Three clusters are identified here: JO2 - St. Petersburg, JO1 - Samarskaya oblast, Sverdlovskaya oblast, Tverskaya oblast, JO5 - Primorskiy krai, Moskovskaya oblast. Enterprises under JO generally preferred foreign equipment, however, during the covered period (2010-2013) no significant purchases of equipment were made.

5. CONCLUSION

The conducted analysis allows us to make the following conclusions regarding the indices of investment activity of subsection DM enterprises based on data in 2010-2013.

1. A 6 factor economic area was built on the grounds of correlation and factor analysis of 10 investment indices of subsection DM industry of the Russian regions of composite forms of ownership (RO, FO and JO).
2. Forms of ownership RO, FO, JO of the subsection DM industry were compared based on the identified 6 factor indices, and statistically significant differences, based on

factor indices, in the investment to shipped products ratio and investment structure in the fixed capital were identified:

- Enterprises under FO have a higher ratio of investments (into fixed capital, machinery and equipment, foreign machinery and equipment) to shipped products compared to the enterprises under RO and JO.
 - Enterprises under FO and JO direct a higher percentage of investments in machinery and equipment on purchase of foreign machinery and equipment, as compared to the enterprises under RO.
3. Within the 6 factor economic area of the industry development, clustering of regions (test of homogeneity) was performed based on each form of ownership using methods of hierarchical classification in two ways:
 - Clustering based on two factors: Investment to shipped products ratio and investments into buildings to shipped products ratio.
 - Clustering based on two factors: Percentage of investments into foreign machinery and equipment in investments in machinery and equipment and ratio of investments in foreign machinery and equipment to shipped products.
 - Moreover, the quality of constructed cluster models of regions was assessed using analysis-of-variance tests (parametric F-test and Kruskal-Wallis rank test).
 4. The preformed clustering visually demonstrated the differences in indices of investment activity of subsection DM enterprises at the level of regional groups during the period between 2010 and 2013:
 - The process of intensive creation of enterprises under FO in certain regions of Russia continued. Foreign investors had fewer financial limitations and invested significant funds into establishment and development of industries in Russia. Regions with enterprises under RO and JO demonstrate low intensity of investment processes which is suggestive of significant financial restrictions and demand constraints on behalf of the Russian enterprises as well as disinterest of foreign partners to invest considerable amounts of money into joint enterprises;
 - Some region clusters with enterprises under FO and JO direct a high percentage of investments in machinery on purchase of foreign machinery and equipment. However, enterprises under JO, unlike enterprises under FO, did not make significant procurements of foreign machinery and equipment during the covered period.

The conducted study detected certain problems in balanced development of subsection DM enterprises broken down into forms of ownership, which should be considered during state regulation. Problems of low intensity of investments and encouragement of processes of introducing advanced foreign technologies at the enterprises under Russian and JO should be resolved. Enterprises under FO, on the contrary, developed quite intensively, and the main problem here - is the increase of the local manufacturing content and integration of these enterprises into Russian manufacturing and innovation networks.

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