Comparison of social results produced by Russian and foreign companies: case Russian electronic industry

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***Abstract*—The purpose of this paper is a comparative analysis of the social results of foreign and joint (FJO) and domestic (Russian – RO) enterprises. We analyze the differences between FJO and RO enterprises for the subsection DL "Manufacture of electrical and optical equipment" at the Russian regional level using methods of multivariate statistical analysis. We find the strong positive correlation between the indicators, related the number of employees and payroll fund and positive correlation between the production value, the number of employees and the annual payroll fund. We determined statistically significant differences between FJO enterprises and the RO enterprises by some of the analyzed indicators. Using cluster analysis we confirmed that FJO enterprises are characterized by a smaller size and lower employment compared with RO enterprises. We found only two regions with the high growth rates of employment and payroll, but with low current levels of employment and payroll. The regions, which are major manufacturing centers, do not demonstrate high growth rates of employment and payroll.**

Keywords— foreign and joint enterprises; domestic enterprises; social results; multivariate statistical analysis; manufacture of electrical and optical equipment; Russian regions

I. INTRODUCTION

Since 2006, foreign and joint enterprises (foreign and joint ownership - FJO) have been intensively created in several industries of the Russian economy. High growth rates of the shipped products of FJO enterprises were noted in subsection DL "Manufacture of electrical and optical equipment" (subsection DL according to the NACE Rev. 1.1. or C26+C27 according to the NACE Rev. 2, Eurostat classification of economic activities). Share of FJO enterprises reached 18% of total production of subsection DL in 2013.

The purpose of this paper is a comparative analysis of the social results of the subsection DL "Manufacture of electrical and optical equipment" enterprises by types of ownership at the regional level. The research period is 2010-2013. The information base includes statistical data at the level of Russia and its regions [1]. We applied the following methods of analysis: correlation, factor, cluster and dispersion analysis and used software product "Statistics" for calculations [2, 3].

Modern economists analyze the differences in foreign, joint and national firms' performance [4-10]. The most attention is paid to the role of foreign ownership in labor market conditions and skills, salary and productivity dynamics, innovations and investment activities in manufacturing sectors. Last years the developed countries' influence for developing countries technologies level and manufacturing growth were also researched [6, 8, 9]. The scientists successfully use economic and mathematic models in their analyses. Most investigations examine the firm data or national economy data. They try to form some guidance for national governments based on their conclusions [8]. We examined the differences between RO and FJO enterprises for the subsection DM "Production of Vehicles and Equipment" in the paper [10]. We found that FJO enterprises have on the average higher salaries with lower labor intensity and payroll-output ratio than the same indicators for RO enterprises.

In this paper we research the subsection DL "Manufacture of electrical and optical equipment", where the process of creating FJO enterprises were slightly less intense than in

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subsection DM. We test the differences between samples of regions and carry out clustering of regions to find the differences between separate regions.

II. Research Methodology

The 9 indicators (Table 1) were used for the analysis.

TABLE I. IIndicators and Their Calculations

№	Indicators[a]
1	Production value
2	Average monthly salary
3	Number of employees
4	Annual payroll fund
5	Labor intensity (Number of employees / Production value)
6	Payroll-output ratio (Annual Payroll fund / Production value)
7	Growth rate of the average monthly salary
8	Growth rate of number of employees
9	Growth rate of annual payroll fund

[a] a. The average values for the period of 2010-2013 years

We apply the methods of multivariate statistical analysis (correlation, cluster, factor and variance analysis). Statistical analysis is carried out at the level of Russian regions. We formed two samples of regions for subsection DL:

- The sample of regions in which foreign and joint enterprises produced significant volumes of products.
- The sample of regions in which domestic (Russian) enterprises produced significant volumes of products.

We excluded from the samples the next regions:

- The regions, in which average annual production of subsection DL by the analyzed ownership form was less than 1 billion rubles.
- The regions, in which there were insufficient data for analysis or very anomalous values of relative indicators.

The following samples of regions with different ownership forms of enterprises were received:

- Russian enterprises (RO) - 56 regions;
- Foreign and joint enterprises (FJO) - 21 regions.

Each sample of regions covered more than 70% of the total employment and payroll fund of subsection DL by the same ownership form. To reduce the variability of the indicators in the statistical analysis, we calculated and used their average values for the period 2010-2013.

III. Results of Statistical Analysis

A. *Correlation and cluster analysis of the indicators.*

To conduct correlation analysis of 9 indicators, the dendrogram based on tree clustering is built.. According to this dendrogram different groups of correlated indicators are allocated depending on linkage distance d (Figure 1). By the reason of significant correlations between indicators' pairs, identified in the correlations analysis, we used the correlation distance as a distance measure between indicators. Ward's method was used to identify rules of the clusters' union. This method is different from all other methods by using dispersion analysis to evaluate the distances between clusters.

Correlation analysis revealed a strong positive linear relationship with the high (close to 1) values of the Pearson correlation coefficient (r, parametric) and Spearman coefficient (R, rank) between groups of indicators at the level of DL:

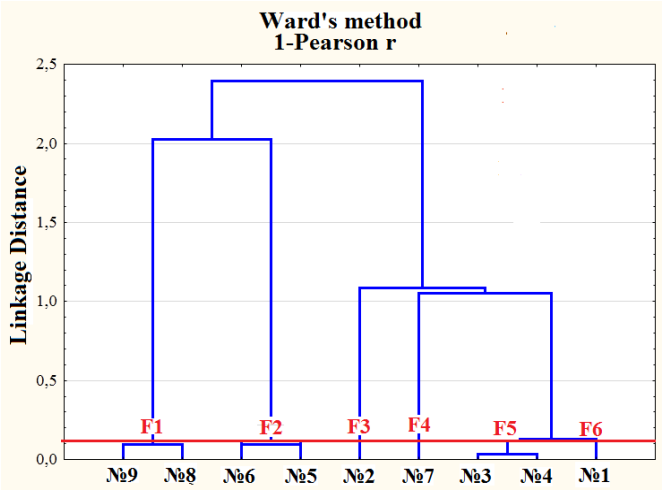

Fig. 1. Vertical dendrogram of the correlation matrix of indicators

- Number of employees and Annual payroll fund(r=0,96 and R=0,96);
- Labor intensity and Payroll-output ratio (r= 0,88 and R=0,87);
- Growth rate of number of employees and Growth rate of annual payroll fund (r= 0,91 and R=0,83).

There is also a correlation between the production value and the number of employees and the annual payroll fund, but it is weaker (r = 0,85 and R=0,78).

B. *Factor analysis of the indicators*

Strong correlation between some initial indicators allows the use the factor analysis. Factor analysis has two main objectives: to reduce the number of indicators and to define linkage structure between indicators, ie classification parameters. Factor analysis as a method of classification is based on the correlations estimates (factor loadings) between initial indicators and factors (or "new" indicators) within the selected factor model and allows finding the factors significance. The aim of factor analysis is to explain the most dispersion by a relatively small number of factors.

Using the factor analysis, the 6-factor model of indicators was formed (Table. 2). The significant (basic) rotated factor loadings (partial correlation coefficients) of the initial indicators on the factors are highlighted in bold color in the table 2.

TABLE II. MATRIX 6-FACTOR STRUCTURE OF INDICATORS

	f5	f2	f1	f4	f3	f6
№1	**0.928**	-0.202	0.007	0.075	0.176	**0.238**
№2	0.167	-0.193	-0.073	-0.055	**0.961**	0.006
№3	**0.973**	0.055	0.007	0.134	-0.031	-0.147
№4	**0.982**	0.002	0.003	0.085	0.140	-0.040
№5	-0.118	**0.925**	-0.033	0.078	-0.308	0.103
№6	0.018	**0.986**	-0.044	0.016	0.007	-0.098
№7	0.190	0.067	0.069	**0.974**	-0.054	0.001
№8	-0.001	-0.040	**0.983**	-0.103	-0.019	-0.010
№9	0.014	-0.033	**0.964**	0.207	-0.066	0.012
Δ	0.317	-0.213	0.212	0.116	-0.120	0.011

These significant factor loadings make it possible to aggregate the initial indicators to interpret relevant factors. The lower line shows the explained dispersion proportion (Δ) of each factor (or weighting factors). Cumulative dispersion for 6 factors is approximately 98%.

On the basis of the generated six factorial indicators we compared their mean values for the samples of regions with RO and FJO enterprises of subsection DL (Fig. 2).

For the reasons of economic interpretation, background-free factorial indicators are formed and investigated. Factor F6 corresponds to the indicator №1, F3 - №2, F4-№7. Factors F1, F2, F5 are defined as the weighted average of relevant substantive indicators.

In the present case parametric F-test shows that the differences between the RO and FJO enterprises highly significant (at the level of 0,0005> p) by a combination of factors due to the highly significant difference between the RO and FJO enterprises for F2 and strongly significant (0,005 > p > 0,0005) - for F5, F3 and insignificant (at p> 0,10) - for other factors F1, F4,F6. The smallness of the sample of regions with FJO enterprises requires control the results by rank Kruskal-Wallis test, which softens the differences between the RO and FJO enterprises for F3,F5 to a statistically significant.

We find the following statistically significant differences:

- labor intensity and payroll-output ratio (F2) of FJO enterprises is significantly lower than the RO enterprises;

- number of employees and annual payroll fund (F5) of FJO enterprises is lower than the RO enterprises;

- average salary (F3) of FJO enterprises is higher than the Russian (domestic) ones.

C. Cluster analysis of regions.

Clustering of Russian regions separately for RO and FJO enterprises was carried out in accordance with Figure 1 and Table 2, in the background-free factor space (F1-F6).

We made two clustering by factors:

1) F5 and F6 (Figure.3);
2) F5 and F1 (Figure.4).

Table 3 shows distribution of Russian regions by clusters.

In these Figures the number of regions in each cluster was indicated in parentheses (blue – RO and red - FJO). F-test shows that the differences between the average values of cluster in their entirety are highly significant for each factor for each type of ownership. The smallness of the clusters samples assumes control of the results rank Kruskal-Wallis test, which confirms the findings of F-test in a bit milder form.

We find that only a few regions show high volume of production and high employment (clusters RO1, RO2, FJO1, FJO2). The leaders are regions with RO enterprises (RO1 – Moscow, St. Petersburg). Regions with FJO enterprises lag behind.

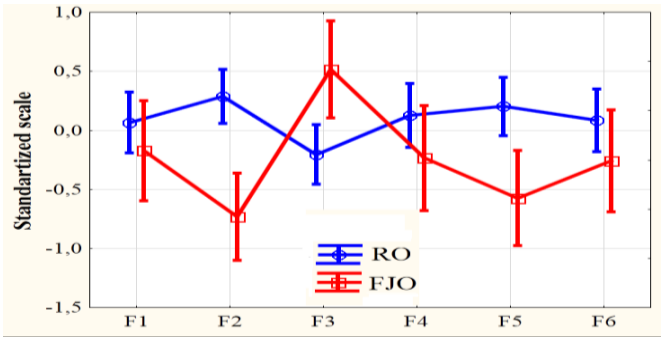

Fig. 2. Standardized mean values of RO and FJO enterprises with 95% confidence intervals

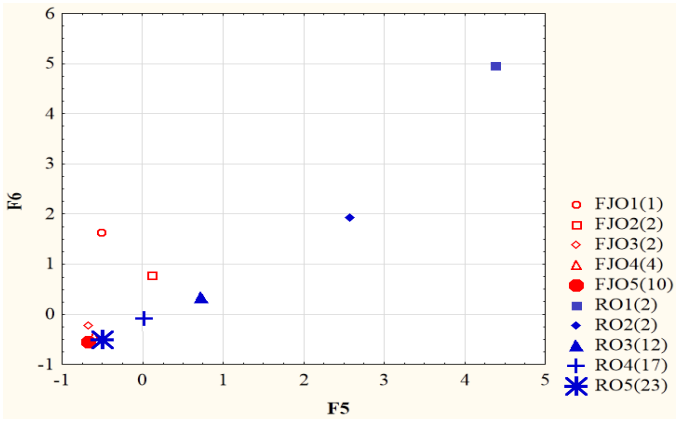

Fig. 3. Scattering of regions clusters with RO and FJO enterprises by the factors F6 and F5

Regions with FJO enterprises are located to the right, i.e., they are characterized by lower employment and payroll fund (F5).

We confirm the conclusion that regions with FJO enterprises are characterized by lower employment and payroll fund (F5). We also find that regions with large enterprises (F5) do not show high growth rates of employment and payroll (F1). Only two clusters (RO6 and FJO5) with two regions demonstrate high growth rates of employment and payroll.

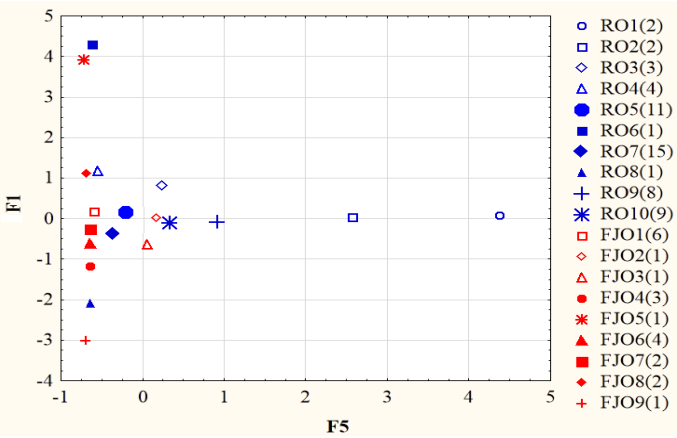

Fig. 4. Scattering of regions clusters with RO and FJO enterprises by the factors F1 and F5

TABLE III. DISTRIBUTION OF RUSSIAN REGIONS BY CLUSTERS

Region	F5-F1	F5-F6	Region	F5-F1	F5-F6
Moscow	RO1	RO1	Kemerovo region	RO7	RO5
St. Petersburg	RO1	RO1	Kirov region	RO5	RO5
Moscow region	RO2	RO2	Bryansk region	RO7	RO5
Sverdlovsk region	RO2	RO2	Belgorod region	RO7	RO5
Samara Region	RO3	RO3	Novgorod region	RO5	RO5
Nizhny Novgorod Region	RO9	RO3	Altai region	RO4	RO5
Vladimir region	RO9	RO3	Irkutsk region	RO4	RO5
Republic Of Tatarstan	RO9	RO3	Volgograd region	RO7	RO5
Perm Region	RO3	RO3	Lipetsk region	RO7	RO5
Novosibirsk region	RO9	RO3	Orenburg region	RO4	RO5
Chuvash region	RO10	RO3	Kostroma region	RO6	RO5
Kaliningrad region	RO7	RO4	Ivanovo region	RO7	RO5
Ryazan region	RO10	RO3	Khabarovsk region	RO4	RO5
Tyumen region	RO9	RO3	Kurgan region	RO7	RO5
Voronezh region	RO5	RO4	Vologda Region	RO8	RO5
Chelyabinsk region	RO9	RO3	Arkhangelsk region	RO7	RO5
Udmurt region	RO9	RO3	Republic of Buryatia	RO7	RO5
Saratov region	RO9	RO3	Kaluga region	FJO1	FJO1
Tomsk region	RO10	RO4	St. Petersburg	FJO2	FJO2
Pskov region	RO5	RO4	Moscow	FJO3	FJO2
Ulyanovsk region	RO7	RO4	Moscow region	FJO4	FJO3
Kaluga region	RO10	RO4	Kaliningrad region	FJO5	FJO3
Republic Of Bashkortostan	RO10	RO4	Novosibirsk region	FJO6	FJO4
Rostov region	RO10	RO4	Irkutsk region	FJO1	FJO4
Yaroslavl region	RO5	RO4	Nizhny Novgorod Region	FJO1	FJO4
Omsk region	RO7	RO4	Ryazan region	FJO8	FJO4
Tula region	RO3	RO4	Republic Of Tatarstan	FJO1	FJO4
Mordovia region	RO7	RO4	Perm Region	FJO7	FJO4
Smolensk region	RO5	RO4	Kirov region	FJO8	FJO5
Tambov region	RO5	RO4	Smolensk region	FJO6	FJO5
Mari El region	RO5	RO4	Chelyabinsk region	FJO4	FJO5
Kursk region	RO7	RO4	Leningrad region	FJO7	FJO5
Krasnoyarsk region	RO7	RO4	Mordovia region	FJO4	FJO5
Tver region	RO7	RO5	Vladimir region	FJO9	FJO5
Oryol Region	RO5	RO5	Ulyanovsk region	FJO6	FJO5
Leningrad region	RO5	RO5	Saratov region	FJO6	FJO5
Kabardino-Balkar Republic	RO7	RO5	Pskov region	FJO6	FJO5
Krasnoyarsk region	RO7	RO5	Republic Of Bashkortostan	FJO1	FJO5
Primorsky Krai	RO5	RO5			

IV. CONCLUSIONS

The conducted analysis allows us to make the following conclusions regarding the FJO and RO enterprises of subsection DL based on data in 2010-2013.

1. We found the strong positive correlation between the pairs of indicators, related the number of employees and payroll fund (№3 and №4; №5 and №6; №8 and №9). We also find the positive correlation between the production value and the number of employees and the annual payroll fund.

2. We determined statistically significant differences between FJO enterprises and the RO enterprises:

- labor intensity and payroll-output ratio (F2) of FJO enterprises is significantly lower than the RO enterprises;

- number of employees and annual payroll fund (F5) of FJO enterprises is lower than the RO enterprises;

- average salary (F3) of FJO enterprises is higher than the Russian (domestic) ones.

3. Using cluster analysis we confirmed that FJO enterprises are characterized by a smaller size and lower employment compared with RO enterprises. We found only two regions with the high growth rates of employment and payroll, but with low current levels of employment and payroll. The regions, which are major manufacturing centers, do not demonstrate high growth rates of employment and payroll.

It is planned to continue the study of distinctions between foreign, joint and domestic enterprises in Russian electronic industry. We are going to analyze the differences of their investment activity and value added.

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