Accounting for the Characteristics of Regional Manufacturing Industries in Developing an Industrial Policy

I.S. Glebova, S.N. Kotenkova, F.S. Abdulganiyev and R. Galiakhmetov
Institute of Management, Economics and Finance, Kazan Federal University,
420008 Kazan, Russia

Abstract: In this study, we examine the conditions and dynamics of manufacturing industries as an important part of an overall mechanism of industrial development. Based on a proposed system of indicators, we rank manufacturing industries in 81 regions of Russia according to their development level during the period between 2006 and 2013. The study applies a ranking technique based on data analysis that constructs an integrated index measuring the development levels of the manufacturing industries (Index). The technique ranks the regions in the descending order of the integrated index. The analysis suggests for the presence of significant disparities in the geographical distribution of the Russian industrial potential. This is largely due to the sole use of naturally existing growth drivers and the low efficiency of government regulation and support measures in developing the country's manufacturing industry.

Key words: Economics, regional economics, industry, manufacturing industry, industrial policy

INTRODUCTION

The instability in the global energy markets and the changes in the oil and gas supply structures of European and Chinese markets affect the Russia's position in the world economy as one of the leading energy supplier. The rationale for this research stems from the need to develop progressive methods of industrial management and appropriate mechanisms for stimulating industrial development of the country for its transition from a raw material export model of economic growth to a more balanced model that is not subject to international pricing environment.

According to the hypothesis, there is a serious imbalance and uneven development of the manufacturing industries in the regional context. The research aims at identifying a system of indicators to adequately assess the development levels of manufacturing industries in the regions of the Russian Federation. In addition, we try to identify their strengths and weaknesses, the position of each region in the country's economy and potential sources of growth. This will allow for building appropriate methods for government regulation of regional systems.

Literature review: The theoretical basis of the study are classic and contemporary works of domestic and foreign researchers on the application of statistical and information methods to assess the development of industrial complexes (Basarac *et al.*, 2015; Panwar *et al.*, 2015), research on the theory of industrial development (Minguela *et al.*, 2014; Chauhan and Singh, 2014), the formulation and implementation of industrial policy (Polemis, 2014; Widodo *et al.*, 2014), the theory and practice of management of industrial enterprises in the conditions of Russia's accession to the WTO. In the literature, the term "industrial policy" primarily refers to a set of policy measures by government to support or develop certain industries or sectors of the economy (Krugman, 1991); government policies aimed at achieving economic and non-economic objectives by controlling the allocation of resources between sectors, complexes and industrial enterprises (Otis *et al.*, 1994).

Industrial policy management implies the fulfillment of all managerial functions, i.e., the development and implementation of decisions and the control over their execution. The control functions are implemented through the elements of management cycle: planning, organization, coordination and regulation, implementation, measurement and analysis. The main objectives of the government's industrial policy are the following: increasing the innovation activity of the industrial sector; enhancing the international competitiveness of the industry; increasing the production of goods with high added value; diversifying the sectoral structure of the industry (Rodnyansky and Yasnitskaya, 2015).

Corresponding Author: I.S. Glebova, Institute of Management, Economics and Finance, Kazan Federal University,
420008 Kazan, Russia

Table 1: Manufacturing industry development indicators (produced by the researchers)

Groups of indicators	Indicators
General economic development of the manufacturing industry (S_1)	Production index (corrected for the informal economic activity) (% to the previous year)
	The share of manufacturing organizations in the total number of organizations (%)
	The turnover share of manufacturing organizations in the total turnover of organizations (%)
	The share of the manufacturing industries in the total amount of gross value added (%)
Innovation activities (S_2)	The share of innovative products in the total amount of shipped products in the manufacturing industries (%)
	The intensity of expenditure on technological innovation (%)
Financial standing of organizations (S_3)	Return on assets of organizations (%)
	Profitability of sold goods (works, services) of organizations (%)
	Equity to total assets ratio (%)
	The share of overdue debt of manufacturing organizations in the total amount of overdue depts (%)
	The share of unprofitable organizations in the manufacturing industries (% of the total number of organizations in this type of economic activity)
Characteristics of fixed assets (S_4)	The share of the manufacturing industry in the total amount of fixed assets for the full carrying value (%)
	The degree of depreciation of fixed assets in the manufacturing industries (%)
Efficiency of production factors (S_5)	Capital productivity ratio (rubble on rubble)
	Capital-labor ratio (thous. rub. per person)
	Labor productivity ratio (thous. rub. per person)
Labor resources in the manufacturing industries (S_6)	The share of employed in the manufacturing industries in the av-erage annual number of employed in the economy of the region (%)
	The ratio of accrued nominal wages in the manufacturing indus-tries to the average wages in the economy of the region (%)

MATERIALS AND METHODS

We propose to analyze the regions in terms of development levels of their manufacturing industries according to the indicators presented in (Table 1). The choice of indicators was determined by the study of statistical data published by the Federal State Statistics Service and the Single Interagency Information System (EMISS). The study applied a ranking technique based on data analysis that constructs an integrated index measuring the development levels of the manufacturing industries (Index). The technique ranks the regions in the descending order of the integrated index. Further, we provide an algorithm for computing the integrated index measuring the development levels of the manufacturing industries.

Normalization of indicators: In the applied formula a normalized value of X_i^M is obtained by dividing the difference between an observed value of X_i and a minimum value of the indicator by its magnitude:

$$X_i^M = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

Where:

X_i^M = The normalized value of ith indicator

X_i = The value of ith indicator for a region

X_{max}, X_{min} = Specified maximum and minimum values of the indicators (reference points)

In this case, as the reference points were taken the maximum and minimum values of ith indicator of an outsider region and a leader region in the respective years. In cases when a directly measured indicator is negatively related to the development of the industry (e.g., the degree of depreciation of fixed assets), applies an inverse linear scaling where the linear scaled indicator is subtracted from one:

$$X_i^M = 1 - \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

In this way, the distribution of the scaled indicator becomes a "mirror image" of the initial indicator. Convolution of the normalized values of the indicators into complex aggregated indicators (sub-indexes). It is assumed that in the structure of the manufacturing industry indexes the factors have the equal weights:

$$S_j = \frac{\sum_{i=1}^{m} X_i^M}{m}$$

Where:

S_j = A sub-index of the jth group of indicators (j = 1, ..., n)

m = The number of initial indicators (adjusted to a common scale), belonging to the K_j sub-index

Construction of the integrated index measuring the development levels of the manufacturing industries, as the arithmetic mean of the resulting sub-indexes:

$$S_j = \frac{\sum_{j=1}^{z} S_j}{m}$$

Where:

I = The integrated index measuring the development levels of the manufacturing industries

z = The number of sub-indexes included in the integrated index

Due to the lack of statistical records for some of the selected indicators before the year 2006, the construction of the ranking of the manufacturing industries using the above described methods was carried out for the period between 2006 and 2013. The estimations were carried out for 81 regions of the Russian Federation with the exception of the Chechen Republic and the Republic of Ingushetia, for which data were incomplete.

RESULTS AND DISCUSSION

The empirical results support our hypothesis about the presence of the serious imbalance and uneven development of the manufacturing industries in the regions of the Russian Federation (Table 2). The findings suggest that the differentiation level of the regions of the Russian Federation on the integrated index, estimated as the ratio between the value of the index for the leader region and for the outsider region was equal to 3.2 in 2013. With regard to the groups of indicators, the corresponding values for the different sub-indexes differ significantly: for S_1 the ratio was 32.6, for $S_2 = 424.7$, $S_3 = 2.2$, $S_4 = 92.3$, $S_5 = 20.2$ and $S_6 = 15$.

To further emphasize the revealed disparities, Table 3, reports a ranking for the bottom 10 regions in terms of the development levels of the manufacturing industries. The disparity is largely determined by the availability of natural resources in the region, the historically developed infrastructure, climatic conditions, the mentality of the population and other objective factors. For instance while the export orientation of the regions producing oil and gas is primarily determined by the geographical and geological factors, the industrial orientation is largely determined by the country's development patterns during the period of industrialization of the 1930's. Throughout the whole study period, the leading group of regions in the ranking belongs to the so called "old" industrial centers, established during the Soviet period. During the last 10-12 years, due to favorable world market conditions (primarily in raw materials and in products with low added value) these regions were able to modernize their production capacity. The industrial base of this leading group of regions is characterized by the oil and gas and metallurgy sectors, dominated mostly by large Russian companies. In this respect, the following regions could be highlighted: the Lipetsk Region (3rd position), the Tula Region (4th position), the Nizhny Novgorod Region (7th position), the Chelyabinsk Region (12th position), the Vologda Region (10th position), the Republic of Tatarstan (9th position), the Perm Region (11th position).

The successful recovery of these "old" centers of industry established the investment and budgetary

Table 2: Ranking of the top 10 regions in terms of the development levels of the manufacturing industries

Regions	Rank by the inte-grated index 2013 year	Value of the integrated index	Rank by S1	Rank by S2	Rank by S3	Rank by S4	Rank by S5	Rank by S6	Rank by the integrated index 2010 year	Rank by the integrated index 2006 year
Kaluga Region	1	0.5675	1	41	47	1	12	2	2	15
Leningrad Region	2	0.5625	27	2	31	4	10	9	15	7
Lipetsk Region	3	0.5470	6	10	27	3	11	3	1	1
Tula region	4	0.5031	3	20	39	2	27	16	13	18
Vladimir Region	5	0.4948	2	42	23	6	55	4	12	10
Samara Region	6	0.4938	28	3	17	44	28	11	8	3
Nizhny Novgorod Region	7	0.4899	11	7	22	15	18	20	4	14
Krasnoyarsk Region	8	0.4854	29	13	1	16	15	29	16	5
Republic of Tatarstan	9	0.4848	33	6	34	5	13	28	18	16
Vologda Region	10	0.4829	5	53	33	22	17	1	7	2

Table 3: Ranking of the bottom 10 regions in terms of the development levels of the manufacturing industry

Regions	Rank by the inte-grated index 2013 year	Value of the integrated index	Rank by S1	Rank by S2	Rank by S3	Rank by S4	Rank by S5	Rank by S6	Rank by the integrated index 2010 year	Rank by the integrated index 2006 year
Republic of Dagestan	71	0.2601	36	75	42	73	77	75	76	71
Altai Republic	72	0.2577	64	73	61	9	76	80	78	66
Nenets Autonomous Region	73	0.2399	80	56	46	30	66	76	74	74
Republic of Tuva	74	0.2315	75	79	2	50	81	81	79	80
Amur Region	75	0.2312	71	59	58	78	73	69	71	73
Republic of Sakha (Yakutia)	76	0.2269	74	71	77	26	56	77	70	77
Magadan Region	77	0.2267	79	55	9	76	72	74	75	75
Zabaikalye Region	78	0.2220	76	64	76	72	71	64	81	78
Jewish Autonomous Region	79	0.2180	60	79	72	77	74	73	80	79
Chukotka Autonomous Region	80	0.2135	81	36	81	63	9	79	72	62
Republic of Kalmykia	81	0.1792	73	79	15	81	79	78	77	81

drivers of growth for the Russian economy in the period 1999-2008. Today, this leading group of regions represents the framework of modern social and economic stability in Russia. However, this situation also creates the main risks for the Russia's economy. The industrial economy represented by companies with an old technological paradigm which primarily produce raw material and products with low added value, largely depends on the external factors. In turn, this may endanger the competitiveness of the country's economy in the next 10-15 years. At the same time, the relatively low position in the ranking of several major industrial regions suggests that they have already transformed their economies in favor of the dominance of the service sector as the main development driver. The most notable examples of such regions are St. Petersburg (21st position), Moscow (47th position), the Krasnodar Region (60th position). At the bottom of the ranking, there are regions that have not been able to restore their industrial potential of the Soviet period. Conventionally, this group of regions can be called "industrial stagnation" centers.

However, some of these regions were able to reach acceptable standards of living due to economic transformation towards the service sector, primarily trade and logistics. Such transformation was possible thanks to their geographical location, e.g., the presence of ports, railroad and transportation hubs, the proximity to main agricultural and touristic zones and the involvement in active migration flows. Another group of the regions characterized as "industrial stagnation" centers were neither able to restore their industrial potential nor transform their economies towards other sectors. These regions became the primary recipients of the federal budget subsidies and represent the most problematic components of the country's economic framework. These lagging regions experience a continuous outflow of the most educated and economically active population which further degrades their infrastructure. A comparative analysis of the development levels of the regional manufacturing industries between 2006 and 2013 reveals that some industries were able to dramatically improve their positions in the ranking during this period (Table 2). The most notable of them are the Arkhangelsk Region (+45 positions), the Republic of Buryatia (+26), the Kursk Region (+24), the Bryansk Region (+21), the Khanty-Mansi Autonomous Region (+16), the Altai Republic (+16), the Ryazan Region (+14), the Tula Region (+14) and the Kaluga Region (+14). On the contrary, a set of regions has strongly regressed in the development levels of the manufacturing industries. This primarily concerns the Republic of Khakassia (-42 position), the Irkutsk Region (-35), the Murmansk Region (-34), the
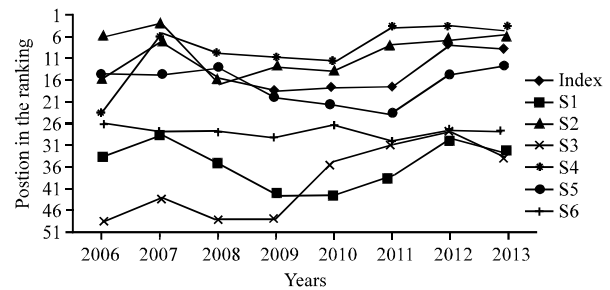

Fig. 1: Changes in the integrated index and sub-indexes of the Republic of Tatarstan from 2006-2013 (Official website of the Federal State Statistics Service)

Republic of North Ossetia-Alania (-28), the Orel Region (-18), the Kemerovo region (-18), the Republic of Karelia (-18) and the Chukotka Autonomous Region (-18 point).

The regions that demonstrate the steady growth trends are the Kaluga Region, the Tula Region, the Omsk Region, the Ryazan Region, the Rostov Region, the Kirov Region, the Bryansk Region, the Republic of Buryatia, the Saratov Region, the Khanty-Mansi Autonomous Region, the Tambov Region, the Sakhalin Region and the Republic of Tuva. As an example we can have a closer look at the manufacturing industry of the Republic of Tatarstan. In 2013, Tatarstan was in the top 10 list of the ranking and was among the regions that have significantly improved their positions since 2006. The region's industrial profile is determined by the fuel and petrochemical industries, large machine-building enterprises and advanced electric and radio equipment production enterprises. As presented in Fig. 1, throughout the whole study period, two groups of indicators have significantly contributed to the integrated index that, in turn, determines the position of the region in the overall ranking. These two groups of indicators were those characterizing innovation activities (S_2) and those characterizing fixed assets (S_4). The share of innovative products in the total amount of shipped products in the manufacturing industries has steadily increased from 2006-2013 and exceeded the national level by 1.2-1.3 times. In 2013, the value of this indicator amounted to 15% which is 5.7% higher than the national average and 5.9% higher than its own regional level in 2006. The intensity of expenditure on technological innovation for the entire period, on average, exceeded the national value by 2 times and in 2013 amounted to 5.24% (Official website of the Federal State Statistics Service). Considering the group of indicators characterizing fixed assets, here, we also observe a positive growth dynamics for the share of the manufacturing industry in the total amount of fixed assets from 14% in 2006 to 18.3% in 2013. It is also necessary to
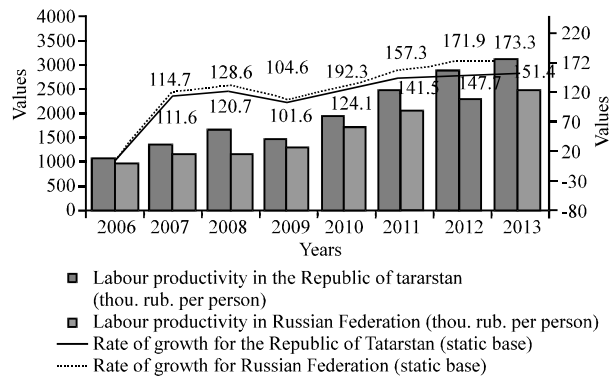
Fig. 2: Changes in the labor productivity in the period 2006-2013 (the left axis in the current prices, the right axis in the prices of 2006, calculated by the researchers on the basis of the Federal State Statistics Service data)

highlight a reduction in the degree of depreciation of fixed assets. By the end of 2013, the degree of depreciation of fixed assets of commercial organizations (excluding small businesses) amounted to 35.5% which was 7.7% lower than in 2006. The positive dynamics is also confirmed by the fact that the replacement rate of fixed assets significantly exceeded the rate of liquidation. In 2013, the values of these indicators were 13.9% and 0.4, respectively (Official website of the Federal State Statistics Service). Therefore, it cannot be argued that the reduction in the degree of depreciation was due to a sharp disposal of completely worn-out assets without their adequate replacement. In addition to the two discussed groups of indicators, relatively favorable trends are observed for the group of indicators characterizing the efficient use of production factors (S_5), according to which Tatarstan was ranked in the 13th position. The growth in the labor productivity in Tatarstan amounted 173.4% in 2013 as compared to 2006 (the national average was equal to 151.4%). The advantage possessed by the Republic of Tatarstan in the labor productivity as compared with the national average has gradually increased since 2006. In 2006, the labor productivity in the region was higher than the national average by 13%. As the growth rate of the labor productivity in Tatarstan was higher than the overall growth rate in the country, in 2013, the labor productivity in Tatarstan exceeded the national average by 29% (Fig. 2).

However, despite the relatively high labor efficiency, we observe the low ratio of capital productivity, characterized by the small values of the respective coefficients. In particular, in 2013, 1 rub. of investment corresponded to 1.73 rub. of products shipped. In 2006, the capital productivity ratio was 1.54.

On this indicator, the region significantly underperformed not only in comparison with the leaders such as the Khanty-Mansi Autonomous Region (7.36), Moscow (6.79), the Kaliningrad Region (5.06) but also in comparison with the national average (2.38) (Fig. 2).

At the same time, in terms of capital-labor ratio the republic of Tatarstan was ranked among the leading regions (8th position) with the indicator value of 1934.2 rub. per person in 2013. These findings suggest that although organizations in the region are fairly well equipped with the fixed assets, they do not pay sufficient attention to the management of these assets. For the remaining three groups of indicators, the Republic of Tatarstan still underperformed, as reflected in the region's modest positions in the respective rankings (Table 2), 33rd position for the group of indicators characterizing the general economic development of the manufacturing industry (S_1), 34th position for the group of indicators describing the financial standing of organizations (S_3) and 28th position for the group of indicators characterizing the labor resources in the manufacturing industries (S_3). The analysis suggests that the enterprises in the region have financial difficulties due to the large share of the expenses and the need for the distribution of profits to cover increasing liabilities. In the long run, this situation may lead to a reduction in the expenditures on technological innovation that in turn will increase the gap between the region's indicators and the ones of the national leaders.

As a result, the Republic of Tatarstan may lose its leading position in the national economy. The analysis of the development of manufacturing industry of the Republic of Tatarstan has allowed to identify the main competitive advantages of the region: the relatively low degree of depreciation of fixed assets, the high labor productivity in the manufacturing industry of the regional economy, the high innovative activity of industrial production and the high capital-labor ratio in the region. The most pronounced features negatively influencing the region's competitiveness are: the low profitability of organizations in the region, the insufficiency of own financial resources, the low utilization efficiency of fixed asset and the reduction in human resources.

CONCLUSION

It could be concluded that the manufacturing industry of modern Russia is characterized by the fragmentation of industrial systems at the regional level, the stochasticity in changing specialization (so called "yawning" effect in searching for orders and technical solutions) and the low efficiency of institutions stimulating the domestic industry in the regions. The

uniform development of all 6 groups of indicators which constitute the integrated index measuring the development level of the manufacturing industries and describe different aspects of the industrial processes is present only in an extremely small number of regions. In most cases, high values for certain groups of indicators are coupled with low values for other groups of indicators. In some cases, there are significant differences in one or several sub-indexes in comparison with the integrated index. As a result, the final integrated index represents an averaged or smoothed estimate that to some extent counterbalances (but at the same time hides) the effect of single sub-indexes describing the manufacturing industries. Thus, the economic parameters of the manufacturing industries located in regions and the quality of industrial policy carried out by the regional authorities is largely determined by the resources, priorities and management skills of the regional actors themselves. With regard to the federal authorities, their main role is to align the conditions and opportunities for the development of the manufacturing industries in the regions. This can primarily be achieved through implementation of targeted federal programs, financial support of investment projects management of the state property and activities undertaken by companies with government participation.

RECOMMENDATIONS

In order to resolve the above discussed problems, we propose the following activities: the development of a road map, showing the previous locations of manufacturing plants and enterprises; the transition from the policy of alignment and support of traditional leaders to a policy of polarized development and support of so called "growth points" that in the future could take leading positions in the national economy; the development of a bank loan system built on a principle of "bad" bank balance that allows to differentiate interest rates by the industries in order to attract investments from the primary industries to the manufacturing industries; the diffusion of project financing practices and

implementation of a tariff policy for exports and imports of medium and high technology products. These measures would help to deploy new productions, provide the domestic market with industrial and consumer goods and ensure the sustainability of economic growth while implementing the positive structural changes in the industry and increasing its competitiveness both domestically and globally.

REFERENCES

Basarac, S.M., V. Vuckovic and P.B. Swkrabic, 2015. Determinants of manufacturing industry exports in European Union member states: A panel data analysis. Econ. Res., 28: 384-397.

Chauhan, G. and T.P. Singh, 2014. Development and validation of resource flexibility measures for manufacturing industry. J. Ind. Eng. Manage., 7: 21-41.

Krugman, P., 1991. Trade with Japan: Has the Door Opened Wider?. University of Chicago Press, Chicago, Illinois, USA., pp: 191-220.

Minguela, R.B., M.J. Fernandez, O.M. Fossas and L.J.I. Sanchez, 2014. Technological collaboration with suppliers in product innovation: Analysis of the Spanish manufacturing industry. Innovar, 24: 55-65.

Otis, L., Jr. Graham and G.L. Otis, 1994. Losing Time: The Industrial Policy Debate. Harvard University Press, Cambridge, Massachusetts, USA., Pages: 373.

Panwar, A., B.P. Nepal, R. Jain and A.P.S. Rathore, 2015. On the adoption of lean manufacturing principles in process industries. Prod. Plan. Control, 26: 564-587.

Polemis, M.L., 2014. Measuring market power in the Greek manufacturing and services industries. Int. Rev. Appl. Econ., 28: 742-766.

Rodnyansky, D.V. and Y.S. Yasnitskaya, 2015. Forecasting the export energy policy of Russia in terms of volatility of world prices on resources. Mediterr. J. Soc. Sci., 6: 313-313.

Widodo, W., R. Salim and H. Bloch, 2014. Agglomeration economies and productivity growth in manufacturing industry: Empirical evidence from Indonesia. Econ. Rec., 90: 41-58.