Methodological Specifics of Forecasting the Development of the Industrial Sector of a Region's Economy Factoring in the Impact of Shock "Impulses" on It (through the Example of the Republic of Tatarstan)

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Abstract

Present-day economic conditions are characterized by a high level of integration and interpenetration between national economic systems. This, in turn, determines the way economic relations that form as a result of the impact of not just internal but external "impulses" on them are to be coordinated and will be operating. The latter are formed, for instance, as a result of overcoming trade barriers in interstate relations or, on the contrary, as a result of restrictions imposed in relation to access to external resources and markets. There are two aspects that impart particular relevance to the processes of generating external impulses. Firstly, Russia's entry into the World Trade Organization (WTO) in 2012 determined a whole spectrum of dimensions for the development and transformation of trade-economic processes (garnering better, compared with existing, and non-discriminatory conditions for the access of Russian products to foreign markets; creating a more favorable climate for foreign investment as a result of bringing the legislative system in line with WTO norms, etc.) (Gafurov, Safiullin, & Safiullin, 2012). Secondly, tensions building over the last several months between the Russian Federation and a particular segment of the global community are generating a number of serious risks associated with a set of institutional and market restrictions, which are directly or indirectly affecting the development of the industrial and financial sectors of the national and, consequently, regional economic systems.

Keywords: regional development, external shock "impulses", forecasting, industry

1. Introduction

The "nature" of the emergence of external "impulses", the depth and extent of consequences arising as a result of their impact on the national and regional economic systems require in-depth exploring. Furthermore, of importance is the fact that macroeconomic consequences reflected in changes in the volumes and dynamics of GDP are grounded in structural changes in particular types of economic activity. This, in turn, determines the character and structure of the development of the regional economic systems, each of which is unique in terms of the reproductive structure.

Thus, in exploring the processes of the impact of external "impulses" on the regional economic systems one should rely on integrated analysis of their sectoral development (Figure 1).

A very important aspect in conducting analysis and assessment of the impact of external "impulses" on regional economic development is systematizing and grouping the types of economic activity into two groups (Sergeyev):

1. The types of economic activity the structure of the sales volume of which is dominated by export shipments (chemical production, etc.);

2. The types of economic activity oriented towards the internal market (production of food products, including beverages and tobacco and textile and clothing manufacture, etc.)

Figure 1. A logical model for the impact of external "impulses" on the regional development of economic systems

For instance, if we construe external "impulses" as the liberalization of external trade (as a result of the country's entry into the WTO), then the character of changes taking place in them will depend on which group a particular type of economic activity belongs to. This is due to the fact that export-oriented and import-substituting types of activity have a different orientation in garnering corresponding effects.

If we consider as external "impulses" sanctions imposed by the global community (e.g., restrictions in respect of export, access to financial markets, transfer of the latest technology), then in this case the effects will have a unilateral negative character, irrespective of whether the types of economic activity belong to any of the above groups (Safiullin, Yelshin, & Shakirova, 2013). It should be noted that external sanctions create a new organizational operating environment for corporations, in large measure limiting their investment activity and, as a consequence, pre-determining a downturn in economic and operating activity. Furthermore, sectoral sanctions can also limit the volumes of import of the latest foreign technology, which can create an additional impulse for the development of national enterprises producing import-substituting goods and services.

Based on the above, the authors have developed a structural-logical scheme for modeling the impact of external "impulses" on the development of the regional types of economic activity (Figure 2).
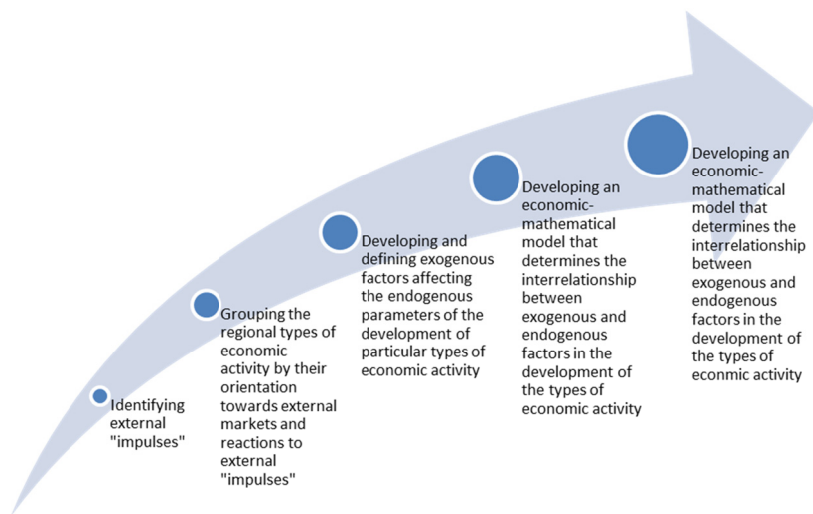
Figure 2. A structural-logical scheme for modeling the impact of external "impulses" on the development of the types of economic activity in particular regions

We find it worth taking a detailed look into a list of indicators that determine an aggregate of exogenous parameters in the development of the types of economic activity. We shall note right away that the quantitative indicators of the development of the types of economic activity (the volume of production, export, import, etc.) are impacted on by a large set of factors. These, for instance, can include the dynamics of the rate of growth of the global and national economy, investment activity in the economy's sector under study, changes in the pricing environment in respect of products turned out, etc. That said, including too many predicators in the model can cause a number of known problems. Due to this, we suggest constructing the model based a limited number of exogenous factors that characterize, above all, the dynamics of the expectations of economic agents as the most crucial indicator of economic development. Besides, augmenting the proposed argumentation, we can note that the examined aggregate of indicators is closely correlated with the expectations of economic agents. Therefore, in order to avoid non-credible results, the baseline equation will not include the examined factors.

Thus, in choosing the functional form of the econometric model for the impact of external "impulses" on the development of regional particular types of economic activity, we excluded a whole set of factors from the number of independent factors in the equation, motivating this step by two major aspects:

1. Possible additional factors are derivatives of factors we use in the model;

2. The use of additional factors can cause the endogeneity problem, which causes bias for estimates of coefficients in empirical models.

The logic of choosing an indicator characterizing the expectations of economic agents into the model for the impact of external "impulses" on the development of the types of economic activity is as follows. Expectations are the central link in the process of determining the future plans for development worked out in the corporate sector. Any actions on the part of economic agents which lead to adjusting the volumes of produced and shipped products follow, primarily, from these expectations. If the expectations of economic agents are adaptive, the current volumes of production and shipments will be determined in large measure by the past values for the rate of gains in them. Modeling expectations was conducted based on an indicator that assesses the region's business activity.

Furthermore, the authors suggest using as an indicator that helps trace the state of business activity on a regular monthly basis a composite index of the region's business activity. In constructing the index, we used the same basic approaches that have been used for constructing and analyzing economic and business activity indexes by the Conference Board, Inc. (USA) since 2001. This indicator is made up of four major components: the index of changes in capital, the stock index, the resource index, and the production index (Safiullin, Yelshin, & Shakirova, 2012). The set of indicators that make up the composite index was determined based on factors affecting the formation of the regional economic situation and the dynamics of its development.

The modeling process involves the determination of monthly indexes of the business and economic activity of a region and its particular sectors of the economy. Using this method helps identify inter-market interactions, determine the structure of the emergence of economic crises, as well as identify the reaction of economic agents on external "impulses".

We shall now lay out a logical model for developing the indexes of the business activity (IBA) of a region and the procedure for testing it through the example of the Republic of Tatarstan. In calculating the IBAs, one uses an array of macroeconomic data provided by official statistics agencies.

2. Results

Macroeconomic data are grouped into the following categories: production, the financial sector, the resource base of the economy, and the consumer market. Inside each category, we determine the weights of the indicators it includes; each category, in turn, has its own weight in the integral index of business activity.

In general terms, the index of business activity is the sum of four major components: three weighted indexes across different sectoral groups of the economy (the index of changes in capital, the resource index, and the production index), as well as the stock index, which reflects trends in the development of the securities market.

The determination of the weighted coefficients of each component of the composite index was based on a cross-correlation analysis that was conducted. The analyzed lag was 3 to 8 months. The weights were calculated in proportion to maximum correlation coefficients obtained (Table 1).

The use of the above methodological approaches helps infer that during the period 2007-2013 the Republic of Tatarstan had varied trends in the dynamics of the business activity of business entities. Over the period 2010-early 2012, the composite leading index of business activity of the Republic of Tatarstan demonstrated, on

the whole, a positive trend, which indicated the augmentation of expectations of economic growth. However, as early as the late second quarter of 2012, its level declined. And starting in September 2013, the dynamics of the level of the index of business activity started to exhibit a substantial downturn (Figure 3).

Table 1. A cross-correlation analysis of weight coefficients that make up the composite leading index

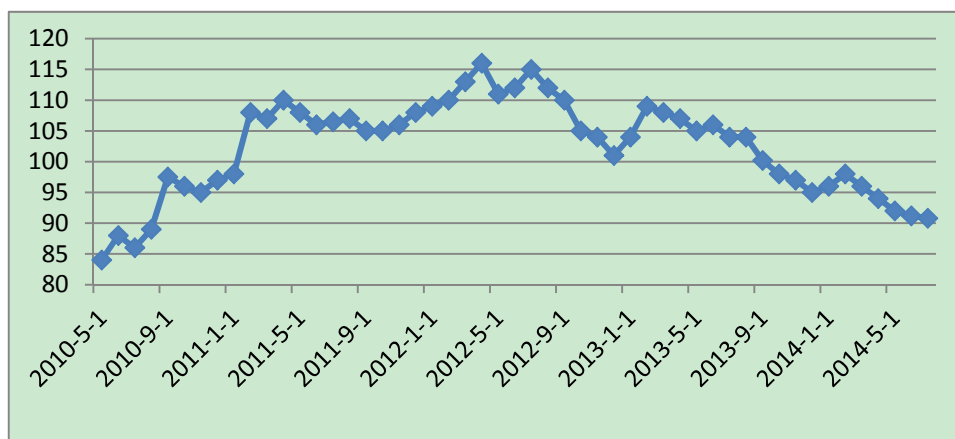| Sub-index	Value of weight assigned	Correlation coefficient
Index of changes in capital	0.33	0.76
Stock index	0.19	0.50
Resource index	0.29	0.69
Production index	0.19	0.26

Figure 3. The dynamics of the composite leading index of the Republic of Tatarstan

Considering that the IBA is constructed based on changes in external and internal markets, we can be fully confident that the developed model for the impact of external "impulses" on the development of the types of economic activity in particular regions analyzes the interrelationship between the external and internal markets of products turned out.

As an endogenous parameter in the model, we chose the volume of production.

Thus, this work aims to test the methodological principles of factoring in the impact of external "impulses" on the development of particular regional types of economic activity and to develop, based on them, algorithms for forecasting their development dynamics, as well as to determine the degree of exposure of the regional economic systems as a whole to external "impulses".

Criteria for constructing the economic-mathematical model were chosen from an available statistics base. The system of indicators does not contain expert indicators or indicators that are based on the results of surveying economic business entities.

Next, we shall present the concept of the impact of external "impulses" on the development of regional types of economic activity through the example of the chemical industry of the Republic of Tatarstan. We shall use it for the mid-term forecasting of the dynamics of production volumes in the examined type of economic activity factoring in the envisaged roadmap for Russia's entry into the WTO, as well as factoring in sanctional restrictions imposed by Western European countries and the US in 2014.

The econometric dependence for indicators is constructed against monthly data in the range of 2009-2014. The whole sample includes 65 observations (Table 2).

The results of assessing the system of equations are provided below:

$$P = 89.05 + 0.105P(-1) + 0.083IBA(-2) \quad (R^2 = 0.7821),$$

where

P is the rate of growth of chemical production (a smoothed series);

IBA is the rate of growth of the composite index of the region's business activity.

Table 2. A characterization of parameters of the statistical significance of an econometric equation that assesses the dependence of the dynamics of the production volumes of the chemical industry of the Republic of Tatarstan on external "impulses"

	Coefficients	t-statistics
Y – cross.	89.05	2.2301
P (-1)	0.105	2.1683
IDA (-2)	0.083	1.2508

The model lets us, based on a step-by-step algorithm for factoring in changes in exogenous variables, work out a forecast of the development of the types of economic activity under study through assessing their reaction to shock impulses (the reaction of economic agents on changes in the norms and rules of external trade activity (one's entry into the WTO), the imposition of foreign sanctions that envisage a system of economic and political restrictions, etc.).

Quite important and representative, in our view, is the assessment of coefficients under a factor that assesses the expectations of economic agents. Thus, if we calculate these values with a breakdown into a set of particular types of the region's economic activity, we can with a great degree of likelihood determine the extent of their reaction to external "impulses". Thereby, in essence, we can determine the level of the competitive capability of these types of economic activity and the region as a whole and forecast their future development factoring in shock impulses that are forming at the moment and will be forming in the future.

We shall next put together a scenario forecast of the development of the exogenous variables of the equation, as well as a methodological approach to the scenario forecasting of shock impulses.

The equation includes two variables, one of which is a lag variable that does not envisage making adjustments to the factual values of past periods. Thus, forecasting exogenous variables involves developing scenarios for the development of the region's business activity factoring in changes in the economic situation and shock impulses getting formed.

Since, according to the concept developed, the level of the region's business activity is calculated based on the assessment of a set of factors that determine it, there is a need for the scenario modeling of the development of the dynamics of the following parameters:

- The dynamics of changes in capital;

- The dynamics of changes in the stock index;

- The dynamics of changes in the resource index;

- The dynamics of changes in the production index.

Furthermore, the first group includes indicators characterizing changes in capital and forms the *index of changes in capital*:

1. The price of oil in the global market. A great influx of oil dollars leads to growth in solvent demand on the part of the budget, producers, and – through an increase in wages – consumers. A decrease in export proceeds, on the contrary, reduces the solvent demand of residents of the internal economy, which has an effect on the economy of the Republic of Tatarstan.

2. The index of consumer prices for the Eurozone. The indicator is calculated by Eurostat and is officially published on the website epp.eurostat.ec.europa.eu; it is expressed as a percentage against the previous month.

3. The rate for loans to non-financial organizations and the deposits of physical persons in the Russian Federation. The credit interest rate affects the accessibility of loans to business entities and lending to them. Theoretically, an increase in interest rates precedes a decline in production volumes.

4. Due to the fact that an increase in the rate impedes economic growth, one should include the growth of the credit interest rate in calculating the leading index with a reverse effect.

The second component of the composite leading index is the RTS stock index, the main indicator of Russia's stock market; it is defined in US dollars.

Other countries' experience shows that the stock index should be used in calculating the composite leading index, since it reflects the expectations of investors (above all, foreign) in respect of changes in the macroeconomic

situation. Besides, fluctuations in companies' capitalization level can lead to adjusting investment decisions, which, in turn, has an effect on the volume of output.

The third group of indicators forms the so-called resource index. It characterizes the internal reserve of the economy of the Republic of Tatarstan. This index includes the following indicators:

1. The rate of growth of extraction of fuel-energy mineral resources. In the production structure of the industry, mineral extraction accounts for a sizeable share and reaches 35% in different periods, which testifies to the substantial impact of this sector on the economy of the Republic of Tatarstan. The indicators of the volume of extraction of minerals are calculated on a monthly basis by state statistics agencies.

2. The volume of chemical production. Tatarstan's chemical and petrochemical industry accounts for almost 14% of the total volume of production in Russia's chemical complex, while in the structure of the republic's economy the industry ranks third (18.9%), behind just the fuel sector (32%) and machinery manufacturing (20.3%). Thus, there is a close correlation between the dynamics of the volume of chemical production and trends in the composite leading index.

3. The average-weighted price for the block of shares of leading enterprises in the raw-materials and processing industry of the Republic of Tatarstan (OJSC Kamaz and OJSC Tatneft). As we know, shares secure the right of their owners (shareholders) to receive a portion of the profits of a joint stock company, to take part in managing the joint stock company, and to claim a portion of property that is left after the joint stock company is terminated. Considering OJSC Kamaz's substantial share of production in the Republic of Tatarstan, we should note that changes in the price of Kamaz shares are of great significance for the Republic of Tatarstan. And OJSC Tatneft is one of the largest companies in Russia's oil-and-gas complex as well. Consequently, the growth of the average-weighted price for the shares of Tatarstan's leading enterprises can be underpinned by various events; it can also testify to the buoyancy of the financial state of the enterprise.

The fourth group of indexes that make up the production index includes:

1. The rate of growth of the volume of shipped goods of one's own production and works and services provided through one's own efforts. This indicator has a high coefficient of correlation with the reference indicator, i.e. the index of industrial production, in a 3-month lag. An increase in volumes of shipped goods helps infer that the sales market is expanding and the volume of output is, consequently, increasing.

2. The freight turnover of specialized automotive transportation enterprises. Growth in shipping products manufactured in the area's territory creates preconditions for increases in production volumes.

3. Commodity reserves in organizations as of the end of the period. Growth in reserves precedes a decline in output and testifies to difficulties with sales. Decreasing reserves indicates growth in demand, after which an increase in production should ensue.

3. Discussions

Our forecast of the dynamics of shock impulses was developed on an adaptive basis, based on analytical retrospective data for the reaction of indicators under study as a result of the emergence of "perturbations" caused by sanctional pressure, as well as by the coming into effect of norms regulating external trade activity in line with the rules and principles of the WTO.

This work examines two scenarios:

3.1 Pessimistic

3.1.1

The routine fulfillment of WTO norms and rules, which envisages a decrease in average-weighted import duty rates from 10% to 6.5-5% by 2015 in the chemical industry (considering that the transition period for liberalizing access to the market is normally 2-3 years).

3.1.2

The further augmentation of the sanctional helix on the part of a number of states within the global community in respect of Russia's institutional and economic development parameters.

3.2 Optimistic

This scenario differs from the first one in that what is envisaged here is a stage-by-stage decrease in the level of tensions between Russia and countries that have instituted sanctions in respect of the economic-political sphere of the Russian Federation.

Forecasting the dynamics of the shocks of liberalizing external trade, as a consequence of Russia's entry into the WTO involves adjusting the trajectory of the development of business activity in the region as a result of changes in main sub-indexes which determine this trajectory. Furthermore, in the event of long-term, strategic shock impulses there arises the effect of cumulative accumulation of the index that characterizes business activity. That said, of importance is the analysis of the dynamics of decrease in duties over time and the determination, based on this, of adjustments in the expectations of economic agents who conduct their activity within the frame of the type of economic activity under study.

At the same time, in the event of short-term impulses (sanctional pressure), there is also the need for assessing the modeling of the structural elements of the composite index of the region's business activity and determining, based on this, the dynamics of the integral indicator.

In developing the forecast of changes in the region's business activity, in scenario modeling we used the following parameters with a breakdown into particular enlarged groups of "external shocks":

1. Group 1. External shocks caused by decreases in tariff duties.

A 0.4% decrease for the quarter in the index of business activity matches overall the reaction observed in retrospective. Gains will be cumulatively accumulated as a consequence of the progressive ramping up of shipments of industrial output abroad as a result of tariff restrictions getting loosened or lifted.

2. Group 2. External shocks caused by sanctional pressure on Russia's economy.

A 0.8% drop in business activity for the quarter, which is also in line with the dynamics of the index of business activity in the first half of 2014 and looks like quite an adequate averaged reaction of the main components of the index of the region's business activity.

Having described the possible scenarios in terms of forecasting the dynamics of exogenous variables factoring in "shock" external impulses, let us address the developed econometric model with a view to working out a forecast of the dynamics of the development of an endogenous variable whose dynamics are determined, above all, by conducted assessments of the developed model and the dynamics of exogenous shocks. A forecast of the dynamics of production in the chemical industry of the Republic of Tatarstan for the two scenarios under examination is provided in Figure 4.
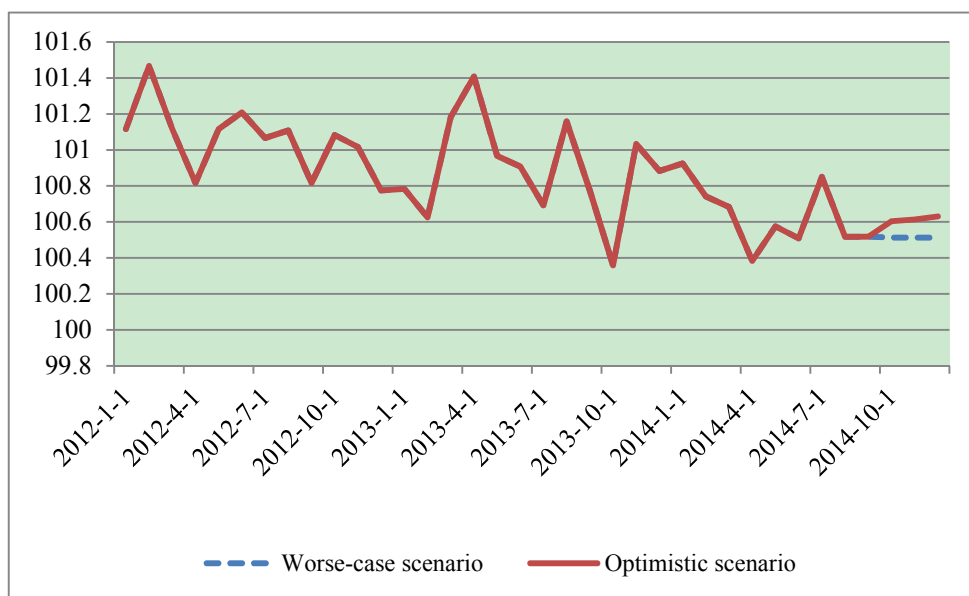

Figure 4. A forecast of the development of chemical production in the Republic of Tatarstan

4. Inferences

The results of the study indicate that the impact of "external" impulses will not have a substantial effect on the chemical industry of the Republic of Tatarstan in the short run. Considering that the value of the coefficient which assesses the reaction of production volumes in the chemical industry as result of adjusting business activity is not high (0.083), the impact of shock impulses does not have an effect on the production indicators of

the type of economic activity under examination. The results of the analysis and the resulting inferences are fully in line with the inferences published in the Report of the Coordination Council of the branches of the Russian Union of Industrialists and Entrepreneurs in Privolzhye Federal Okrug. In particular, it states that the expansion of the presence of foreign producers in the internal market will, above all, stiffen price competition, forcing one to reduce prices, and, consequently, affect the financial result and not volumes of industrial output. In addition, the report states that Russia's entry into the WTO will not have an effect on their position in the markets of the far abroad, and that they do not see any advantages and benefits for themselves.

That said, the pressure on the part of certain members of the global community on Russia's economic development in the form of sanctions has a more substantial impact within the forecast horizon under examination as it counter-balances and even suppresses the effects of joining the WTO which are positive for the type of economic activity under examination. That said, in the short run these shocks do not lead to significant adjustments in the production volumes of chemical and petrochemical enterprises in the Republic of Tatarstan.

In conclusion, we should note that the developed methodological approach helps assess the extent of the reaction of particular types of economic activity to the impact of shock "impulses" on the national and regional economic systems. Furthermore, the values of coefficients pointing to the elasticity of examined endogenous parameters as a result of current and future adjustments to the expectations of economic agents can in large measure testify to the degree of susceptibility of particular types of economic activity to various impacts. Consequently, we can judge the current and future levels of the competitive capability of not just the regional sectoral types of activity but that of the entire region as a whole.

Thus, the developed methodological apparatus helps forecast the economic development of particular regional types of economic activity factoring in the impact of external "impulses" on them, which forms sustainable bases for developing sectoral programs for the development and deployment of production forces factoring in the prospects for their development.

Acknowledgements

References

Ageyev, A., Kuroyedov, B., & Sandarov, S. (2008). A Strategic Matrix and Ratings for Russia's Regions. *Ekonomicheskiye Strategii, 7*(65), 116-121.

Davletshin, I. A. (2011). Modeling the Effective Management of Risks at Enterprises within a Region's Petrochemical Complex. *Mikroekonomika, 2*, 107-111.

Ermolaeva, P. O. (2014). Citizen (Dis)engagement during Assessment of Sports Mega-Events: The Case of the 2013 Universiade in Kazan, Russia. In *Impact Assessment and Project Appraisal*. Taylor & Francis.

Gafurov, I. R., Safiullin, M. R., & Safiullin, A. R. (2012). *An Analysis of Structural Chasms in the Competitive Capability of Production Operations within the Petrochemical Cluster of the Republic of Tatarstan*. Kazan: Kazan Universitet.

Galeyeva, G. M. (2012). Innovations as an Element of Strategic Management and Enhancement of the Competitive Capability of Enterprises within the Petrochemical Cluster of the Republic of Tatarstan. *Natsionalnyye Interesy: Prioritety i Bezopasnost, 36,* 46-51.

Granberg, A. G., & Mikheyeva, N. N. (2009). The Impact of the Global Crisis on the Strategy for the Spatial Social-Economic Development of the Russian Federation. *Region: Ekonomika i Sotsiologiya, 4*, 69-101.

Krasnova, O. M., & Galdina, A. A. (2012). Assessing the Non-Observed Economy in the Republic of Tatarstan. *Ekonomicheskiy Vestnik Respubliki Tatarstan, 4*.

Porter, M. E. (2000). *Competition. Saint Petersburg: Izdatelskiy Dom "Viliyams"*.

Program for the Social-Economic Development of the Republic of Tatarstan for 2011-2015. Retrieved from http://www.mep.tatar.ru

Report on the Results and Major Focus Areas of the Activity of the Ministry of Industry and Trade of the Republic of Tatarstan as of Year End 2010. Retrieved from http://mpt.tatarstan.ru/rus/info.php?id=122423

Report on the Results and Major Focus Areas of the Activity of the Ministry of Industry and Trade of the Republic of Tatarstan as of Year End 2011. Retrieved from http://mpt.tatarstan.ru/rus/info.php?id=122423

Report on the Results and Major Focus Areas of the Activity of the Ministry of Industry and Trade of the Republic of Tatarstan as of Year End 2012. Retrieved from http://mpt.tatarstan.ru/rus/info.php?id=122423

Safiullin, A. R. (2011). *Competitive Advantages (The Territorial-Sectoral Level).* Germany: LAP Lambert Academic Publishing GmbH & Co. KG.

Safiullin, M. R., Elshin, L. A., Prygunova, M. I., & Galyavov, A. A. (2013). Complex Analysis of Prospects of the Volga Federal District Regions Development: Methodology and Practice. *World Applied Sciences Journal, 27*(4), 508-511.

Safiullin, M. R., Yelshin, L. A., & Shakirova, A. I. (2012). Assessing Business and Economic Activity as an Instrument for Short-Term Forecasting. V*estnik Rossiyskoy Akademii Nauk, 7*, 623.

Safiullin, M. R., Yelshin, L. A., & Shakirova, A. I. (2013). Positioning Regions Based on the Composite Index of Social-Economic Attractiveness and Identifying the Points of Future Growth. *Ekonomicheskiy Vestnik Respubliki Tatarstan, 3*.

Sergeyev, P. B. (2010). *The Sectoral Aspects of Russia's Entry into the World Trade Organization (through the Example of the Copper Subsector)* (PhD thesis). Yekaterinburg.

The collection *Social and economic development of the Republic of Tatarstan in 2012*. Retrieved from http://mert.tatarstan.ru/rus/info.php?id=550305

The collection *Social and economic development of the Republic of Tatarstan in 2013*. Retrieved from http://mert.tatarstan.ru/rus/info.php?id=598890

Yermolayeva, P. O., Safiullin M. R., & Noskova, Ye. P. (2013). The Competitive Capability of the Oil-and-Gas Sector of the Republic of Tatarstan: A Sociological Interpretation. *Vestnik SGSEU, 5*.

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