Mathematical Evaluation of Managing the Investment Activity (The Example of Food Industry in the Republic Of Tatarstan)

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Abstract. Now, when the Russian economy entered a positive phase of the cycle in 2017-2018, with minimal losses to adapt to external shocks arising in previous years. Against the background of improving quantitative indicators in Russia and its individual regions, there is a deterioration in the structural parameters that characterize the quality of economic growth. There are certain methodological and organizational bases of regulation of investment activity in the region, making possible to research the investment efficiency evaluation, considering the time lag on the example of the food industry of the Republic of Tatarstan. The article discusses various mathematical approaches and methods of managing the selection of investment projects, macroeconomic factors that are forming the investing appeal of regions and industries.

1. Introduction

The urgent need to increase the pace of economic development is relevant both for Russia as a whole and for its regions, which demonstrate increasing inconsistency in territorial development. Strengthening regional aspects of managing the economy determines the need for the development and validation of methods and tools of state regulation of the economy that would be appropriate to modern conditions. The complicated situation in the investment field, also due to the sanctions policy, expressed not only in the narrow range of its revival (which includes mainly the export-oriented industries), but also in the uneven geographical distribution of investments. Under these circumstances, the development of investment activity is an important source of economic growth is largely dependent on the government's economic policies, including the regional level. Research in this area require an objective analysis of the essence, trends and issues of the state investment policy in the region, identifying its development directions and coordination of interests of investment activity subjects.
2. Materials and methods

There are certain methodological and organizational bases for regulating investment activities in the region. These are the concepts of economic development of the region, such as “The strategy of socio-economic development of the Republic of Tatarstan for the period up to 2030”; “Strategy of development of the Republic of Tatarstan’s agricultural sector for the period 2016-2021”, with the outlook for 2030. They aimed primarily at identifying and justifying priority areas for investment in the region, the formation of the main directions of regional investment policy.

The Republic of Tatarstan occupies the leading position in the National Investment Climate Rating in 85 regions of the Russian Federation, conducted by the Agency for Strategic Initiatives in four areas of research (business institutions, regulatory environment, infrastructure and resources, supporting small business) and includes 44 core and 33 additional indicators. According to preliminary data of the Territorial Body of the Federal State Statistics Service of the Republic of Tatarstan (Tatarstanstat), in January-September 2018, Tatarstan was in 1st place among the regions of the Volga Federal District, reaching 368.4 billion rubles [1]. Investments were made more in the fixed assets of manufacturing industries (35%) and mining (20%). The chemical and petrochemical industry and mechanical engineering occupy a significant share in the structure of the processing industries. The share of investments in the fixed capital of agriculture and food and beverage production was about 6%, which is significantly lower than the volume of investments in the republic's specialization sectors (Figure 1).

Figure 1 - Sectoral structure of investments in fixed assets, January-September 2018 [1].

Historically, the Republic of Tatarstan has a favourable geographical location, being in the very centre of the Volga region and occupying 2.3% of the country's agricultural land. Since 2000, the volume of gross agricultural output increased by more than 2 times the share of Russian production of agricultural products is about 4.6% (based on 2017) [2]. The share of the agro-industrial complex of Tatarstan together with the food industry accounts for about 12% of the gross regional product. The gross agricultural output of the region is among the top three in Russia. Moreover, undoubtedly, it is not the first year that the region has been the leader in the production of marketable milk, ranking first among the constituent entities of the Russian Federation.

The problem of food security is one of the main socio-economic goals and values of state policy and is put forward by many countries as a priority over military security. The growth of demand for crop
and livestock products in the world in the long term will be ensured by: population growth; promotion of a healthy lifestyle, which contributes to an increase in demand for crop products, in particular, vegetable production; urban lifestyle contributes to a change in diet towards increasing the energy value of products, which leads to an increase in consumption of livestock products [3]. The level of development of the regional food market has a direct impact on quality of life and overall socio-economic development of the region. In this regard, optimization of development of the food market is one of the priorities of the government, both at the federal level and at the level of individual regions. Food market operation mechanism based on the interaction objectively acting factors, phenomena and processes in the field of production, distribution, exchange and consumption of food.[4]. The functioning of this market is determined by the ratio of the population's needs, domestic production capacity and the development of inter-regional relations. However, it should also be noted that urbanization is associated with significant changes in the diet of a person above and beyond the price and income influence, usually by shifting food consumption towards sources that are more convenient, including purchases in supermarkets and food away from home, and often in the direction of greater reliance on more processed foods [5].

The agri-food industry comprises an integrated complex production chain, which ranges from the primary agriculture to the mature food and beverage sector. It is considered as one of the largest sectors worldwide with significant contribution to the economic advancement of nations and major social impact. While food corporations and individual farmers adapt their production to consumer expectations, international and governmental institutions promote the respect of the environment, protect medium- and/or small-sized farms and help agri-food producers [6]. Fostering agricultural growth can serve as a critical entry point for designing effective strategies to transform the rural economy [7] and investments in agricultural research for development (AR4D) are key to agricultural growth [8]. Evidence to date suggests that investment in agricultural research for development (AR4D) provides high economic returns [9].

As world experience shows, in modern conditions monitoring of food markets is becoming the main tool for analysing trends in market indicators (including purchasing and consumer prices, volumes of exported and imported products), focused on solving problems of their state regulation. Access to markets in developed countries has always been an important factor for success of the economy in developing countries [10].

The study of food markets involves the use of various theoretical and methodological approaches and tools, automated tools for processing different-quality information sources [11], the development of dynamic operational forecasts, contributing to their adoption of scientifically based managerial making and regulatory measures, taking into account the identified trends in the development of the regional food market, in determining the basic parameters of the market's perspective, the formation of regional government programs, providing food country security.

Ensuring the sustainability of the regional economic system is an urgent problem of the modern period of socio-economic development of the country. Structural economic management requires practical and reasonable tools to achieve target indicators of food security [12]. Ignoring the factors affecting the stability of the economic system, may lead to increased economic and social disparities, accelerating the decline in production, increased unemployment, inflation and, consequently, to the loss of economic and food security of the region and a sharp decline in living standards. However, the achievement of a state of security cannot happen by itself, automatically. State policy of regulation of natural processes must be grounded. It requires deliberate, systematic and ongoing work related to the diagnosis of sustainable development of regional economic systems.

The implementation of the Strategy of Agro-industrial Complex implies the development in the Republic of Tatarstan of a competitive vertically integrated cluster of the Agro-industrial Complex,
focused on high quality products and generation of added value, with the formation of basic subclusters
within it: “Grain”, “Sugar”, “Oil and Fat”, “Vegetable”, ”Fruitful”, ”Meat”, ”Dairy”, ”Aquaculture”,
as well as the formation in conjunction with the basic cluster of the Agro-Industrial Complex of a
separate innovation cluster “Eco-nutrition” [3].

The agricultural sector is traditionally a subsidized sector of the regional economy. This statement
is confirmed by analysis of the structure of investments in fixed assets of Agro-industrial complex
of sources of financing, which showed that significant support is provided by the regional authorities. In
this regard, we assessed the efficiency of investments in fixed assets of the agricultural sector. As the
criteria for assessing their efficiency was chosen index return on investment in fixed assets of the
agricultural industry and the profitability fluctuations within a certain time lag.

To do this, we introduce a relative indicator of variation “h”, showing the correlation between the
level of profitability and the degree of its variation. The coefficient of variation “h” is calculated by the
formula (1) and has a threshold value equal to or less than 30% (33%).

\[
h = \frac{\sigma}{PI_{cp}} \leq 30\% (33\%) , \quad (1)
\]

where - relative indicator of variation; \( PI_{cp} = \frac{1}{n} \sum_{i=1}^{n} PI_i \) - the average value of the return on
investment in fixed assets of the agricultural sector, taking into account the discounting; \( \sigma = \sqrt{D} \) -
standard deviation of profitability, where \( D = \frac{1}{n-1} \sum_{i=1}^{n} (PI_i - PI_{cp})^2 \) - dispersion.

Then, from the point of view of the investment potential of the industry, the higher the level of
profitability and the lower the degree of fluctuation, the more attractive the regional industry is for
investment. On the other hand, if the degree of fluctuation grows with the level of profitability, the
industry will be less attractive due to its instability. Therefore, given the obvious variability of
profitability, this approach is proposed, reflecting the correlation between the level of profitability and
the degree of its fluctuations. The advantage of this approach is that it allows you to estimate the rate of
fluctuation.

That is, if the indicator of variation (h) is above 30% (33%), then the industry can be rated as less
attractive for investment, despite the high profitability. Therefore, investments in fixed assets of the
agricultural sector are assessed as inefficient. Thus, when assessing the effectiveness of investments,
stability of profitability is preferable, which can be objectively assessed by the magnitude of the
coefficient of variation and its comparison with the threshold value.

Profitability index was determined by the formula (2) as the ratio s discounted cash flow return
of income for the initial investment, taking into account the discount rate of 15% and a two years’ time
lag.

\[
PI = \frac{PV}{I} \times 100\%; \quad (2)
\]

where \( PI \) - Index of profitability of investments in fixed assets of the agricultural industry,\%;
\( PV \) - the accumulated value of the discounted income of the agricultural industry, rubles; \( I \) - the volume
of investments in fixed assets of the agricultural sector, rubles;

Then, if the value of the criterion PI > 1, then investments in the regional industry are profitable
and provide profitability at the level of the accepted discount rate. Moreover, conversely, when PI < 1 -
unprofitable. When \( PI = 1 \), the value of the net present value is zero and the investment does not generate income.

The accumulated value of discounted income (PV) is determined by the formula (3):

\[
PV = \sum_{i=1}^{n} \frac{CF_i}{(1 + r)^t},
\]

(3)

where \( CF_i \) - balanced financial result of activities of organizations of the region of the agricultural industry in the period \( t \), rubles; \( r \) - discount rate,\%; \( n \) - the number of researched periods; \( t \) - time (investment) lag;

According to estimates of the investment lag based on the Domar formula and distributed lag models, produced by D.A. Liokumovich and E.A. Rutkovskaya [13], for the agricultural industry lag \( \leq 2 \) years. In our calculations, the lag coefficient has a value of two.

Thus, taking into account the smoothing procedure based on the moving average method (we chose a three-position smoothing system), we found that the average level of return on investment in the agricultural sector is 1.29%. Of course, the indicator exceeds the rate of profitability, but not by far.

Further, according to the formula (1), we define the standard for the fluctuations of the researched investments and estimate their effectiveness:

\[
PI_{cp} = \frac{1}{9} \sum PI_i = 1.29 \%;
\]

\[
D_{C,X} = \frac{1}{n-1} \sum_{i=1}^{n} (PI_i - PI_{cp})^2 = 0.24; \quad \sigma_{C,X} = \sqrt{0.24} = 0.49 \%;
\]

\[
h_{C,X} = \frac{0.49}{1.29} = 0.3798 = 37.98 \% \approx 38 \%.
\]

Thus, while protecting the source data from accidental impacts, the level of variability of investments in the agricultural sector was 38%. The variability of the indicator, though it is more than the normal value \( h \leq 30 \% \) (or 33%), but the proximity of the indicator to both boundary values allows to qualify it as “quasistable”. This indicates a trend in the profitability of investments in the agricultural sector, which has a slight fluctuation and demonstrates the relatively stable development of this industry (Figure 2).
3. Results.

Thus, despite the relatively low, but relatively stable profitability, investments in fixed assets of the agricultural sector can be evaluated relatively efficiently. However, in such a situation it is necessary to increase the efficiency of investments in agriculture of the republic. According to the Minister of Agriculture and Food of the Republic of Tatarstan, the promising areas for investment in this area are the “construction of livestock farms for the production of milk and meat, greenhouses for vegetables cultivation, creation of breeding and genetic and logistic centers for the processing of agricultural products, construction feed mill for animal husbandry and fish farming” [14].

As an integrated and systematic approach to the strategic objectives of socio-economic development of regions, some of its complexes considered program-target method of management based on the principles of systematic and strategic planning [15].

Based on systematic and strategic planning conceptual scheme for food complex there is developed strategic map, which implements the principles of regional regulation of investment activity of the industrial complex. The specificity and modern level of the process of the formation of regional development programs leads to the conclusion about the need to develop methods for developing and implementing programs, which should, in addition to the fundamental principles of program management, take into account: target orientation and systematic approach (classification of projects and programs in three groups (economic development programs, destination and social), enables the application programs for the first two groups, previously informed criteria EV selection of effective projects); inter the connection of the regional development programs with the hierarchy and quantitative certainty of the strategic goals, formulated in accordance with the methodology of the balanced scorecard; resource availability of programs (in accordance with the developed concept, projects are included in the regional investment development program only if the resources of the regional budgets are used as incentives for each project); manageability of the program (the presence of the necessary set
of legal acts, the recognized criterion of management efficiency, a single management body, management information support, feedback and monitoring).

Strategic goal setting includes the following sequence:
1. The formation of the core of the food complex.
2. Determination of strategic priorities for sustainable and competitive development of the food industry.
3. Determination of the range of food complex enterprises to be modernized and restructured.
4. Elaboration of the concept of sustainable, competitive and lean development of branches of the food industry.
5. Identification of redundant and obsolete enterprises.
6. Regulation of markets for agricultural raw materials and food

The formation of a macroeconomic environment, namely the mobilization of innovation and investment reserves, such as the development of extrabudgetary structures to create favorable conditions for the emergence and effective operation of innovation (venture) firms, is of great importance; processes for strategic marketing, R & D, organizational, technological, economic and operational preparation of production, production and design of innovations, their introduction (or transformation into innovation) and distribution to other spheres (diffusion); stimulating domestic demand for domestic food; improvement of customs policy (expeditious adjustment of duties and excises, cancellation of ineffective duties, implementation of the principle of escalation of customs duties). This set of measures certainly requires the formation of the institutional and organizational prerequisites for a regional food industry development policy:

- Formation of the system of state (regional) institutions, development banks, support of domestic exports, investment insurance agency.
- Making public investments:
- Implementation of competitive public procurement, rationalization of the structure of public investment, prioritization of public investment programs;
- State support of programs for the renewal of fixed assets at the expense of the federal budget through state exchanges;
- Creating and ensuring the functioning of the system of state functioning of the system of state information support.

4. Conclusions

Thus, the most important role in ensuring sustainable socio-economic development of the territories belongs to the constituent entities of the Russian Federation. The basis of economic growth and improving the welfare of the population are investments. Their scale and results of use can be significantly influenced by government, affecting the conditions and factors of investment activity.

Thus, the agri-food complex has an impact on the quality of life of the population, food security, on the social and environmental situation. Agro-industrial complex of the Russian Federation over the past decades continues to remain in a state of instability. In the context of the sanctions policy of food security is essential and integral part of the national government and, primarily, of economic security. In this capacity, the Agro-industrial complex of the state characterizes the economic sustainability and political independence of the existing system. The most important role and significance in the formation of industry clusters, intraregional and interregional markets, is the development and implementation of the development strategy, which aims to strengthen and expand economic ties within the region and between regions.

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