Competitiveness Review

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Abstract

Purpose – This paper aims to investigate the competitiveness of Russian regional medium-sized oil complexes with relatively small fossil oil reserves. Taking into account the urgency for competitiveness, the authors have developed a specific assessment methodology and competitive development strategy that could be implemented within the framework of a scenario approach.

Design/methodology/approach – The suggested methodology for assessing the competitiveness of regional production complexes is based on the pattern method. Validation is provided for a modular structure and an approach to constructing indices of competitiveness of production complexes. A system of competitiveness indicators has been devised in relation to regional oil complexes.

Findings – The case study of the oil complex of the Republic of Udmurtia has yielded competitiveness assessment forecast for a variety of development scenarios up until 2025. A methodology of competitiveness assessment is proposed as a result of the analysis of the two cases.

Research limitations/implications – This analysis is based on the oil complex in Udmurtia, Russia. The main limitation of the research scope is the extent and nature of the industrial complex. The proposed design can be used for large industrial complexes operating in the field of industrial production. It needs to be extended to more clusters, more industries and other countries' settings for the sake of comparison and generalization.

Practical implications – The practical effects of the study suggest a set of strategic development tools of assessment of the dynamics of industrial complexes' development, identification of competitive advantage and "bottlenecks" and definition of the objectives and programs of their long-term development and justification of policies and programs of perspective development.

Originality/value – This paper reveals specific features of oil complexes' competitiveness, which has seldom been investigated both theoretically and empirically.

Keywords Development scenarios, Predictive assessment, Oil complex, Competitiveness, Competitiveness indicators, Russia, Production complex, Territorial production system

Paper type Research paper

Introduction

Many scholars and practitioners show that in market-based economic models, competition is the major driving force that coordinates the activity of market players by balancing the proportions of social production and creating opportunities for the maximum satisfaction of stakeholders needs (Belyaeva, 2013) and the best employment of resources in society as a whole (Porter, 1990, 1998). Thus, the competition is the engine of the development and successful functioning of modern economic systems. Furthermore, competition affects economic entities, generating the need to ensure their competitiveness which is the key characteristic of their ability to develop and perform successfully. This gives rise to a major scientific and practical problem of ensuring the

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competitiveness of economic entities and shaping competitive strategies of their development.

In today's conditions when competition is getting tougher, traditional approaches to maintaining competitiveness regarding the building of competitive strategies of individual companies are giving way to approaches that focus on increasing the competitiveness of major production complexes that group a substantial number of companies and organizations and whose scale of activities often spreads beyond the borders of a specific country or region (Aiginker, 1998; Badinger, 2013). As a rule, the activity of such complexes (or their major integral parts) is connected with the formation of territorial production associations. Therefore, the study of national competitiveness focuses not only on industry complexes but also on territorial production systems (henceforth TPS) that, on the one hand, include a strong production complex integrating key enterprises (firms) that manufacture its core products and whose performance results determine operational conditions and welfare of all companies making up the TPS: those making semi-finished products and components for its main production line, as well as companies providing maintenance and support and supplementary services. On the other hand, TPSs include organizations that provide information, consulting and other services for supporting the operations of its key production units, financial institutions (banks and other lenders, insurance companies, etc.), research and design and engineering organizations and the like. Finally, TPSs have to incorporate the so-called territorial institutions in the form of various government agencies and social protection services.

Literature on competition and competitiveness

Competitiveness is the key characteristic of economic entities from the point of view of their operation in a competitive environment. There is no standard or universal approach to measuring the competitiveness of socio-economic systems. This is, in the first place, due to varying competitive conditions in different countries and markets, qualities of the object of analysis and the unique conditions that shape its competitive advantages, national financial and statistical reporting standards, the scale of activity of the socio-economic system and a number of other attributes. One of the key requirements for measuring the competitiveness of a socio-economic system is the possibility to obtain quantifiable indicators as well as a composite (integral) competitiveness index based upon a set of indicators. This index and its components, in turn, become the main criteria for evaluating the operation success (or failure) and development prospects of the socio-economic system.

Our approach to evaluate the TPS that incorporates, on the one hand, a strong production complex – the core of the system – whose performance results have a critical impact on the entire system. Another crucial operational factor for any TPS is location that implies the geographical proximity of various elements (parts of a TPS), which, in turn, provides for lower production costs and, consequently, enhanced competitive advantages of products, thanks to shared technological, research, educational and social infrastructure (Enright, 2002). A system like this, therefore, calls for designing an individualized methodology for assessing its competitiveness.

Speaking about TPSs as an object of analysis, it should be noted that the optimum type of TPSs (in terms of ensuring competitiveness and creating further competitive advantage) in the current situation is the cluster that is defined as a geographical concentration of related firms, specialized suppliers, supporting service providers, firms in related branches and related institutions (e.g. universities, standardization agencies and trade associations) in which both competition and collaboration takes place (Porter, 1998).

The concept of clusters as an optimal business model and their competitive advantages was validated in the works of many leading scientists, including Enright (2002), Swedish economists Solvell *et al.* (2003), Danish scientist Lundvall and Johnson (1994), Norwegian economists Asheim and Isaksen (2002), British scientist Dunning (1993) and many others. It is worth noting that despite certain differences in the definition of clusters, their structure and the mechanisms of cluster formation, most academics and practitioners agree that the key feature of clusters from the point of view of their competitiveness and further competitive advantages is the possibility and a deliberate policy of competition among its constituent elements. Stated differently, constant competition among companies, organizations, financial institutions, etc. making up a cluster is a prerequisite for its functioning and development.

If we apply all the above to modern Russia, however, it could be said that there are no proper clusters in this country, primarily because competition among individual elements forming TPSs is either weak or nonexistent. We, therefore, believe that it is premature to take clusters as an object of analysis. This, in turn, makes it impossible to directly use the cluster approach to study and develop Russian TPSs and calls for the creation of a separate country-specific method as part of addressing the task of boosting the competitiveness of regional production complexes in Russia (Krivorotov *et al.*, 2011).

When creating a methodological approach to competitiveness assessment of a production complex (within the corresponding TPS), it is necessary to say that the overwhelming number of existing frameworks aims to generate an integral index of competitiveness that aggregates its various aspects and characteristics. It should be noted that competitiveness assessment methods applicable to various entities (from standalone companies to big corporations, regions and states) and frameworks for building competitive strategies and advantages, assessing competition effects, etc. have been extensively developed in the works of many scholars with regard to modern socio-economic systems. In addition to the aforementioned literature, credit should given to many other scholars, such as Carpenter *et al.* (1988), Krugman (1994), Nickell (1996), Nachum *et al.* (2001), Beggs and Klemperer (1992), Lau (1982), Schmidt (1997), Goldberg and Knetter (1999); Kadiyali *et al.* (2001), Lipovatz *et al.* (2000), Blakely (2001), Ahn (2002), Przybyla and Roma (2005), Putsis and Dhar (1998); Cotterill *et al.* (2000), Roberts and Samuelson (1988), Shankar and Bayus (1999), Peteraf (1993), Aiginker (1998), Brooksbank and Pickernel (1999), Camagni (2002), Clark *et al.* (2005), Reinert (1994), Borg (2009), Badinger (2013).

Despite the relatively thorough elaboration of competitiveness assessment methods, they have certain downsides. Some of them are structured below:

- many of the methods assess competitiveness in terms of investment climate with regard to the object of analysis, which considerably narrows down the task being addressed and, consequently, the obtained solutions as they miss out many aspects of competitiveness and its essential components;
- in many cases, the methodological approaches are based on scoring and expert evaluations, making the results fairly conventional with a high degree of subjectivity that is typical of such assessment; and

- in some cases, the proposed frameworks lack comprehensiveness, as they are limited to assessing only individual competitiveness characteristics of the object of research.

Therefore, today, there is no universal methodological apparatus that would provide for a comprehensive in-depth competitiveness assessment of a production complex to reveal and develop its competitive advantages and eliminate (rectify) weaknesses. The development of a methodology for a comprehensive in-depth competitiveness assessment of a production complex within a territorial production complex, thus, becomes one of the critical tasks of ongoing research on competitiveness (Krivorotov *et al.*, 2014). Another important task of applied studies in this field is to adapt the methodology to specific conditions of production complexes taking into account their production profiles and competitive environment.

Methodology of measuring the competitiveness of a production complex

By the competitiveness of a production complex as a multifaceted socio-economic system we mean the ability of the production complex as whole and of its key companies to maintain and ensure a steady growth of their economic performance results and to maintain an acceptable quality of life and level of income in the territory where they operate.

The central module of the research is a system of methods for measuring the competitiveness of production complexes comprising an integral competitiveness index that combines various characteristics of the production complex, prospects and possibilities for its development and living standards of the population (Krivorotov *et al.*, 2011).

The integral index of competitiveness – C_{PC} – that is calculated on the basis of the sum total of all competitiveness indicators:

$$C_{PC} = \sqrt[n]{\prod_{i=1}^{n} C_{PC,i}}, \qquad (1)$$

where $C_{PC,i}$ is the indicator reflecting the competitiveness of operational aspects of the production complex.

C_{PC} and its elements provide the basis for devising initiatives and programs aimed at increasing the competitiveness of the production complex and its constituent parts. The indicators provide critical information to potential investors' decision-making.

The calculation of $C_{PC,i}$ is based on matching the indicators of the production complex's competitiveness against corresponding indicators of the baseline (benchmark) model:

$$C_{PC,i} = \frac{V_{PC,i}}{V_{base,i}}, \qquad (2)$$

where $V_{PC,i}$ is the value of the indicator i of the competitiveness of the production complex; $V_{base,i}$ is the benchmark value of the competitiveness indicator i.

When using equations (1) and (2), the baseline (benchmark) model of the production complex has C_{PC} and $C_{PC,i}$ equal to 1. In this case all values of $C_{PC,i}$ exceeding 1 signify a level of competitiveness that is higher than that of the benchmark model. $C_{PC,i}$ below 1 means that the competitiveness of the production complex is lower than that of the benchmark model.

Indices of competitiveness of production complexes are proposed to be constructed within a system of modules. The proposed method outlines two major modules of indicators:

(1) *A module of indicators of competitiveness of a production complex* (C_{m1}) *that includes the following:*
   - index of the natural resource capacity and available mineral reserves of the production complex (C_{PC1});
   - an index of market demand for key products of the production complex (C_{PC2});
   - an index of the operational efficiency of the core companies of the production complex (C_{PC3});
   - an index of production and financial capacity (C_{PC4});
   - an index of innovation performance and the novelty of products (C_{PC5});
   - an index of environmental safety and energy efficiency of the companies making up the production complex (C_{PC6}); and
   - an index of restrictions and risks to the development of the production complex (C_{PC7}).

(2) *A module of indicators of competitiveness of territorial infrastructure and social environment* (C_{m2}) *includes*:
   - an index of infrastructure and service sector development (C_{PC8});
   - an index of the state of the social environment and demographic potential of the home area of the production complex (C_{PC9}); and
   - an index of limitations and risks to the development of the territorial complex (C_{PC10}).

Each of the above measures includes a certain number of components that create a detailed model of the production complex's competitiveness. Over 50 individual measures of competitiveness are considered within the method. Below is the description of the make-up of the competitiveness indices listed above.

An index of the natural resource capacity and available mineral reserves of the production complex (C_{PC1})

The index supposes that the better the production complex is supplied with natural resources and mineral reserves, the more competitive it is and the more appealing it is to external investors. It is suggested that the following components of the indicator in question that characterize various types of natural resources and geographical conditions should be singled out:

- *The availability in the home territory of its own fossil fuel reserves* (C_{FR}): The measure is taken into account if the production complex specializes in the extraction or processing of fossil fuels. If the production complex is not engaged in these kinds of businesses, the measure is excluded from the calculation of the indicator C_{PC1}.

- *The availability in the home territory of ore reserves* (C_{OR}): The measure is taken into account if the production complex actively uses ores in making its end commodities or specializes in extracting and processing various ores. If ore deposits do not play a significant role in the operations of the production complex, the measure is ignored.
- *The availability in the home territory of other types of mineral resources* (C_{MR}): Similar to previous cases, the measure is only taken into account when these types of resources are critical to the operation of the production complex such as natural and geographic conditions (C_G).

Given the fact that different components of the index C_{PC1} can have a different degree of impact on the operation and development of the production complex, as well as a fairly big "spread" between their weights (some of the measures might be close to zero, while some of them, on the contrary, can be of high value), the resulting indicator is supposed to be calculated on the basis of the arithmetical mean according to the equation:

$$C_{PC1} = \frac{1}{N_{inc}} \sum_{j=1}^{N_{inc}} C_{PC1,j}. \qquad (3)$$

where N_{inc} is the number of the components of the indicator C_{PC1} that is being taken into account;

$C_{PC1,j}$ is the value of the relevant competitiveness factor that is included in C_{PC1}. $C_{PC1,j}$ is represented by C_{FR}, C_{OR}, C_{MR} and C_G.

The algorithm for calculation of individual components of the C_{PC1} index and the peculiarities and rules of their application for determining the aggregate competitiveness indicator of the production complex (C_{PC}) are discussed in previously published papers by the authors (Krivorotov *et al.*, 2011).

Index of market demand for the core products of the production complex (C_{PC2}*)*

The key measure of market demand for core products and market saturation is price dynamics. Therefore, for product *k* manufactured by the production complex, the following equation can be drawn up for calculating the competitiveness indicator measuring the market demand for it ($C_{MD,k}$):

$$C_{MD,k} = \frac{I_{price,k}}{I_{bas.price.}}, \qquad (4)$$

where $I_{price,k}$ is the mean price index for core product *k* of the production complex in an integral period (usually three to five years, rarely one year), in per cent. Calculating the index $I_{price,k}$ for a fairly long integral period makes it possible to exclude the influence of accidental market volatility that can be brought about by random factors or short-term movements in external development conditions; $I_{bas.price.}$ is the baseline price index for the period, in per cent. As a rule, the index is represented by the Industrial Product Price Index.

The resulting indicator (C_{c2}) is defined as follows:

$$C_{PC2} = \sum_{k=1}^{N_k} C_{MD,k} \cdot b_k. \quad (5)$$

where b_k is the weight (significance) of end product k in the operation of the production complex, expressed in arbitrary units.

Index of the operational efficiency of the core companies of the production complex (C_{PC3})

The operational efficiency index is calculated on the basis of a method of measuring the competitiveness of an enterprise that was previously used by the authors. According to the method, operational efficiency of an enterprise is defined as the ratio between revenue and production costs. When adapting the index to production complexes, the calculation of the C_{PC3} index can be broken down into the following two steps:

(1) a combination of the core companies of the complex is identified as well as the types of business activity they are involved in (the latter is done when there are two and more core companies engaged in a particular business activity); and

(2) an operational efficiency index is calculated for each of the identified types of business activity which is calculated as the following ratio:

$$O_{eff,j} = \frac{V_{sales,j}}{Z_{sales,j}}, \quad (6)$$

Here, $V_{sales,j}$ is the revenue from the sales of output from dominant activity j, expressed in monetary units;

$Z_{sales,j}$ is the cost of production and distribution of products for dominant activity j, expressed in monetary units.

For real-term calculations, the index C_{TPC3} is broken down into two components: the individual index of operational efficiency ($C_{eff.ind}$) and the general index of operational efficiency ($C_{eff.gen}$) of the core companies of the territorial production complex that differ in the approach for determining the reference value.

When calculating $C_{eff.ind}$, the average index of operational efficiency of leading manufacturers forming the competitive field in the selected business activity is assumed as the reference value for measuring competitiveness. For $C_{eff.gen}$, the average index of operational efficiency of the entire sector that all constituent companies of the production complex are engaged in (manufacturing, agriculture etc.) is assumed as the reference value.

The index of production and financial capacity (C_{PC4})

According to the suggested method, the index includes the following two components:

(1) economic performance of the home territory of the production complex (C_{EP}). It is usually determined through the gross product per capita ratio;

(2) workforce productivity in the dominant types of business activity of the production complex (C_{WP}).

Thus, the C_{PC4} index is calculated by the equation:

$$C_{PC4} = \sqrt{C_{EP} \cdot C_{WP}}. \tag{7}$$

Index of innovation performance and the novelty of products (C_{PC5}*)*

The index reflects one of the key aspects of the production complex's competitiveness because, today, the survival and successful performance of most companies directly depend on their innovation progress and the degree of novelty of their products or services. The index C_{PC5} is made up of the following five steps:

(1) an indicator of spending on innovation in the constituent companies of the production complex ($C_{inn.fund}$);
(2) an indicator of novelty of the products of the complex ($C_{inn.pr.}$);
(3) an indicator of the state of capital assets and the up-to-dateness of technology and production cycles that are used by the constituent companies of the production complex (C_{tech});
(4) an indicator of the renewal capability of the core companies of the complex (C_{ren}); and
(5) an indicator of personnel capacity to embrace advances in science and technology ($C_{inn.hr}$).

The index C_{PC5} is, therefore, calculated by the expression:

$$C_{PC5} = \sqrt[5]{C_{inn.fund} \cdot C_{inn.pr} \cdot C_{tech} \cdot C_{ren} \cdot C_{inn.hr}}. \tag{8}$$

The indicator of spending on innovation in the constituent companies of the production complex ($C_{inn.fund}$) is usually calculated on the basis of the share of innovation costs in the total output of the dominant companies of the complex.

The indicator of novelty of the products of the complex ($C_{inn.pr}$) is calculated on the basis of two individual indicators:

$$C_{inn.pr} = \sqrt{C_{inn.adv} \cdot C_{nov.adv}}, \tag{9}$$

where $C_{inn.adv}$ indicates the degree of innovation in products expressed in arbitrary units; and

$C_{nov.adv}$ is the indicator of the degree of novelty of products expressed in arbitrary units.

The $C_{inn.adv}$ indicator is calculated on the basis of the share of innovative products (services) in the total output. As for the $C_{nov.adv}$ indicator, it is determined by expert assessment. Under the suggested methodological framework, experts rate appropriate criteria on a scale of 1 to 20, where 1 is the lowest level of competitiveness and 20 is the highest level. The board of experts consists of production engineers, researchers and analysts who specialize in the corresponding industry. To improve the objectivity and credibility of assessment, special methods might be used for organizing the work of experts. It is recommended that the score of 12 should be used as the baseline assessment of any parameter that meets a certain standard level of competitiveness in a majority of companies (organizations).

The indicator of the state of capital assets and the modernization of technology and production cycles that are used by the constituent companies of the production complex (C_{tech}) is computed through two components:

$$C_{tech} = \sqrt{C_{FPA} \cdot C_{tech.adv}}, \tag{10}$$

where C_{FPA} measures the state of fixed production assets, defined in arbitrary units; and $C_{tech.adv}$ indicates the technology modernization level and production cycles used by the constituent companies of the production complex, expressed in arbitrary units.

The indicator of the renewal capability of the core companies of the complex (C_{ren}) can be broadly defined as the ratio between an average development period for a new product and an average length of time it has been in the market. But, in practice, the approach is hard to apply, so expert assessment is used for calculating the C_{ren} indicator.

Similarly, the indicator of personnel capacity to embrace advances in science and technology ($C_{inn.hr}$) is determined through expert analysis for the entire production complex (as one system bonded by production, financial and structural ties and working for a common result).

Index of environmental safety and energy efficiency of the companies making up the production complex (C_{PC6}*)*

The index C_{PC6} includes the following three key components of competitiveness:

(1) energy intensity of the territorial economy and core companies of the production complex (C_{energy});

(2) the environmental performance index of the core companies of the production complex (C_{env}); and

(3) the measure of the assimilative capacity of the territory (C_{AC}).

$$C_{PC6} = \sqrt{C_{energy} \cdot C_{env} \cdot C_{AC}}. \tag{11}$$

For practical calculations, it is useful to split the indicator C_{energy} into two components, as has been done with some of the other indicators:

- total energy intensity of an economy ($C_{energy.tot}$); and
- energy intensity of a specific production complex ($C_{energy.ind.}$).

$C_{energy.tot}$ defines the energy intensity of the entire economic system in the home territory of the production complex. Therefore, for calculating $C_{energy.tot}$, an account of indicators showing the consumption of fuel and energy resources by the core companies of the production complex (its dominant types of business activity), as well as the same measures in allied manufacturers, companies incorporated in other production complexes (that are not related to the one being analyzed), service industries, the welfare sector, etc., should be taken.

Unlike $C_{energy.tot}$, $C_{energy.ind}$ is calculated only for the dominant companies (types of business activity) of the production complex.

The index C_{env} broadly measures the environmental impact of the core companies of the production complex. Today, the environmental performance of industry is becoming crucial for the sustainable development of different countries. Given that the environment is impacted through a number of media, it is possible to single out the following three components in the index C_{env}:

(1) environmental performance of the core companies of the production complex in terms of their impact on air quality ($C_{env.air}$);

(2) environmental performance of the core companies of the production complex in terms of their impact on water quality ($C_{env.water}$); and

(3) environmental performance of the core companies of the production complex in terms of water generation and consumption ($C_{env.waste}$).

In practice, though, only the first two components are often taken into account when measuring the competitiveness of production complexes. As for $C_{env.waste}$, it is only estimated for production practices that generate solid waste in an amount that makes a substantial contribution to the overall impact of the core companies of the production complex on the environment.

To measure the indices $C_{env.air}$ and $C_{env.water}$, numerous factors and parameters should be taken into account (e.g. the composition of pollutants, how hazardous they are to living species, the "accumulated" pollution level in the home territory of the production complex, etc.), which will inevitably result in relatively complex and bulky methods for computing the considered indicators. Moreover, much of the input data that are required for the calculations are not supported by statistics reporting systems, while some of the components are probabilistic estimates, which makes calculating the indices even more difficult. For this reason, simplified algorithms are used for practical aggregate calculations of the indices $C_{env.air}$ and $C_{env.water}$. As a rule, this proves enough for the holistic assessment of the production complex's competitiveness in the context of all indicators considered by this method. The suggested method allows (provided that all necessary input data are available) a detailed measurement of individual environmental performance indices.

Another issue is what should be adopted as baseline values of competitiveness indicators when calculating the indices $C_{env.air}$ and $C_{env.water}$. It is recommended to use similar data from the world's most developed economies as baseline values for the indices in question.

The measure of the assimilative capacity of the territory (C_{AC}) defines the competitiveness of the production complex in terms of environmental quality. For a general case, it is defined as the ratio (Belik, 2008):

$$C_{AC} = \frac{ELC}{FP}, \tag{12}$$

where *ELC* is the environmental load capacity of the territory that reflects the regeneration capacity of an ecosystem and is equal to the maximum anthropogenic impact that all recipients and ecosystems of the territory can sustain in the long term without damage to their structural and functional characteristics, expressed in conventional tonne per year (Akimova and Moseykin, 2009); *FP* is the ecological footprint in the area, in conventional tonnes per year.

It is recommended that ELC should be computed using the method by Akimova and Khaskin (2009). Alternatively, the energy approach (Akimova and Moseykin, 2009) could be used in which the assessment is performed through the integral criterion of the maximum allowable energy load.

Index of risks to the development of the production complex (C_{PC7})

Restrictions and risks that are factored in when computing C_{PC7} as well as their calculation algorithms are specific to each production complex. It is possible, however, that the restrictions and risks are minimized and are not taken into account in practical calculations. In this case $C_{PC7} = 1$. In the general case:

$$C_{PC7} = \sqrt[M]{\prod_{i=1}^{M} C_{risk,i}}, \qquad (13)$$

where $C_{risk,i}$ indicates the competitiveness of the production complex with regard to risk (restriction) i to the development of the production complex, expressed in arbitrary units; M is the number of risks (restrictions) that are taken into account as affecting the development of the production complex.

The risk factors include and are not limited by the level of corruption, the size of a shadow economy, fuel and power supply restrictions, high seismic activity in the home territory of the production complex and the probability of man-made disasters.

Index of infrastructure and service sector development (C_{PC8})

Infrastructure plays the most crucial role in the operation of any production complex, effectively creating economic and living conditions. In view of the numerous aspects of infrastructural development, the index in question could be broken down into five key components:

(1) availability of transport and transportation routes (C_{transp}). The indicator primarily measures the quality of road and rail networks;

(2) quality of power grids and power supply systems (C_{grid});

(3) quality of information technology and telecommunication systems (C_{IT}); estimated on the basis of the quality of mobile phone services and internet connection;

(4) availability of education (C_{ed}); and

(5) availability of and access to health care facilities (C_{health}).

Because all the aforementioned indicators are equally important from the point of view of the production complex's competitiveness and all of them must be in place (have non-zero values), the aggregate index (C_{PC8}) is defined by the equation:

$$C_{PC8} = \sqrt[5]{C_{transp} \cdot C_{grid} \cdot C_{IT} \cdot C_{ed} \cdot C_{health}}. \qquad (14)$$

Index of the state of the social environment and demographic potential of the home territory of the production complex (C_{PC9})

The C_{PC9} index includes the following four components:

(1) an indicator of trends in the age and gender composition in the home territory of the production complex (C_{age});

(2) living standards and wealth of the population in the home territory of the production complex (C_{wealth});
(3) an indicator of the labor market (C_{LM}); and
(4) an indicator of the quality of life and well-being of the population (C_{LQ}).

The aggregate index C_{PC9} is defined by the equation:

$$C_{PC9} = \sqrt[4]{C_{age} \cdot C_{wealth} \cdot C_{LM} \cdot C_{LQ}}. \quad (15)$$

The obtained solutions will determine the quality and objectivity of measurements and, consequently, of proposed activities and recommendations.

Measuring competitiveness of Russian medium-sized regional oil complexes

The methodological approach proposed above was tested for assessing the competitiveness of Russian regional oil complexes. The central object of analysis was the oil complex of the Republic of Udmurtia that has relatively small oil reserves, low oil production (less than 10 to 15 million tonnes a year) and mature oil fields. For oil complexes like this one, the task of securing and maintaining a high level of competitiveness and, consequently, maintaining the current oil production level is a vital one because its technical and economic efficiency of oil production (first of all, in terms of the cost of extraction) is, all else being equal, much lower than that of major oil- and gas-rich regions of Russia. The only way to ensure "the normal existence" and development of such production complexes is by implementing competitive development strategies and securing additional competitive advantages, which will enable them to successfully address the challenges of long-term development. The two other objects of study were the oil complexes of the Republic of Bashkortostan and of Perm Territory. The sample of these case studies was dictated by the following two considerations:

(1) oil complexes play a critical role in the economy of these regions of Russia, largely driving their macroeconomic performance;
(2) the oil complexes in question are comparable in terms of crude oil production volumes and are characterized by high depletion of existing oil fields, which makes implementing competitive development strategies and acquiring additional competitive advantages virtually the only way to their successful long-term development;
(3) unlike the oil complex of Udmurtia, the oil complexes of Bashkortostan and Perm Territory have oil-refining activities, making it possible to measure additional competitive advantages created by oil refining; and
(4) the considered regions are all part of the same federal district and have similar natural, geographic and climate characteristics that make them "equal" in terms of economic and living conditions.

Input information for measuring the competitiveness of the oil complexes in question was sourced from the Federal State Statistics Service and its regional branches, reports and analytical data released by the oil companies operating in the regions. Customized statistical data forms and specialist statistical and analytical materials such as "The State Report on Natural Resources and Environment" were used for calculating some of the competitiveness indices.

The method assumes that a number of indicators are not supported by regular statistics reports and that they are to be determined by means of expert assessment and opinion. Most notably, it is the group of indices of innovation performance and the novelty of products of the oil complexes in question. To measure competitiveness by these indicators, a survey of experts from various companies of the oil complexes as well as scholars and specialists in oil industry development and related sectors (over 20 people in total) was conducted. The wide array of experts shows the objectivity of the obtained assessments.

The results of measuring competitiveness of the oil complexes between 2006 and 2011 allow for the following five conclusions:

(1) Oil complexes possess low levels of competitiveness (the aggregate index for all aforementioned oil complexes was below "1" throughout the period of investigation). The main causes for this are believed to be outdated equipment and technologies; investment and innovation inertia of the companies; poor performance results coupled with inadequate living standards and low income of the population in the home territories of the complexes; underdeveloped infrastructure; and, in some cases, adverse nature, geographical and climatic conditions.

(2) One of the key development problems of the considered oil complexes is low oil reserves, which is the main factor limiting oil production. It is, therefore, vital for the oil complex of Udmurtia to focus development efforts on upstream operations and the discovery (expansion) of new oil fields, introduction of new oil recovery methods, development of hard-to-recover reserves, viscous oil and oil fields of the undistributed subsoil fund.

(3) Another key development problem of Udmurtia's oil complex has to do with inadequate production facilities, the use of obsolete production patterns and low innovation activity in its core companies. This warrants considerable investment and an "aggressive" technological policy toward the expansion and overhaul of production that should become a priority development area for the companies in the short term.

(4) In view of the limited crude oil reserves as well as their low accessibility and quality, the effort to expand the oil complex's operations, boost its performance and strengthen its competitive position could focus on developing oil refining by building an oil refinery utilizing cutting-edge technology. Another argument in favor of building such a facility is the fact that the vast majority of Russian refineries are worn out and obsolete.

(5) The low energy intensity of Udmurtia's economy, including the constituent companies of the oil complex, calls for an additional criterion when assessing and implementing projects for modernization and production capacity expansion. The criterion should characterize the energy efficiency of the projects suggested for implementation.

The performed assessment made it possible to establish action areas and customized activities for the development of the oil complexes that are aimed at increasing its competitiveness.

Scenarios and development forecast for the oil complex of the Republic of Udmurtia

One of the key tasks to be addressed is forecasting and planning production complexes' development indicators. Today, the world science has build a body of experience in forecasting the development of individual companies and socio-economic systems as large as a national economy or even making projections for world development trends. Taking into account modern scientific advances in designing and implementing various methods of forecasting, a methodological framework for managing competitiveness and making projections for indicators of competitiveness in a production complex is proposed that represents a multi-step procedure that is based on a scenario approach and is implemented in phases. In each of the phases, methods and models are used that yield the best results for the sake of the final goal of the phase and may not be related to methods used at earlier stages. The proposed methodology includes the following phases of solving the forecasting:

- *Phase 1*: Build a development scenario for the forecast period. Drivers that directly impact the performance of the production complex are typically assumed as the basic parameters of the scenario. For example, when forecasting the development of an oil complex, average global oil prices are adopted as the basic parameter of the scenario, as oil is the key commodity of the complex.
- *Phase 2*: Set targets for key indicators of competitiveness for each stage of the forecast period (indicative planning; Ackoff, 1981; Ansoff, 1979).
- *Phase 3*: Devise controls for reaching the set targets and ensure required competitiveness levels over the forecast period. The core of the phase focuses on constructing a mathematical and statistical model of the dependence of key competitiveness indicators on a set of controls that characterize appropriate projects and activities:

$$\vec{C} = F\left(\vec{X}\right) \tag{16}$$

where $\vec{C}$ is a vector of key competitiveness indicators; and

$\vec{X}$ is a vector of controls.

- *Phase 4*: Build projections for resulting key performance indicators in the production complex by volume and by value for each of the scenarios.
- *Phase 5*: Build scenario-specific projections for competitiveness indicators in the production complex within the framework of an aggregate model for competitiveness assessment.
- *Phase 6*: Model and evaluate the impact of the production complex's development on performance indicators of territorial institutions and social environment. Make a forecast for performance indicators in territorial institutions and social environment.

- *Phase 7*: Scenario-specific assessment of competitiveness of the production complex at every stage of the forecast period for each of the scenarios.

As mentioned above, the oil complex of the Republic of Udmurtia served as a case study on improving the competitiveness of regional production complexes. The effectiveness of proposed projects and activities was measured in terms of competitiveness indicator trends over the forecast period. Projections were made through to 2025 in accordance with the methodology described above. Three scenarios of the future development of Udmurtia's oil complex were developed. Global prices of Urals crude blend were adopted as the key factor determining scenario specifics.

Having adapted the resulting figures to suit the aforementioned scenarios, it is possible to say that under the pessimistic scenario, which correlates with the baselines (inertia) scenario (Socio-economic Development Strategy of the Republic of Udmurtia Up Until (2025), 2009) by most parameters, oil production in the Republic is expected to stand at 6 million tonnes a year by 2025. As for the most likely and optimistic scenarios, the lower and upper limits of the forecast range under the "Diversification and Technological Transition" scenario are adopted correspondingly as projected oil production. The most likely scenario, therefore, provides for oil production in the Republic of Udmurtia to be 8 million tonnes a year by 2025, while according to the optimistic scenario, it might grow to 10 million tonnes annually.

The results of competitiveness analysis for the oil complex of the Republic of Udmurtia that have been inferred from the above stated oil production forecasts as revealed by the constructed scenarios including an oil refinery project with the annual throughput of 5 million tonnes of oil show that the proposed activities and projects aimed at improving the competitiveness of the oil complex and its constituent companies will make it possible to reach acceptable levels of competitiveness that exceed the baseline even in the worst case scenario (Figure 1).

It should be emphasized that the proposed policy would provide a basis for eliminating "bottlenecks" for the failing indicators of competitiveness revealed in 2006-2010. These are, in the first place, the indices of production and financial capacity (C_{TPC4}) and innovation performance and the novelty of products (C_{TPC5}) that will reach the baseline level by 2020-2025.

Conclusion

In contemporary economic systems, traditional approaches to ensuring competitiveness through the development of competitive strategies of standalone companies are gradually giving way to approaches that focus on enhancing the competitiveness of production complexes that can operate globally, reaching beyond individual countries or regions. This calls for the development of appropriate methods of competitiveness assessment in production complexes incorporated in TPSs.

The proposed methodology for assessing the competitiveness of production complexes is based upon a system of indices that reflect its various aspects and facets. When assessing the competitiveness of a production complex for the current period and a forecasted period, the obtained measures are compared with a benchmark model whose characteristics are set beforehand and are used as baseline values in calculations.

The conducted assessment of competitiveness of three Russian oil complexes have proved the universal nature of the designed methodology for competitiveness

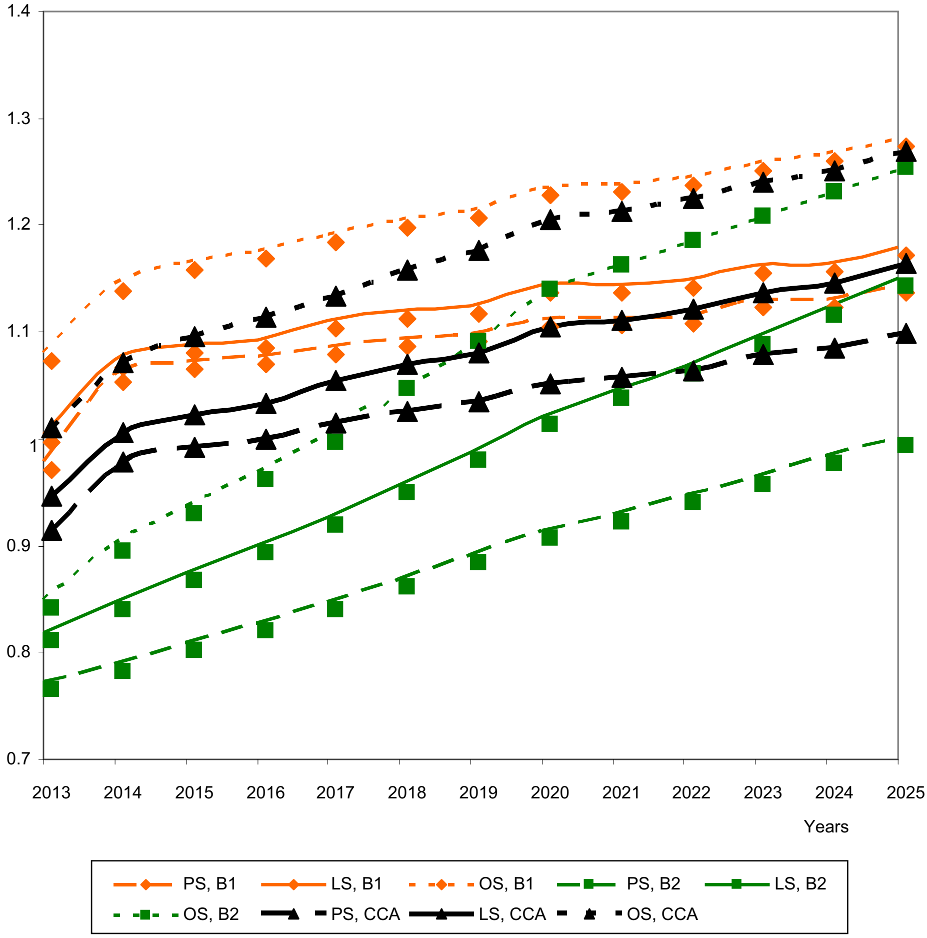

Figure 1.
Competitiveness assessment predictions for the oil complex of Udmurtia up until 2020 in context of scenarios[1]

assessment and the possibility of utilizing it for practical tasks of identifying and evaluating competitive advantages (disadvantages) of the analyzed production complex, creating and customizing activities and development programs for the production complex, assessing long-term development strategies and selecting the best options from a variety of alternatives. If properly adjusted, the proposed method could be applied to any production complex operating nationally or globally.

A methodological approach has been built for forecasting indicators and managing the competitiveness of production complexes. The methodology is a complex phased procedure that is based on a scenario approach and uses a combination of methods for forecasting indicators at various stages, i.e. indicative planning methods, statistical and economic modeling and expert analysis. The implementation of the proposed phased procedure will make it possible, on the one hand, to obtain objective competitiveness assessments for a production complex over the forecast period and to construct rational control measures that will enable it to reach optimum competitiveness levels in the forecast within the context of the designed scenarios.

A comprehensive review of the scientific results and practical effects of the conducted research allows for a conclusion that the proposed scientific and methodological approach is an effective tool for addressing the tasks of planning the current and strategic development of a production complex and managing this development.

Note

1. PS is for pessimistic scenario; LS is for most likely scenario; OS is for optimistic scenario; B1 is Module 1 of indicators; B2 is Module 2 of indicators; CCA is comprehensive competitiveness assessment.

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