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INTEGRAL ESTIMATION OF TIMBER INDUSTRY COMPETITIVENESS

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Abstract

In times of digital transformation of society and globalization of socio-economic processes, the problem of competitiveness becomes an acute one for business entities and integrated structures, industries and complexes, and the state. For timber industry, the study and improvement of competitiveness are notable for its complexity, interdisciplinary and intersectoral nature. The article presents a methodology for the comparative assessment of timber industry competitiveness by territorial entities and the region as a whole. The calculation of the integral estimation of competitiveness over a long period of time allows determining the main factors and development risks and identifying problems in forestry management. The estimation of the integral index to determine competitiveness over time makes it possible to predict specific indices included in the methodology. A composite integral index to determine timber industry competitiveness is calculated in stages on the basis of specific indices of forest conservation, protection and reproduction using economic and mathematical methods of analysis. The paper presents an algorithm for assessing timber industry competitiveness in several regions. For the quantitative estimation, three groups of indices have been identified that characterize the specifics of forestry as a branch of economy. They are the use, reproduction, conservation and protection of forests. The calculation of the level of the timber industry competitiveness was carried out using the example of the Arkhangelsk region, the Komi Republic, the Vologda region, and the North-West Federal District as a whole.

Keywords: Competitiveness, estimation of timber industry competitiveness, integral index, system of indices

1. Introduction

1.1. Relevance and practical significance

The problem of increasing competitiveness of regions, integrated entities and industries is always relevant due to the importance to fill the budgets of the regions and the federation. Theoretical and practical aspects of competitiveness of enterprises have been studied in detail, but with respect to large objects, methods and techniques are subject to disputes, research and constant updating. The topic of competitiveness of territorial and industrial facilities most acutely arises in connection with socio-economic globalization and digital transformation of society as a whole. For twenty years, the issue of increasing competitiveness of the Russian timber industry has been an urgent issue. Improving competitiveness of the timber industry complex was included in the previously existing strategies (State Department of Forestry, 2019). The analysis of the development directions for 2002 and the "Strategy 2020" show that their main goal was to provide the domestic and CIS markets with competitive wood and paper products. Thus, these programs did not take into account the fundamental changes in the world market connected with the development of the Asian economy. Instead of the old ineffective strategy, in 2018 a new strategy for the development of the Russian forest complex until 2030 was adopted (Strategy for the development of the forestry complex of the Russian Federation until 2030, 2019). This defines the strategic goal of increasing the long-term competitiveness of the timber industry and achieving higher contribution of the timber sector to the socio-economic development of Russia (Pappila, 2009; Strategy for the development of the forestry complex of the Russian Federation until 2030, 2019). Thus, timber industry enterprises are faced with the task of improving competitiveness to ensure economic growth. There are reserves for this, as well as the potential for increasing competitive advantages in the forest complex due to, for example, its optimal structure (Moiseev, 2015; Pappila, 2009). Timber industry is the basis, condition and raw material base for the development of the entire forest complex of the country, which is reflected in the action plan with eight key areas, expected results and deadlines. This plan for the forest complex mobilization was developed by the Ministry of Industry and Trade [Strategy for the development of the forestry complex of the Russian Federation until 2030, 2019] with the participation of industry experts, business, science, and environmental organizations. However, this strategy has a lot of skeptical opinions. Thus, a number of experts believe that the events were developed based on outdated information and there is no single methodology for assessing the competitiveness of the timber industry complex in the regions. In this regard, relevant organizations further develop scientific approaches and perform their practical testing in the framework of the strategy implementation (Koroleva & Konstantinov, 2019; Moiseev, 2015). The authors also joined in important scientific research and set the goal to determine the timber industry competitiveness of the territories using appropriate methodological assessment tools. A comparative assessment of the timber industry competitiveness in the regional economy is relevant due to the fact that the development of the timber industry complex in the regions differs. Accordingly, the estimation of competitiveness will allow us to determine regional features of the timber industry and its problems, as well as to identify the driving forces for growth and to design development directions and growth rates. Practical significance of the comparative assessment

methodology to determine the competitiveness of the regional timber industries consists in identifying the possibilities of using the determinants of production factors and creating optimal conditions for the action of the determinants. For business entities, the calculation of the integral index of timber industry competitiveness can become the basis for the development of the target criteria for managerial decisions and transformations that ensure the creation of competitive advantages.

1.2. The theoretical aspect of competitiveness research

At present, a lot of scientific and practical theories of competitiveness, competitive strategies and assessment methods have been developed.

The first stage of the development of competitiveness theories is associated with the works of J. Schumpeter and refers to the stage of the industrial economy (until the 1960s) (Schumpeter, 2007). The next stage in the development of approaches to competitiveness is connected with the formation of the theory of industrial organization (1960–1990). The third stage, which began in the 1990s, correlates with the post-industrial economy, in which the resource approach, the concepts of key competencies and the intellectual capital were developed (Balkyte & Tvaronavičiene, 2010, Varga, 2017). Currently, the development of the competitiveness theory is taking place together with the development of the digital economy. This division of the development of the competitiveness theory into periods is rather arbitrary, since ideas arose and were formed in parallel, but on the whole it shows the evolution of views on the formation of competitive advantages and approaches to assessing competitiveness. Nevertheless, non-scientific research and practical testing remain relevant, especially with the transformation of the economy into digital space. Cardinal changes in the external and internal environment of business entities stimulate the emergence of new methods, systems and approaches to managing competitiveness (Balassa, 1965). The most common are the methods for assessing competitors' capabilities through special expert studies and indirect calculations based on accumulated data (Gordeev & Pyzhev, 2015; Zaitsev, 2007).

Another new area of research is the comparative assessment of competitiveness of associations, complexes and other integrated structures, which is connected with the unification of entities to achieve common goals, reduce transaction costs and increase competitiveness due to a synergistic effect. This is also noted in the works of Porter (2005), a world expert in the field of competitiveness: "Today's slogans of companies are mergers, alliances, strategic partnerships, joint work and supranational globalization of activities" (p. 256). So, to compare the competitiveness of countries on the basis of production factors, Heckscher-Ohlin model is interesting (Vokhmyanin, 2017). Ballas's index (Balassa, 1965, Vokhmyanin, 2017) is calculated by the volume of exported goods to assess the comparative advantages of countries. Gordeev and Pyzhev applied Ballas's index to evaluate countries in terms of the production of wood products of low and medium pulp and paper processing (Anokhina & Seredina, 2010; Mironova & Stateeva, 2000). They found that in 2013 Russia and the USA had a comparative advantage in the production of low-value-added forest products out of 15 countries (Akulich, 2011; Vokhmyanin, 2017). An important index of the country's competitiveness in the timber products market, according to the researchers, is not the export of primary raw materials (wood), but a comparative advantage in the production of high-value-added products. According to this index, Russia has the lowest value (0.48), which shows low competitiveness of pulp and paper products. This method can be successfully applied

for interregional assessment of industries, including the timber industry (Gordeev & Pyzhev, 2015). The lack of the method lies in the narrow interpretation of the results based on the product export indices, which does not allow a comprehensive assessment of the industrial competitiveness.

Zaitsev's (2007) methodology for assessing competitiveness is based on indices that take into account the use of the characteristics of forest resources: specific gravity of coniferous stands in production forests, estimated logging area, specific gravity of high class bonitet stands in industrial forests, average distance of logging (Zaitsev, 2007). This technique allows evaluating mainly the resource component of the timber industry competitiveness, without taking into account the processing industry. At the same time, the problem and the difficulty of assessing forest resources lies in the fact that they perform many different functions, since the same forest resources as part of natural objects have different areas of application (Trishkin, 2014).

Regarding the determination of the level of competitiveness of individual industries in the region, one can single out Anokhina and Seredina's (2010) methodology developed to assess the competitiveness of the region's agro-industrial complex. The method of selecting factors, calculating indices and the integral index using the geometric mean formula determines the position of the regional complex among the complexes of the neighboring subjects (Kalinina & Andreeva, 2019).

The analysis of the methods shows that in order to assess regional timber industry competitiveness, it is necessary to select indices that in the best way characterize the situation in the timber industry. The regional timber industry competitiveness is determined, first of all, by the volume and state of the use of natural resources, capital and infrastructure.

2.   Problem Statement

Achieving the results by 2030 set in the development strategy to ensure the competitiveness of forest industries involves a mechanism for estimating and quantifying the results (Forestry development for 2013–2020, 2019). For timber industry, studying and improving competitiveness is distinguished by complexity, interdisciplinary and intersectoral. In this regard, the development of scientific approaches for quantitative estimation of the results obtained and their practical testing during the implementation of the strategy is further developed in the research of specialized organizations and in our scientific research.

3.   Research Questions

The study addresses the following tasks:
- the selection of specific indices of the timber industry functioning in the region;
- the study of the significance ("weight") of timber industry activities for a comprehensive presentation of its competitiveness;
- the formation of the system of general indices to assess timber industry competitiveness in the region;
- the comparison of timber industries in the regions based on the developed methodology;
- the determination of the integral estimation of competitiveness for individual regions over time;
- the use of the developed method to improve industry management and achieve strategic indices.

4. Purpose of the Study

The purpose of this study is to develop a methodological approach for the comparative assessment of timber industry competitiveness based on indices reflecting the fulfillment of its functions in the use, conservation, protection and reproduction of forest resources. As a scientific hypothesis of the study, it is suggested that the presentation of timber industry competitiveness in the form of a composite integral index based on specific indices of forest conservation, protection and reproduction using economic and mathematical methods of forest management analysis is possible, and gives decision-makers a tool for management and forecasting the development of the industry and economy.

5. Research Methods

At the same time, ensuring competitiveness only through the use of production factors is limited and suggests additional sources of their effective and rational use (Official statistics, 2020). These sources act as the determinants of production factors. With respect to the regional level of the timber industry complex, these are investments and the development of related and supporting industries. The determinants can provide a different level of competitiveness of the regional timber complex depending on economic, organizational, political, legal, social and cultural conditions created in the region.

The choice of research tools is determined by the purpose and features of the manifestation of the category of timber industry competitiveness in practice when organizing and managing the economy. The use of expert assessments, factor analysis, economic and mathematical methods made it possible to identify specific indices reflecting the peculiarities of the timber industry, its features that are distinctive from other types of activities, to obtain the significance scores of the selected specific indices and to quantify the level of the regional timber industry competitiveness. Methodologically, the calculation of the integral estimation of competitiveness begins with the selection of indices and assigning them "weights" that take into account the relative importance of a particular index. At the initial level, many indices were selected. For the calculated level, the number of indices was reduced and they were grouped into three groups. The main conditions for selecting indices to calculate the integral estimation are theoretical ones as they should reflect the essential aspects of timber industry activity and the practical ones as they can be found in the public domain and / or calculated on the basis of actually available information (Official statistics, 2020).

The estimation of the timber industry competitiveness (C) is carried out according to formula (1) without taking into account the "weight" and significance of the indices and according to formula (2) taking into account the "weight" and significance of the indices (Plastinin et al., 2020):

$$C = \sum_1^3 J_1 + \sum_1^3 J_2 + \sum_1^3 J_3 \quad (1)$$

where J_1, J_2, J_3 are the values of the normalized specific indices (from 1 to 3) by groups;

$$C = \sum_1^3 J_1 \cdot d_1 + \sum_1^3 J_2 \cdot d_2 + \sum_1^3 J_3 \cdot d_3 \quad (2)$$

where d_1, d_2, d_3 are the "weights" and significance of the corresponding group of indices.

As a whole, the general comparative index of competitiveness can be determined using the composite coefficient(s), taking into account the influence of the socio-economic situation on the timber industry competitiveness in the region (see formula 3) (Plastinin et al., 2020):

$$C = \mathrm{K}_N \cdot \left(\sum_1^3 J_1 \cdot d_1 + \sum_1^3 J_2 \cdot d_2 + \sum_1^3 J_3 \cdot d_3 \right) \quad (3)$$

where K_N is the coefficient that takes into account the influence of socio-economic characteristics on the level of the timber industry competitiveness (for example, the level of criminalization in the timber complex, targeted regional support for certain types of timber industry activities, etc.).

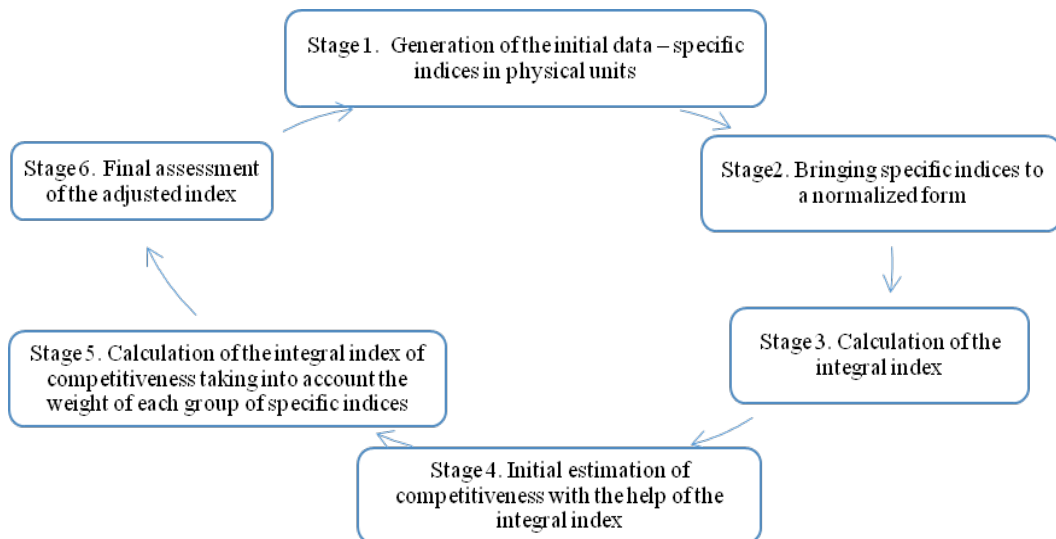The scheme for the quantitative calculation of the integral index of competitiveness is presented in Figure 1.

Figure 1. The algorithm for determining the integral index

6. Findings

The determination of weight coefficients of both individual characteristics as part of composite indices and of specific quality indices is advisable to be carried out on the basis of expert assessments, which are specified in the monitoring process. In the process of the study, the experts selected indices by region in the following groups:

I. "Forest use" (the proportion of the area of forest land leased out in the total area of forest land; the amount of payments to the budget system of the Russian Federation from the use of forests located on forest land, per 1 ha of forest land; the length of forest roads built in a year);

II. "Forest reproduction" (the ratio of the area of artificial reforestation to the area of forest retirement as a result of clear-cutting; the area (increase in area) of artificial reforestation in a year; the forest cover of the territory);

III. "Forest conservation and protection" (the specific area of forest land destroyed by fires, pests and diseases; the proportion of the area of forests in which forest pathological examinations were carried out to the total area of forest land).

According to the experts, the most significant (important) one is the group of indices that took the highest places with corresponding scores. Next, the "weight" of the index groups is determined by dividing the sum of places by the sum of the places of each group. As a result, the index value for "Forest use" is 0.5; "Forest reproduction" – 0.3; "Forest conservation and protection" – 0.2.

An example of calculating the timber industry competitiveness in the North-West Federal District (NWFD) and the three constituent entities of the Russian Federation is presented in Table 1. For the calculation (according to formula 2), the authors used the Federal Forestry Agency's (Forestry development for 2013–2020, 2019) monitoring data based on the indices (indicators) of the effectiveness of the implementation of the State Program of the Russian Federation "Forestry Development" for 2013–2020, and the target values of the regional forestry development programs. The assessment of the timber industry competitiveness in the NWFD showed that the Vologda region is the leader and ranks first in terms of export of unprocessed timber, fiberboard, and glued plywood. At the same time, despite the leadership in exporting certain items of goods, the strategy aimed at improving the structure of exported products and the production of better and more competitive goods by timber industry enterprises, which will make it possible to achieve high foreign currency earnings from export activities, remains relevant.

Table 1. The comparative assessment of the timber industry competitiveness in the North-West Federal District in 2018

	Arkhangelsk region	The Komi Republic	Vologda region	NWFD
Forest use				
1. The proportion of the area of forest land leased out in the total area of forest land (note 1)	60.9 / 0.98	27.2 / 0.44	62.2 / 1.0	47.9 / 0.77
2. The amount of payments to the budget system of the Russian Federation from the use of forests located on forest land, per 1 ha of forest land, rub. (note 2)	87.4 / 0.40	64.5 / 0.29	218.7 / 1.0	120.2 / 0.55
Total for group I	-/ 1.38	- / 0.73	- / 2.00	- / 1.32
Forest reproduction				
1. The ratio of the area of artificial reforestation to the area of forest retirement as a result of clear-cutting	85.0 / 1.00	79.6 / 0.94	85.0 / 1.00	76.4 / 0.90
2. The forest cover of the territory	54.0 / 0.74	72.8 / 1.00	68.7 / 0.94	54.3 / 0.75
Total for group II	- / 2.74	- / 1.94	- / 1.94	- / 1.65
Forest conservation and protection				

1. The specific area of forest land destroyed by fires (note 3)	0.03 / 1.00	0.03 / 1.00	0.03 / 1.00	0.03 / 1.00
2. The specific area of forest land destroyed by pests and diseases	0.02 / 1.00	0.02 / 1.00	0.02 / 1.00	0.02 / 1.00
Total for group III	- / 2.00	- / 2.00	- / 2.00	- / 2.00
The integral index of timber industry competitiveness taking into account significance	**1.91**	**1.35**	**1.98**	**1.55**

1 - the Federal Forestry Agency's monitoring databased on the indices (indicators) of the effectiveness of the implementation of the State Program of the Russian Federation "Forestry Development" for 2013–2020 (as of the beginning of 2019);
2 - the Federal Forestry Agency's monitoring databased on the indices (indicators) of the effectiveness of the implementation of the State Program of the Russian Federation "Forestry Development" for 2013–2020 (plan for the beginning of 2019);
3 - target indices of the State program of the Arkhangelsk region "Development of the timber industry complex of the Arkhangelsk region (2014–2024)" (as of the beginning of 2016), the State program "Development of the timber industry complex of the Vologda region for 2014–2020", the State program of the Komi Republic "Forestry Development"

Below, the integral index of competitiveness is calculated for the Arkhangelsk region. The Arkhangelsk region has better logistics compared to the Vologda region, as it has a convenient geographical location, which allows supplying competitive timber products abroad by sea and rail. The calculations (Table 2) show that for the analyzed period, the forestry competitiveness in the Arkhangelsk region increased. However, taking into account the "weights" (significance), there was a decrease in 2016, as the index "The amount of payments to the budget system of the Russian Federation from the use of forests located on forest land, per 1 ha of forest land" decreased, and this index is included in the first target group, the "weight" (significance) of which is the highest (0.5).

Table 2. The estimation of the timber industry competitiveness in the Arkhangelsk region over time according to the actual data for 2012-2016

	2012	2014	2016
	Absolute values / normalized values		
I. Forest use			
1. The proportion of the area of forest land leased out in the total area of forestland	54.7 / 0.91	58.2 / 0.97	60.0 / 1.0
2. The payments to the budget system of the Russian Federation from the use of forests located on forest land, per 1 ha of forest land, rub.	40.1 / 0.99	40.6 / 1.0	36.5 / 0.90
Total values of indices for group I	- / 1.90	- / 1.97	- / 1.90
Total values of indices, taking into account the "weights" of the group	0.95	0.99	0.92
II. Forest reproduction			
3. The ratio of the area of artificial reforestation to the area of forest retirement as a result of clear-cutting	58.3 / 0.63	92.0 / 1.0	92.0 / 1.0
4. The forest cover of the territory, %	54 / 1.0	54 / 1.0	54 / 1.0

Total for group II	- / 1.63	- / 2.0	- / 2.0
The total values of indices, taking into account the "weights" of the group	0.49	0.6	0.6
III. Forest conservation and protection			
5. The specific area of forest land destroyed by fires	0.038 / 0.53	0.023 / 0.87	0.020 / 1.0
6. The specific area of forestland destroyed by pests and diseases	0.030 / 0.67	0.024 / 0.83	0.020 / 1.0
Total for group III	- / 1.20	- / 1.90	- / 2.0
The total values of indices, taking into account the "weights" of the group	0.24	0.38	0.40
The integral index of the timber industry competitiveness (without the "weights")	4.73	5.87	5.90
The integral index of the timber industry competitiveness (taking into account the "weights")	1.68	1.97	1.92

Figure 2 shows the timber industry competitiveness index in the Arkhangelsk region for 2012-2016, taking into account and without consideration of the "weights" (significance) of the specific indices. The calculation of the integral index of competitiveness over time shows the unstable development of the timber industry in the Arkhangelsk region. The greatest success was achieved in 2014, followed by a slight decrease in 2016. Approximation and smoothing of the development trend of the timber industry competitiveness in the Arkhangelsk region shows a positive trend in the near future.
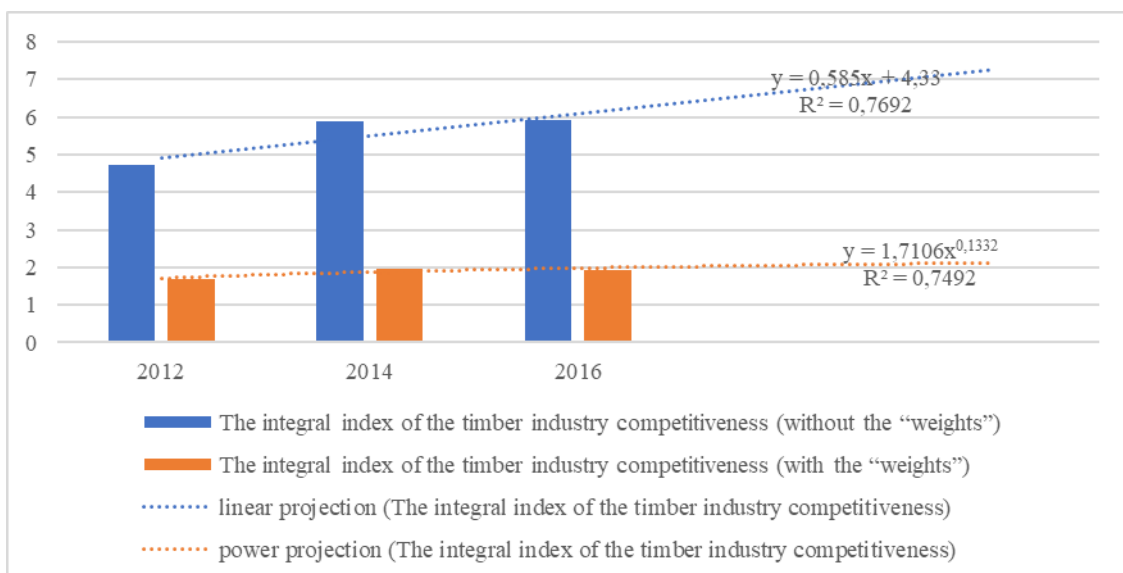

Figure 2. The performance and forecast of the timber industry competitiveness index in the Arkhangelsk region in 2012-2016, taking into account and without consideration of the "weights" (significance) of the specific indices

7. Conclusion

The conducted research on the study, development and application of the methodological approaches to estimate timber industry competitiveness made it possible to obtain reliable results of the timber industry competitiveness in separate territories and the region as a whole. The presented methodology is flexible and easy for adapting the calculation of the quantitative indices of the timber industry competitiveness, as well as including and excluding the indices based on the set tasks. The advantage of the developed approach to estimate competitiveness is the use of freely available indices of the timber industry development.

The calculation of the comparative integral estimation for the subjects of the North-West Federal District made it possible to identify the strongest of them – the timber industry complexes of the Vologda and Arkhangelsk regions. A smaller integrated level of competitiveness is obtained for the timber industry of the Komi Republic. Analyzing the integral index of the timber industry competitiveness in the Arkhangelsk region over time, one should note the unstable development, which shows a number of problems with increasing competitiveness, for the solution of which additional research should be conducted and a development program should be worked out.

Thus, the calculation of the integral estimation of competitiveness over a long period of time allows determining the main factors and risks of development and identifying forestry management problems. The estimation of the integral index of competitiveness over time makes it possible to predict the specific indices included in the methodology, respectively, to use the methodology for planning and forecasting the development of the industry and the regions.

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