BRANCH-WISE ECONOMY

UDC 338,12, 338012, LBC 65.3

Branch analysis in the context of evolutionary development of economic systems

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Abstract. Upgrading of Russian economy claims special attention to long-term problems of its development in order to make it stable and purposeful. The necessity to improve social and economic parameters and comprehensive innovation development of territorial economic systems requires elaboration of sound policy and regions' strategies in relation to regional branches that form their potential. The article proposes an approach to reform national economic sectors on the basis of their life cycle analysis and allocation of functional features of a single mesoeconomic system. The research is aimed at selecting key parameters of sectors' development at the regional level. The evolutionary approach that serves as the basis for the methodology gives an opportunity to determine the factors that have the greatest impact on life cycle dynamics. The article singles out the following main groups of factors: resources, product, technology, market, banking sector, public policy. By analyzing life cycles of the Yaroslavl region's chemical industries (synthetic rubber and carbon black production) it is concluded that the only way to ensure sustainable development of branches lies in the continuous implementation of innovations, a process affected by cyclicity and determined by factors of exogenous and endogenous nature.

Key words: economic system; branch; life cycle of a branch; evolutionary development; cycle-formative factor; innovations.

The study of any system involves determining its overall tendencies, trends ШТ its development. This approach is particularly relevant for economic systems which have recently become more dynamic.

A lack of interaction between fundamental economic science and business and its needs is believed to be one of the modern post-industrial society paradoxes; the practice of modern economic development has significantly surpassed the level of theoretical generalizations and recommendations [4, p. 8].

The disbalance between theory and practice presupposes deeper research into prerequisites for the development of economic systems of various levels including those on the basis of life cycle theories, as this would create the possibility of greater validity of necessary reforms. Nowadays, the concept of life cycles in economic science has a primarily descriptive character, so the life cycle model is rarely applied in practice.

The life cycle concept appeared at the end of the 19th century as a set of ideas including a study of the heredity and development patterns. In economic sciences the product's (good's) life cycle concept has become more widespread.

J.J. Lambin, a well-known expert in the field of marketing, describes the essence of this concept as follows: "The market potential determines the scale of the economic possibility that commodity market provides. This first quantitative measure of attractiveness must be supplemented with dynamic estimate characterizing its duration that is evolution of potential demand in time" [3].

Expanding the boundaries of the concept described by J.J. Lambin one can define a branch as some economic space where goods are not only sold but produced. While conducting the analysis, it is worthwhile to expand "market" parameters (market capacity, scale of competition, level of concentration) with dynamic characteristics, such as stages of the branch's life cycle, possible profit growth, rate of technological changes. This approach is also associated with the transformation of the very goal of the branch's analysis when not just only assessing the situation in a separate manufacture at the moment but making a forecast of its development on these data basis.

In fact the theory of the branch's life cycle is an extension of the idea of cyclical development of the economic situation described in the works of the classics – such as J.M. Keynes, N.D. Kondratiev, J. Schumpeter. Cyclicity is a natural way of economic development, a universal form of movement that reflects uneven flow of economic processes.

Already in the 19th century economical science differentiated a cycle of 7–12 years later being called after C. Juglar (1819–1905). The scientist made a great contribution to the study of industrial fluctuations nature in France, the United Kingdom and the USA based on the fundamental analysis of fluctuations in interest rates and prices. The research has showed that these fluctuations coincide with investment cycles which in turn result in changes of GDP, inflation and employment. In literature this cycle is also called as "business cycle", "production cycle", "average cycle".

Modern researchers, experts in strategic management pay particular attention to interaction of four development cycles: an economic cycle, a sectoral cycle, a cycle of the enterprise's (firm's) development and a product life cycle. According to them the cycles of a lower level are "embedded" in the cycles of a higher level as their components thus determining characteristics of the latter [7, p. 182]. Although, of course, the development cycle of a higher level determines a new system quality and it is not a simple sum of cycles of a lower level.

These provisions reveal the system approach to the study of economic phenomena, but in this case, the system is quite complicated and has some specific characteristics. First, the

influence of the cycles of one level on the cycles of other levels remains unconditional, but it is important to point out the possibility of multi-directional character of this influence. Indeed, the growth of national economy does not mean the increase in production volumes in all the branches of industry; on the other hand, expansion of the scope of individual, including basic, industries results in positive dynamics at the macroeconomic level.

Moreover, the response of individual industries to the changes in external environment may be different not only in size, but also in vector – one and the same impact from the outside can have completely opposite effects for different sectors. For example, if the increase in oil prices has a positive impact on the dynamics of extractive industries, then cargo transportation enterprises will experience difficulties due to the growth of prices for fuel, which is the end product of oil processing.

The fluctuations of different cycles are formed not only under the influence of external factors. The influence from the inside, the change in a certain part of economic system at a certain level may change the dynamics of the system, setting a different trajectory within the life cycle. These changes are usually based on innovations implementation processes

The most well-known analysis of the life cycle of the industry belongs to M. Porter, the founder of strategic positioning. Specifics of his research lies in the fact that he was first to examine in detail all the stages of life cycle from the position of competitive dynamics based on such structural characteristics as the number and size of firms, the level of technological and strategic uncertainty, costs, price, buyers, competitors and the intensity of competition.

According to M. Porter, despite the fact that the original structure, production potential and investment decisions of the firms are specific for each industry, one can generally distinguish the most important evolutionary processes. Each industry is experiencing some kinds of certain predictable (and interacting) dynamic processes, although their speed and direction vary depending on the industry [8, p. 217]. Such processes include long-term changes in growth rates, in the level of uncertainty, in the competitive situation, in the cost of original resources and exchange rates, and in the structural shifts in related industries.

The life cycle concept serves as a "simplified model", a fundamental principle for analyzing economic phenomena. The use of such theories, that are called models, is expedient insofar as it helps escape from unimportant details, and identify the principal economic ties in the evolution of economic system [5, p. 49].

Evolution as a focused irreversible change in any process, system, subject always happens in real (dynamic or historical) time. In a broader sense, the term "evolutionary" includes the research into the processes of long-term progressive changes [6, p. 28].

Scientific substantiation of development prospects for individual branches implies the allocation of specific factors in external environment that have the greatest influence on them, taking into account the specifics of the life cycle of given industries.

At the regional level economic branches are developed in comparable conditions and under the influence of similar factors of financial, institutional, and demographic nature. To determine the current stage of life cycle concerning the given economic branch and to identify what should be changed for avoiding a decline or preserving the stage of growth, it is necessary to conduct a detailed analysis of these factors.

For these purposes, the following groups of factors presented in table 1 were identified: resources; product; technologies; market; banking sector; state policy.

Since the cyclical character of economic development is conditioned by different

The major factors influencing the stage of the life cycle of economic branches

Group of factors	Factors
Resources	Raw materials (price for raw materials, availability of resources)
	Labour (availability of labor resources, average labour remuneration in the region)
	Capital (shortage of capital leads to a slowdown in growth rates)
	Information (demand, state of affairs in related branches, etc.)
Technologies	Rate of technological changes (rapid or slow change in production technologies)
	Qualification of personnel (demand of the branch in employees of a certain level of training)
	Easiness of entering and leaving the branch (barriers to entry and leaving)
Product	Directions and rates of product innovations
	Degree of product differentiation (highly specialized or multiproduct productions)
	Import substitution (singularity of a product in the global market, competition with foreign producers)
Market	Scope and growth rates of the market (porential scope of the market and its growth rates in the short-term, medium and long-term periods)
	Scale of competition and competitive situation (competition in the local, regional, global level; monopoly, oligopoly, etc.)
Banking sector (availability and cost of loan resources)	
Government policy (state support measures, import and export duties, tax concessions, etc.)	

factors, both endogenous and exogenous, there is the obvious need for a detailed research into the so-called cycle-forming factors. At that, it is important to assess not only the effect of individual factors, but also different options of the industry dynamics under the changes in individual factors (when the ratio of the impact of factors changes, the stage of life cycle shifts), as well as the overall synergy effect.

The traditional model of branch's lifecycle, proposed by the majority of researchers, includes four stages of development: a newly emerged industry, growing industry, mature industry and industry in decline or crisis; but, taking into account the influence of all the above factors on the evolution of an industry, this curve can vary considerably.

R. Grant, commenting on the traditional S-shaped curve of life cycle, explains that branches vary in development models. Branches that provide for basic needs – housing construction, food processing and making clothes, perhaps, will never enter the stage of recession, because such needs are unlikely to become obsolescent. Some branches may undergo rejuvenation in the process of life cycle (motorcycle industry). In addition, branches may be at different stages of their life cycle (e.g. automotive market) in different countries (or even in different regions) [1, p. 304].

To explore the life cycle, it is necessary to assess the scope of the term "branch". N.M. Rozanova defines the branch as a set of manufacturers of goods that differ in technological proximity of production (a structure from the point of view of supply), thus distinguishing it from the concept of market: the market is a set of sellers of substitute goods (a structure from the point of view of demand) [11, p. 29].

N.V. Pakhomova and K.K. Richter propose to use the term "branch" for naming a group of companies that produce and sell interchangeable (in manufacturing) products using similar technologies and equipment of the market of production factors [9, p. 149].

In practice, however, the term "branch" is now replaced by the concept "economic activity" that introduces an element of uncertainty in the conceptual framework. Although there is no definition of the word "branch" in statistical reports, but the terms "branch affiliation", "branch structure" are actively used in scientific publications and in practice.

A detailed study of the types of economic activity reveals that the individual productions within a single section of OKVED (All-Russian Classifier of Types of Economic Activity) vary significantly in their economic characteristics, level of competition and development prospects, and also in the pace of technological progress, the size of markets and other parameters; all this should be taken into account when elaborating the strategy for the development of the national economy branches, regions and enterprises.

In particular, if we analyze the TEA (type of economic activity) "chemical production" in the Yaroslavl Oblast, we can observe significant differences among such groups as the production of fertilizers and nitrogen compounds, manufacture of synthetic rubber, manufacture of paints and varnishes, manufacture of pharmaceutical products, etc. In order to trace the difference of life cycles on an example, let us consider two sectors: manufacture of synthetic rubber (OKVED code 24.17) and production of technical carbon (soot) (included in OKVED code 24.66 – production of other chemical products). These branches use raw materials that are similar in their origin (refinery waste), and they work, in fact, for one customer – automotive industry; and the only difference is that the synthetic rubber (SR) plant was shut down several years ago, and the technical carbon production plant is developing steadily at present.

Synthetic Rubber Plant No.1 (now the joint-stock company "SK Premier"), built in 1932, is the factory that produced the world's first synthetic rubber, which was necessary for manufacturing tires [12]. Later the best option for technological process was found, which led to a sharp increase in rubber production, and its prime cost reduced. In the post-war time the production was developed and improved. Along with the launch of the Yaroslavl oil refinery the plant SK-1 was reconstructed. The use of gases obtained during oil processing, made it possible to organize large-scale production of synthetic alcohol, methylstyrene and other kinds of raw material for chemical industry [10].

In the early 1970s the specialists at the plant worked out a process of obtaining one of the so-called "liquid" rubbers. The launch of large-scale production of isoprene rubber SKI-3 that is a full substitute for natural rubber can be considered a turning point in the history of the plant. The highly automated production of new raw materials for tire and other industries was launched in the shortest period. However, in 1993 the complex SKI-3 in Yaroslavl witnessed a shortage of raw materials. The whole industry in the country was sliding into recession, economic ties between producers and consumers in the former Soviet republics were breaking. By 1996, the non-payment and barter transactions in the country had reached their pinnacle. The new leadership decided to focus on the manufacture of adhesives and putties that had previously been auxiliary productions. This resulted in the fact that the more businesslike competitors ejected the Yaroslavl plant from the rubber and latex market. In 2001 the plant got a new investor – OJSC Alliance Group, specializing in crisis management. According to its managers, it was planned to reconstruct and upgrade the existing capacities and set up the production of new quality and range for entering the domestic and foreign market [13].

In Russia, as well as in leading foreign countries, synthetic rubbers are used mainly for manufacturing tires.

According to analysts, synthetic rubber production remains a very promising sphere for Russia, despite certain difficulties in the development and an ongoing redistribution of property. Russia's share in the global production of SR is 7%, which is significantly higher than the similar share of other polymers. A wealth of experience in this field and the great authority of the Russian synthetic rubber in the

global market suggest that it is enough to make relatively small effort to restore the Russian production of synthetic rubber to its leading position in the world [14].

Obviously, during the 1990s, all rubber plants in the country faced the lack of raw materials and required production upgrade. However, one cannot say definitely that synthetic rubber industry is in recession in the country as a whole. For example, at present, OJSC Voronezhsintezkauchuk, which is also one of the first producers of synthetic rubbers and latexes, has mastered the production of new grades of rubber under the program "Green tire". Serial production of styrene-butadiene thermoplastic elastomers launched at the plant in 1991 is currently the only one of its kind in the CIS nations, its production output is constantly growing, and export deliveries constitute about 50%.

The location of most of Russia's synthetic rubber plants in the remote regions of the country's European part, including in Central Russia, is disadvantageous; they experience difficulties not only with transportation of raw materials, but also with exporting the rubber itself. The rubber in South-East Asia is much more expensive than in Europe, but it is difficult to deliver it there. As for the enterprises in the Urals-Volga region that account for two-thirds of Russian rubber, the problem of export logistics is even more acute. In many respects, it is the logistics barrier that makes Russian exporters focus mainly on the European market rather than on a more attractive Asian market. Experts believe that if we had money and will, we could easily enhance ethylene production in Russia twice, up to four million tons even with the existing raw material base [15].

As for the plant SK-1 in Yaroslavl, in the 2000s it actually came under the control of Sibur Group that was going to establish full-cycle production. The far-reaching plans were not implemented, the plant turned out unnecessary in the production chain, therefore it was shut down.

Thus, despite its bright history, the life cycle of synthetic rubber industry in the Yaroslavl region came to its end, while in the whole country this industry is in the stage of maturity and has all the opportunities for growth. Continuous modernization of production, promising R&D and efficient management are the conditions for successful work.

The importance of complying with these conditions is confirmed by the pace of development of the technical carbon (soot) manufacturing industry that is represented in the region by the plant "Yaroslavsky Tekhnicheskiy Uglerod" (JSC YaTU) that holds leading positions in Russia and in the world market. The capacity of the enterprise is over 200 thousand tons of carbon black per year.

Carbon black is used as a reinforcing component in the production of rubber and other plastic materials. Demand for carbon black in Russia from 2007 to 2011 has grown by 25.7%. More than half of all produced carbon black is used in the production of tires and rubber technical goods. The Russian market of carbon black is export-oriented. In 2007–2011 on average more than 60% of the total demand accounted for export [16].

JSC YaTU exports over 80% of its production to Europe and America, Asia and Africa. Regular consumers of products of JSC Yaroslavsky Tekhnicheskiy Uglerod include well-known manufacturers of tires and rubber products like Goodyear, Michelin, Continental, Nokian, Trelleborg, Semperit. At present the company is among the five largest plants in the world that manufacture carbon black.

Construction of Novo-Yaroslavsky carbon black plant was launched in 1962. Originally it was constructed as carbon black production under Novo-Yaroslavsky oil refinery. From May 6, 1963, carbon black production was separated from the refinery and made independent enterprise. On December 3, 1974 it was renamed Novo-Yaroslavsky plant of carbon

black, since 1992 it is an open joint stock company Yaroslavsky Technicheskiy Uglerod [17].

By the end of the 1980s the plant had 12 technological flows producing up to 150 tons of carbon per year. In 1993 the enterprise was the first to introduce a system of closed-loop water supply by reconstructing treatment facilities and completely abandoning the discharge of water into nearby water bodies. Even in crisis conditions in 1994 the company was one of the first in Russia to launch the manufacture of carbon black grades according to ASTM classification. In 2000, the control of technological flows was fully computerized.

In 2001 the plant launches its own power station. All exhaust gas from the production of carbon black is burned in waste heat boilers, and the generated steam is recycled by the steam generators into electricity, and its amount covers the demand of the enterprise to the full [18].

The above data makes it clear that due to constant upgrading and modernization, the carbon black manufacturing industry in the Yaroslavl Oblast has long been at the stage of growth and, despite the existing problems similar to those of the synthetic rubber industry, it successfully has been operating and developing successfully.

In any case, there are many options which can be foreseen in the course of strategic and tactical planning for the successful functioning of enterprises in a particular industry. But the modern way of development of all the industries implies the only opportunity for stable growth – constant implementation of innovations.

Research into the dynamics of innovations implementation only confirms the adequacy of the cyclic approach. A number of works on innovation management study the interrelation of individual cycles of innovations development, the logic and dynamics of transition from one cycle to another. It is noted that a new cycle of product and process innovations, as in any cyclic model, can be initiated not only by internal industry factors of technological development (endogenous processes), but also factors that are external in relation to the industry, the "shakings of environment" that are not dependent on a specific sector (exogenous processes).

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