FEATURES OF CYCLICAL DEVELOPMENT OF AUTOMOTIVE INDUSTRY

Gavrilenko, Natalia G., *Siberian State Automobile and Highway University, Omsk, Russia.*

ABSTRACT

The transport complex of the country creates conditions for economic growth, delivers cargo and employees to the places of production of goods and services, acts as a powerful catalyst and serves as an effective means for solving geopolitical tasks. The article contains the theoretical foundations of cyclical development of the economic objects of the industry. The regular connection between the dynamics of periodic recessions and the rise of the economy and indicators of vital activity of motor transport is shown, the complete life cycle of the system's existence and the so-called long cycle with duration of 40–60 years are presented in detail. The innovation factor is determined at the same time as a key factor in development of road transport. Accordingly, the intensity of the evolutionary process of upward and downward waves of the long cycle is estimated.

Keywords: road transport, economy, cyclic development, evolution, innovations.

Background. *Road transport as a component of the transport complex plays a key role in the everyday life of a large part of the population, the person most often meets with it. Unlike other modes of transport, cars in a significant amount are owned by private individuals and private individuals manage them. It is the changes concerning road transport that are most noticeable for the economy. Obeying its laws, it in its turn is experiencing periods of recovery, peaks of development, recession and crisis. This pattern is fully justified theoretically.*

Objective. *The objective of the author is to consider cyclical development of automotive industry, essentially at the example of its developments in Russia.*

Methods. *The author uses general scientific and engineering methods, comparative analysis, economic assessment.*

Results.

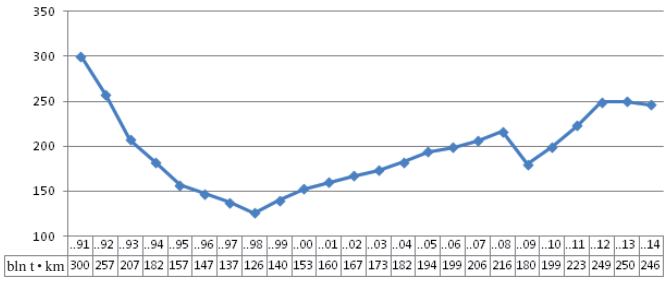
Cycles and periods

Dynamic indicators of freight turnover and passenger turnover of road transport in Russia during the last 24 years (Pic. 1, 2) [1] illustrate a rather definite cyclicality. At the same time, the dynamics of freight turnover reflects the economic crises of 1998, 2008 and 2014. Passenger turnover also shows a downward wave in its development, the main decline is observed in 2006–2007. A significant feature is that the rate of growth in the fleet of cars in ownership during this period is the largest (9,8 %) in the last 24 years (Pic. 3). Therefore, it can be assumed that one of the main reasons for decrease in passenger turnover is the increase in fleet of private cars, and therefore the question of possibility of changing the direction of the wave remains open.

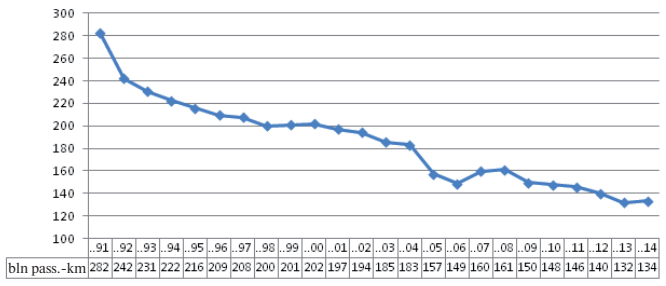
Let's consider the cyclicity factor in more detail. The factor of recurrence of the same processes through relatively equal intervals of time is present practically in all spheres of our life. A cycle is a life span of a particular formation from the moment of initiation to the moment of destruction or degeneration [2]. Each stage has its own peculiarities, from which the main goal in the study of cycles is development of measures of influence on the process for obtaining the maximum result at this or that stage of the cycle.

In the economy, the concept of cycles emerged in 18th century. The cyclic schemes became more widespread closer to its second half, while initially one type of cycle was identified – the medium-term one. This cycle was also called «industrial» or «business» (C. Juglar, K. Marx). At the beginning of 20th century, various types of cycles were mentioned (J. Schumpeter), the existence of economic fluctuations lasting 3,5 years (J. Kitchin), 20 years (S. Kuznets) and 50 years (N. Kondratiev). After the Second World War, ultra-long-term cyclic processes were analyzed for up to 300 years, they were also called cycles of hegemony and general wars (A. Toynbee, I. Wallerstein, J. Goldstein, etc.), «logistics cycles» (R. Cameron), «age-old trends» (F. Braudel), and so on.

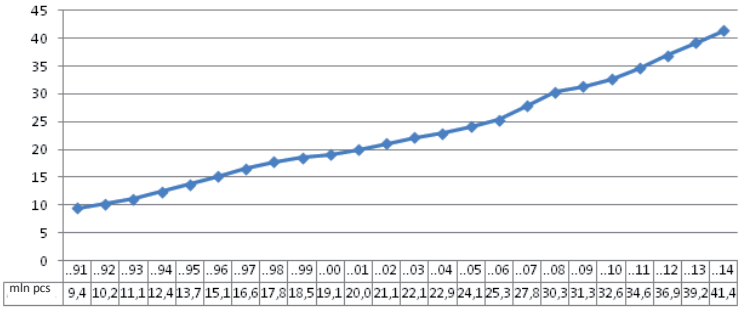
Economic cycles interested the minds of a large number of famous scientists of XIX and XX centuries. The British historian of economic thought Mark Blaug in his works «Great economists before Keynes...» and «Great economists since Keynes...» formed a list of the



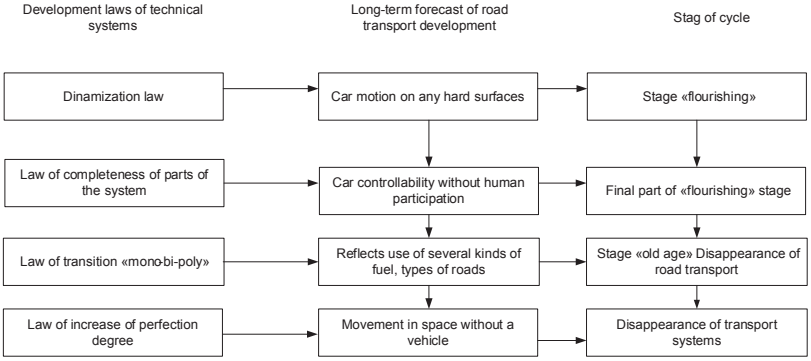
Pic. 1. Indicator of freight turnover of road transport of the Russian Federation for the period 1991–2014, billion t•km.



Pic. 2. Indicator of passenger turnover of road transport of general use of the Russian Federation for the period 1991–2014, billion pass.-km.



Pic. 3. Number of passenger cars (at the end of the year) owned by citizens in Russia, mln pieces.



Pic. 4. Stages of development of road transport.

most significant names for the economy [3, 4]. Analyzing the main work of scientists designated by Blaug, one can state with a high degree of certainty that from the middle of 19th century about 35 % of them devoted to some extent their work to the problem of cycles.

Most authors, as factors that cause cyclical development of the economy, mention monetary manipulation on the part of the state at an earlier time and, increasingly, recently, scientific and technological progress.

An interesting fact is that development of the theory of cycles finds its origin simultaneously with the advent of road transport. It was in 18th century that a steam engine (1769) was invented by an Englishman James Watt and a three-wheeled steam wagon by the French engineer Nicolas Cunho (1770), and until that time in 1672, Ferdinand Verbiest, a member of the Jesuit community in China, manufactured the first steam engine car, but as a mere toy for the Chinese emperor. The fact of simultaneity of the events can be linked precisely to the state of the economy, because at a certain level of development of the production of vehicles, intensification of business and trade processes that required rapid overcoming of distances, it depended on the progress of transport and along with it was subjected to periodic stages of decline and growth.

A similar idea was first reflected in the works by Marx. He rightly remarked that before the beginning of the industrial revolution (around the end of 18th century) there were no regularly recurring booms and depressions: «This peculiar life path of modern industry (in the form of a ten-year cycle of periods of medium revitalization, high pressure production, crisis and stagnation, cycle interrupted by smaller fluctuations, which we do not observe in any of the earlier epochs of mankind) was impossible even in the period of childhood of capitalist production» [5].

Innovative-cyclical development

Considering a car as a technical system, we can assume that its life cycle is subject to the law of S-shaped development (according to G. S. Altshuller) [6]. According to this law, road transport must go through three stages – «childhood», «flourishing» and «old age», with the last stage ending with modification of the vehicle or in general degeneration into another kind.

The full life cycle of road transport as a result of scientific and technological progress (STP) consists of shorter cycles. Of particular importance in the study of its features is the innovation-cyclical theory of economic development of Shumpeter–Kondratiev. On the basis of this theory, in particular, the concepts of academician S. Yu. Glazyev are built. He considers cyclic processes, focusing on the aggregates of technologically coupled industries that preserve integrity in the process of their development, under the conditions of so-called technological modes (TM).

The scientist claims that the life cycle of the TM covers about a century, while the period of its dominance in development of the economy ranges from 40 to 60 years (as STP accelerates its advancement, and the duration of scientific and production cycles decreases, the mentioned period gradually decreases). On the surface of economic phenomena, this period manifests itself in the form of long waves of economic conjuncture, the periodicity of which was first established by N. D. Kondratyev.

According to S. Yu. Glazyev, we are moving to the sixth technological mode (cycle), the features of which comprise artificial intelligence systems, global information networks, integrated high-speed transport systems, formation of a continuous innovation process, etc. As the key factors of the sixth technological mode (2010–2050), the author identifies nanotechnologies and cellular technologies, as advantages – a sharp decrease in the energy and material consumption of production, the design of materials and organisms with pre-determined properties [7].

Reducing energy intensity with regard to road transport is likely to lead to a change in the source of energy. It should be noted that the advantages of the fifth technological mode (1970–2010) were recognized

Table 1

Road transport evolution [12]

Reference periods	Features of road transport development	Commensurability of development intensity and direction of the long cycle wave
Upward wave 1770–1810	Appearance (1769) and beginning of work on improving the car (in England, France, Russia, the United States three-wheeled steam wagons were created, in the United States a steam dredger-amphibian and a wheel steamer appeared).	Intensity of design development is rather low, implementation rate is high.
Downward wave 1810–1840	Research is being carried out on development of ICE (France, Switzerland), steam omnibuses (England) are being introduced. 1834 – creation of an electric car	Intensity of design development is rather high, implementation rate is below average.
Upward wave 1840–1870	In 1860, a two-stroke internal combustion engine was created (Belgium), three years later its mass production was set up, and a four-cycle engine appeared (France).	Intensity of design development is rather low, implementation rate is quite high.
Downward wave 1870–1885	Search for possibility of using gasoline, a dynamometer, a three-wheeled electric car, powered by a battery (England) were invented.	Intensity of design development is quite high, implementation rate is low.
Upward wave 1885–1914	In Germany and France, the first production of cars was set up, by 1900 it was possible to talk about the national automobile industry in ten countries on three continents. There were pneumatic tires, patented disc brake and electric starter, in 1885 a carburetor engine was created.	Intensity of design development is high, implementation rate is high.
Downward wave 1914–1930	Automatic transmission, hydraulic brake, power steering, most of the mechanics technologies used today, were invented.	
Upward wave 1930–1950	By 1930, the number of car manufacturers had fallen dramatically as a result of consolidation and growth of the automotive industry, in part due to the impact of the Great Depression.	
Downward wave 1950–1970	The principle of motion on an air cushion was invented. The power of the engine increased, the speed of transport increased.	
Upward wave 1970–1990	The intensive development of automotive production began in new countries, primarily in the Asian region. Attention to the safety of the car increased.	
Downward wave 1990–2010	Tendencies to improvement of the environmental and economic performance of ICE, creation of hybrid systems, improvement of driving performance, «intellectualization» of the car develop.	

as individualization of production and consumption. So, there is reason to assume that individualization of consumption just led to a drop in passenger turnover in the market of road transportation in the face of an increase in the number of cars for personal use.

Based on the prevailing trends, the innovative component plays a primary role in development of transport, and consequently, formation of road transport system as innovative will allow it to achieve most effectively progress within the boundaries of a cyclically developing economic space.

Upward and downward waves

Describing the concept of an innovation system, S. Metcalfe defines the innovation system as a set of different institutions that jointly and individually contribute to creation and expansion of new technologies, forming the basis that serves governments to formulate and implement policies that affect the innovation process. As such, this system is designed to create, store and transmit knowledge, skills and artifacts that determine new technologies [8].

C. Freeman sees the innovation system as a complex system of economic actors and public institutions (such as values, norms, law) involved in creating new knowledge, storing, disseminating, transforming into new technologies, products and services consumed by society [9].

According to N. I. Ivanova the innovation system is understood as a set of interrelated organizations (structures) engaged in production and commercialization of scientific knowledge and technologies within national borders – small and large companies, universities, state laboratories, technology parks and incubators [10].

The essence of the innovation system is a set of institutions and organizations that are transforming scientific knowledge into new types of competitive products and services in order to ensure socio-economic growth as stated by A. F. Sukhovei and I. M. Golova [11].

By association with these definitions it can be concluded that an innovative transport system is a set of institutions supporting the process of creating and disseminating new knowledge and technologies related to the provision of road transport services.

It is legitimate, however, to put forward a hypothesis that the very process of emergence of

innovations is subject to the laws of long cycles. The development of road transport from the moment of origin passes like a kind of jerks, presumably increasing at the stages of a long cycle with a periodicity of 40–60 years and slowing down during the recession stages. Having reached the point of bifurcation, further development continues avalanche-like and regardless of the phase of the long cycle. The correspondence of intensity of the evolutionary process of upward and downward waves of the long cycle is illustrated in Table 1.

Based on the presented table, evolutionary activity can be divided into three stages.

The first stage is invention of the car and its main parts (1770–1930), the period of technological discoveries. At the stage of the downward wave, the intensity of the design developments is quite high at low rates of implementation, at the stage of the upward wave there is a reverse trend.

The second stage is intensive introduction of the car into life (1930–1970), we can talk about the national automobile industry in many countries and emergence of transportation process as such. More cars were sold not to enthusiasts, but to the ordinary consumer. 1930 can be designated as a bifurcation point, a change in the direction of the long wave downward did not affect road transport. External factors restraining the development of the economy, including world wars, were not a deterrent to the automotive industry, development continued to be avalanche, even during the Great Depression.

The third stage is widespread use of automotive industry (1970–2010), and it is followed by the growth in turnover and passenger turnover in almost all countries. There is a growing need for new modes of transport.

Conclusions. *So, there is every reason to conclude that road transport, existing in the economic space and carrying out a binding function in it, is subject, like the entire economic organism, to the effects of cyclical changes.*

It is possible to single out a full cycle of development of motor transport from the moment of its appearance to the moment of disappearance or degeneration into a new species, from which the processes of modernization of vehicles acquire special significance. There are also intermediate stages of crisis and growth associated with fall and rise of the national economy, and in connection with this, with the increase or decrease in the demand for transportation.

The intensity of the process of origin of innovations is also most likely dependent on the direction of the wave of the long cycle. Understanding the passage of such processes allows to build more accurate forecasts for the strategy for development of the road transport system, and at the same time to choose more effective directions for its implementation.

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Information about the author:
Gavrilenko, Natalia G. – Ph.D. (Economics), associate professor at the Department of Economics and Enterprise Management of Siberian State Automobile and Highway University, Omsk, Russia, gng@pirsoilgas.ru.

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