Cyclicity of Development of the Global Automobile Industry

Ajupov A. A.[1], Kurilova A. A.[2], Kurilov K. Yu.[2] & Bogatirev V. D.[3]

[1] Kazan Federal University, Institute of Management, Economics and Finance, Kazan, Russia

[2] Togliatti State University, Togliatti, Russia

[3] Samara State Aerospace University, Samara, Russia

Correspondence: Kurilova A. A., Togliatti State University, Togliatti, 445667, Russia Tel: 7-917-122-3879. E-mail: aakurilova@yandex.ru

Abstract

For manufacturers of vehicles the estimation of probability of occurrence in the market of sales of negative dynamics is actual, including on the basis of the information on cycles of development of branch. In the present paper the hypothesis of presence of cyclicity in development of branch on manufacture of vehicles is proved. The conclusion about existence of superlong-term cycles (waves) which are continuation of Kondratev long wave's time for completion of the superbig cycle of branch on manufacture of vehicles is made.

Keywords: automotive industry, the dynamics of the global automotive industry, cyclical, super long cycle

1. Introduction

The world industry for the production of vehicles is an important component of the global economy. According to OICA, aggregate indicators of the industry for the production of vehicles allow to equate it to the sixth largest economy in the world. "Direct" number of employees in the automotive industry is more than 8 million people - about 5% of all those employed in the sphere of material production. The number of employees indirectly related to the production of vehicles around the world more than 50 million people. Industry for the production of vehicles plays a key role in the development of technologies of other industries and society as a whole. Total expenditure for research, development and modernization of production is about 85 billion Euros per year.

Automotive is also a major source of government revenue for most countries. According to OICA, fees and taxes on vehicle manufacturers in 26 industrialized countries amounted to 430 billion Bole Euros per year.

At the same time the industry for the production of vehicles is largely dependent on the state of market for products that the general state of the global economy. Negative trends in the global economy reduced sales of vehicles, leading to a drop in the profitability of production, and with significant and long-term negative dynamics - to stagnation in the industry and the bankruptcy of vehicle manufacturers.

2. Theory

For vehicle manufacturers is the actual market behavior forecasting sales of vehicles, as well as the assessment of the likelihood of the market sales of negative dynamics. The formation of such objective forecasts allow you to select the best time to start new investment projects, depending on the generated forecasts. When this is the actual formation of forecasts, both in the short and medium and long term.

The use of short-term and medium-term forecasts will ensure the effective planning and management of the company in the short and medium term from 1 year to 3 years.

In particular, such predictions can be used to determine the optimal value of inventories, development of measures to reduce costs, including borrowing resources and liquidity management assets vehicle manufacturer. These projections can also be used in order to create an optimal policy for personnel management of the enterprise.

Long-term forecasting (over three years) is necessary for the effective management of the company, including through instruments such as investment policy, the policy of the development of new vehicle models and policy choice of the optimal time-to-market with new developments. Interconnected use of various management tools company, depending on the phase of long-term economic cycle, see Figure 1, shown in Table 1.

It is logical to hypothesize that the vehicle market and industry development of vehicles subject to the laws of cyclic development. Therefore, it is possible to determine the types of cycles, the timing of their existence and causes.

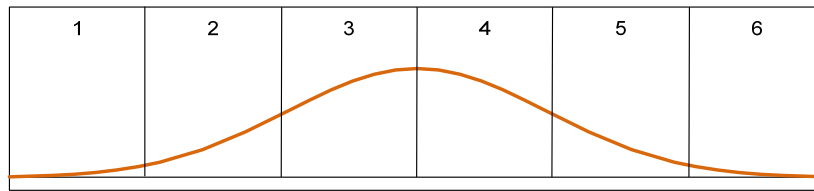| 1	2	3	4	5	6

Figure 1. Phases of long-term economic cycle

As part of the evidence for this hypothesis is necessary to solve the following problem - to confirm or refute the hypothesis of having cyclical market for a vehicle.

If you confirm the hypothesis of a cyclical market for a vehicle it is possible to perform additional tasks - determine the types of cycles and their duration, the main phases and causes.

The proof of the hypothesis and problem solving must be made using available data on the production and sales of vehicles using prediction methods based on the average of the dynamics, trend extrapolation, determine the correlations and the construction of the regression equations.

For the assessment, prediction and draw conclusions using available data on the sales of vehicles across the world, as well as the available data on the production and registration of vehicles.

By the end of 2007, the world has sold about 65.8 million motor vehicles (cars, light trucks, trucks and buses). Compared with 2006, there was an increase in sales to 2.87 million vehicles or 4.56%.

In this case, for the year was as follows sales structure - a major share in the global sales of vehicles are passenger cars - 68%, sales of other vehicles (light commercial vehicles, heavy trucks, buses) account for 32% of total sales.

By the end of 2008 the global auto industry produced about 69.4 million vehicles (passenger cars, light commercial vehicles, trucks and buses). In comparison with 2007 there was a decrease in production at 2.6 million vehicles or 3.7% .
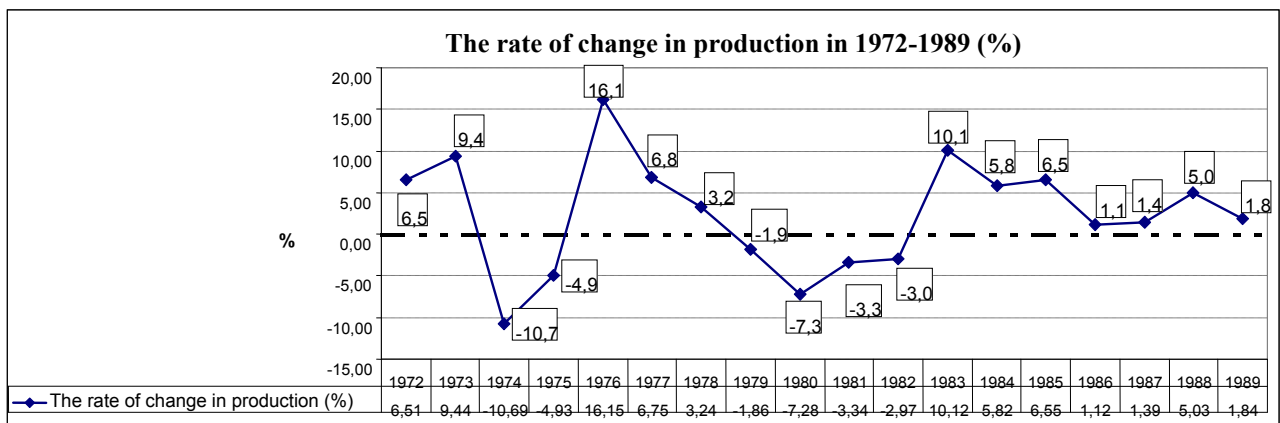
During the period from 1950 to 2008 the volume of production of vehicles has increased more than 6.5 times c 10.5 mln. up to 69.4 million cars.

Compared with the same period of 1988 the volume of production for twenty-year period increased by 43.51%, or in absolute terms by 21 041 thousand units.

For ten years (1998 - 2008), the volume of production of vehicles has increased from 52,098 thousand. up to 69 400 thousand units The increase in production vehicles in absolute terms amounted to 17 302 thousand or 33.2% .

Analysis of the rate of change in volume production of vehicles for the period from 1971 to 2008 suggests that the dynamics of the vehicle manufacturing industry there is a certain cyclical development, see Figure 2. At the same trends in growth and a decrease in the rate of change in output (Figure 2) can be divided by the criterion of the term "life" of trends in the following main categories:

- Short-term - up to three - four years (1991-1993, 1993-1995, 1998-2001)

- Medium - more than four years (1974-1980, 1980-1986, 1986-1991, 2001-2008).

The rate of change in production in 1972-1989 (%)

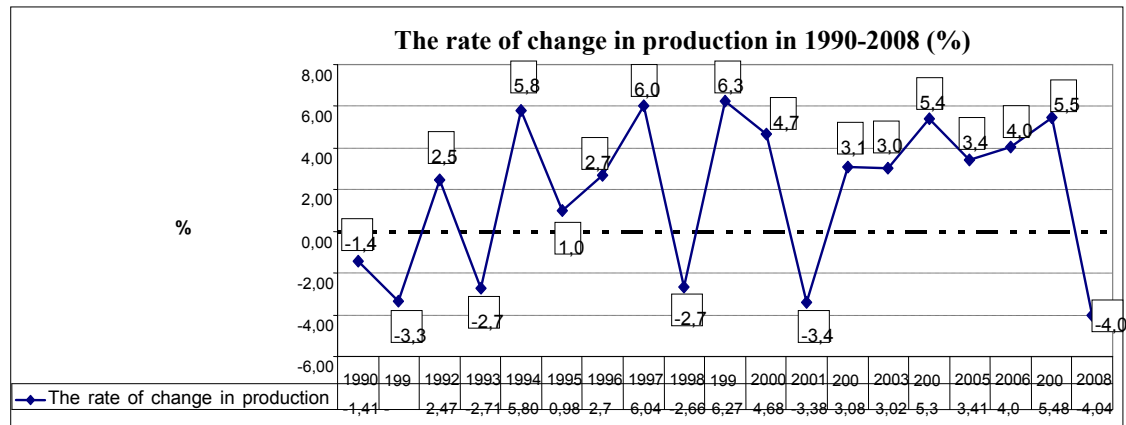|	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
The rate of change in production (%)	6,51	9,44	-10,69	-4,93	16,15	6,75	3,24	-1,86	-7,28	-3,34	-2,97	10,12	5,82	6,55	1,12	1,39	5,03	1,84

Figure 2. The relative rate of change in output in% between 1972-2008

It is logical to assume that the short-term cyclical fluctuations in the rate of change in output correspond to short-term business cycles lasting 3-4 years, which in the early 20-ies of XX century, described by an American economist Joseph Kitchin, and the medium-term cyclical fluctuations over four years correspond to the cycles of Juglar.

The main cause of short-term cycles in the industry for the production of vehicles associated with short-term fluctuations in demand and supply and delay information about these changes, and therefore, produced excessive stock of vehicles in the warehouses of manufacturers, distributors and dealers of products. When you see this kind of cyclical changes in the rate of production decreases and becomes negative. With lower sales volumes and normalization of the level of reserves to a level corresponding to the current demand, the rate of change in production volumes increase. The amount of residue in the global system sales of vehicles can be defined as the difference between the volumes of production and sales by the end of the period. This value can also be characterized as the value overproduction vehicles.

Consequently, the output can be roughly expressed by the formula (1).

$$V_p = V_s + V_r \qquad (1)$$

Where: V_p - output; V_s - sales; V_r - the amount of residues (overproduction).

If there are sufficient data on the sales and production of vehicles is possible to calculate the threshold value of the ratio of the volume of production vehicles and the remains of vehicles, the excess of which leads to a decrease in the rate of change of production vehicles. For example, the average ratio between the residues (volume overproduction) for the period 2005-2007 was 7.7%. If we take 7.7% of the estimated threshold ratio of production vehicles and fund vehicles, the model of sustainable continuous growth of production vehicles will be as follows (2) (3):

$$V_p - V_s \le V_p * 0,077 \qquad (2)$$

or

$$V_r \le V_p * 0,077 \qquad (3)$$

Where: V_p - output; V_s - sales; V_r - the amount of residues (overproduction).

From this model, the assertion that the steady growth in the rate of production of vehicles is only possible if the amount of residues (volume of overproduction) does not exceed 7.7% of the volume of production vehicles. Exceeding this level for a number of years will lead to a drop in the rate of change of vehicles and the absolute production vehicles.

The reason for the medium-term cycles is a violation of investment capital in the active elements of fixed capital, ie in the means and instruments of labor.

The absence of pronounced cycles with a longer period of development in the dynamics of vehicles due to the following factors:

1. The absence of a complete saturation of the market. If we pay attention to the ratio between the number of the world's population and the number of registered vehicles, it can be seen that this ratio is at 0.13 pc. vehicles on the 1st person on the planet. This indicator for developed countries the ratio is 0.8 in the United States, 0.53 pc. / pers. in Germany and 0.58 pc. / pers. in France. Therefore, there is a significant reserve growth market for vehicles is at least three or four times.

It should be noted that the main market potential is in developing countries, including the countries of BRIC. This is due to the fact that the level of motorization in developing countries is quite small - for China - 0.03 pc. / Pers., For Russia - 0.24 pc. / Pers., Turkey - 0.12 pc. people.

Level of this index is determined by income population, the presence of a developed road network, as well as a number of other factors that determine the possibility of widespread use of vehicles for personal and commercial purposes. For example, the cost of a driver's license in China is at a level of 800 RMB (Chinese Yuan), which is equivalent to $ 120 dollars, with per capita income of $ 770 USD.

Consequently, the world production of vehicles there is a considerable reserve of growth in sales and production of vehicles that can be implemented with changes in factors affecting the sale of vehicles. A good practical proof of this is that the measures for the development of national economies, taken by the Government of India and China, as well as a number of developing countries, lead to an increase in production and sales of vehicles.

Therefore, considerable time and quantitative dimensions of fluctuations in the volume of sales and production volumes can be diagnosed only when the world market will be saturated with vehicles. Therefore, cycles with a longer life can be diagnosed in a saturated market. So the market is the market of the United States.

The ratio of the number of vehicles and the population in the United States reached 0.8 vehicles per capita and cars - 0.44 per person United States. On the importance of these indicators USA occupies a leading position among other countries.

If you pay attention to the dynamics of change in the volume of sales of vehicles and the rate of change in sales in the United States for the period 1964 - 2009 (Figure 3), we can clearly see the development of the market cycles Vehicle Sales USA, having different lengths.
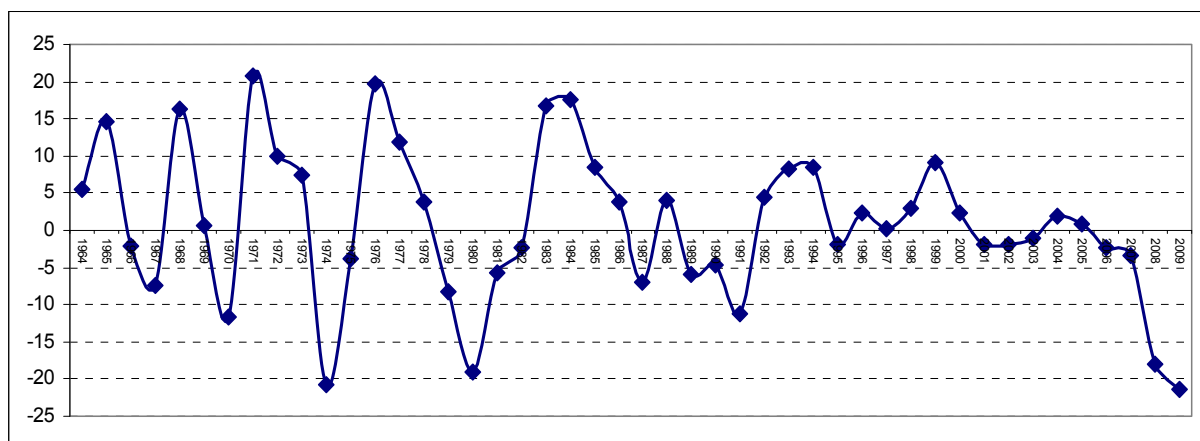

Figure 3. The dynamics of the rate of change in sales in the United States for the period from 1964 – 2009

The dynamics of changes in the volume of sales to determine the US market cycles lasting three years (1964-1967 period, 1967-1970 years), five years (1970-1975 years), sixteen years (1975-1991 years) and ceased to exist long cycle, which began in 1991 and lasted for more than 18 years.

Assessment of the dynamics of the rate of change in sales in the United States (Figure 3) for the period from 1964 - 2009 allows the diagnosis of short-term fluctuations in the indicator in the period in which the average is three or four years.

These observations lead to the conclusion that the market is the United States, there are short development cycles for up to three years, medium-term development cycles lasting up to 6 years of age and long-term development cycles lasting 16 years or more.

Thus, suggested the lack of significant long-term cycles in the global vehicle market, because of its lack of saturation is correct.

Saturation of the world market of vehicles will allow to diagnose long-term variations not only in the local, saturated markets, but also on the world markets as a whole. Before reaching the saturation medium and long-term cycles, it will be possible to diagnose only on local saturated markets such as the United States market and the market of Western Europe.

2. The presence of long-term cycles of development of national industries of vehicles that are in opposition, not to diagnose long-term cycles of global vehicle manufacturing industry (see. Figure 4,5), since there is a trend to a decrease in one of the national industries for the production of vehicle offset beginning of growth to another, see. Figure 4.
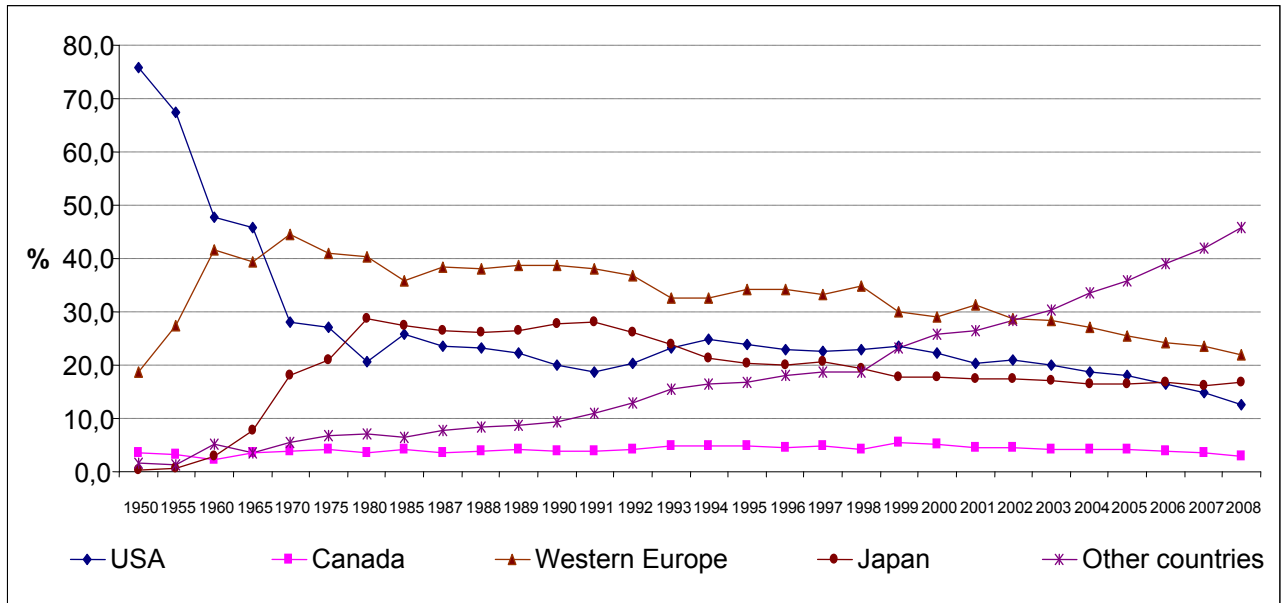
Figure 4. Change in the share of the world market in the production of vehicles % worldwide

As can be seen from Figure 4, the largest share in the production of vehicles has reached the United States in 1950, at the same time, since 1950, comes her constant intense significant decline, which ended in 1980. After 1980, the share of the United States stagnation in manufacturing continued, but at a slower pace.

The above assumption is also confirmed by the dynamics of change in the share of domestic producers such as the United States Ford (Ford), General Motors (GM), American Motors (American Motors) in the market share of the United States.
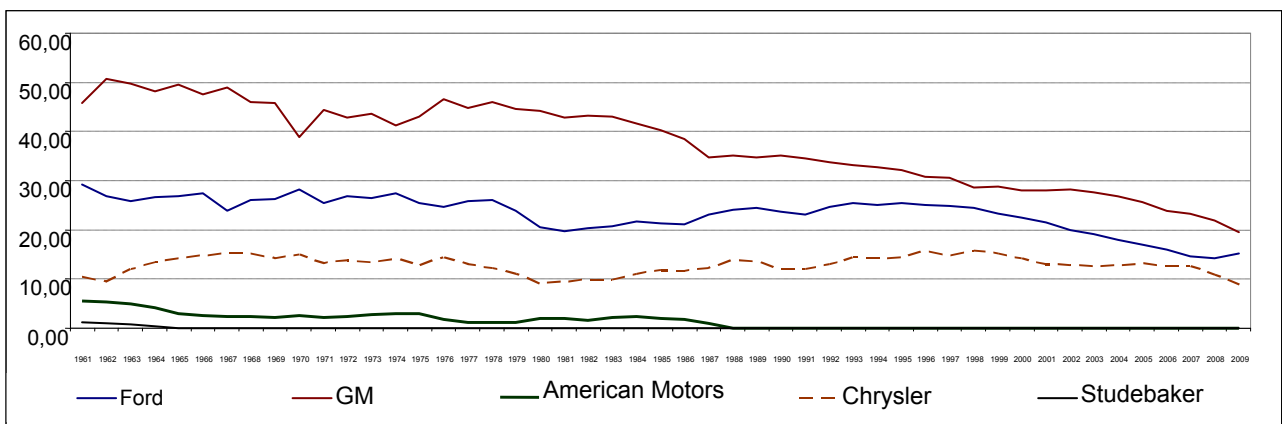

Figure 5. Change in the share of producers in the United States the total vehicles sold in the USA in %

This will mean the end of a multi-year upward trend of world production of vehicles that existed due to the constant migration of technology and investment in developing countries with cheap labor and low-cost. In 1999, China and India produced 1,830 thousand pcs. and 818 thousand pcs. vehicles, which is a kind of historical minimum, after which the production of vehicles has increased several times. If we take 1999 for the start point of the production cycles of industry vehicles in China and India, roughly the end of cycles, taking into account the previously defined term life cycle development of national industries in the 60-70 years old, will be in 2059 - 2069.

Closing up-trend will be accompanied by increasing competition in the market for a vehicle, the departure of the producer countries from the production of vehicles and quite significant economic and social shocks, due to the fact that the industry for the production of vehicles provides a significant number of jobs in the industry itself, and in related industries. Ultimately, this may lead to a vehicle with new consumer properties, which allow to begin a new cycle on the basis of the new product.

3. Results

Thus, with respect to the industry for the production of vehicles can talk about very large-scale cycles (waves) with a lifetime of 146-156 years. These extra-large cycles (waves) have an internal structure, which consists of large cycles (waves) the development of national industries for the production of vehicles that are at different stages of development and are often in opposition. It is reasonable to assume the existence of similar extra-large cycles (waves) in the other branches of the global industry.
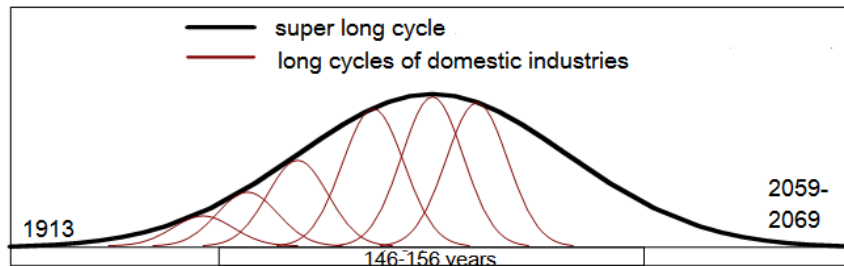

Figure 6. Sample dynamics and structure of the development of the very large cycle (wave) for the industry for the production of vehicles

In assessing the internal structure of the very large cycle industry, we can determine the relationship between the very large term life cycle of length greater than the first cycle of domestic industries that have introduced an innovative product or service, deviations between the time of the introduction of these products and services to other national industries, as well as the absence / presence of factors accelerating / decelerating the development of large cycles in a particular national industry, see. equation (1).

$$T = t + n_1 + n_2 + n_3 + ... + n_n + a_1 + a_2 + a_3 ... + a_n \qquad (1)$$

where: T - the life of the very large cycle; t - the length of the first great cycle of domestic industries have introduced an innovative product or service; n - the deviation between the timing of the introduction of an innovative product or service previous national industry for the production of vehicles, experienced a recovery period and the introduction of a product or service from another national industry, which began to develop; a - time estimate factors accelerating / decelerating the development of large cycles in a particular national industry. For example, the First and Second World Wars, have delayed development cycles in Western Europe and Japan.

Based on the formula (1), we can conclude that in the case where the period of implementation of the innovative product or service is the same, and the factors that accelerate / slow down the development of large cycles in a particular domestic industry, have the same orientation and are equal, then we have (2).

$$T = t \qquad (2)$$

where: T - the life of the very large cycle; t - the length of the first great cycle of domestic industries that have introduced an innovative product or service.

In fact, due to variations in the timing of the introduction of product innovation among national sectors, the difference in the factors accelerating / decelerating the development of large national industry-specific cycles $T > t$, for example, for the industry for the production of vehicles, based on the analysis carried out above, the very large term life cycle global industry for the production of means of transport (T) is defined as follows (3):

$$T = 67 + 4 + 2 + 41 + 39 - 1 + 2 = 154 \qquad (3)$$

where: $t = 67$ (the cycle of the vehicle manufacturing industry USA); $n_1 = 4$ (deviation between the beginning of the development cycle of the industry for the production of vehicles in Japan and for the start of the cycle in the United States -1917 - 1913); $n_2 = 2$ - (deviation between the beginning of the development cycle of the industry for the production of vehicles in Western Europe and the beginning of the cycle period in Japan -1917 - 1919); $n_3 = 41$ - (deviation between the beginning of the development cycle of the industry for the production of vehicles in South Korea and for the start of the cycle in Western Europe - 1960 - 1919); $n_4 = 39$ - (deviation between the beginning of the development cycle of the industry for the production of vehicles in China and India, and for the start of the cycle in South Korea - 1999 - 1960); $a_1 = -1$ - (actual deviation of the cycle time in western Europe from the United States); $a_2 = +2$ - (fact deviation cycle length of Japan from the United States).

Thus, on the basis of formula (3) was determined period the very large cycle approximately equal to 154 years, which corresponds approximately to the duration previously defined ultrahigh 146-156 cycles per year.

4. Conclusions

Summarizing the above material, it can be concluded that the hypothesis of cyclicity in sales vehicles confirmed.

Term cycles of development in sales of vehicles can be divided into short-term - to 4 years, medium-term more than 4 years, the long-term from 11-70 years old and super-large-lived from 146 to 156 years.

Cycles with a longer "life" are not diagnosed in the dynamics of the global automotive industry as a whole, and there are national industries for the production of vehicles and components are super long cycle development of the industry for the production of vehicles extra large loops are actually a continuation of the long-wave Kondratiev propagating as exports of investment and technology from the country, to develop the production of vehicles and exhausted positive growth factors, other national economy.

Existing extra-large loop completes its existence about 2059-2069. Completion extremely large cycle will cause significant changes in the industry for the production of vehicles, related primarily to increased competition in the industry and radical change in the consumer properties of vehicles, including the emergence of new types of vehicles that run on new fuels.

Confirmation of the hypothesis of cyclicity, as well as the definition of types of cycles of duration, main phases and causes makes it relevant to the solution of the problem - forecasting the development of the global market for vehicles, including on the basis of the data obtained about the cycles of development of the industry, which will be solved in the future.

References

Coccia, M. (2010). Foresight of technological determinants and primary energy resources of future economic long waves. *International Journal of Foresight and Innovation Policy, 6*(4), 225-232. http://dx.doi.org/10.1504/IJFIP.2010.037468

Coccia, M. (2010). The Asymmetric path of Economic Long Waves. *Technological Forecasting and Social Change, 77*(5), 730-738. http://dx.doi.org/10.1016/j.techfore.2010.02.003

Juglar, C. (1862). Des Crises commerciales et leur retour periodique en France, en Angleterre, et aux Etats-Unis.

Kitchin, D. (1923). Cycles and trends in the economy. *Review of Economic Statistics, 1*, 10-16. http://dx.doi.org/10.2307/1927031

Kondratiev, N. D., Yakovets, Yu. V., & Abalkin, L. I. (2002). Large cycles conditions and the theory prediction. Selected Works. *Economy*, 341 - 393.

Linstone, H. A. (2011). Three eras of technology foresight. *Technovation, 31*(2-3), 69-76. http://dx.doi.org/10.1016/j.technovation.2010.10.001

Metz, R. (2011). Do Kondratieff waves exist? How time series techniques can help to solve the problem. *Cliometrica, 5*(3), 205-238. http://dx.doi.org/10.1007/s11698-010-0057-9

Production statistic 1998-2008. Retrieved August 23, 2010, from http://oica.net/category/production-statistics

Reijnders, J. P. G. (2009). Trend movements and inverted Kondratieff waves in the Dutch economy, 1800-1913. *Structural Change and Economic Dynamics, 20*(2), 90-113. http://dx.doi.org/10.1016/j.strueco.2009.03.003

Ryoo, S. (2010). Long waves and short cycles in a model of endogenous financial fragility. *Journal of Economic Behavior and Organization, 74*(3), 163-186. http://dx.doi.org/10.1016/j.jebo.2010.03.015

The World Fact Book. Retrieved August 23, 2012, from http://www.cia.gov/library/publications/the-world-factbook/

U.S. Total Vehicle Sales Market Share by Company, 1961-2009. Retrieved August 23, 2010, from http://WardsAuto.com/ReferenceCenter

U.S. Vehicle Sales, 1931-2009. Retrieved August 20, 2010, from http://WardsAuto.com/ReferenceCenter

Vehicles in Operation by Country, 2003-2007. Retrieved August 24, 2010, from http://WardsAuto.com/ReferenceCenter

World Vehicle Production by Vehicle Type, 1951-2009. Retrieved August 23, 2013, from http://WardsAuto.com/ReferenceCenter