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**LONG WAVES IN THE PRE-  
INDUSTRIAL PERIOD:  
A TIME SERIES ANALYSIS OF  
SOVIET RESEARCHERS' DATA**

BASIC RESEARCH PROGRAM

WORKING PAPERS

SERIES: HUMANITIES  
WP BRP 177/HUM/2019

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DATA**<sup>2</sup>

Kondratiev long cycle is generally treated as a phenomenon of a modern world economy. However, the existence of major cycles before the Industrial Revolution does not contradict the theoretical views of Kondratiev, the founder of the long-waves theory. We have discovered Kondratiev's documents, which show him going farther back in history. The key question we are trying to answer is why are major cycles not associated with a pre-industrial economy? We also have at our disposal a number of unknown and little-known historiographical sources, which indicate that Soviet researchers cared about the existence of long cycles in the pre-industrial period. At the same time, Soviet scientists had done a tremendous amount of work to construct the time series on historical data of Russia. Using this data, we concluded that the existence of Kondratiev waves in the Russian Empire was very probable.

Keywords: long waves, Kondratiev cycles, pre-industrial economy, grain prices, time series analysis.

JEL Classification: Z.

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<sup>2</sup>Work on this article has been supported by the Basic Research Program at the National Research University Higher School of Economics (Moscow).

## **Introduction**

The existence of long cycles before the Industrial Revolution is an inexplicable fact of the technological innovation theory, which has become widespread in long-wave literature. Nevertheless, in recent decades, evidence confirming their existence is accumulating (Metz 1984; Zschocke 1984; Goldstein 1987; Metzler 1994, etc). Sooner or later, the accumulation of these ‘anomalies’ will lead to a resolution of the contradiction between theory and practice. Some studies already exist, that analyze the results of the empirical research in that area, and its influence on the development of the long-waves theory (Barr 1979; Полетаев, Савельева 2009; Diebolt 2012).

However, it remains unclear what the contribution was of Soviet researchers in this respect. The main reason for this is a strong presumption that after 1930, when Kondratiev, the founder of the long-wave theory, was arrested, Soviet scientists had not conducted any research on long cycles. In the present study, the correctness of this claim is challenged. We have at our disposal a number of unknown and little-known historiographical sources, which indicate that Soviet scientists cared about the existence of long cycles in the pre-industrial period.

At the same time, Soviet researchers had done a tremendous amount of work to construct the time series on historical data of Russia. However, western readers have limited knowledge of this data (Kahan 1985; 1989), which is of interest in the study of long cycles in the pre-industrial period. European economies remain the main topic in most long-wave literature. Accordingly, western researchers’ explanations of the long economic waves that preceded the Industrial Revolution do not pertain to the Russian experience, because Russian society developed in a socio-economic context, quite differently to that of western states. In other words, this historical material serves as a fertile ground for the analysis of the contradictions that exist between theory and practice.

## **Why are Kondratiev waves not associated with a pre-industrial economy?**

The answer to this question can be found by examining the reception of Kondratiev's ideas in the Western scientific community. The fact is, that the publication of an abridged translation of Kondratiev's article (1935) ultimately led to active discussions, but were based on extremely fragmented ideas about his scientific heritage. This publication made him, a prisoner at that time, famous in the international scientific community: soon afterwards major cycles were named in his honor by Joseph Schumpeter (1939). Only much later, Kondratiev's major works were reissued (1989; 1991) and translated into foreign languages (1984, 1998). When we consult these works, we find the explanation of the time frame of his research, "And yet, however much we want to go farther back in history, owing to the condition of the data, and also for reasons of the homogeneity and comparability of the phenomena under study, we cannot go too far back – no farther than the late eighteenth century" (1984, 32). Also, he never used concepts such as 'first long wave' and 'second long wave,' unlike the translator of his famous article.

It should be added that in Western literature, there is confusion regarding how Kondratiev explained long cycles, since his major works were translated rather late. Opinions were expressed that he allegedly explained major cycles by solar activity (Chaunu 1974, 57), or "various exogenous shocks to the system, such as wars and gold discoveries" (Blaug 1986, 114); he wrote about "the important role of the innovation process" (Fontvieille 1991, 238) and of mineral discoveries (Blainey 1970, 298, 313). Some researchers allege that Kondratiev never offered a theoretical explanation (Rostow 1951, 64; Perez 2010, 190; Hagemann 2014, 124). This means that it is not clear that the existence of long cycles before the Industrial Revolution contradicts the theoretical views of Kondratiev.

First of all, we note that in the literature of the early 20th century, extensive time series data can be found, and its analysis made assumptions about the existence of long cycles before the Industrial Revolution. Such data was accessible

to Kondratiev's environment, as evidenced by the fact that during discussions at the Institute of Economics, Oparin, the famous critic of Kondratiev's ideas, used data on grain prices in England in the 17th and 18th centuries (1998, 75).

Moreover, it has been possible to identify previously unknown rough drafts by Kondratiev, which show him going "farther back in history." On the basis of a comparison between different sheets from two archival documents, it is possible to reconstruct the source text with data on grain prices of Denmark from 1600 to 1902 (RGAE. Stock 769. List 1. Dos. 8, 10). From the graph, we can see that the prices of rye<sup>3</sup> and oats<sup>4</sup>, despite all deviations and irregularities, exhibit a succession of long cycles in the pre-industrial period (figure 1). At any rate, these documents indicate that the problem of the existence of long cycles before the Industrial Revolution had attracted the interest of Kondratiev.

Finally, it should be noted that the existence of long cycles in the pre-industrial period does not contradict the theoretical views of Kondratiev. Unlike most modern economists, he did not link long cycles with technological innovations, "their basic cause is to be found in that mechanism for the accumulation and diffusion of capital which is adequate for the creation of new basic productive forces" (1984, 104). In principle, this explanation allows for the existence of major cycles in the early modern period.

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<sup>3</sup>We have used Kondratiev's method for identifying cycles in time-series data.  
Secular trend for the period from 1600 to 1809:  $y=0.0207x + 5.9526$

<sup>4</sup>Secular trend for the period from 1631 to 1809:  $y=0.0091x + 2.845$

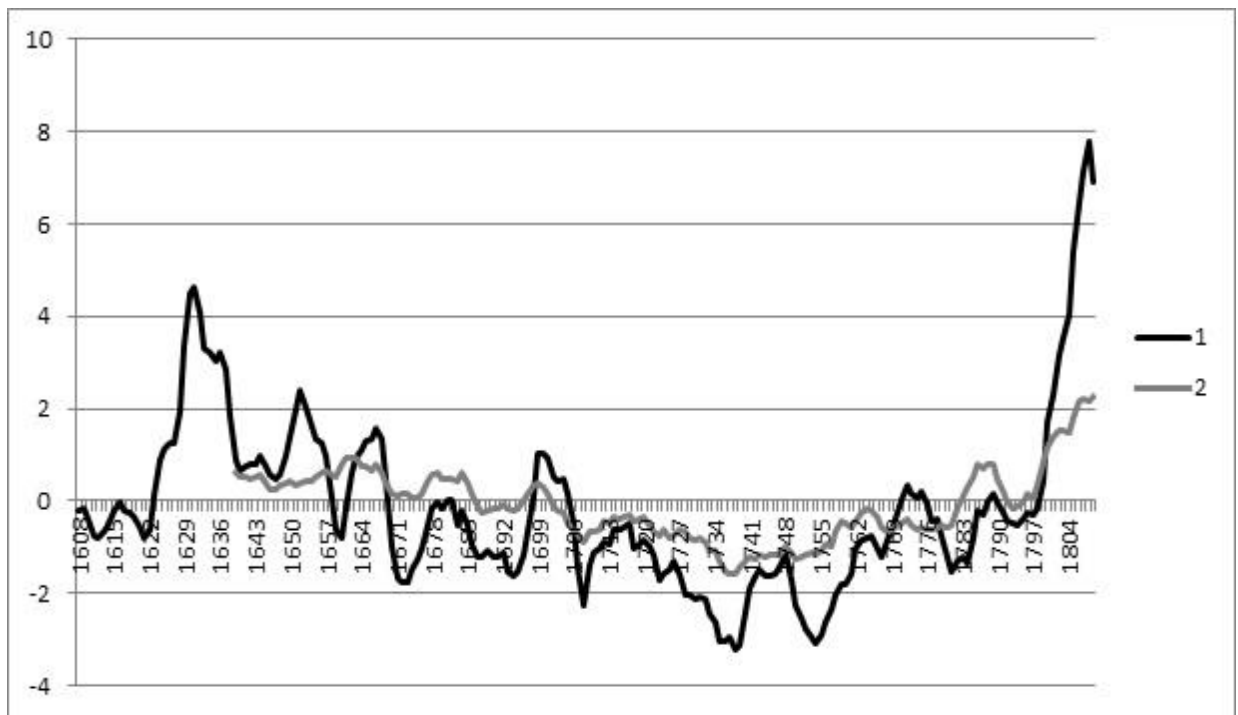


Figure 1. *Long waves in rye (1) and oats (2) prices in Denmark (deviation from theoretical series, theoretical smoothed over nine years)*  
 Source: RGAE. Stock 769. List 1. Dos. 8, 10.

Why did Kondratiev not make assumptions about this issue? Most likely, the answer can be found in the political context of the discussions in the USSR. Kondratiev first proposed the existence of long cycles in 1922 in his monograph *The World Economy and Its Conjunctures during and after the War (2004 [1922])*. His assessment of the crisis of 1920–1921 contradicted the notions of the inevitable and swift collapse of world capitalism – such ideas were especially typical for representatives and supporters of the Left Opposition. Therefore, Kondratiev’s position could not but draw the attention of well-known Marxists. Thus, Osinsky believed that the long-cycles theory meant “to find capitalist crises even under the Czar Goroh<sup>5</sup>”, and from this to draw a conclusion, “always has been, always will be” (1923, 12). It is unlikely that Kondratiev could afford to expand the time frame of his research.

It should be added that we also do not know his opinion on long waves before the Industrial Revolution, although their existence does not contradict the theoretical views of Kondratiev. The fact is that the participants in the Soviet

<sup>5</sup>In days of yore

discussions (Discussion 1998 [1928], 122), in contrast to modern scientists, did not contemplate ‘long waves’ and ‘major cycles’ as synonyms. They believed the major cycle (long cycle) to be strictly periodic. This strict use of these terms was motivated by a dispute between Kondratiev and Trotsky, who in 1923, stated that Kondratiev’s long-term fluctuations are not cycles: they can only be considered as long waves, which are determined by random factors and ‘the external conditions in which capitalist development occurs’(1923, 9). There is a reason that Kondratiev chose ‘cycle’ rather than ‘wave’.

### **Kondratiev’s contemporaries and long waves before the Industrial Revolution**

As is widely known, in the 1920s, the idea of long cycles had come under heavy criticism. This idea was developed by the staff of the Conjuncture Institute, of which Kondratiev was the director. Among the staff, Rainoff conducted research relating to the issue of long waves before the Industrial Revolution. Using data on discoveries in physics in Germany, France, and England in the seventeenth, eighteenth, and nineteenth centuries, he discovered long waves (1929, 296). In other words, “The intensity of creative activity of scientists in the realm of physics alternatively strengthened and weakened in each of these countries” (ibid.). Rainoff also claimed that between the long waves of creative productivity and “waves in economic life exists an undoubted and easily traced connection”, since the end of the 18th century (ibid., 302). However, he did not find that there was such a connection before the Industrial Revolution.

Like many researchers, Rainoff ceased investigating long waves after Kondratiev’s arrest in 1930. Nevertheless, he maintained a card index on inventions relating to metallurgy since 1740. This data file contains about 3600 entries (*RGB OR*. Stock 441. Carton 18. Dos. 1-3; Carton 19. D. 1-3). Furthermore, Rainoff’s article was translated into Russian in 1983, and is one of the first Conjuncture Institute staffs’ papers, publicized in the USSR after 1930. However, this translation was abridged and did not mention Kondratiev’s name.

Let us turn to the critics of Kondratiev. There was no consensus among them. For instance, Pervushin, one of the pioneers of business-cycle research in Russia (Owen 2013), believed that long waves exist, “but these are not capitalistic waves” (Discussion 1998 [1928], 110). He claimed that Kondratiev proved nothing since he was “working with two-and-a-half cycles” (ibid., 109).

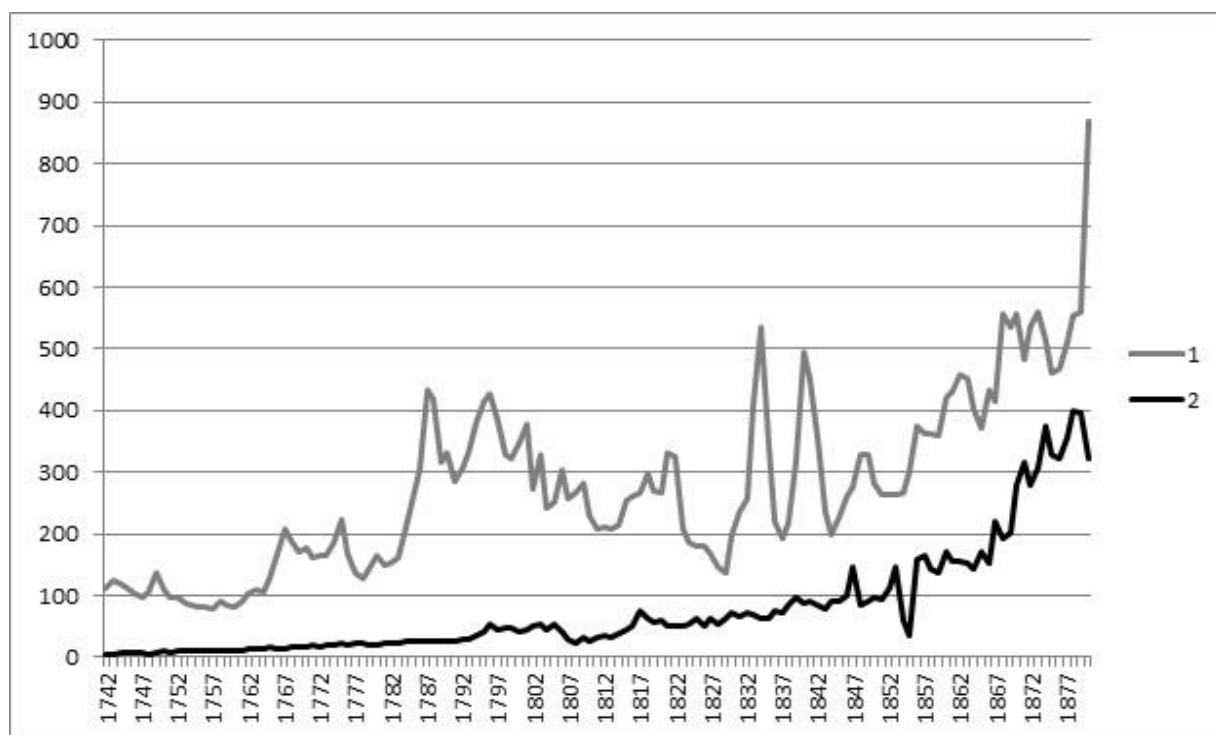


Figure 2. Rye prices (1) and export turnover (2): Russia, 1742–1880

Source: Price data in kopecks per *chetvert'* from *Миронов*

Export data in million rubles from *Опарин (1968)*

Kondratiev’s most important and rigorous critic was Oparin, who believed that “long period fluctuations were only detected for the movement of prices and the interest on long-term investments” (1998 [1928], 82). Following discussions with Kondratiev, he alone among their contemporaries studied long waves. Oparin’s study remained unknown to the scientific community. The study focused on Russian foreign trade in 1742–1917, and it identified that the customs indicators show long wave-like fluctuations. Oparin rejected the view that the increase or decrease in duties on imports was happening due to competing interests. According to him, the reasons for these fluctuations in duties were linked to the world price of



goods (1968, 109-110). Oparin's study was based on time-series data reconstructed by him (figure 2), and he mentioned his book, written together with Kondratiev (1998 [1928]). However, Oparin did not mention Kondratiev's name.

### **Soviet historians and long waves before the Industrial Revolution**

Soviet historians had analyzed foreign literature on long waves before Soviet economists did. Therefore, the historians pioneered the study of time-series data. It was due to the influence of French historiography of long cycles before the Industrial Revolution.

In this connection, it should first of all be noted that in 1977, the Russian translations of Braudel's and Furet's articles were published. They stressed the relevance of the study of economic cycles, and Braudel had used the term, 'classic Kondratiev cycle.'

Somewhat later, studies regarding the French historiography of long cycles were conducted. Sokolova presented the analysis of Labrousse's long cycles to Soviet readers (1979, 162-166). Afanasyev assessed Braudel's study of economic cycles (1980, 35). Finally, we should mention Kahk's and Rimmel's research (1983). They revealed Labrousse's, Simiand's, Braudel's, Nicolas' and other scientists' study in the field of long cycles. Moreover, Kahk and Rimmel presented a comparative analysis of early modern harvest waves, by graphical methods analysis.

It is important to note that these research papers were published before the rehabilitation of Kondratiev in 1987. This could help to explain why the authors did not mention Kondratiev and Imbert, who is known for his monograph entitled '*Des mouvements de longue durée Kondratieff*' (1959). However, we cannot but discover their names while reading Braudel's papers on long cycles. Also, the soviet historians did not use the term 'major cycle'. It is not unusual that such terms as 'long cycle' and 'long wave' were used as euphemisms.

In 1985, Mironov published a book providing a vast data base of Russian grain prices by region and by year from 1708 to 1915. He presented the results of researching Kondratiev cycles. For the first time in half a century, a soviet scientist applied Kondratiev's method for identifying major cycles. As a result of his investigations, Mironov dated Kondratiev cycles as taking roughly 45 to 50 years, in the following order: (1) from 1658 to 1708, with a peak in 1683; (2) from 1708 to 1754, with a peak in 1734; (3) from 1754 to 1799, with a peak in 1775; (4) from 1799 to 1844, with a peak in 1822; (5) from 1844 to 1896, with a peak in 1868 (1985, 120).

However, Mironov's book raises many questions. How could he identify major cycles since 1658? His book only contains information on Russian grain prices since 1708. How should we find information on archival sources in a particular year? Why did not Mironov present the homogeneous time series, which he used to identify major cycles? Unfortunately, Mironov also did not present any graphs and equations that were used for identifying Kondratiev cycles. In this regard, we checked Mironov's calculations.

First, we checked the reliability of his sources of the 18th century and his calculations of average prices<sup>6</sup>. Using published sources, we checked Mironov's information of the 19th century (Фомин 1829; Егунов 1855; Рахматуллин 1970; Ковальченко, Милов 1974). We constructed a homogeneous time series of grain prices<sup>7</sup>. And then we used Kondratiev's method for identifying long waves<sup>8</sup>. The evaluation revealed another dating of cycles: from 1725 to 1762 the declining wave; from 1763 to 1795 the rising wave of the next cycle; from 1796 to 1830 the declining wave of this cycle; from 1831 to 1881 the rising wave (figure 3). Our analysis is limited to before the 1880s, but we shall notice that in the 1880s and 1890s there was a decrease in the grain prices.

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<sup>6</sup>According to my calculations, the price of rye, per *chetvert'*, was: 40 kopecks in 1708; 44 kopecks in 1709; and 68 kopecks in 1710. According to Mironov, the costs of *chetvert'* for those same years were, respectively, 35, 36, and 41 kopecks. Also, some typos were discovered in his monograph. In the years 1761–1764, the cost per *chetvert'*, in kopecks, was 78, 90, 95, and 105. However, in Mironov's monograph these prices are on average 2.5 times lower (See Мустафин, 2017).

<sup>7</sup>To that end, we calculated Russian average prices in the 19th century and presented prices as quantities of kopecks (contained 0.0018 grams of silver) per *chetvert'*

<sup>8</sup>Secular trend for the period from 1708 to 1880:  $y=2.3825*x+31.657$

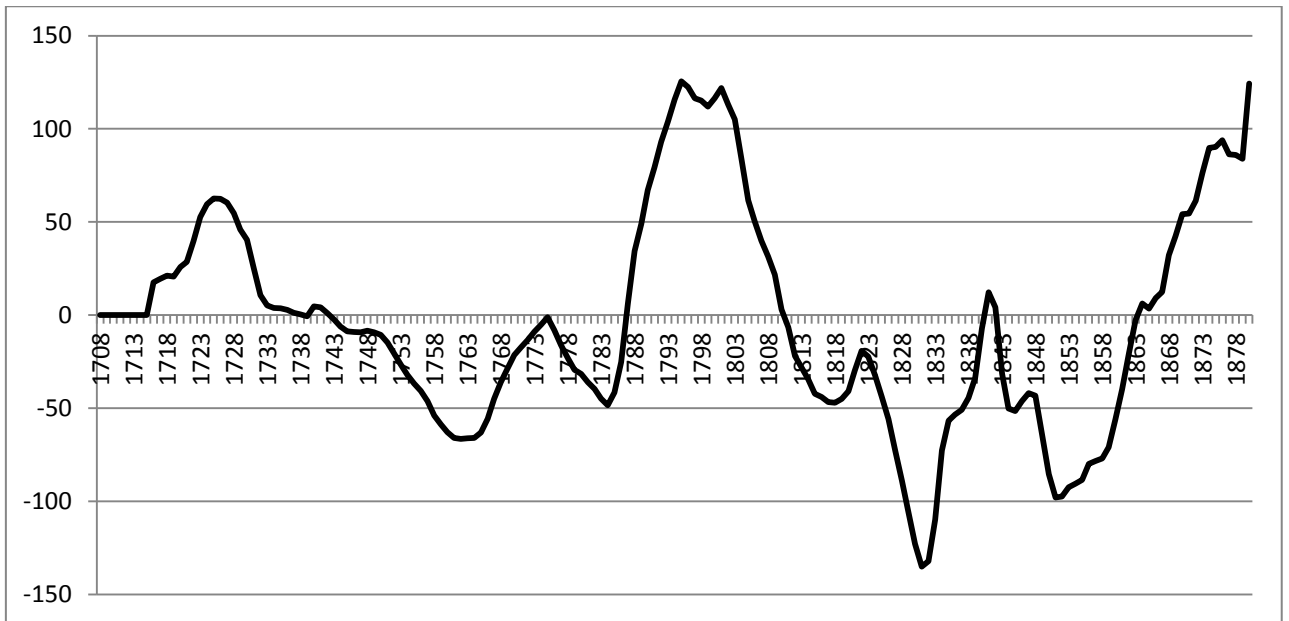


Figure 3. *Long waves in rye prices in Russia (deviation from theoretical series, theoretical smoothed over nine years)*

Source: Data from *Миронов*

It should be added that Mironov associated fluctuations of the grain price with yield changes (*ibid.*, 124). However, there is no data, on an annual basis, on yield changes in Russia in the 18th century. We should therefore test various hypotheses about the reasons of the grain price fluctuations.

### **Did long waves exist in the Russian Empire?**

First, attention should be paid to 10-year periods of the rye yield. This data was compiled by Catherine Indova (1970). The information disputes Mironov's explanation of the reasons of the grain price fluctuations. We see that there was a direct correlation between rye prices and yield in the first half of the eighteenth century, but there was an inverse correlation between these indicators, beginning from the 1760s. Also note, that while the rye yields of the 1710s and 1780s were at roughly the same level, the price of grain was highly variable (see figure 4). In other words, the yield data does not explain the price increase in the second half of the eighteenth century.

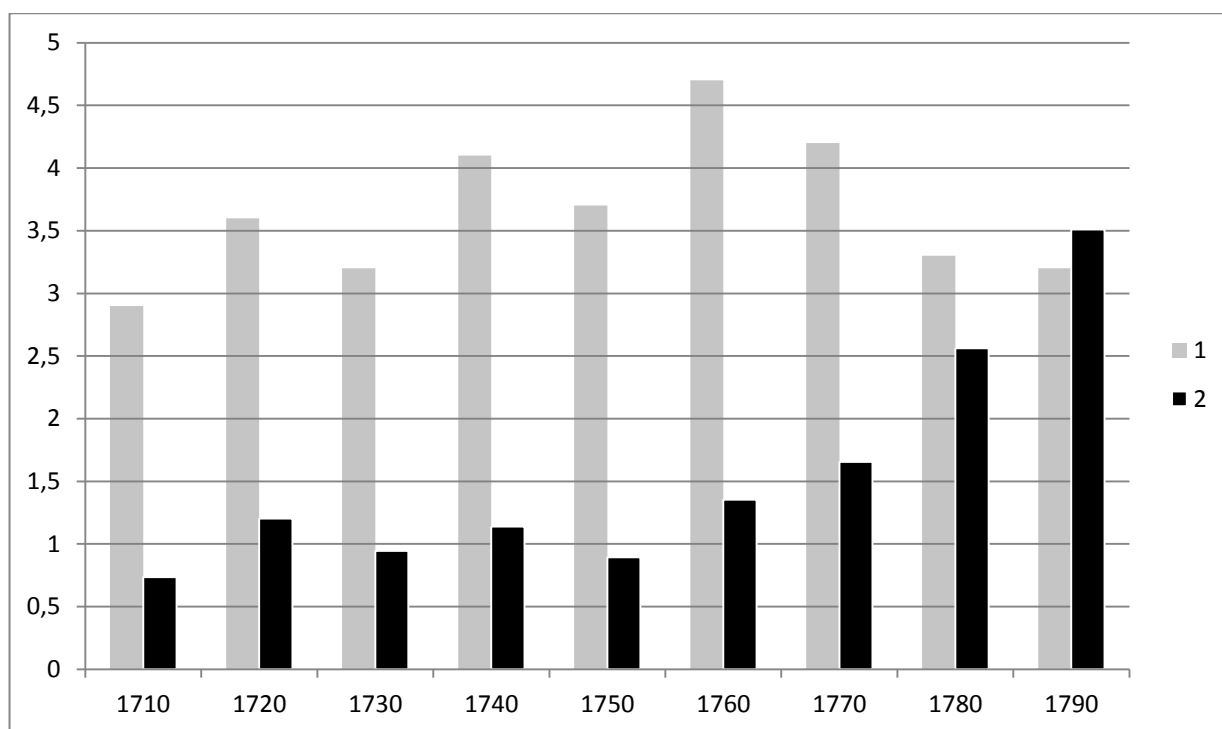


Figure 4. *Rye output seed ratio (1) and rye prices (2) in Russia*

Source: Price data in rubles per *chetvert'* from *Миронов*

Yield data from *Индова*

Can the fluctuations in the price of grain be linked to wars? At first sight, there was no relation between war years and years of high prices in the Russian Empire, as Mironov mentioned (1985, 126). He, like Kondratiev, listed wars in periods of price increases and decreases. However, this method is crude. In this regard, attention should be paid to Lyubomir Beskrovnyj's data on recruits<sup>9</sup> (1958; 1973). The fact that the recruitments were not conducted on an annual basis, makes it difficult to analyze this data. We therefore analyzed three-year periods. We can see that there was a direct correlation between rye prices and recruits over a period of more than 150 years (figure 5). The correlation coefficient was estimated as 0.47. This is not only because the expansion of the Russian army led to increased demand for crops. It should be added that peasant communities, giving their fellow-villagers to the army, paid emergency fees for the supply of recruits (RGVIA. Stock 23. Dos. 825; 843).

<sup>9</sup>Beskrovnyj's data is not totally accurate and homogeneous (RGADA. Stock 1261. List 12. Dos. 4). However it is suitable for estimating long-term trends.

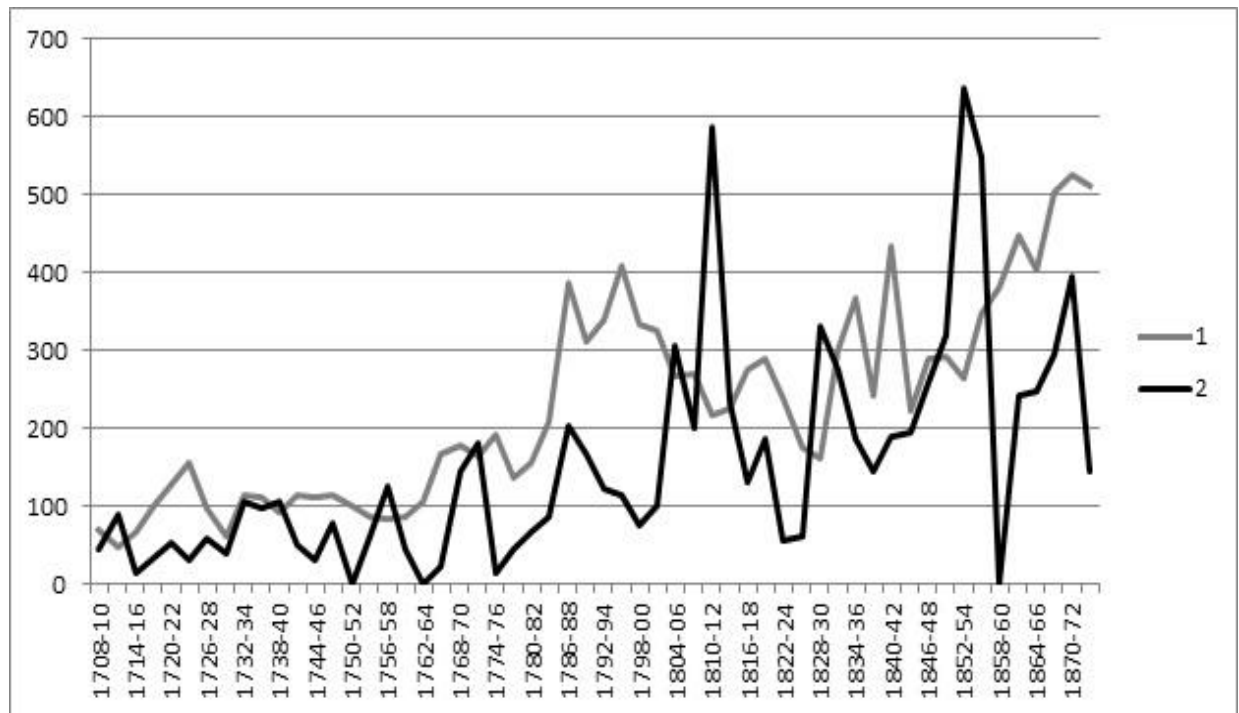


Figure 5. *Rye prices (1) and number of recruits (2): Russia, 1708–1873*

Source: Data on prices in kopecks per *chetvert'* from *Миронов*

Data on recruits in 1000 persons from *Бескровный*

In our view, the most influential forces were trends in external demand. The thing is that prior to the 1760s, the Russian government regulated crop exports: during poor harvests, the government limited exports and even purchased crops abroad. Perhaps, that explained why there was a direct correlation between rye prices and yield in the first half of the 18th century, as noted above. The Russian government not only allowed duty-free crop exports but moved from protectionism beginning from the 1760s (Мустафин, 2017). As a consequence, the grain prices increased by the end of the century. Why do we see that the introduction of protectionist tariffs led to a decrease in the prices of crops, and vice versa? Russian foreign trade was in the hands of foreign merchants: Russia actually did not own a merchant fleet until the second half of the 19th century (Кулишер 2003, 316). Therefore, the introduction of protectionist tariffs led to a decrease of not only import, but also export. Indeed, in the first third of the 19th century, the declining grain prices coincided with the introduction of protectionist tariffs. Also, during this period, the Corn Laws influenced Russian prices. It should be added that The

United Kingdom played a key role in the Russian foreign trade. The next rising wave coincided with the repeal of the Corn Laws and the liberalization of foreign trade of Russia. However, in 1876, the Russian government embarked upon a road of robust protectionism, thereby causing a decline in grain prices.

These considerations can be supported by a statistical analysis of the data, compiled by Oparin (1968) and Mironov (1985). We see there was a direct correlation between exports and rye prices (figure 2). The correlation coefficient was estimated as 0.77.

### **Concluding Comments**

This investigation led to the cautious conclusion, on the basis of the available information, that the existence of long waves in the Russian Empire was very probable.

But that is not the primary focus of this work. Our findings cast doubt on the view that Kondratiev wave is only a phenomenon of a modern world economy. In studying the reception of Kondratiev's ideas, the formation of this view was explained.

We also question whether the long waves that occurred during the pre-industrial period could only be explained by natural factors. The sources we studied suggest the possibility of a link between economic waves and wars. Also, in studying long waves in the Russian Empire, we run up against the problem of the relations between the economic center and the economic periphery.

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