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KONDRATIEFF'S THEORY OF LONG CYCLES[1]

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INTRODUCTION

NIKOLAI Dmitrievich Kondratieff's theory of long cycles has received much attention.[2] While many writers on business cycles have taken the existence of long waves for granted, and some have endeavored to test the existence of long cycles in particular fields,[3] no one has actually confirmed the existence of "long cycles in economic life" on the basis of a broad statistical inquiry.

Professor Kondratieff, of the Agricultural Academy and of the Business Research Institute of Moscow, formulated his theory of long cycles in several books and papers published between 1922 and 1928. The criticism that his writings encountered in his own country helped to sharpen the precision of Kondratieff's thought and resulted in a more definite statement of his hypothesis. Unfortunately, the paper containing the fullest statement of Kondratieff's views on the phenomenon of long cycles is available only in Russian; and the theoretical model of long cycles developed in that article has found slight attention outside Russia.[4]

The purpose of the present paper is to study the statistical and theoretical aspects of Kondratieff's work on long waves and to survey the critical literature to which it gave rise in Soviet Russia during the brief period when some degree of free scientific discussion was tolerated in that country. In Section I, the different studies in which Kondratieff developed his theory of major cycles are surveyed; Section II contains a brief analysis and interpretation of Kondratieff's findings expressed in his most recent studies; and Section III deals with the explanation of long cycles suggested by Kondratieff. Section IV is devoted to discussions of Kondratieff's writings by Russian economists, and the paper concludes with an appraisal of Kondratieff's work.

I

Kondratieff first sketched his theory of long cycles[5] in a short section of a study on economic conditions during and after the first World War,[6] published in 1922. Here Kondratieff offered a tentative dating of the long cycles, stressing their *cyclical* character. He stated the hypothesis very cautiously: "We consider the long cycles in the capitalistic economy only as probable" (p. 255). The hypothesis immediately attracted the attention of the economists of Soviet Russia. It was discussed in most of the reviews of his book and in general was commented on unfavorably. Kondratieff thought it necessary to reply to the principal reviewers in a long paper[7] in which, for the first time, he formulated several of the main ideas developed in subsequent publications.

[1] The author is greatly indebted to Professor Arthur F. Burns for helpful guidance and suggestions.

[2] See particularly Joseph A. Schumpeter, *Business Cycles* (New York, 1939), where "Kondriatieffs" occupy a prominent place.

[3] Jenny Griziotti-Kretschmann, "Richerche sulle fluttazioni economiche di lunga durata," *Giornale degli Economisti*, July, 1933, pp. 461–508. Jürgen Kuczinsky, *Das Problem der Langen Wellen und die Entwicklung der Industriewarenpreise in den Jahren 1820–1933* (Basel, 1934).

[4] Simon Kuznets, in *Secular Movements in Production and Prices* (Boston and New York, 1930), mentions it on p. 266; and Rolf Wagenführ, in *Die Konjunkturtheorie in Russland* (Jena, 1929), discusses it at some length.

[5] Kondratieff always uses the expression "long cycles," not "long waves."

[6] N. D. Kondratieff, *Mirovoe khoziaistvo i ego conjunktury vo vremja i posle vojny (The World Economy and its Condition during and after the War*, Vologda, 1922), p. 242. All books and papers of Russian economists mentioned in the present paper are in Russian, unless otherwise noted.

[7] N. D. Kondratieff, "Some Controversial Questions Concerning the World Economy and the Crisis," *Sotsialisticheskoe Khoziaistvo*, 1923, No. 4–5, pp. 50–87.

Much of his work during the following years was devoted to the study of long cycles. An introductory paper entitled "On the Notion of Economic Statics, Dynamics and Fluctuations," [8] in which he discussed the place of the study of cyclical processes in the science of economics, appeared in 1924. In the following year, Kondratieff published in Volume I of the theoretical review of the Business Research Institute of Moscow, which he had directed since 1920, the results of his statistical investigations. Principally through this paper,[9] which was also published in German, and later in English, have economists outside Russia become acquainted with Kondratieff's theory of long cycles. In the following discussion, we shall refer to this paper as the "first paper."

The publication of this study revived the discussion that followed his publication of 1922. The review *Planovoe Khoziaistvo* alone published in 1925–26 not less than six papers dealing with the study. Virtually all the reviews and papers published by the other members of the Business Research Institute and by the leading Russian economists were unfavorable to Kondratieff. They differed only in the quality of the criticism and the vehemence of the language used. Most of the critics deplored the absence of a theory explaining the origin and the dynamics of the long cycles; and only one or two endorsed Kondratieff's conclusions or recognized the fruitfulness of his work.

Kondratieff was unimpressed by the general rejection of his views. In a paper read in February, 1926 before the Economic Institute in Moscow,[10] he made only a few minor changes in the formulation of his original thought in order to avoid misinterpretations. He did not enlarge upon the statistical material used to derive the long cycles, although a few time series were extended to include the first postwar years. The only significant addition was a section containing a "first attempt to give a tentative explanation of the long cycles" (p. 57). We shall refer to this publication as the "second paper."

This paper aroused even more criticism. At the next meeting of the Economic Institute, D. I. Oparin presented a long paper (prepared with the help of a staff of nine assistants), embodying the results of a critical study of Kondratieff's first paper, and containing a thorough criticism of Kondratieff's sources, methods, and conclusions. Other papers which appeared in various Russian periodicals concentrated their attention on the theoretical interpretation of the long cycles, given in the second paper. Other critics ignored this paper and continued to base their criticism on Kondratieff's previous writings.

Kondratieff had another opportunity to restate his theory in a paper on the Dynamics of Industrial and Agricultural Prices; [11] in one section, he studied the long waves in the prices of the two commodity groups and their relation to the dynamics of the long swings in economic life. Soon after the publication of this study, Kondratieff was removed from his position as head of the Business Research Institute. Some months later, the official Soviet Russian Encyclopedia referred to his theory on the major cycles in a single sentence: "This theory is wrong and reactionary." [12] In the fall of 1930, Kondratieff was arrested as the alleged head of an illegal, anti-governmental "Peasants' Labor Party" and deported to Siberia [13] without trial. Contemporary Soviet Russian economists ignore Kondratieff's work, and his name is not even mentioned in the most recent Russian studies on business cycles.

II

Kondratieff's first and second papers were based on the same collection of time series.

[8] *Sotsialisticheskoe Khoziaistvo*, 1924, No. 2, pp. 349–82. A section of this study was published in the *Quarterly Journal of Economics*, Vol. XXIX (1925), pp. 575–83, under the title "The Static and the Dynamic View of Economics."

[9] N. D. Kondratieff, "The Major Economic Cycles," *Voprosy Conjunktury* (Problems of Economic Conditions), Vol. I (1925), pp. 28–79. A German translation appeared in *Archiv für Sozialwissenschaft und Sozialpolitik*, Vol. 56 (1926), pp. 573–609. An English translation, summarizing certain sections of the German text and omitting the tables, appeared in this REVIEW, XVIII (November, 1935), pp. 105–15.

[10] This was published two years later: N. D. Kondratieff and D. I. Oparin, *Bolshie Zicly Conjunktury* (*Major Economic Cycles*, Moscow, 1928).

[11] *Voprosy Conjunktury*, Vol. IV (1928), pp. 5–85. Abridged German translation is given in *Archiv für Sozialwissenschaft und Sozialpolitik*, Vol. 60 (1928), pp. 1–85. In Section V of this paper, which we shall refer to as "third paper," the tentative explanation of the major cycles given in the second paper is repeated.

[12] *Malaia Sovetskaia Enziklopedia*, Vol. IV (Moscow, 1929), p. 133.

[13] *Ibid.*, second edition, Vol. V (Moscow, 1937), pp. 743–44.

These series were analyzed by the following statistical operations:

First, the trend was eliminated [14] by a double operation. All the original data (with the exception of price and interest rate series) were divided by the population.[15] Then, a trend curve was fitted to the per capita data by the method of least squares.

The deviations from the trend were smoothed by a 9-year moving average in order to eliminate all movements other than the long cycles: random fluctuations, business cycles, and the possibly existing short cycles. The smoothed deviations from the trend were supposed to reflect the long cycles; [16] but the turning points of the long cycles were dated not from the smoothed, but from the unsmoothed, data. No reason for this procedure was given by Kondratieff. In a footnote, he remarked: "The question how to determine the minima and maxima deserves special study. For the time being, we leave the question open. Therefore, we consider the turning points indicated in the summary table only as the most probable and as the closest approximations to the real ones." [17] In the third paper, he presented the turning points derived from both the unsmoothed and the smoothed data, but he did not come back to the question of the proper determination of the turning points.

Kondratieff did not indicate how many time series he analyzed before he arrived at his conclusions.[18] In order to obtain as full a picture as possible of the extent of his statistical investigations, we have summarized in Table 1 the results of his analysis, as far as they can be ascertained from his several papers.[19] In the table, the evidence as to the existence of long waves is certainly less convincing than in the summary tables published in the first and second papers, in which only the series showing long cycles were listed.

As a result of his investigations Kondratieff suggested the following dating of long waves:

1. From the end of the 1780's or the beginning of the 1790's to 1844–51, with a peak in 1810–17.

2. From 1844–51 to 1890–96, with a peak in 1870–75.

3. A rise from 1890–96 to 1914–20, when the decline "probably begins."

Kondratieff believed that the existence of the major cycles was "at least very probable." [20] He conceded that the period covered by the statistical data was not long enough "to enable us to assert beyond doubt the cyclical character of those waves. Nevertheless we believe that the available data are sufficient to declare this cyclical character to be very probable." [21] He stated further, "A strict periodicity in social and economic phenomena does not exist at all — neither in the long nor in the intermediate waves (business cycles). The length of the latter fluctuates at least between 7 and 11 years, i.e., 57 per cent. The length of the long cycles fluctuates between 48 and 60 years, i.e., 25 per cent only." [22]

[14] The theoretical justification for the elimination of the trend is given by Kondratieff's distinction between reversible (recurring, wavelike movements) and non-reversible processes (population growth, changes in technique) in economic life. See his paper in the *Quarterly Journal of Economics*, *loc. cit.*

[15] Two series covering the whole world were not divided by population. No reason is given for this exception.

[16] The first paper contained only the original data, the formulas of trend, and the smoothed deviations for ten series. For the remaining series, only the turning dates of the major cycles were entered. With the exception of wholesale prices, the charts contained only the smoothed deviations from the trend. In the second paper, the trend values and the unsmoothed deviations for ten series were also given. The charts were improved by presenting the original series with the fitted trend as well as the unsmoothed and the smoothed deviations from the trend.

[17] *Archiv für Sozialwissenschaft und Sozialpolitik*, Vol. 56 (1926), p. 588, footnote 24.

[18] He summarized only the results obtained for the 25 series wherein major cycles were found to exist. In the first paper, he mentioned six series where the analysis led to a negative result: French wheat, coffee, sugar, and cotton consumption, and United States wool and sugar production, adding that it was absolutely impossible to discover long waves "in some other cases." In the one-page English abstract of this paper, published in the same issue of *Voprosy Conjunktury*, he mentioned five more series which revealed no major cycles. Thus, in at least 11 cases (ten of them physical quantities series) the results of the analysis were negative.

[19] In the third paper, Kondratieff analyzed four more series: price indexes of agricultural and nonagricultural commodities in the United States and in Great Britain. Since they are components of the analyzed wholesale price series, we did not enter them in Table 1.

[20] Second paper, p. 71.

[21] This REVIEW, *op. cit.*, p. 112. For Kondratieff's views concerning the regularity of the economic processes, see his paper, "The Problems of Forecasting," *Voprosy Conjunktury*, Vol. II (1926), pp. 1–42. German abstract in *Annalen der Betriebswirtschaft*, 1927, Nos. 1 and 2, pp. 41–64 and 221–52.

[22] This REVIEW, *op. cit.*, p. 112.

TABLE 1. — TIME SERIES ANALYZED BY KONDRATIEFF *

Series	Lower turning point	Upper turning point	Lower turning point	Upper turning point	Lower turning point	Upper turning point
1. Price series						
England						
Wholesale prices	1789	1814	1849	1873	1896	1920
Price of Consols †	1790	1816	1844	1874	1897	1920
Wages of agricultural workers	1790	1812–17	1844	1875	1889	1921
Wages of textile workers	....	1810 ‡	1850	1874	1890	1921
France						
Wholesale prices	....	....	....	1873	1896	1920
Price of the Rente †	....	1816 ‡	1844	1872	1894	1921
Wages of coal miners	....	....	1849	1874	1895	....
United States						
Wholesale prices	1790	1814	1849	1866	1896	1920
2. Value series						
England						
Foreign trade	....	1810 ‡	1842 §	1873	1894	1920
France						
Imports	....	....	1848	1880	1896	1920
Exports	....	....	1848	1872	1894	1914
Total foreign trade	....	....	1848	1872	1896	1920
Discounts, Bank of France	....	1810 ‡	1851	1873	1902	1914
Deposits, Bank of France			no long cycles			
Deposits, savings banks	....	....	1844	1874	1892	....
3. Physical quantity series						
England						
Coal production	....	....	1850 ‡	1873	1893	1914
Pig iron production	....	....	....	1871 ¶	1891	1918
Lead production	....	....	....	1870	1892	1916
France						
Coal consumption	....	....	1849	1873	1896	1914
Wheat consumption			no long cycles			
Cotton consumption			no long cycles			
Coffee consumption			no long cycles			
Sugar consumption			no long cycles			
Wheat acreage			no long cycles			
Oats acreage †	....	....	1850 ‡	1875	1892	1915
Germany						
Coal production	....	....	....	1873	1895	1918
Pig iron production			no long cycles			
United States						
Coal production	....	....	....	1873	1896	1918
Pig iron production	....	....	....	1875–80	1900	1920
Steel production			no long cycles			
Wool production			no long cycles			
Sugar production			no long cycles			
No. of spindles, cotton industry			no long cycles			
Cotton acreage	....	....	....	1874–81	1892–95	1914
Whole World						
Coal production	....	....	....	1873	1896	1914
Pig iron production	....	....	....	1872 ‖	1894	1918

* Turning points, and also the following footnotes, are from the "second paper." The dating of the last turning point is in several cases slightly different from that in the abstract published in this REVIEW (*op. cit.*), which is based on the "first paper."

† Inverted cycles.

‡ Approximate date.

§ Other minima: 1837 and 1855.

¶ Other maximum: 1881.

‖ Other maximum: 1882.

III

Kondratieff was fully aware of the difficulty of drawing definitive conclusions from the analysis of merely a few time series. "To make our conclusions derived from the analysis of those curves more convincing, and to avoid becoming the victim of the defects of a statistical method, particularly in the earlier period, we must supplement our analysis by the study of the concrete features of the evolution of the capitalist system with the help of not only statistical data but also of descriptive materials. As far as possible, we have undertaken such a survey, and have found that it strengthens the conclusions set forth above." [23] The result of the survey to which Kondratieff referred was the establishment of five "empirical characteristics" of long waves.

According to Kondratieff, profound changes in economic life take place before the beginning of a long upswing. They consist of changes in technology (preceded by important discoveries and inventions), of the inclusion of new countries in the system of the world economy, and of changes in the gold production and monetary circulation. Most social upheavals (wars and revolutions) take place during the long upswing. During the rise of long cycles business cycles are characterized by short depressions and intense upswings; during the downswing, the converse is true. In the period of the downswing of the long cycles, agriculture, as a rule, suffers an especially pronounced and prolonged depression.

To demonstrate the relation of "social upheavals" and "inventions" to long cycles, Kondratieff furnished a chronicle of wars and revolutions and a list of inventions for each phase of the major cycles. Both are simple inventories of events, in which no guiding principle of selection can be detected. No attempt was made by Kondratieff to evaluate the importance of the events or inventions listed.

Kondratieff attributed to the recurring relationships merely an empirical character. He attempted to show why a causal relationship cannot exist between these phenomena and the major cycles. In particular, he insisted [24] that the long cycles are neither due to swings in gold production nor limited to the price sphere alone. "We have arrived at the conclusion that the long waves in the movement of prices are an integral part of the major cycles in economic dynamics. These swings of long duration, and especially swings in prices, cannot be explained by external, random causes, and least of all by the influence of gold production." [25]

The empirical characteristics played a double role in Kondratieff's argument. They were supposed to strengthen his hypothesis by showing that the major cycles are not anchored in the purely economic processes alone, but that similar alternating periods can be observed in the connected fields of technological progress and of social and political history. At the same time Kondratieff pointed out why these characteristics, advanced by his opponents as possible exogenous causes of major swings, cannot be the cause of the long cycles. No explanation of the origin of long cycles was offered in the first paper. The theoretical model of the dynamics of the major cycles, developed in Kondratieff's second and third papers, is essentially a theory of investment cycles of long duration.

Kondratieff started with Alfred Marshall's distinction between the market, short term, and long term equilibria, which Kondratieff called the first, second, and third order equilibria. The three kinds of equilibria correspond to wavelike fluctuations of different duration, the major cycles being fluctuations around the third order equilibrium level.[26] Kondratieff extended Marshall's equilibrium concept to *all* elements of the economic process; those elements, like prices, fluctuate while tending to approach the position of equilibrium. "The wavelike fluctuations are processes of alternating disturbances of the equilibrium of the capitalistic system; they are increasing or decreasing deviations from the equilibrium levels." [27]

To reinforce the hypothesis of long cycles, Kondratieff borrowed from Karl Marx the idea

[23] Second paper, p. 37.

[24] Directed against those opponents who tried to prove that long cycles are limited to the price movement. See below.

[25] Third paper, p. 35.

[26] Kondratieff did not show how the short fluctuations and business cycles are linked to the disturbances of the equilibria of the first and of the second order.

[27] Second paper, p. 58. It is interesting to note that this scheme is very close to the three-cycle model developed by Joseph Kitchin, "Cycles and Trends in Economic Factors," this REVIEW, v (1923), pp. 10–16, and by Joseph Schumpeter in *Business Cycles*, Vol. I, Ch. IV, Section D.

that business cycles are caused by the periodic reinvestment of fixed capital with an average life of 10 years. But Kondratieff modified Marx's idea, introducing a graduation in durability, in the production period and in the amount of investment corresponding to different kinds of capital goods: "The material basis of the long cycles is the wear and tear, the replacement and the increase of the fund of basic capital goods, the production of which requires tremendous investment and is a long process." The basic capital goods are "big plants, important railways, canals, large land improvement projects, etc. . . . As a matter of fact, the training of skilled labor belongs in this category." [28] "The replacement and the increase of this fund is not a continuous process. It takes place in spurts which are reflected in the major cycles of economic life. The period of increased production of these capital goods corresponds to the upswing. The upward deviation of the elements of economic life from the existing equilibrium level of the third order, corresponding to the above scheme, is the upswing of long duration which is interrupted by fluctuations of shorter duration. Conversely, the slowing down of this process causes a movement of economic elements toward the equilibrium level and below it. It must be stressed that the equilibrium level itself changes in the process of cyclical fluctuations, and shifts, as a rule, to a higher level." [29]

Once the long duration of cycles had been linked to the life period of certain durable capital goods, it remained to be demonstrated why reinvestment (or increase of the fund of basic capital goods) is not a continuous process. On this point, Kondratieff introduced Tugan Baranowsky's theory of free loanable funds.

Particularly large investments require important amounts of loanable capital. Therefore, the following conditions must be fulfilled before a major upswing can start: "1 — High propensity to save.[30] 2 — Relatively large supply of loan capital at low rates. 3 — Its accumulation at the disposal of powerful entrepreneurial and financial groups. 4 — A low price level, inducing savings and long term capital investment." [31] Loanable funds, accumulated in excess of current investment, must remain free, i.e., liquid. The bulk of the loan capital is said to be provided by classes whose real income increases with the sinking price level.

Expansion, induced by the application of the inventions of the preceding period, finds its limitation in the increased interest rate and in actual capital shortage. The upper turning point is thus explained in terms close to those of the monetary over-investment theory. The lower turning point remains unexplained. The entire description of the cumulative process shows how conditions favorable to an expansion are brought about, but fails to point out what factors cause the transition from contraction to expansion. "The upswing is indeed not an absolute necessity," conceded Kondratieff in his third paper (p. 38). Nevertheless, he concluded his second paper with the affirmation that "each consecutive phase is the result of the cumulative process during the preceding phase, and, as long as the principles of the capitalistic economy are conserved, each new cycle follows its predecessor with the same regularity with which the different phases succeed each other." [32]

According to Kondratieff, the major cycles exist not only in *certain* aspects of economic activity, but in the *entire* economic process. The final result of the study of long cycles must therefore be a synthetic picture which shows how the major cycles in different spheres are connected with the rhythmical movement of long duration of the economic system as a whole.[33]

In his first paper Kondratieff did not definitively link the major waves to the existence of the capitalist economy. "We do not have sufficient data to affirm that cyclical swings of the same character are also proper to non-capitalistic systems. If they are linked to the capitalist economy, we can affirm that the collapse of capitalism will bring about the disappearance of the long waves." [34] With such a prudent formulation, he exposed himself to severe attack. Therefore he carefully stated at the very

[28] Second paper, p. 60.
[29] *Ibid.*, p. 61.
[30] Kondratieff used the term "intensity to save."
[31] Third paper, p. 38.
[32] Second paper, p. 68.
[33] Second paper, p. 11.
[34] First paper, p. 65.

beginning of his second paper: "My study refers only to capitalistic society. Consequently, I do not extend my conclusions to any other economic system." [35] He stressed the international character of long waves and claimed that the turning points he found refer at least to all capitalistic countries of Western Europe. He admitted that the dynamics of the American economy might possibly lead to a different dating of the turning points.[36]

IV

In our discussion of the criticism provoked by Kondratieff's writings, we shall not pretend to give a full account of the critical papers, published in Russia, which deal with Kondratieff's theory of long cycles; our aim is merely to extract from the papers the more penetrating criticisms advanced against his methodology and conclusions. The papers vary widely in character: some are predominantly polemical. Sukhanov, Granovsky, and Svetlov made only a superficial analysis of Kondratieff's work; the main purpose of their contributions was to expose the implications and conclusions to which Kondratieff's theory, in the opinion of these authors, logically leads. Bogdanov dealt exclusively with the methodological and theoretical aspects of Kondratieff's investigations. Guberman, Gerzstein, and Eventov made a serious effort to discuss Kondratieff's methodology and to test his findings; they examined critically the factual basis of his conclusions. The most complete analysis of Kondratieff's work is that of Oparin, whose paper contains a detailed examination of the whole body of statistical and historical material used by Kondratieff.[37]

The principal points discussed by Kondratieff's Russian critics bear on the following matters:

1. The logic of the decomposition of time series, particularly the implications of the elimination of the trend.
2. The significance of the results of Kondratieff's investigations.
3. The regularity of long waves.
4. The hypothesis advanced by Kondratieff to explain the generation of the long cycles.

1. *The logic of the decomposition of time series.* The methodological part of Kondratieff's work in particular attracted the attention of his critics; he was one of the first Russian economists to use the methods of mathematical statistics. The employment of this technique met with general approval, although Oparin and Eventov thought it necessary to justify the use of mathematics for economic analysis by quoting Karl Marx.[38] Several authors insisted that each step of a statistical analysis must correspond to some theoretical concept; therefore, they reproached Kondratieff for having neglected to give a definite economic meaning to each statistical operation performed.

When he eliminated the trend, Kondratieff failed to formulate clearly what the trend stands for. He stated in his second paper: "I believe that, fundamentally, the trend can correspond to real general tendencies of economic evolution. Nevertheless, we cannot claim that the trend curves fitted by us reflect those tendencies exactly" (p. 13).

Oparin insisted that the trend is meaningful only if it represents the equilibrium level of the long swings. As early as 1924, when discussing Kondratieff's paper,[39] "On the Notion of Economic Statics, Dynamics and Fluctuations," Oparin stated: "In order to measure swings in economic life, it is necessary to establish a scheme proper to the phenomenon. Swings in economic life [40] can be scientifically analyzed only as departures from the schematic equilibrium. Consequently, swings in economic life must be measured, not in relation to a previous

[35] Second paper, p. 5. In subsequent discussion, however, he frequently forgot this limitation and spoke of "long cycles in the world economy."

[36] Second paper, p. 37.

[37] All the other authors quoted in this paper either criticized a particular point of Kondratieff's investigations, or touched on his findings in papers devoted to other subjects. Short contributions of the participants in the discussion of Kondratieff's second paper at the Economic Institute are available in the Kondratieff-Oparin volume.

[38] Both quote the following lines from a letter of May, 1873, by Marx, addressed to Engels: "Do you know those charts, where the movement of prices, discount rates, etc. . . . during the year, is plotted? To analyze the phenomenon of crisis, I have attempted several times to compute the formulas of those irregular curves (I think that is possible if sufficient reliable material can be made available) in order to determine mathematically the main laws governing the crisis."

[39] *Sotsialisticheskoe Khoziaistvo*, 1924, No. 2, pp. 375–76.

[40] More of Oparin's theory of economic equilibrium is to be found in his paper, "Das theoretische Schema der gleichmässig fortschreitenden Wirtschaft als Grundlage einer Analyse ökonomischer Entwicklungsprozesse," *Weltwirtschaftliches Archiv*, Vol. 32 (1930), pp. 105–34 and 406–44.

time point, but to an established equilibrium system."

According to Oparin, a trend curve fitted to annual data by the method of least squares may give a fairly satisfactory approximation to the points of equilibrium corresponding to business cycles. Deviations from such a trend curve will at least make their peaks and troughs clearly visible. But if the trend curve is supposed to pass through the equilibrium points of the major waves, it is not the sum of the squares of all the annual deviations but rather the sum of squares of the major deviations (positive and negative maximum amplitudes) that have to be minimized. To this end a sufficient number of observations, in any case more than 1½ or 2½ cycles, is necessary. A least-squares curve fitted to the available data is not likely to pass approximately through the equilibrium points of the long cycles. The addition of the data for half a long cycle at the beginning or the end of the analyzed series will change the "theoretical normal" represented by the trend. To illustrate his point, Oparin continued some of Kondratieff's series into the years in the downswing period of the third long wave (after the World War), and fitted new trend curves to them. The new curves differ considerably from those computed by Kondratieff: the long swings determined by the use of Kondratieff's technique and those based on Oparin's trends have different timing and amplitude. Oparin concluded that "the formal mathematical criterion (method of least squares) applied by Professor Kondratieff is of little use in finding the theoretical normal of the long cycles in the analyzed series." [41]

Earlier, Bazarov had pointed out [42] that Kondratieff's technique does not lead to a clear separation of the trend and of the long waves. If the sum of the squares of deviations has to be minimized, it is always possible, with a parabola of a sufficiently high degree, to fit a trend curve that follows closely the turns of the "major swings." Deviations from such a trend would either contain no long cycles or yield different cycles according to the formula chosen.

L. Eventov [43] pointed out, in addition, that the decomposition of a time series into a trend and several cyclical fluctuations implies the independence of the different movements. Accepting Cournot's view that the trend is independent of cyclical fluctuations, Kondratieff looked upon the economic process as a sum of the actions of independent forces. Eventov insisted on the unity of the economic process and the interaction between the fluctuations of different duration and the "secular movement." Eventov doubted that there is any justification for separating the cyclical swings from the "evolutionary tendencies" represented by the trend. Moreover, if the trend reflects "evolutionary tendencies" of a *qualitative* character, it is inadmissible to determine the equilibrium points of the trend from empirical data of a *quantitative* character.

V. Bogdanov [44] took the same position as Eventov. In Bogdanov's opinion, Kondratieff's outstanding merit is his having raised the question of the relation of the long waves to the secular trend. In Kondratieff's model, the trend embodies the average rate of growth of the economic system, whereas the long waves reflect the acceleration or the retardation of this process of growth. Therefore, both the trend and the long waves are manifestations of the same process and its decomposition is purely artificial.

Bogdanov asserted that Kondratieff's long cycles are merely the result of the latter's statistical manipulations. The long waves are not independent of the business cycles, as Kondratieff implies, but are merely the results of the summation of particular business cycles of varying amplitude which happen to fall within each phase of the long waves. Bogdanov rejected the polycyclical model of economic fluctuations. To imply that an economy can be, simultaneously, at the peak of a long wave and at the trough of a business cycle appeared to him nothing more than a theoretical abstraction.[45]

[41] *Op. cit.*, p. 90.

[42] Review of Kondratieff's first paper in *Ekonomitcheskoe Obozrienie* (November, 1925), pp. 255–58.

[43] L. Eventov, "On the Nature of Fluctuations of Long Duration in the Capitalistic Economy," *Problemy Ekonomiki*, 1929, No. 1, pp. 54–73, and No. 2, pp. 47–68.

[44] V. Bogdanov, "On the Question of the Regularity of the Historical Evolution of Capitalism," *Pod Znamenem Marksizma* (June, 1928), pp. 80–98.

[45] S. Guberman, in "The Problems of the Short and Long Cycles," *Sotsialisticheskoe Khoziaistvo*, 1927, No. 1, pp. 28–59, went even further and objected to the use of per capita data for production and foreign trade since such use suggests a functional relationship between the size of the population

2. *The significance of Kondratieff's results.* Kondratieff's conclusions were met with the same skepticism [46] as his method of analysis. We shall note later that several writers did not contest the existence of long swings, but merely denied their cyclical character. Other authors, examining the series analyzed by Kondratieff, arrived at the conclusion that the presumed long waves were definitely established only for series including the price element. Only a few of Kondratieff's opponents questioned the actual choice of the time series used.

We owe to Oparin the most complete test of the time series selected by Kondratieff. Oparin was aware of the difficulty of obtaining a sufficient number of time series covering the whole nineteenth century; but upon checking the sources quoted by Kondratieff, he discovered that Kondratieff had not used all the series available.[47] Moreover, in several cases, Kondratieff's choice seemed to Oparin to lack logic. Kondratieff established long waves in British lead production, but not for world output of this metal. Oparin argued that either the long cycles are a phenomenon occurring in the entire capitalistic world, in which case the world production of lead must be subject to cyclical fluctuations of long duration; or the oscillations discovered are limited to British production, and if this is true, Kondratieff's broad conclusions are not justified.

Turning to the evidence of long waves presented by Kondratieff, Oparin concluded, after a careful survey of all the series for which details of analysis had been given, that "long waves can be observed only in the movement of prices and of the long-term interest rates. The long waves immediately disappear from wage and foreign trade series when changes in the price level are eliminated. The physical series as a whole do not show long swings which could be considered long cycles in economic life." [48]

Granovsky also, after a brief study of the material used by Kondratieff to support his hypothesis, concluded that Kondratieff succeeded only in proving once more that long period changes in the price level had taken place. Except in the price movement, there is no evidence of long waves. "They are the fruit of the imagination of Professor Kondratieff, who discovered the well known swings in the price movement, caused by a combination of several occasional factors, and erroneously took them for an indication of business conditions during a period of 125–130 years." [49]

Guberman arrived at a similar conclusion, after he had tested several of Kondratieff's series: "All that remains . . . to be explained as an independent phenomenon is the movement of prices in the 19th and 20th centuries." [50]

While most of the other writers believed that they had destroyed Kondratieff's hypothesis by proving that major swings are confined to price movements,[51] Gerzstein [52] went a step further. In his view, it is crucial to disprove the assertion that major swings in the price movement and in production have the same direction. After a careful study of trends in production of the principal capitalistic countries, Gerzstein concluded that Kondratieff's position is not supported by the facts.

Gerzstein reviewed briefly the economic history of the period during the upswing and the downswing of the first (1790–1844/51) and the second (1844/51–1890/96) Kondratieff waves. Drawing his examples mainly from Great Britain and the United States, he showed

and the industrial output. According to Guberman the increase of industrial production is primarily linked to other factors and "the increase of the population is a function of the increase of the industrial output." Moreover, the relationship between the volume of industrial output and the size of the population was the same during the different phases of the capitalistic economy.

[46] Kondratieff found only one partisan among the Russian Marxist economists. W. E. Motyleff in "The Accumulation Theory of Rosa Luxemburg," *Vestnik Sotsialisticheskoi Akademii*, 1923, Vol. 4, pp. 156–57, declared categorically: "If there are Marxists who deny the cyclical character of the long cycles, this can only be imputed to their insufficiently profound analysis of the evolution of the capitalist society during the 19th century."

[47] As indicated in Section I, several of these series actually were analyzed by Kondratieff, without yielding the expected result; but Kondratieff mentioned this fact only in the English abstract.

[48] *Op. cit.*, p. 113.

[49] E. Granovsky, "On the Business Cycle Theory of the 'Soviet' Bourgeois Economists," *Vestnik Kommunisticheskoi Akademii*, Vol. 30(6) (1929), p. 94.

[50] *Op. cit.*, p. 39.

[51] Sukhanov denied that the price movement exhibits *waves*. According to him, it is adequate to consider the price curve as composed of several *sections*, with breaking points that can easily be explained by historical events.

[52] A. Gerzstein, "Do Long Waves in Economic Life Exist?" *Mirovoe Khoziaistvo i Mirovaia Politika*, Vol. III (1928), No. 8/9, pp. 3–42, and No. 10, pp. 13–35. Also published as a book.

that the period 1815–40 (Kondratieff's downswing — falling prices) was a time of unprecedented development of the productive forces and was really *the* period of the industrial revolution. The cessation of wars and the reestablishment of relatively free international commerce caused the drop in agricultural prices, thus decreasing the cost of living and furthering an increase in industrial output.

The "declining" period of the second price wave coincided with the rapid industrialization of the United States and of Germany. Only the decrease in the rate of growth of British industry seems to support Kondratieff's hypothesis. But Gerzstein pointed out that this retardation was only the consequence of the increased industrialization of the European continent and of the United States. England lost its position as the leading producer and exporter of finished goods, particularly machines; Gerzstein objected to the identification of this unique process in one country, accompanied by opposite developments in other countries, with the downswing of a "long wave" of a *cyclical* character.

Finally, in the upswing of the most recent price wave (1890–1914), Gerzstein found many signs of a general retardation of the growth of the productive forces and of industrial and agricultural output, as compared with the preceding decades coinciding with a Kondratieff "downswing." Here again the facts clearly contradict the implications of Kondratieff's hypothesis. These contradictions seemed to Gerzstein to be convincing enough to invalidate the hypothesis of the *cyclical* character of the "long waves." [53]

The validity of the *empirical characteristics* was refuted with the same determination as the existence of the long waves to which they refer. Here again, Oparin furnished the most comprehensive critical survey. To him, Kondratieff's selection and dating of inventions [54] seemed rather arbitrary. What really matters is the point in time when a scientific discovery enters the production stage; this point is not the same for every country and is, moreover, extremely difficult to determine exactly. Moreover, Oparin did not share Kondratieff's view that inventions are applied in "clusters." Are they not, he asked, also introduced during the downswings, at least during the years corresponding to the upswings of business cycles falling within the downswing of a long cycle? Finally, Oparin did not see how the technical improvements due to new inventions could be reconciled with a rise in prices.[55]

Studying the list of wars and revolutions which, according to Kondratieff, occur more frequently during the upswings, Oparin found instead a *clustering around the turning points*. After elimination of the events of the 5–7 years in the neighborhood of the turning points, important as well as trivial [56] events cited by Kondratieff were found to be *equally distributed* over the different phases of the long waves.

Oparin did not deny that the downswing in prices is accompanied by a deep depression in agriculture (Kondratieff's third characteristic). Unlike Kondratieff, however, he found its cause not in the more rapid decrease of agricultural, compared with industrial, prices, but in the growing difficulty of meeting interest and annuity payments for mortgages contracted in a period of higher prices.

[53] Reducing Kondratieff's findings to the price movement, several of his opponents offered alternative theories of changes in the price level. In line with orthodox Marxist theory, Guberman suggested that the downward movement in prices since the beginning of the nineteenth century was due to the increased productivity of labor. To sustain this statement, he used data from the U. S. Census of Manufactures. The only two movements in the inverse direction, from 1850 to 1870 and from 1897 to the outbreak of the World War, were due, according to Guberman, to an unusual increase in gold production. Gerzstein saw in the fluctuations of gold production the principal cause of the price waves. Oparin recommended consideration of G. Cassel's explanation of the movement of wholesale prices in terms of changes in the relative quantity of gold in circulation, "not because I am convinced that it is correct, but to fill the gap left by the collapse of the theory of long cycles."

Oparin noted that Cassel's curve of the relative quantity of gold during the period 1800–50 lies nearly always *above* the price curve. He suggested computation of the "normal gold stock" for this period, not by extrapolating the annual estimated "normal" rate of increase of 2.8 per cent (taking the years 1850 and 1910 as a basis) but a *lower* rate (*op. cit.*, p. 144). W. Woytinsky, in his paper, "Das Rätsel der Langen Wellen," *Schmoller's Jahrbuch*, Vol. LV (1931), No 4, pp. 1–42, and in his book, *Internationale Hebung der Preise als Ausweg aus der Krise* (Frankfurt, 1931), proceeded in this way and used a curve of normal quantity of gold based on two different normal rates of growth.

[54] For instance, Kondratieff suggested the year 1831 as the date of the invention of the automobile.

[55] *Op. cit.*, p. 120.

[56] Kondratieff lists all the six coalitions against Napoleon, but overlooks the British-American war of 1812. Eventov notes that an insurrection in the Balkan province of Herzegovina has the same weight in the list as the American Civil War or the French Revolution.

Oparin also admitted that the proportion of prosperity and depression years in business cycles may differ in periods of rising and in periods of falling prices. But he insisted that this fact could be accounted for exclusively by the influence of the price level itself without the hypothesis of long cycles.

A review of the objections raised by numerous other authors would lead us too far afield. In general they constitute an elaboration of the points made by Oparin, particularly as far as the difficulty of the selection and dating of pertinent inventions is concerned.

3. *The regularity of long waves.* Kondratieff's Russian critics unanimously denied the existence of long waves of *general* and *periodic* character. But none disputed the contention that periods of different intensity of growth exist in certain elements of economic activity, or even in the development of a national economy as a whole. In opposition to Kondratieff, most of them affirmed that the differences between successive phases are not only of a *quantitative* but also of a *qualitative* character. And they all deny the *cyclical* character of the processes investigated by Kondratieff.

Leon Trotsky was one of the first to pay attention to the theory outlined briefly in Kondratieff's first book.[57] Trotsky recognized the existence of long swings in economic life, but refused to concede their cyclical character. He took the view that long swings were due to concrete, unique, political and economic circumstances. "As for those large phases of the trend of the capitalist evolution (of 50 years) for which Professor Kondratieff incautiously suggests use of the term 'cycles,' we must stress that their character and duration are determined not by the internal dynamics of the capitalist economy, but by the external conditions which constitute the framework of capitalist evolution" (p. 9). Trotsky held that the concept of long cycles was not fruitful. "Our main task is to establish the curve of capitalist evolution, embodying both its non-periodic (basic trends) and its periodic (recurring) elements. We must do this for the countries in which we are interested and for the world market as a whole." He illustrated his idea by a chart in which long cycles are replaced by a succession of linear downward and upward trends of unequal duration and different slope.

Kondratieff's Russian critics shared a common approach clearly expressed by Professor G. A. Studensky, Kondratieff's colleague at the Agricultural Academy of Moscow: "A cycle means fluctuations within the framework of a fundamentally unchanged system, whereas in the case we are considering, each new wave of technical change results in the shifting of the economic system to a new, qualitatively different, stage of organization and technique, with a resulting number of important social-economic changes. The waves of technical progress must be interpreted, not as cycles, but as phases of reversible historical process of the development of productive force which proceeds by jolts and is accompanied by crises." [58] The view that major swings, if they exist at all, are not cycles, was shared by Oparin,[59] Novojilov, Gerzstein, Granovsky, and Guberman.

Pervushin [60] indicated that, even if the periodicity of the major waves were granted, their *cyclical* character remains unproved so long as the way in which each phase necessarily gives rise to the following one is not shown. "To prove the existence of the major cycles it is not sufficient to find swings of long duration. You must prove that the causes of the upswing necessarily originate the factors which bring about the depression." [61]

Against Kondratieff's assertion of the cyclical character of the major swings in economic life, many of his opponents stressed the *evolutionary*

[57] Leon Trotsky, "On the Curve of the Capitalistic Evolution," *Vestnik Sotsialisticheskoi Akademii*, Vol. 4 (1923), pp. 3–12. S. A. Pervushin, in "Fundamental Questions of the Theory and the Methodology of Economic Fluctuations," *Planovoe Khoziaistvo*, 1926, No. 12, pp. 120–36, took the view that long waves reflect secular movements not necessarily geared to the capitalist economy. He suggested investigation of the connection between long waves and the dynamics of agricultural production. Granovsky (*loc. cit.*) wondered if Kondratieff implied that a socialist society also would be subjected to wave-like movements of long duration.

[58] G. A. Studensky, "The Agricultural Depression and the Technical Revolution in Farming," *Journal of Farm Economics*, Vol. XII (1930), pp. 552–72.

[59] Oparin suggested reservation of the term "cycle" for business cycles and that a distinction be made between the long and the cyclical swings.

[60] *Op. cit.*, p. 124.

[61] A. Svetlov in his review of the Kondratieff-Oparin volume, in *Planove Khosiaistvo*, 1929, No. 1, pp. 285–87, pointed out that the "most characteristic" phase of the cycle, the crisis, was absent from the major cycles. "This focus of all the contradictions of the capitalistic system is lacking in the long cycle."

character of the capitalist economy. The capitalist system is subject to constant changes, argued Sukhanov; [62] to each of its phases, from early semi-feudalism to the contemporary monopolistic form, there corresponds a different rate of growth. The long swings "discovered" by Kondratieff as deviations from a "theoretical normal" merely reflect those different periods. Nothing warrants the assumption that the capitalist economy will continue to evolve as in the past and so produce new "Kondratieffs." "The physiology of an organism in evolution is different in the successive stages of its evolution. Capitalist evolution is an organic process with definite different stages: youth, maturity, decline . . . and even death" (p. 161). The dynamics of each phase must be studied. In eliminating the trend, Kondratieff loses the essential characteristic of every period: its rate of growth.

Bogdanov maintained a similar attitude. In addition to the changes in the internal structure of the capitalistic economy, he saw in the changing character of the relations between the capitalist and the non-capitalist countries an additional factor in the causation of long swings. To Kondratieff's claim that the long cycles have an international character, Bogdanov objected that there is no reason to suppose a correspondence between the periods of retardation and acceleration in the growth of the different national economies. On the contrary, historically, the retardation in the development of one economy frequently resulted from the fact that the economy of another country developed more intensively. When a country has reached a certain level, the "center of capitalistic development" shifts from it to another country.[63]

4. *The causation of long cycles.* Kondratieff's assertion that the "empirical characteristics" he had listed are not exogenous causes of the long cycles, but only "passive manifestations," brought down upon his head the accusation that he sought to develop a super-Marxian view of history. Excluding the possibility that the long waves (as well as other fluctuations) may also be induced by external factors, and claiming that they are due solely to endogenous forces, Kondratieff made a fetish of the long waves, according to Bogdanov and Svetlov. Bogdanov held that major swings in economic life have exogenous causes. "The historical evolution of capitalism is determined by certain external factors. These factors must be looked upon as being, to a certain extent, accidental and independent of the internal rhythm of the capitalistic economy." [64]

Recognition of exogenous causes of long swings and rejection of their cyclical character was the common attitude of the Russian economists before Kondratieff formulated his "tentative theory" of long waves.[65] In the discussion that followed publication of the theory, two main features played a predominant role: the discontinuous replacement of basic capital goods, and the periodicity of capital investment.

Kondratieff's critics were not convinced that certain inventions and techniques would have to wait as long as 20 years before they materialized as new plants and machines, simply because capital for the installation of new inventions and the replacement of old plants was lacking. Moreover, we have seen that Kondratieff himself put inventions in the category of empirical characteristics, which have no direct causal relationship to the generation of long cycles. Consequently, long cycles appear to be pure reinvestment cycles.

Several economists endeavored to show that the replacement of capital goods was not a discontinuous process. Gerzstein pointed out that the life of capital goods varies from 5 years (tools) to 100 years (buildings), and that the variety of the different kinds of durable goods suggests a continuous, if not absolutely regular, process, rather than a succession of discrete clusters.

Bogdanov asked in what conceivable lapse of time would the Suez Canal or the Pacific Railway have to be replaced. Many other writers stressed the importance, in economic life, of maintenance and current replacement as compared with complete renewal. They depre-

[62] N. Sukhanov, "Long Waves in Economic Life," *Planovoe Khoziaistvo*, 1926, No. 4, pp. 159–69.

[63] W. A. Bazaroff, in "The Lines of Development of the Capitalistic and the Soviet Economies," *Planovoe Khoziaistvo*, 1926, No. 5, pp. 71–90, took a similar view.

[64] *Op. cit.*, p. 88. We have pointed out above that the role of gold discoveries was recognized by several writers as an external cause of the price movement.

[65] In all the papers published before Kondratieff's second paper, the absence of a theory of long cycles was unanimously deplored. See the papers of Sukhanov, Guberman, and Granovsky, quoted above.

cated Kondratieff's view of the whole problem from the technical rather than the economic point of view, especially his neglect of the importance of the obsolescence rate. Bogdanov and several others remarked that even the replacement demand due to the "echo-phenomenon" would be strongly influenced by business conditions prevailing at the time when replacement is due.

In the same measure as its "real" basis, the monetary aspect of Kondratieff's theory seemed, to his Russian critics, to lack realism and consistency. "Why should the application of new inventions be subordinated to the preliminary accumulation of loanable funds?" was asked by Gerzstein. Taking a conservative view of the working of the credit mechanism, Kondratieff neglected the possibilities of a credit expansion and became unrealistic. Gerzstein quoted J. A. Schumpeter and A. Hahn, showed the role of credit expansion in the upswing of the business cycle, and asserted that a similar process could take place at the lower turning point of a long wave.

In Gerzstein's opinion, even Kondratieff's factual description of the formation of loanable funds during the downswing is unrealistic. In discussing savings, Kondratieff mentioned only savings out of "income paid out," but neglected business savings. Even if it were true that important groups of income-receivers save more (or exclusively) during depression, this is certainly not true of corporate business.

Gerzstein wondered why loanable funds should be accumulated during the downswing and, if so, why they should remain idle for (possibly) as long as 30 years. On this last point he quoted Kondratieff who, in an earlier work, wrote, "One of the basic ideas of Tugan-Baranowsky's business cycle theory should not be accepted without discussion; the theory of the accumulation of *free*, not invested capital. Did this kind of capital ever exist?" [66]

Gerzstein also objected to Kondratieff's explanation of the upper turning point as a crisis caused by a shortage of capital. Not the absolute scarcity of loanable funds limits the expansion, but the impossibility of investing funds at a sufficiently high rate of return. At the peak, investors refrain from new ventures and shift from new shares to bonds of good standing and other fixed interest values. [67]

Oparin endeavored not only to refute Kondratieff's arguments but also to check his findings. The factual basis of the theory of loanable funds is extremely meager. Unable to secure data on new capital flotations, Kondratieff tried to prove his point with the help of a series of French savings-bank balances. Analysis of this series by Kondratieff's method yielded long waves of expansion matching the downswing of the long cycles. But Oparin pointed out that the so-called long cycles of savings-bank balances are an illusion. The curve rises steadily except for two instances. The first corresponds to the troublesome period of the 1848–50 revolution, and the subsequent coup d'état by Napoleon III; the second reflects the withdrawals during the Franco-German war of 1870–71. Finally, the declining rate of increase during the last years before World War I is due to the increasing diversion of the nation's savings to the commercial banks. Thus, the "periodic accumulation of loanable funds," as represented by savings-bank balances, is a fairly continuous process, influenced however by wars, revolutions, and the development of new institutions.

* * *

Our survey of the Russian discussion of the character of the long swings would be incomplete if we omitted the accusation directed against Kondratieff on account of his theory of long cycles. We must bear in mind that the violent opposition Kondratieff encountered among Marxist economists was due to the alleged "apologetic character" of his theory.

The "apologetic character" of Kondratieff's theory, denounced by Sukhanov, Granovsky, Gerzstein, Guberman, and Eventov, was described by Granovsky, as follows: Kondratieff measures all cyclical movements as deviations from the trend. This implies the existence of a continuous evolution of the capitalistic economy. Long and short swings appear only as temporary deviations from a regular, normal process. Furthermore, according to Kondratieff, the downswing of a new long wave started in 1914–20. This causes the whole postwar situation to appear in a different light. The

[66] N. D. Kondratieff, *M. I. Tugan-Baranowsky* (Petrograd, 1923).

[67] *Op. cit.*, p. 21.

leaders of Soviet Russia expected this period to be one of wars and revolutions immediately preceding the final disintegration of the capitalist economy. From Kondratieff's scheme, the world economy would appear to have merely entered into a new phase of the regularly occurring long swings. Since it seems to follow from Kondratieff's analysis that a lower turning point will *necessarily* follow after two or three decades of a downward movement, the outlook changes significantly.

This point illustrates the peculiar character of the discussion that developed in Russia upon the formulation of Kondratieff's theory. The violence of the conflicting opinions and the tendency to link economic analysis to political consequences were rooted in the political atmosphere of the country itself. We have omitted mention of the frequent references to Marx, intended to strengthen the position of one or the other side, and the repeated attempts to discard Kondratieff's views merely on the ground that similar views had been expressed also by "bourgeois" economists.

V

Does the evidence presented by Kondratieff support his hypothesis with sufficient strength? The Russian economists unanimously and emphatically answered this question in the negative. But most of the Russian critics were more eager to demolish Kondratieff's theoretical explanation of the long cycles and to scrutinize the suspicious implications of the new theory than to analyze critically the evidence presented.[68] Even the able criticism of Oparin took much of Kondratieff's findings for granted. A critical examination of the statistical evidence presented by Kondratieff in support of his views remains to be undertaken.

In this section we do not intend to discuss either Kondratieff's technique or its underlying assumptions; [69] instead we shall merely make some remarks concerning the time series that he used to date the long cycles, and the theory put forward by Kondratieff.

The data in Table 1 (page 206) show significant differences in the nature of the series yielding long cycles and in the length of the time period covered by Kondratieff's collection of time series.[70] With one exception, all price and value series reveal "major swings." The result is significantly different when we turn to the production and consumption series. Kondratieff himself stressed the importance of this group: "Our study would lose much of its force if we did not also analyze the behavior of purely physical series." [71] In only 11 of the (at least) 21 production and consumption series which he studied could Kondratieff ascertain the existence of long cycles. Not more than two of the seven French physical-quantity series mentioned by him exhibit long cycles; and in one of them, oat acreage, Kondratieff found "inverted cycles," without giving any explanation for the inversion.

Kondratieff claimed to have found 2½ cycles in the historic record. But of the 25 series in which Kondratieff found long cycles, only four cover 2½ cycles; another four cover 2 cycles; the remainder cover 1 or 1½ cycles. Eight of the eleven physical quantity series alleged to have long cycles cover *only 1 cycle*; three more series in this group cover an additional upswing, but for two of them the evidence was so doubtful that Kondratieff assigned to the first turning point only an "approximate" date. Of the eight series covering 2 full long cycles, six of which were in the price group, the dating of the first turning point of four also remained uncertain.[72] All four series which start before the beginning of the nineteenth century are

[68] Many of Kondratieff's critics questioned the choice of the time series studied. The lack of continuous, consistent, and reliable production statistics in the first half of the nineteenth century explains the limitations of Kondratieff's investigation in the field of production, although, as was pointed out by Oparin, Kondratieff neglected, for no apparent reason, to use some of the time series that were available.

[69] We would largely endorse the objections raised by Bazarov, Eventov, and Bogdanov.

[70] Kondratieff gave no reason for the choice of the series studied. For instance, he failed to explain why, in addition to the total value of foreign trade, French imports and exports were analyzed separately, whereas only the total value of foreign trade was analyzed for England. With the exception of two series of world wide coverage, all series pertain to the major capitalistic countries. Our summary table contains 16 French, 8 English, 8 American, and 2 German series. The surprisingly strong representation of French data is certainly due to the fact that many series go back to the beginning of the nineteenth century.

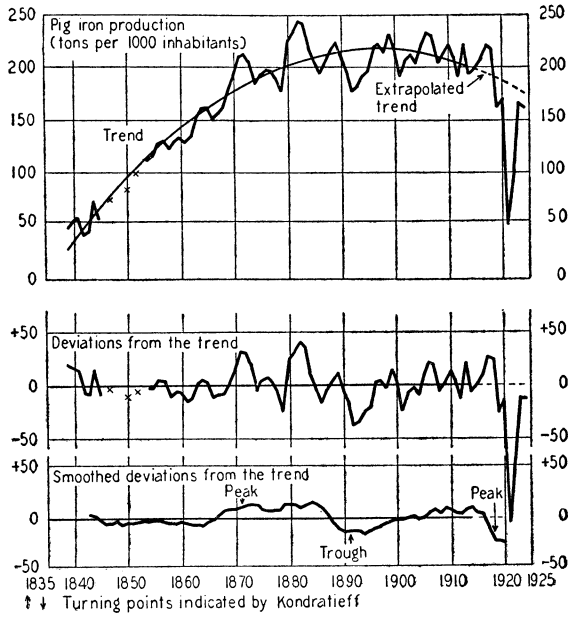
[71] This REVIEW, *op. cit.*, p. 108.

[72] In several other cases, alternative maxima or minima are given, as in the case of British foreign trade, where, besides the trough in 1842, "other minima" are shown for 1837 and 1855. In other cases, intervals of several years are indicated. Thus, the first peak in U. S. cotton acreage is supposed to fall between 1874 and 1881.

price series. Judging from the data in Table 1, the turning points of long cycles, with the exception of the last cycle, were determined by Kondratieff exclusively from series dominated by the price element.[73]

Even the few production series which Kondratieff considered as demonstrative of long cycles fail, upon closer examination, to support his conclusions. As an example, we present in Chart 1 a series for English pig iron production,

CHART 1. — PRODUCTION OF PIG IRON IN ENGLAND, ANNUALLY



taken from Kondratieff's second paper.[74] From 1845 to 1866 the smoothed deviations from the trend[75] show negative deviations, with two minima of the same amplitude (−6.9) in 1849 and 1864. The unsmoothed deviations from which Kondratieff determined the turning points of the long waves have a minimum in 1861 (−16.5). Kondratieff solved this difficulty by not indicating the lower turning point, and by entering in his summary table only the following peak. He dated this peak 1871, with the remark, "another maximum in 1881." The unsmoothed deviations show a peak in 1871 (30.9) and a higher peak in 1882 (39.7), not in 1881 (30.9). The preference seems to have been given to the lower peak because it was closer to the turning point of the price series. The smoothed deviations show three consecutive peaks in 1873, 1880, and 1884, the last of which was the highest (11.8, 12.8, and 13.4).

Similar, though not serious, neglect of the rules which Kondratieff himself set applies to the next turning point, when the minimum deviation falls in 1892 (−39.4) and not in 1891 (−18.8). The corresponding point of the smoothed deviations comes in 1894. The last turning point was fixed at 1918 although the minimum deviation falls in 1921.

The turning points of the other English series were indicated by Kondratieff in an equally arbitrary manner. Although both the coal and the lead production series were available (in the source that he used) beginning only with 1854, an "approximate" low was determined for coal in 1850, but no such extrapolation was attempted for lead.

The British and the American wholesale price indexes and Bowley's wage series for agricultural workers[76] are the only series going back to the beginning of the first long cycle. The wage series is available beginning with 1789. Kondratieff fixed a minimum in the following year. Moreover, the first 32 years of the series were not used for the computation of the trend; instead, a linear trend was based on the period 1822–1913 and was extrapolated for the years 1789–1821. Both Chart 2 and Table 2 show that, without exception, the turning points indicated by Kondratieff are not those which would have been determined if his own

[73] It is interesting to note that, when in 1922 Kondratieff first affirmed the existence of long cycles in economic life and suggested their turning points (which are essentially the same as those given in his later publications), he referred exclusively to literature dealing with price movements, quoting Jevons, Took and Newmarch, Sauerbeck, Aftalion, and a paper on prices by Jean Lescure. Apparently Kondratieff first arrived at the hypothesis of long cycles by studying price movements, and later endeavored to supplement the statistical evidence by value and production series.

[74] The data for this chart are from pages 262–63 of the second paper.

[75] The formula of the trend computed for 1839–1914 (the lacking data for 1846, 1848, 1849, 1851, and 1853 were interpolated) is given in the first paper as

$$y = 194.86 + 2.22\,x - .0566\,x^2.$$

It was corrected to

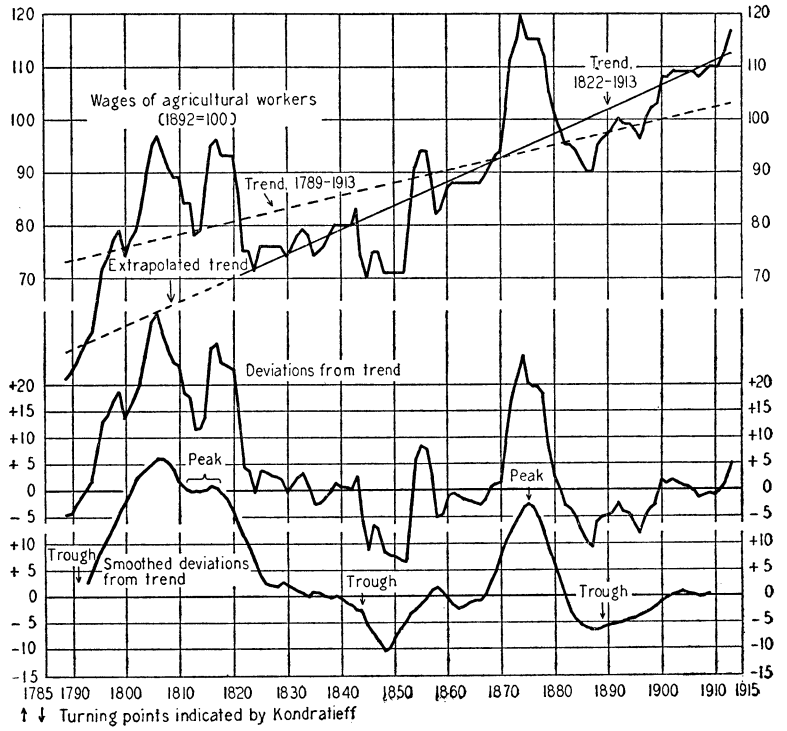
$$y = 199.30 + 2.28\,x - .0556\,x^2$$

in the second paper. The trend was extrapolated for 1915–24.

[76] A. C. Bowley, "The Statistics of Wages in the United Kingdom during the Last Hundred Years," *Journal of the Royal Statistical Society*, September, 1899, and W. Page, *Commerce and Industry*, Vol. II, Statistical Tables (London, 1919).

rules had been applied. Oparin has shown [77] that if this wage index is deflated by the index of wholesale prices the long waves indicated by Kondratieff disappear.

CHART 2. — WAGES OF AGRICULTURAL WORKERS IN ENGLAND, ANNUALLY



Another English series, the price of Consols, was available from 1816. Nevertheless, Kondratieff determined a first minimum in 1790, once again without even proceeding to the sort of analysis he himself had devised. He based his judgment exclusively on some general indications of the price of Consols between the French Revolution and the end of the Napoleonic Wars.

This criticism of Kondratieff's material could be extended to cover all of his series. Less arbitrariness in the choice of the period to which the trend was fitted, and more adequate trend formulas, would have yielded, for nearly all series, deviations of a different shape. Closer conformity to his own rules for the determination of turning points would have resulted in a much less uniform picture than the one Kondratieff presented to his readers. As many of his Russian critics pointed out, only the well-known swings in the price movement would have remained.

Even if we accept the results of Kondratieff's analysis at their face value, one conclusion is clear. Since the turning points of the long cycles were determined from unsmoothed deviations from secular trends, business cycles of a particularly large amplitude are apt to determine the turning points of the "long cycle." Thus, the severe crisis of 1847 and the depression of the 1890's determine the troughs of the second long wave. The strong expansion on the "Gründerjahre," following the Franco-German

TABLE 2. — COMPARISON OF THE TURNING POINTS FOR THE SERIES, WAGES OF AGRICULTURAL WORKERS IN ENGLAND *

Indicated by Kondratieff	Determined from unsmoothed deviations	Determined from smoothed deviations
1790	?	?
1812–17	1806	1807
1844	1852	1848
1875	1874	1875
1889	1887	1887
1921	†	†

* For a complete description of the source of these data, see footnote 76 of text.
We also fitted a linear and parabolic trend to the whole period for which original data are given by Kondratieff. In both cases, the minima and maxima are the same as those indicated in this table.
† Original data end in 1913.

[77] *Op. cit.*, p. 100.

war of 1870–71, accounts for its peak. If Kondratieff had had the opportunity to pursue his analysis, he would have had no difficulty in fixing another long-cycle trough at the bottom of the great depression of the 1930's.

The same is true, though in less degree, of smoothed data. In many series, cyclical swings of particularly large amplitude influence moving averages strongly enough to produce the illusion of major cycles.

Examination of Kondratieff's statistical work leads us to the conclusion that he did not succeed in showing the existence of "long cycles in economic life." [78] His assertion that "there is no less regularity in the long waves than in the intermediate ones [business cycles], and if we want to designate the latter as cyclical, we are bound not to deny this characterization to the former" [79] is based on three arguments: (1) the long waves recur in regular time intervals; (2) series of differing character exhibit simultaneous and similar fluctuations; and (3) the long waves are an "international phenomenon."

Our analysis shows that the existence of long swings could not be proved in the production series studied by Kondratieff; [80] that data for all four major capitalistic countries and the two series with world-wide coverage pertain only to one cycle; that, consequently, neither the international character of the phenomenon nor its recurrence at regular time intervals can be ascertained from the material presented.

The theory offered by Kondratieff to explain the cyclical recurrence of long cycles has no empirical foundation. He did not show that investment of "basic capital goods" clustered around time points separated by periods of from 48 to 60 years. As Bogdanov and Gerzstein pointed out, the process of reinvestment is an economic and not a purely technical one. Even if the investment process were discontinuous, reinvestment, which depends not only on actual wear and tear but also on the obsolescence rate, cost of maintenance, interest rates, wages, technical progress, and rate of operation, would be continuous.

An additional difficulty arises from the cyclical character of Kondratieff's investment theory. According to this theory, important inventions introduced at a certain time point require a particularly high investment. The capital goods so produced have a set lifetime of about 50 years. Their successive replacement produces what has been called the "echo-phenomenon." *One* original period of intense investment would be sufficient to produce these periodic fluctuations. Kondratieff also introduces in his scheme waves of *new* inventions; consequently, we must assume that the application of new inventions occurs at the time of the replacement of the original investment. If there were no synchronization of new and replacement investment (of sufficient magnitude to cause the long waves), we would obtain a whole cluster of simultaneous swings of long duration.

Kondratieff is not explicit on this point; he speaks only of the periodical "replacement and extension" of the stock of basic capital goods. The application of the new inventions made during the last part of the downswing is, however, subordinated to the accumulation of a sufficient amount of loanable capital. In this way, the "echo-replacement" and the application of new techniques seem to be merged to produce the long waves jointly.

Kondratieff's assumption that free loanable funds can wait as long as one quarter of a century to be invested, remaining unaffected by the expansions and contractions of successive business cycles, is certainly one of the weakest points in his argument, and one which could not withstand an empirical test. Thus Kondratieff's entire theoretical construction emerges, after consideration, as extremely unrealistic.

Although the hypothesis of cyclical swings of long duration, upon which shorter cyclical movements are superimposed, should be discarded, the view that the capitalist economy has passed through several successive stages of development characterized by different rates of growth and geographical expansion deserves attention. Economic analysis of the present day would probably gain in precision and significance if it were based on a more closely

[78] As Kondratieff himself stated (second paper, p. 11), the existence of long waves in the dominating elements of economic life, and not only in the price sphere, is under discussion. It is beyond the scope of this paper to discuss the question whether price movements exhibit cycles of long duration or a succession of different levels.

[79] This REVIEW, *op. cit.*, p. 112.

[80] Walter Isard, in "A Neglected Cycle: The Transport-Building Cycle," this REVIEW, XXIV (1942), concludes that the existence of "Kondratieffs" cannot be proved in American production series.

articulated distinction among the different phases of capitalist economy. The "curve of the capitalist evolution" would then yield a picture more complicated than a curve, and certainly more irregular than Kondratieff's long cycles. We should substitute for the hypothesis of long periodic swings the study of the successive stages of our present economic system, of its increasing geographic scope and its changing relations to the non-capitalistic spheres. This would divert us from the construction of abstract models of time sequences toward the study of the actual dynamics of our economic system.