
The Long Waves in Economic Life

Author(s): N. D. Kondratieff and W. F. Stolper

Source: *The Review of Economics and Statistics*, Vol. 17, No. 6 (Nov., 1935), pp. 105-115

Published by: The MIT Press

Stable URL: <http://www.jstor.org/stable/1928486>

Accessed: 26/10/2009 16:51

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=mitpress>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



The MIT Press is collaborating with JSTOR to digitize, preserve and extend access to *The Review of Economics and Statistics*.

The Review of Economic Statistics

VOLUME XVII

NOVEMBER, 1935

NUMBER 6

THE LONG WAVES IN ECONOMIC LIFE

N. D. KONDRATIEFF

FOREWORD

The editors of the REVIEW OF ECONOMIC STATISTICS are happy to be able to present in translation the peculiarly important article by Professor Kondratieff, which, under the title "Die langen Wellen der Konjunktur," appeared in the *Archiv für Sozialwissenschaft und Sozialpolitik* in 1926 (vol. 56, no. 3, pp. 573-609). The combining circumstances of an increasing interest in "long waves" and the difficulty of securing access to the original article would alone justify translation and publication of Kondratieff's contribution to the theory of the trade cycle. In addition, the editors would take this means of indicating their intention from time to time of rendering available to the English-using world outstanding articles in foreign periodicals.

This translation of Professor Kondratieff's article was made by Mr. W. F. Stolper of Harvard University. Due to the limitations of space, the editors have taken the liberty to summarize certain sections of this translation. With the exception of a ten-page appendix of tabular material, however, all tables and charts have been included.

I. INTRODUCTION

THE idea that the dynamics of economic life in the capitalistic social order is not of a simple and linear but rather of a complex and cyclical character is nowadays generally recognized. Science, however, has fallen far short of clarifying the nature and the types of these cyclical, wave-like movements.

When in economics we speak of cycles, we generally mean seven to eleven year business cycles. But these seven to eleven year movements are obviously not the only type of economic cycles. The dynamics of economic life is in reality more complicated. In addition to the above-mentioned cycles, which we shall agree to call "intermediate," the existence of still shorter waves of about three and one-half years' length has recently been shown to be probable.¹

But that is not all. There is, indeed, reason to assume the existence of long waves of an average length of about 50 years in the capitalistic economy, a fact which still further complicates the problem of economic dynamics.

II-III. METHOD

[Sections II and III of Kondratieff's exposition may be summarized as follows:

The succeeding study is to be confined solely

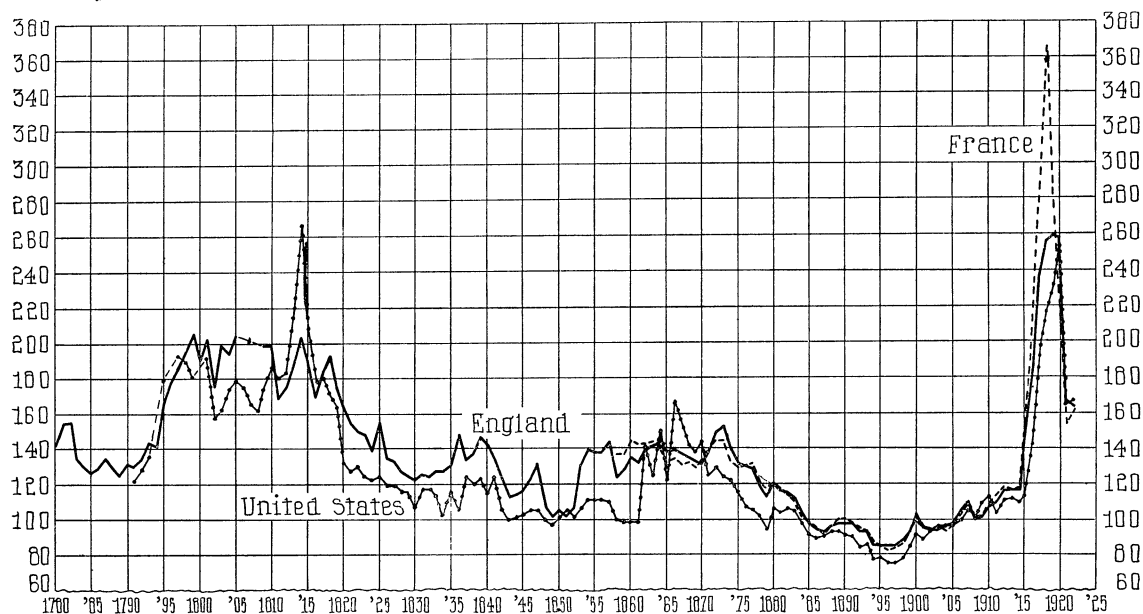
¹ Cf. J. Kitchin, "Cycles and Trends in Economic Factors," REVIEW OF ECONOMIC STATISTICS [hereafter referred to as "this REVIEW"], v (1923), pp. 10-16.

to an inquiry into various problems connected with these long waves. Investigation here is made difficult by the fact that a very long period of observation is presupposed. We have, however, no data before the end of the eighteenth century and even the data that we do have are too scanty and not entirely reliable. Since the material relating to England and France is the most complete, it has formed the chief basis of this inquiry. The statistical methods used were simple when no secular trend was present in the series. If the series displayed a secular trend, as was the case among physical series, the first step was to divide the annual figures by the population, whenever this was logically possible, in order to allow for changes in territory. Then the secular trend was eliminated by the usual statistical methods applied to each series as a whole; and Kondratieff refers specifically to the methods presented by Dr. Warren M. Persons in this REVIEW in 1919 and 1920. The deviations from the secular trend were then smoothed by a nine-year moving average, in order to eliminate the seven to eleven year business cycles, the short cycles, and random fluctuations possibly present.]

IV. THE WHOLESALE PRICE LEVEL

While the index of French prices goes back only to the end of the 1850's, the English and American indices date back to the close of the eighteenth century. In order not to overburden

CHART I. — INDEX NUMBERS OF COMMODITY PRICES*
(1901-10 = 100)



* The French data are taken from the *Annuaire Statistique* [Statistique Générale de la France], 1922, p. 341; the index number has been recalculated on a gold basis through use of dollar-franc exchange rates.

For England, there is for 1782-1865 the index of Jevons; for 1779-1850, a new index number, computed by Silberling and published in this REVIEW, v (1923); for the period after 1846, we have Sauerbeck's index, which at present is carried on by the *Statist*. Since Silberling's index is based upon more complete data of the prices of individual commodities than that of Jevons, we have used the former for the period 1780-1846. From 1846 on we use Sauerbeck's index number. Both indices have been tied together on the basis of their relation during 1846-50, for which period they are both available; after this procedure, we have shifted the series to a new base, 1901-10. For the period 1801-20 and since 1914, in which periods England was on a paper standard, the index numbers have been recalculated on a gold basis.

For the United States, we use the following series, which have been tied together: for 1791-1801, H. V. Roelse (*Quarterly Publications of the American Statistical Association*, December, 1917); 1801-25, A. H. Hansen (*ibid.*, December, 1915); 1825-39, C. H. Juergens (*ibid.*, June, 1911); 1840-90, Falkner (Report from the Committee on Finance of the United States Senate on *Wholesale Prices, Wages, and Transportation*, 52d Congress, 2d session, Report No. 1394, Part 1 [Washington: Government Printing Office, March 3, 1893]); since 1890, the B. L. S. index. All index numbers are on the base 1901-10. For the Greenback period (1862-78), they have been recalculated on a gold basis. All data [except Silberling's index] are taken from the *Annuaire Statistique*, 1922 [which utilizes the sources above cited].

this study with figures, the statistical data are presented exclusively in the form of charts.¹

The index numbers of prices plotted on Chart I have been neither smoothed nor treated in any other way. Nevertheless, a mere glance at the chart shows that the price level, despite all deviations and irregularities, exhibits a succession of long waves.

The upswing of the first long wave embraces the period from 1789 to 1814, i.e., 25 years; its decline begins in 1814 and ends in 1849, a period

¹ [Ten pages of tabular material were given by Kondratieff at the end of his article. The charts presented in this translation are not merely reproductions of those in the original article but have been drawn anew from the data given in his tabular appendix. A few slight discrepancies between the new charts and those of Kondratieff were discovered, but in no case were the discrepancies significant.—Editors.]

of 35 years. The cycle is, therefore, completed in 60 years.²

The rise of the second wave begins in 1849 and ends in 1873, lasting 24 years. The turning point, however, is not the same in the United States as in England and France; in the United States the peak occurs in the year 1866, but this is to be explained by the Civil War and casts no doubt on the unity of the picture which the course of the wave exhibits in the two continents. The decline of the second wave begins in 1873 and ends in 1896, a period of 23 years. The length of the second wave is 47 years.

² In the upswing, the English index exhibits several peaks, which fall in the years 1799, 1805, 1810, and 1814; but since after the year 1814 a distinctly downward tendency can be observed, we regard this year as the turning point.

The upward movement of the third wave begins in 1896 and ends in 1920, its duration being 24 years. The decline of the wave, according to all data, begins in 1920.

It is easily seen that the French prices after the close of the 1850's move generally parallel to the English and American prices. It is, therefore, very probable that this parallelism existed in the preceding period as well.

We conclude, therefore, that three great cycles are present in the movement of the price level during the period since the end of the 1780's, the last of which is only half completed. The waves are not of exactly the same length, their duration varying between 47 and 60 years. The first wave is the longest.

V. THE RATE OF INTEREST

The course of the interest rate can be seen most conveniently from the movement of the discount rate and the quotations of interest-bearing securities. Because the latter depend less on random fluctuations and reflect more accurately the influence of long-run factors, we use here only the quotations of state bonds.

CHART 2
QUOTATIONS OF INTEREST-BEARING SECURITIES

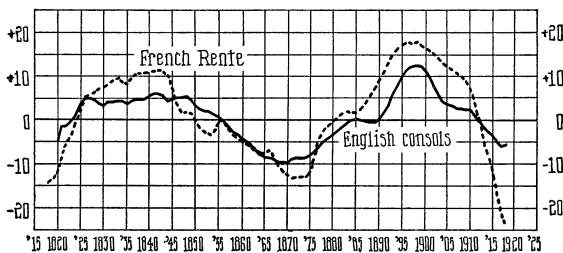


Chart 2 shows the quotations of the French Rente¹ and of English consols.² Both have a secular trend during the period of observation. The chart shows the deviations from the secular trend smoothed by means of a nine-year moving average.

¹ Until 1825 the quotations of the five-per-cent Rente, after this the quotations of the three-per-cent Rente. In order to connect both series, we have first computed relatives with the base 1825-30 for both series. Then we shifted the base of the combined series to 1901-10, in order to make them comparable with the price curve. The original data are taken from the *Annuaire Statistique* [Statistique Générale de la France], 1922.

² According to the data in William Page, ed., *Commerce and Industry*, Vol. 2 (London, 1919), statistical tables, pp. 224-25. Relatives have been calculated from the figures, with the base 1901-10.

The quotations of interest-bearing securities manifest, as is well known, a movement opposite to that of general business activity and of the interest rate. Therefore, if long waves are operative in the fluctuations of the interest rate, the movement of bond quotations must run in a direction counter to that of commodity prices. Just this is shown in our chart, which exhibits clearly the long waves in the movement of the quotations and consequently of the interest rate.

The chart starts only after the Napoleonic Wars, i.e., about the time that the first long wave of commodity prices had reached its peak; it does not cover the period of the upswing of the latter. Considering the data at hand, however, we may suppose that the quotations of state bonds took part in this movement also.

English consols actually manifest a decidedly downward tendency between 1792 and 1813. Their quotation in 1792 is 90.04; in 1813, on the other hand, it is 58.81. Although they drop most rapidly in the years 1797 and 1798, yet this steep decline is only an episode, and the general downward tendency from 1792 to 1813 stands out quite clearly.³

Accordingly, the period from the beginning of the 1790's up to 1813 appears to be the phase of rising interest rates. This period agrees perfectly with that of the rising wave of commodity prices.

The wave of bond quotations rises after 1813⁴ — or the wave of the interest rate declines — even till the middle of the forties. (See the chart.) According to the unsmoothed data, consols reached their peak in 1844; the Rente, in 1845. With this, the first great cycle in the movement of the interest rate is completed.

The downward movement of bond quotations (or the rise of the interest rate) during the second cycle lasts from 1844-45 to 1870-74.⁵ From this time onward until 1897, the market price of interest-bearing securities rises again, and consequently the interest rate goes down. With this, the second great cycle is completed.

The new decline of the quotations (rise in the

³ Cf. N. J. Silberling, "British Financial Experience, 1790-1830," this REVIEW, I (1919), p. 289.

⁴ The first years have disappeared from our chart because of the use of the nine-year moving average.

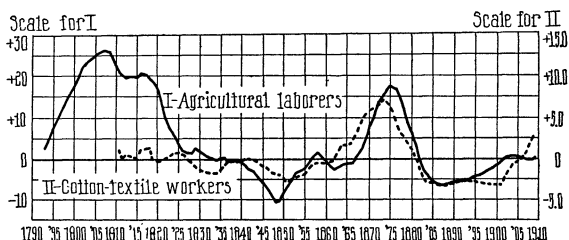
⁵ According to the original data, consols actually reach their lowest point in 1866, but the general tendency continues to be one of decline until 1874. The slump of quotations in 1866 is connected with the increase in the interest rate just preceding the money-market crisis of that year, and with the Austro-Prussian War.

rate of interest) lasts from 1897 to 1921. Thus the existence of great cycles in the movement of the interest rate appears very clearly.¹ The periods of these cycles agree rather closely with the corresponding periods in the movement of wholesale commodity prices.

VI-VII. WAGES AND FOREIGN TRADE

[In Section VI, Kondratieff examines the course of weekly wages of workers in the English cotton-textile industry since 1806 and of English agricultural laborers since 1789.² The original wage data are reduced to a gold basis and then expressed in the form of index numbers with 1892 as the base year. Chart 3 presents these

CHART 3.—WAGES IN ENGLAND



wage figures as deviations from trend, smoothed by use of a nine-year moving average. Kondratieff devotes the remainder of this section to a description of the series presented in Chart 3, from which analysis he concludes that, despite the scantiness of the available data, "long waves are undoubtedly present in the movement of wages, the periods of which correspond fairly well with those in commodity prices and the interest rate."

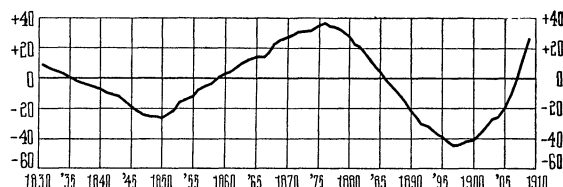
¹ The existence of these cycles is also confirmed by several other studies: P. Wallich, "Beiträge zur Geschichte des Zinsfußes von 1800 bis zur Gegenwart," *Jahrbücher für Nationalökonomie und Statistik*, III. Folge, Vol. 42, pp. 289-312; J. Lescure, "Hausses et Baisses Générales des Prix," *Revue d'Economie Politique*, Nr. 4 (1912); R. A. Macdonald, "The Rate of Interest Since 1844," *Journal of the Royal Statistical Society*, LXXV (1912), pp. 361-79; T. T. Williams, "The Rate of Discount and the Price of Consols," *ibid.*, pp. 380-400. Also *ibid.*, pp. 401-11, the discussion of the last-mentioned studies, especially the speech of E. L. Hartley, pp. 404-06.

² [Earnings of cotton-textile workers for 1806-1906 are taken from G. H. Wood, *The History of Wages in the Cotton Trade* (London, 1910), p. 127; beginning with 1906, they are from the *Abstract of Labour Statistics*.

For agricultural laborers, wage data for 1789-1896 are from A. L. Bowley, "The Statistics of Wages in the United Kingdom During the Last Hundred Years: Part IV, Agricultural Wages," *Journal of the Royal Statistical Society*, LXII (1899), pp. 555 ff. Thereafter, the figures are from Page, *op. cit.* The data refer to England and Wales.]

For his foreign-trade series presented in Section VII, Kondratieff takes the sum of French exports and imports. The figures were first corrected for population changes, and thereafter the secular trend (in the form of a second-degree parabola) was eliminated. The resulting deviations, smoothed by use of a nine-year moving average, are presented in Chart 4. After an

CHART 4.—FRENCH FOREIGN TRADE



examination of the chart, the author concludes that the data on foreign trade also show the existence of two great cycles, the periods of which coincide with those observed in the other data.]

VIII. THE PRODUCTION AND CONSUMPTION OF COAL AND PIG IRON, AND THE PRODUCTION OF LEAD

So far we have examined the movements only of such magnitudes, sensitive to changes in business conditions, as possess either a purely value character, e.g., commodity prices, interest rates, and wages, or at least a mixed character such as the data on foreign trade. Our study, however, would lose much of its force if we did not also analyze the behavior of purely physical series.

For this purpose we choose English coal production,³ and French consumption of coal,⁴ as well as the English production of pig iron and of lead.⁵ We divided the original figures by the population, and eliminated from the resulting series the secular trends. The deviations from the lines of trend, after being smoothed by use of a nine-year moving average, were then analyzed. The results are shown in Chart 5.

Continuous data are available, unfortunately, only for the period after the 1830's, in part even only after the 1850's. Consequently, only one and one-half to two great cycles can be shown, but these appear with striking clarity in both charts.

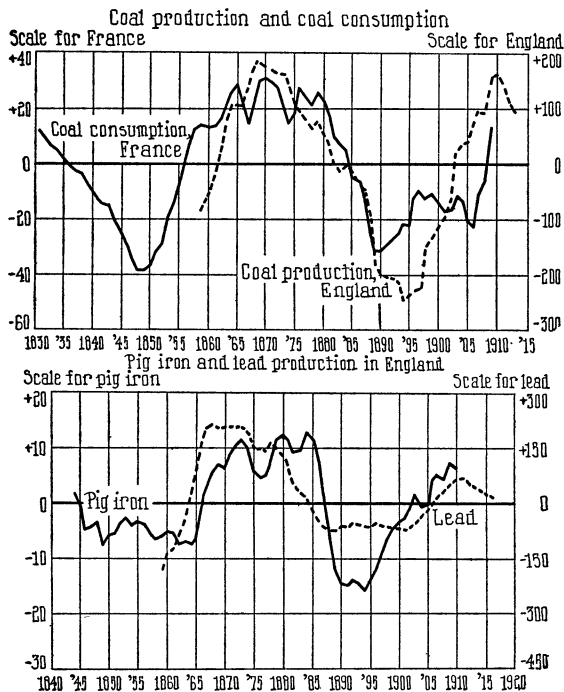
³ According to the data of W. Page, *op. cit.*

⁴ *Annuaire Statistique*, 1908 and 1922.

⁵ According to *British and Foreign Trade and Industry*, and the *Statistical Abstract [for the United Kingdom]*.

There is a retardation in the increase of coal consumption [in France] until the end of the 1840's, then the advance becomes more rapid and reaches its peak in 1865, according to the smoothed curve (on the chart), and in 1873, according to the unsmoothed curve. In the latter year, English coal production also reaches a maximum, according to the unsmoothed curve. Then

CHART 5.— CONSUMPTION OF COAL IN FRANCE AND PRODUCTION OF COAL, PIG IRON, AND LEAD IN ENGLAND



follows the decline, which comes to an end in 1890-94, giving way to a new long upswing. So we observe in the data relative to the rapidity in the increase of coal production and coal consumption nearly the whole of two large cycles, the periods of which correspond closely to the periods we have already found when considering other series.

Similarly, English production of pig iron and lead indicates sufficiently clearly the existence of one and one-half large cycles.

IX. OTHER SERIES

For the sake of brevity, we break off here the systematic analysis of the long waves in the behavior of individual series. We have also examined other data, some of which likewise showed the same periods as those mentioned

above, although several other series did not show the cycles with the same clarity. Value series which show long waves are the deposits and the portfolio of the Bank of France, and deposits at the French savings banks; series of a mixed (quantity x price) character are French imports and English imports, and total English foreign trade. As regards the movement of indices of a physical character, the existence of long waves has been established in the coal production of the United States, of Germany, and of the whole world; in the pig-iron production of the United States and of Germany and of the whole world; in the lead and coal production of the United States; in the number of spindles of the cotton industry in the United States; in the cotton acreage in the United States and the oat acreage in France, etc.

It was absolutely impossible, on the other hand, to establish long waves in French cotton consumption; in the wool and sugar production of the United States; and in the movement of several other series.

X. STATISTICAL FINDINGS

The evidence we have presented thus far permits some conclusions.

(1) The movements of the series which we have examined running from the end of the eighteenth century to the present time show long cycles. Although the statistical-mathematical treatment of the series selected is rather complicated, the cycles discovered cannot be regarded as the accidental result of the methods employed. Against such an interpretation is to be set the fact that these waves have been shown with about the same timing in all the more important of the series examined.

(2) In those series which do not exhibit any marked secular trend — e.g., prices — the long cycles appear as a wave-like movement about the average level. In the series, on the other hand, the movement of which shows such a trend, the cycles accelerate or retard the rate of growth.

(3) In the several series examined, the turning points of the long waves correspond more or less accurately. This is shown clearly by Table 1, which combines the results of the investigation not only of the data considered above but also of several other series.¹

¹ Table 1 enumerates the maxima and minima according to the original data. The problem of the most accurate method

TABLE I

Country and series	First cycle		Second cycle		Third cycle	
	Beginning of rise	Beginning of decline	Beginning of rise	Beginning of decline	Beginning of rise	Probable beginning of decline
France						
1. Prices . . . . .	....	....	....	1873	1896	1920
2. Interest rate . . . . .	....	1816*	1844	1872	1894	1921
3. Portfolio of the Bank of France . . . . .	....	1810*	1851	1873	1902	1914
4. Deposits at the savings banks . . . . .	....	....	1844	1874	1892	....
5. Wages of coal miners . . . . .	....	....	1849	1874	1895	....
6. Imports . . . . .	....	....	1848	1880	1896	1914
7. Exports . . . . .	....	....	1848	1872	1894	1914
8. Total foreign trade . . . . .	....	....	1848	1872	1896	1914
9. Coal consumption . . . . .	....	....	1849	1873	1896	1914
10. Oat acreage ¹ . . . . .	....	....	1850*	1875	1892	1915
England						
1. Prices	1789	1814	1849	1873	1896	1920
2. Interest rate	1790	1816	1844	1874	1897	1921
3. Wages of agricultural laborers	1790	1812-17	1844	1875	1889	....
4. Wages of textile workers . . . . .	....	1810*	1850†	1874	1890	....
5. Foreign trade . . . . .	....	1810*	1842‡	1873	1894	1914
6. Coal production . . . . .	....	....	1850*	1873	1893	1914
7. Pig iron production . . . . .	....	....	....	1871§	1891	1914
8. Lead production . . . . .	....	....	....	1870	1892	1914
United States						
1. Prices	1790	1814	1849	1866	1896	1920
2. Pig iron production . . . . .	....	....	....	1875-80	1900	1920
3. Coal production . . . . .	....	....	....	1893	1896	1918
4. Cotton acreage . . . . .	....	....	....	1874-81	1892-95	1915
Germany						
Coal production . . . . .	....	....	....	1873||	1895	1915
Whole world ²						
1. Pig iron production . . . . .	....	....	....	1872¶	1894	1914
2. Coal production . . . . .	....	....	....	1873	1896	1914

¹ Reversed cycles.² The data which refer to the whole world have not been corrected for population changes.

* Approximate dates.

† Another minimum falls in the year 1835.

‡ Other minima lie in the years 1837 and 1855.

§ Another maximum falls in the year 1881.

|| Another maximum falls in the year 1883.

¶ Another maximum falls in the year 1882.

It is easy to see from this table that there is a very close correspondence in the timing of the wave movements of the series in the individual countries, in spite of the difficulties present in the treatment of these data. Deviations from the

for the determination of the maxima and minima would deserve a special analysis; at present we leave this question open. We believe only that the indicated turning points are the most probable ones.

general rule that prevails in the sequence of the cycles are very rare. It seems to us that the absence of such exceptions is more remarkable than would be their presence.

(4) Although for the time being we consider it to be impossible to fix exactly upon the years that marked the turning points of the long cycles, and although the method according to which the statistical data have been analyzed

permits an error of 5-7 years in the determination of the years of such turnings, the following limits of these cycles can nevertheless be presented as being those most probable:

First long wave	<ol style="list-style-type: none"> 1. The rise lasted from the end of the 1780's or beginning of the 1790's until 1810-17. 2. The decline lasted from 1810-17 until 1844-51.
Second long wave	<ol style="list-style-type: none"> 1. The rise lasted from 1844-51 until 1870-75. 2. The decline lasted from 1870-75 until 1890-96.
Third long wave	<ol style="list-style-type: none"> 1. The rise lasted from 1890-96 until 1914-20. 2. The decline probably begins in the years 1914-20.

(5) Naturally, the fact that the movement of the series examined runs in long cycles does not yet prove that such cycles also dominate the movement of all other series. A later examination with this point especially in mind will have to be made to show which ones of these share the described wave-like movement. As already pointed out, our investigation has also extended to series in which no such waves were evident. On the other hand, it is by no means essential that the long waves embrace all series.

(6) The long waves that we have established above relative to the series most important in economic life are international; and the timing of these cycles corresponds fairly well for European capitalistic countries. On the basis of the data that we have adduced, we can venture the statement that the same timing holds also for the United States. The dynamics in the development of capitalism, however, and especially the timing of the fluctuations in the latter country may have peculiarities.

XI. EMPIRICAL CHARACTERISTICS

We were led to these conclusions by the study of statistical series characterizing the movement of the capitalist economy. From another point of view, the historical material relating to the development of economic and social life as a whole confirms the hypothesis of long waves. We neither can nor shall undertake here an analysis of this material. Nevertheless, several general propositions which we have arrived at concerning the existence and importance of long waves may be presented.

(1) The long waves belong really to the same complex dynamic process in which the intermediate cycles of the capitalistic economy with their principal phases of upswing and depression run their course. These intermediate cycles, however, secure a certain stamp from the very existence of the long waves. Our investigation demonstrates that during the rise of the long waves, years of prosperity are more numerous, whereas years of depression predominate during the downswing.¹

(2) During the recession of the long waves, agriculture, as a rule, suffers an especially pronounced and long depression. This was what happened after the Napoleonic Wars; it happened again from the beginning of the 1870's onward; and the same can be observed in the years after the World War.²

(3) During the recession of the long waves, an especially large number of important discoveries and inventions in the technique of production and communication are made, which, however, are usually applied on a large scale only at the beginning of the next long upswing.

(4) At the beginning of a long upswing, gold production increases as a rule, and the world market [for goods] is generally enlarged by the assimilation of new and especially of colonial countries.

(5) It is during the period of the rise of the long waves, i.e., during the period of high tension in the expansion of economic forces, that, as a rule, the most disastrous and extensive wars and revolutions occur.

It is to be emphasized that we attribute to these recurring relationships an empirical character only, and that we do not by any means hold that they contain the explanation of the long waves.

XII. THE NATURE OF LONG WAVES

Is it possible to maintain that the existence of long cycles in the dynamics of the capitalist economy is proved on the basis of the preceding statements? The relevant data which we were able to quote cover about 140 years. This period comprises two and one-half cycles only. Although the period embraced by the data is sufficient to

¹ Cf. A. Spiethoff, "Krisen," (*Handwörterbuch der Staatswissenschaften*, 4th edition).

² Cf. Ernle, *English Farming Past and Present* (London, 1922), and G. F. Warren and F. A. Pearson, *The Agricultural Situation* (New York, 1924).

decide the question of the existence of long waves, it is not 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.

We are led to this conclusion not only by the consideration of the factual material, but also because the objections to the assumption of long cyclical waves are very weak.

It has been objected that long waves lack the regularity which business cycles display. But this is wrong. If one defines "regularity" as repetition in regular time-intervals, then long waves possess this characteristic as much as the intermediate ones. A strict periodicity in social and economic phenomena does not exist at all — neither in the long nor in the intermediate waves. 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.

If regularity is understood to be the similarity and simultaneity of the fluctuations of different series, then it is present to the same degree in the long as in the intermediate waves.

If, finally, regularity is understood to consist in the fact that the intermediate waves are an international phenomenon, then the long waves do not differ from the latter in this respect either.

Consequently, there is no less regularity in the long waves than in the intermediate ones, and if we want to designate the latter as cyclical, we are bound not to deny this characterization to the former.

It has been pointed out [by other critics] that the long waves — as distinct from the intermediate ones which come from causes within the capitalistic system — are conditioned by casual, extra-economic circumstances and events, such as (1) changes in technique, (2) wars and revolutions, (3) the assimilation of new countries into the world economy, and (4) fluctuations in gold production.

These considerations are important. But they, too, are not valid. Their weakness lies in the fact that they reverse the causal connections and take the consequence to be the cause, or see an accident where we have really to deal with a law governing the events. In the preceding paragraphs, we have deliberately, though briefly, considered the establishment of some empirical

rules for the movement of long waves. These regularities help us now to evaluate correctly the objections just mentioned.

1. *Changes in technique* have without doubt a very potent influence on the course of capitalistic development. But nobody has proved them to have an accidental and external origin.

Changes in the technique of production presume (1) that the relevant scientific-technical discoveries and inventions have been made, and (2) that it is *economically* possible to use them. It would be an obvious mistake to deny the creative element in scientific-technical discoveries and inventions. But from an objective viewpoint, a still greater error would occur if one believed that the direction and intensity of those discoveries and inventions were entirely accidental; it is much more probable that such direction and intensity are a function of the necessities of real life and of the preceding development of science and technique.¹

Scientific-technical inventions in themselves, however, are insufficient to bring about a real change in the technique of production. They can remain ineffective so long as economic conditions favorable to their application are absent. This is shown by the example of the scientific-technical inventions of the seventeenth and eighteenth centuries which were used on a large scale only during the industrial revolution at the close of the eighteenth century. If this be true, then the assumption that changes in technique are of a random character and do not in fact spring from economic necessities loses much of its weight. We have seen before that the development of technique itself is part of the rhythm of the long waves.

2. *Wars and revolutions* also influence the course of economic development very strongly. But wars and revolutions do not come out of a clear sky, and they are not caused by arbitrary acts of individual personalities. They originate from real, especially economic, circumstances. The assumption that wars and revolutions acting

¹ One of the best and most compelling arguments for the assumption that scientific and technical inventions and discoveries are not made accidentally but are intimately connected with the needs of practical life is given by the numerous cases in which the same inventions and discoveries are made at the same time at different places and entirely independently of one another. Cf. the long list of such cases in W. F. Ogburn, *Social Change* (New York, 1924), p. 90. Cf. also Dannemann, *Die Naturwissenschaften in ihrer Entwicklung und in ihrem Zusammenhange* (Leipzig, 1923).

from the outside cause long waves evokes the question as to why they themselves follow each other with regularity and solely during the upswing of long waves. Much more probable is the assumption that wars originate in the acceleration of the pace and the increased tension of economic life, in the heightened economic struggle for markets and raw materials, and that social shocks happen most easily under the pressure of new economic forces.

Wars and revolutions, therefore, can also be fitted into the rhythm of the long waves and do not prove to be the forces from which these movements originate, but rather to be one of their symptoms. But once they have occurred, they naturally exercise a potent influence on the pace and direction of economic dynamics.

3. As regards the *opening-up of new countries for the world economy*, it seems to be quite obvious that this cannot be considered an outside factor which will satisfactorily explain the origin of long waves. The United States have been known for a relatively very long time; for some reason or other they begin to be entangled in the world economy on a major scale only from the middle of the nineteenth century. Likewise, the Argentine and Canada, Australia and New Zealand, were discovered long before the end of the nineteenth century, although they begin to be entwined in the world economy to a significant extent only with the coming of the 1890's. It is perfectly clear historically that, in the capitalistic economic system, new regions are opened for commerce during those periods in which the desire of old countries for new markets and new sources of raw materials becomes more urgent than theretofore. It is equally apparent that the limits of this expansion of the world economy are determined by the degree of this urgency. If this be true, then the opening of new countries does not provoke the upswing of a long wave. On the contrary, a new upswing makes the exploitation of new countries, new markets, and new sources of raw materials necessary and possible, in that it accelerates the pace of capitalistic economic development.

4. There remains the question whether the *discovery of new gold mines*, the *increase in gold production*, and a consequent *increase in the gold stock* can be regarded as a casual, outside factor causing the long waves.

An increase in gold production leads ultimately

to a rise in prices and to a quickening in the tempo of economic life. But this does not mean that the changes in gold production are of a casual, outside character and that the waves in prices and in economic life are likewise caused by chance. We consider this to be not only unproved but positively wrong. This contention originates from the belief, first, that the discovery of gold mines and the perfection of the technique of gold production are accidental and, secondly, that every discovery of new gold mines and of technical inventions in the sphere of gold production brings about an increase in the latter. However great may be the creative element in these technical inventions and the significance of chance in these discoveries, yet they are not entirely accidental. Still less accidental — and this is the main point — are the fluctuations in gold production itself. These fluctuations are by no means simply a function of the activity of inventors and of the discoveries of new gold mines. On the contrary, the intensity of inventors' and explorers' activity and the application of technical improvement in the sphere of gold production, as well as the resulting increase of the latter, depend upon other, more general causes. The dependence of gold production upon technical inventions and discoveries of new gold mines is only secondary and derived.

Although gold is a generally recognized embodiment of value and, therefore, is generally desired, it is only a commodity. And like every commodity it has a cost of production. But if this be true, then gold production — even in newly discovered mines — can increase significantly only if it becomes more profitable, i.e., if the relation of the value of the gold itself to its cost of production (and this is ultimately the prices of other commodities) becomes more favorable. If this relation is unfavorable, even gold mines the richness of which is by no means yet exhausted may be shut down; if it is favorable, on the other hand, even relatively poor mines will be exploited.

When is the relation of the value of gold to that of other commodities most favorable for gold production? We know that commodity prices reach their lowest level toward the end of a long wave. This means that at this time gold has its highest purchasing power, and gold production becomes most favorable. This can be illustrated by the figures in Table 2.

Gold production, as can be seen from these figures, becomes more profitable as we approach a low point in the price level and a high point in the purchasing power of gold (1895 and the following years).

TABLE 2.—SELECTED STATISTICS OF GOLD MINING IN THE TRANSVAAL, 1890-1913*

Year	Cost of production	Profit
	Per ton of gold ore	
1890.....	42 sh. 2 d.	7 sh. 2 d.
1895.....	33 sh. 5 d.	11 sh. 11 d.
1899.....	28 sh. 0 d.	14 sh. 3 d.
1903.....	24 sh. 9 d.	14 sh. 11 d.
1906.....	22 sh. 2 d.	11 sh. 6 d.
1913.....	17 sh. 11 d.	9 sh. 10 d.

* Cf. W. A. Berridge, "The World's Gold Supply," this REVIEW, II (1920), p. 184.

It is clear, furthermore, that the stimulus to increased gold production necessarily becomes stronger the further a long wave declines. We, therefore, can suppose theoretically that gold production must in general increase most markedly when the wave falls most sharply, and vice versa.

In reality, however, the connection is not as simple as this but becomes more complicated, mainly just because of the effect of the changes in the technique of gold production and the discovery of new mines. It seems to us, indeed, that even improvements in technique and new gold discoveries obey the same fundamental law as does gold production itself, with more or less regularity in timing. Improvements in the technique of gold production and the discovery of new gold mines actually do bring about a lowering in the cost of production of gold; they influence the relation of these costs to the value of gold, and consequently the extent of gold production. But then it is obvious that exactly at

the time when the relation of the value of gold to its cost becomes more unfavorable than theretofore, the need for technical improvements in gold mining and for the discovery of new mines necessarily becomes more urgent and thus stimulates research in this field. There is, of course, a time-lag, until this urgent necessity, though already recognized, leads to positive success. In reality, therefore, gold discoveries and technical improvements in gold mining will reach their peak only when the long wave has already passed its peak, i.e., perhaps in the middle of the downswing. The available facts confirm this supposition.¹ In the period after the 1870's, the following gold discoveries were made: 1881 in Alaska, 1884 in the Transvaal, 1887 in West Australia, 1890 in Colorado, 1894 in Mexico, 1896 in the Klondike. The inventions in the field of gold-mining technique, and especially the most important ones of this period (the inventions for the treatment of ore), were also made during the 1880's, as is well known.

Gold discoveries and technical improvements, if they occur, will naturally influence gold production. They can have the effect that the increase in gold production takes place somewhat earlier than at the end of the downswing of the long wave. They also can assist the expansion of gold production, once that limit is reached. This is precisely what happens in reality. Especially after the decline in the 1870's, a persistent, though admittedly slender, increase in gold production begins about the year 1883;² whereas, in spite of the disturbing influences of discoveries and inventions, the upswing really begins only after gold has reached its greatest purchasing power; and the increased production is due not only to the newly discovered gold fields but in a considerable degree also to the old ones. This is illustrated by the figures in Table 3.

¹ Berridge, *loc. cit.*, p. 181.

² Cf. *Statistical Abstract of the United States*, 1922, pp. 708-09.

TABLE 3.—GOLD PRODUCTION, 1890-1900
(Unit: thousand ounces)

	World total	Transvaal	United States	Australia	Russia	Canada	Mexico	India
1890.....	5,749	440	1,589	1,588	1,135	65	737	9
1895.....	9,615	2,017	2,255	2,356	1,388	101	290	230
1900.....	14,838	3,638	3,437	4,461	1,072	1,020	411	412

Source: Berridge, *loc. cit.*, p. 182

From the foregoing one may conclude, it seems to us, that gold production, even though its increase can be a condition for an advance in commodity prices and for a general upswing in economic activity, is yet subordinate to the rhythm of the long waves and consequently cannot be regarded as a causal and random factor that brings about these movements from the outside.

XIII. CONCLUSIONS

The objections to the regular cyclical character of the long waves, therefore, seem to us to be unconvincing.

In view of this circumstance and considering also the positive reasons developed above, we think that, *on the basis of the available data, the existence of long waves of cyclical character is very probable.*

At the same time, we believe ourselves justified in saying that the long waves, if existent at all, are a very important and essential factor in economic development, a factor the effects of which can be found in all the principal fields of social and economic life.

Even granting the existence of long waves, one is, of course, not justified in believing that economic dynamics consists only in fluctuations around a certain level. The course of economic activity represents beyond doubt a process of

development, but this development obviously proceeds not only through intermediate waves but also through long ones. The problem of economic development *in toto* cannot be discussed here.

In asserting the existence of long waves and in denying that they arise out of random causes, we are also of the opinion that the long waves arise out of causes which are inherent in the essence of the capitalistic economy. This naturally leads to the question as to the nature of these causes. We are fully aware of the difficulty and great importance of this question; but in the preceding sketch we had no intention of laying the foundations for an appropriate theory of long waves.¹

¹ I arrived at the hypothesis concerning the existence of long waves in the years 1919-21. Without going into a special analysis, I formulated my general thesis for the first time shortly thereafter in my study, *The World Economy and Economic Fluctuations in the War and Post-War Period* (*Mirovoje chozjajstvo i jego konjunktury vo vremja i posle vojny* [Moscow, 1922]). During the winter and spring of 1925, I wrote a special study on "Long Waves in Economic Life" ("Bol'schije cykly konjunktury"), which was published in the volume of the Institute for Business Cycle Research, *Problems of Economic Fluctuations* (*Voprosy konjunktury*, Vol. 1). Only at the beginning of 1926 did I become acquainted with S. de Wolff's article "Prosperitäts- und Depressionsperioden," *Der lebendige Marxismus, Festgabe zum 70. Geburtstage von Karl Kautsky*. De Wolff in many points reaches the same result as I do. The works of J. van Gelderns, which de Wolff cites and which have evidently been published only in Dutch, are unknown to me.