Business Cycles Revisited: A Theoretical, Historical and Statistical Analysis

Prof. Claude Diebolt
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1. Kuznets Swings versus Kondratieff Waves

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What is cliometrics?

- Cliometrics is economics in the service of history and history in the service of economics ⇒ *The Cliometric Voice* (2012).

- Main ambitions:
  - Avoiding the development of economic history without economics
  - Introducing modern quantitative methods in economic history
  - Producing new statistical datasets
  - Using the counterfactual approach
  - Discussing the multiplicity of erroneous representations in economic history (myths, falsifications, etc.):

  Economic cycles: a mistake that succeeded?
Is there still a place for cliometrics and economic history in economics? (1)

- Improving the quality of the data: new databases, more critique on the databases used.

- Complexity of economic mechanisms: debates around the proper way of modelling.

- Role of measurement: econometrics/statistics.

- Culture and institutions do matter.

- Path dependency: history matters.
Is there still a place for cliometrics and economic history in economics? (2)

- Cliometrics for history as experimental economics for today? Yes. Economic actors are not passive: game theory, analytic narratives.

- Cliometrics as mathematics/mathematical economics? No.

- Cliometrics as physics? Yes. Linking economic theory with observed stylized facts or “laws”.

- Cliometrics as biology? Yes. Evolutionary perspective.

- Cliometrics as political philosophy? Yes. Designing optimal institutions instead of describing the world.
What I do to contribute to this!

- Publishing in the field.
- Teaching and supervising PhDs.
- The French Cliometric Society.
- Editing journals:
  - *Cliometrica*
  - *Historical Social Research. An International Journal for the Application of Formal Methods to History – Cliometric Section*
  - *Série AF Histoire Economique Quantitative*
From traditional approaches...

- Technical progress and economic growth occur mainly in cycles of efforts and tensions, with breaks of various scales and intensity.

- Economic history shows how relativistic these movements are: they are not necessarily to be found in all economic systems nor in all countries.

- Some characterise a period, others an economy.

- Without a theory or a combination of theories, the study of economic cycles is both impractical and sterile.
Economic cycles

- Economic fluctuations existed already before the Industrial Revolution and in many cases they could be explained by the alternation of good and bad harvests.
- No regular pattern could be observed in this alternation, as exogenous events obviously came to blur the graph of a possible endogenous rhythm, inherent in the very nature of economic dynamics.
- During the 19th century, fluctuations were more frequent and more regular: growing importance of manufacturing industries and the opening up of the world market made it possible to compensate for the shortage of agricultural products.
- Moreover, the importance of technical and particularly financial factors increased. Crises had a tendency to become industrial. One of their main characteristics was that they were affected by a general overproduction.
Jevons and Juglar

• The long series of quasi-decennial cycles which started in 1825 was bound to raise questions among economists.

• Two of them, William Stanley Jevons and Clément Juglar, decided to look into the issue. In some ways they followed similar approaches, especially as they were much more interested in cycles than in crises: this was a major break with their predecessors (Ricardo, Mill, Marx, etc).

• Furthermore they made extensive use of the available time series. However, they differed on two main points: the strict periodicity of the fluctuations and the analysis of their causes.
In a 1875 writing, Jevons first formulated the hypothesis that sunspot cycles (of a duration of 11.1 years) implied a temperature cycle which in turn caused a harvest cycle and *in fine* a cycle of grain prices.

It was however difficult for Jevons to connect the periodicity of sunspots with that of grain prices, a series which did not provide identifiable variations. He therefore turned to the analysis of credit cycles between 1825 and 1867, which, according to him, presented a periodicity of 10.8 years. There remained a gap between both durations which Jevons was unable to explain.

In the end, in his publication *The Periodicity of Commercial Crises and its Physical Explanation* written in 1878 – Jevons concluded, on the basis of new calculations, that there was a credit cycle which had an average length of between 10.3 and 10.46 years. Since a new study of sunspots made it possible to date the periodicity of the corresponding cycle to 10.45 years, Jevons was in a position to assert that “it becomes highly probable that the two periodic phenomena [...] are connected as cause and effect”.
Juglar (1)

- Juglar, whose book *Commercial Crises* was first published in 1862 with a second edition in 1889, studied the course of crises in France, England and the United States.

- Schumpeter (1954) considered him as “one of the greatest economists of all times”. His method was comparative and was based on the empirical study of long series.

- In short, his approach was supposed to be scientific: “if we rely not only on statistical data, but also on large numbers, long periods in three big countries, we consider that we have met the main conditions of a scientific demonstration better than arguable assertions.” (1862, p. XII).
Juglar (2)

• For Juglar, there was almost no doubt about the fundamental cause of crises and hence of cycles: once accidental causes or specific events had been discarded, the cause of crises was to be found in the modifications of credit conditions, especially the development of discounts and he therefore assumed that the evolution of currency flows played a major role.

• It should be mentioned that in his second edition (1889), Juglar’s approach remained identical, but at the same time he specified that he used more numerous statistical data and he considered a longer period of time. Moreover he differentiated himself from Jevons by refusing any strict periodicity of the cycle and he just noted that crises occurred “over a period of 5 to 10 years”. In this second edition, Juglar also proposed an analysis of the cycle phases, which is still used today: prosperity duration of 5 to 7 years, crisis duration from a few months to some years; depression duration some years.
... to the statistical analysis of the cycle (1)

- If we can date back to Juglar and Jevons the use of long series to characterise the economic cycle, the credit for the first really statistical analysis of these series has to go to Moore and Persons.

- Moore (1914) used the periodogram to detect two cycles of a respective duration of eight and 33 years in the rainfalls in the Ohio Valley.

- As for Persons (1919), he seems to be the first economist to have proposed to split time series into four components: the trend, the cycle, seasonality and a purely accidental hazard.
However, as early as 1913, Wesley Clair Mitchell published the first book totally devoted to the study of economic oscillations (business cycles). He developed a new methodological approach which he summed up as follows: “To observe, analyze, and systematize the phenomena of prosperity, crisis, and depression is the chief task” [Mitchell, 1913, p. 20]. From this position, there was no need to decide between the different cycle theories; they need only be used to select the relevant facts.

During the 1920s there was a real blossoming of institutions dedicated to research on the cycle and the economic situation. In 1920 the Moscow Institute, chaired by Kondratieff, was created; one in Stockholm in 1922, in Paris and London in 1923, Berlin in 1925, etc. In January 1927 the Austrian Research Institute on Business Cycles (Österreichische Konjunkturinstitut) was created at Ludwig von Mises’ behest.

Mitchell and Persons’ intellectual influence on most of these new institutions is quite obvious, yet their futures turned out to be diverse: the Moscow institute was closed in 1928 and Kondratieff was banished to Siberia; the European institutes as well as Harvard’s lost their credibility, as they had been unable to predict the 1929-1930 crisis.
The ‘Tinbergen moment’ (1)

- The decline of economic research institutes paved the way for attempts at modelling cycles. The most obvious name which comes to mind in that respect is that of Jan Tinbergen, the first Nobel Prize winner in economics in 1969, together with Ragnar Frisch. The Dutch economist’s research, considerable as it is, did not come out of the blue, it was directly prepared by the work of three authors, namely Yule, Slutsky and Frisch.

- Georges Udny Yule [1926] had showed that one had to be very careful when calculating correlations (in a statistical sense) between chronological series: these might prove to be nonsense correlations.

- The Russian economist Eugen Slutsky (1937), in an article written in 1927 but which was published in English only in 1937, stressed even more strongly the importance of random shocks, as, by accumulating, they might produce series which could be compared to a combination of sinusoidal swings. Kuznets [1929, p. 274], who might have read Slutsky’s article in its original version, came to the conclusion that “if cycles arise from random events, […], then we obviously do not need the hypothesis of an independent regularly recurrent cause”.

The ‘Tinbergen moment’ (2)

• Ragnar Frisch proposed in 1933 in the paper written for the book to pay homage to Cassel, he proposed a small dynamic macro-economic model of the cycle: from a mathematics perspective it was a mixed system of recurrence equations and differential equations.

• Following up on these three authors, Jan Tinbergen designed and assessed the first econometric model of the cycle. This dynamic macro-economic model was a real achievement: it contained 71 variables, 48 equations and covered the period 1919-1932.

• What is more interesting from a present-day point of view is the first volume considered from its methodological dimension. The method used was called by Tinbergen “correlation analysis”. In fact the aim was simply to assess the coefficients of a multiple linear regression (possibly with lagged variables) by minimising residual sum of squares. This estimated equation is then characterized by the correlation coefficient – the famous of modern econometricians –, whose value varies from 0 to 1. The closer to unity the correlation coefficient, the better the statistical fit.
Keynes, Hayek etc.

• The Great Depression of the 1930s was without precedent, utterly different from the 19th century classical crises in both form and scale, and was to produce abundant theoretical literature. Out of this crop, well analysed by Haberler (1937), in spite of his close proximity to these debates, two names emerged: Hayek, the best-known representative of the Austrian economics school, and Keynes.

• The Austrian theory of the business cycle fits into a more general context of economic literature’s between-the-wars interest in questions of economic conjuncture, which was accentuated by the 1929 crash. From a different angle, the theory is linked to a traditional subject for the Austrians, the mode of integration of money to real phenomena. Although theirs is not the only work in the Austrian theory of the cycle, Mises and Hayek are its two main authors.

• Keynes’ *General Theory* (1936) is of course not devoted to studying or explaining the cycle. However, chapter 22 provides a precise idea of the problematic raised by the author. The analysis uses the complete set of Keynesian conceptual tools: propensity to consume, the multiplier effect, the principle of effective demand, liquidity preference and above all the marginal efficiency of capital.
... and the 30 Glorious years

- The Cambridge economist's conceptual system, as soon as *the General Theory* was published, was taken up and developed by several authors, often young ones, to think the cycle anew.

- The first one to do so was R.F. Harrod, who published his *Trade Cycle* in 1936. He was followed by Samuelson, Hansen and Hicks, but also by Kaldor and Kalecki.
The neo-classical synthesis

- From a theoretical point of view, the Thirty Glorious Years were dominated by what was called the “neo-classical synthesis”, i.e. a combination of Keynesian macro-economics and of marginalistic micro-economic analysis.

- Two economists were responsible for this synthesis: on the one hand Hicks with *Mister Keynes and the Classics* [1937] and *Value and Capital* [1939]; and on the other Samuelson [1948] with his *Foundations of Economic Analysis*. Then came Friedman’s developments and Lucas model based on imperfect information and rational expectations. Latter the *Real Business Cycle* (RBC) theorists.
RBC

- The first Real Business Cycle models were developed by Kydland and Prescott (1982) and Long and Plosser (1983), in a complete break with the traditional view of the cycle.
- Firstly, this approach considers that monetary policies have no bearing in the cycle dynamic; it also insists on the exogenous character of technological shocks.
- Secondly, it considers that cycles are not an expression of disequilibrium; on the contrary, they are the gauges that measure an economy’s best adjustment to equilibrium.
- Lastly, it prevents cycles from being seen as variations of a same trend rather than changes to the trend. In fact, it is an integrated vision of the growth of cycles.
- However contestable the RBC approach, it is today a major macroeconomic research project. Its advantage obviously lies in its methodology: quantitative simulations to simplify economic representation; however, the underlying economic message in this approach, all things being equal, remains relatively weak.
Renewal of econometric approaches (1)

- The first half of the 1970s appears retrospectively as the golden age of macro-econometric modelling. However, already at the beginning of that decade the analysis of time series made considerable progress. Box et Jenkins [1970] in particular, relied on the previous works of Yule and Wold and developed a forecasting methodology based on the use of stochastic processes of the ARMA type.
- The Box-Jenkins root gave birth to Time Series econometrics which brought about a new way of looking at business cycles.
- Sims and the use of “vector auto-regressions” (VAR). From this point of view, an important debate launched in the early 1980s was to feed the world of economists and statisticians. It had been known for a long time that many series incorporated a linear trend and as we saw, Persons (1919) was probably the first economist to propose splitting them into different components, one of them being the cycle. As a direct result, many practitioners extracted the trend through empirical smoothing or regression methods (it is sometimes fallacious to use Granger and Newbold’s wording, 1974), and the cycle was then measured as the gap to the deterministic trend.
Renewal of econometric approaches (2)

• Nelson and Plosser’s seminal article (1982) was to question such an approach of non-stationarity and to introduce a second class of non stationary, purely stochastic processes, which followed a random path.

• On the basis of this analysis, many research works - Beveridge and Nelson [1981], Perron [1988], Harvey [1989], etc. – developed new extraction methods of the business cycle, but the debate on that issue is far from being closed.

• Today there is a rather general agreement on the terms of Burns and Mitchell’s definition (1946, p.3): “A cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years”.

• Monetary shocks? Real shocks? Exogenous approach of the business cycle or endogenous concept? The question remains open and the debate about the origin, cause and dating of the economic cycle is still completely topical.
The dream of all cycle theorists today!

- To develop a general theory so good that it could serve as a code or handbook translating the meaning of past and current economic situations into terms of future movements.

- This remains a dream! The best we can do is to synthesise existing theories of why the circular flow of socio-economic moves—or not—in the rhythms that we call long movements of the Kondratieff type, Kuznets, Juglar, Kitchin cycles, etc... trapped in a never ending reading list since Schumpeter’s 1939 naming of the species and conceptual framework... clustering of innovations, leading sectors and creative destruction!
Science-fiction or not?

• The *naming of species* after the biologists has its counterpart both in physics and in economics, whereas in the natural sciences this type of nomenclature has proven relatively uncontroversial the same cannot be said of economic cycles.

• An attempt has been made in this study to do justice to fascinating, wide-ranging and continuing debate:
  → authors who deny or doubt the very existence of economic cycles;
  → those who try to demonstrate their existence and to provide a theoretical explanation.

↓

The same methodological problem since 150 years:
Theory-free econometrics vs. Econometric-free theory!
The Kondratieff Wave

- Idealized long wave
- War of 1812
- Start of secondary recession
- Civil War
- Gradually declining plateau
- World War I
- Roaring 20s
- Recession
- Vietnam War
- Early 1970s
- 2000
- Late 1940s
- War on terrorism
- 60 years

Actual US wholesale prices
Idealized long wave

- 1800
- 1820
- 1840
- 1860
- 1880
- 1900
- 1920
- 1940
- 1960
- 1980
- 2010
Time series analysis (I)

• The classical approach of business cycles analysis at the beginning of the 20th century… illustrated by Kuznets, Kondratieff etc…

• Mainly four problems arose within this approach:
  
  o the trend problem (estimation and elimination),
  o the Slutsky-effect problem (all cycles may be due to the summation of random causes),
  o the problem of causality (what about covariation of time series or their components?),
  o and the “measurement without theory” problem (what are the adequate dynamic theories explaining growth and cycles?).
Time series analysis (II)

• Since Nelson and Plosser, substantial literature has developed on the nature of the trend (deterministic or stochastic) and the relative importance of the shocks in the macroeconomic times series via unit root tests ⇒ See Beveridge and Nelson, Engle and Granger, Harvey, Hodrick and Prescott, Perron, Phillips, Etc.

• Spectral analysis ⇒ often presented as the most valuable method for seeking dependences expressed as lags between different magnitudes. Its use in this presentation was determined by the search for maximum objectivity in the observation of time series and the possibility of applying it to a large number of series.
Spectral analysis

- Spectral analysis is based on the theory of stochastic processes and had limited applications in cliometrics (see Ewijk, Gerster, Metz, Reijnders, Etc.).

- The core hypothesis is that a given time series consists of a large number of sinusoidal components with different frequencies (univariate spectral analysis).

- It makes it possible to divide a particular category of records into a set of oscillations of different frequencies and then to show the links between the components with the same frequency in the various series examined (cross-spectral or bivariate spectral analysis).

- A reminder of the method is my paper for the NATO Advanced Research Workshop.
The aim of this paper is the comparison of the behaviour of the per capita GDP (log transformed) in 15 OECD countries, with on the one hand a study of the national cyclical features of the 15 OECD countries and on the other a search for common factors in these cycles.

We use the now well-known database drawn up by Maddison, expressed in 1990 US dollars extended by EUROSTAT indicators.

The series are decomposed additively into a trend, a cycle and a random component (the cyclical and irregular components respect the statistical property of stationarity) to reveal the different cyclicity in the series studied. The Johansen test show clearly that national growth trends, are cointegrated = linked by linear relations and probably common factors.
Analysis of Spectra

- The spectral density functions show that the cyclical movement can be decomposed into two distinct cyclical components. One is short and of the Kitchin type and the other an intermediate phenomenon between the Juglar business cycle and a long Kondratieff type of cycle.

- The latter, a Kuznets type cycle with a frequency of 15-20 years and comparatively large amplitude, underlies GDP conjuncture.
Spectral density functions

- Germany
“More widely accepted in recent years is the 15- to 25-year swing in economic growth rates uncovered by Nobel laureate S. Kuznets. The cycle is more evident in the United States than elsewhere. M. Abramovitz recognises the Kuznets cycle as associated with population growth and immigration. Most economists hold that this cycle was material only for the period from 1840 to 1914”.

Kuznets cycles
Results (I)

• The economic situation is governed essentially by a 15-20-year frequency and not by short cycles of the Kitchin or Juglar type or by long movements of the Kondratieff type.

• The driving force underlying this frequency ⇒ an economic reaction to demographic mechanisms, for example via the movement of large investments or the labour market.
Results (II)

• Three essential mechanisms linked to demographic factors:
  → a cycle linking work and employment (the productivity cycle),
  → an effect linking unemployment and wages (the Phillips effect),
  → finally a link between demand and income (the consumption function).

• These three mechanisms play greater or lesser roles according to the period and the country ⇒ they can increase or reduce the cycles and hence account for the international disparities observed.
Analysis of Cross-Spectra: Coherence

• The search for similarities and synchronisation of the different national cycles.

• We first analyse the coherence between the different cycles using coherence of 0.7 or more as the criterion of significance ⇒ Coherence makes it possible to measure the degree of linear correlation between components of the same frequency in two processes. The closer it is to 1 for a given frequency, the more the two processes move in a similar manner for this frequency or periodicity.
Analysis of Cross-Spectra: Phases

- Followed by study of the phases of the cyclical processes whose coherence is significant. The phase makes it possible to measure the time shift of a process in relation to another. A positive phase shows that the second series is ahead of the first and the opposite if it is negative. Interpretation of the phase is then strongly linked with coherence as the analysis of a lag between two processes is only meaningful if the processes are related, that is to say if their coherence is high.

- The results of the two methods can be represented schematically to make it easier to examine and interpret the results.
Results (I)

- Coherence is represented by lines (dotted, unbroken or double unbroken) indicating their degree of importance (0.7, 0.8 and 0.9 respectively), while the phases are shown by the direction of the coherence relation with the beginning of an arrow showing the process that is ahead with regard to the process at its extremity (a double arrow means that there is no lag between the processes—they are synchronous).

- Forces governing national intermediate cycles are not independent between countries and there is thus strong interconnection between national cyclicity. This can be shown in more detail by a grouping in three geographic zones and linked to notions of similar, common cycles and growth regimes.
Results (II)

• A first parallel can be made between the English-speaking countries (United States, Canada and the United Kingdom) that are linked in a joint cycle through their common historical, political and geographic context.

• A second, can be set between the European countries in the broad sense (the countries of continental Europe and Scandinavia) ⇒ sometimes common with certain neighbouring countries (e.g. Belgium and the Netherlands and Germany and Austria), explained in particular by a flexibility of the labour market and geographic mobility.

• Finally, Japan seems to form a zone all by itself with a cycle similar to that of all the European countries but more advanced.
Conclusion

• A major, new result for the understanding of economic dynamics in the nineteenth and twentieth centuries ⇒ the existence of a single intermediate cycle with a frequency of 15 to 20 years that calls into question or even contradicts (at least partially) previous work on economic cycles.

• This understanding of cyclical mechanisms is all the more essential today as it will make it possible to put forward more concerted and more cooperative economic policies aimed at parallel development of activities.

• Next step: innovation cycles, i.e. world series of patents!
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