AFC ASSOCIATION FRANÇAISE DE CLIOMÉTRIE

WORKING PAPERS

Nr. 11, 2012

Economic Cycles: A Synthesis

Thierry AIMAR, Francis BISMANS, Claude DIEBOLT

Economic Cycles: A Synthesis

Thierry AIMAR, Francis BISMANS, Claude DIEBOLT[1]

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. In fact each cycle derives part of its specifics from a more fundamental underlying movement. Hence the nature of each cycle depends on the socio-economic systems which generate it, although their causes and periodicities might vary through history, depending on the economic structures of the countries in question.

However, without a theory or a combination of theories, the study of economic cycles is both impractical and sterile. Obviously there is no need to endorse the fundamental causes identified by one theory or another but it is necessary to understand the effects these causes have on economic life as well as the repercussions of the various elements on one another.

We do not aim to repeat the comprehensive work of the great economists of the past such as Haberler (1943) or Schumpeter (1939, 1954). We will start with a selection of results which we consider as accepted, which come from various studies' experience-based conclusions and their confrontation with economists' essential hypotheses, investigating causes and analysing the economic cycle, to contribute some additional elements to the most recent theoretical, statistical and econometric developments.

In line with our statement on the relativity of economic fluctuations, we should specify that we do not again mean here to discuss *in extenso* Schumpeter's distinction (1939) between cycles of the Kitchen, Juglar and Kondratieff types, with their respective periodicities. We will deal only with the shorter cycle in this attempt at synthesis, which can also be called "classical", even if we will at some stage say a few words about the Kondratieff-type long cycles.

[1]Corresponding author: cdiebolt@unistra.fr

From Traditional Approaches…

Economic fluctuations existed already before the Industrial Revolution and in many cases they could be explained by the alternation of good and bad harvests. However, 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. At the same time, the harvests had a lower impact, both because of the growing importance of manufacturing industries and because 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. Ricardo (1821, ed. Sraffa, p. 265), when he published the first edition of his *Principles* in 1817, had the example of the English crisis of 1815 right under his nose and he made sure he stressed the phenomenon: “The commencement […] of peace after a long war, generally produces considerable distress in Trade. It changes in a great degree the nature of the employments to which the respective of countries were before devoted; ; and during the interval while they are settling in the situations which new circumstances have made the most beneficial, much fixed capital is unemployed, perhaps wholly lost, and labourers are without full employment”

The 1815 crisis, which was followed by another one in 1818-1819, was to raise fierce controversies about possible general overproduction and Say’s law, between Sismondi [1819, 1827] and Malthus [1820] on the one hand and Ricardo [1821] and Say [1815-1821] on the other.

However, economic historians, such as Bairoch (1997, pp. 401-402) generally agree to date the first real “modern” crisis back to 1825. According to Hicks’ interpretation (1989, chap.11, also 1981), this first crisis was followed by others in 1836-1837 (which hit mainly the United States), 1848, 1857 and 1867; later the phenomenon weakened, at least in Great Britain. When one looks at this succession of dates, the notion of cycle comes immediately to mind as these crises seemed to happen at 10-year periodicities. This is the “classical cycle”, the “old” cycle to use the terminology of Hicks (1989).

Two authors, Stuart Mill [1848, book III, chap.12] and Marx [1894, book III, section 5], although they did not have much experience of crises, produced a good analysis of this classical cycle and particularly of its critical point, namely the crisis. For the two of them, the explanation focused on England and stressed the influence of credit mechanisms as well as the role of the Bank of England. For Marx [1894, book III, volume 7, p. 151]: "[…] the whole crisis seems to be merely a credit and money crisis"; for Stuart Mill [1848, p. 528]: "the fall, as well as the rise, originating not anything affecting money, but in the state of credit"

Here in fact is the underlying explanatory scheme of these two authors. In the early days of economic depression, prices and interest rates were low compared to the values observed during the prosperous period. Progressively, the recovery of economic activity induced a rise in some prices, while the interest rates remained low. The financing of an increasing price level was rather unproblematic, using bills of exchange. However there came a time when trade credit was not sufficient anymore; firms turned then to bank credit, which meant that bank rates were pushed up. In the long run, the accumulation of bills of exchange in the banks' portfolios, as well as speculation encouraged by a lasting price increase, resulted in a mistrust of bank notes. This distrust resulted in a sudden increase of the basic currency, i.e. gold. Second-rank banks which did not have sufficient reserves to face the demand for gold would turn towards the Bank of England, which, when its metal reserves started to dwindle, made credit more expensive and in so doing plunged the economy in a crisis.

Hence it was the Bank of England which triggered the crisis and the resulting bankruptcies of banks and firms as well as the fall in prices when it tried to protect its gold reserves. To curb the further collapse of prices and put the economy back on the road to prosperity, the Bank of England had to restore the banks' and firms' confidence by lowering its bank rate at the appropriate time. This is what Hicks called Thornton's precept (Bagehot's lender of last resort comes immediately to mind, but in fact Thornton came much earlier as his *Paper Credit* dates back to 1802!).

Actually the Bank of England was to make this concept its own progressively and to learn to handle its bank rate wisely. It thus acquired the means to avoid major crises so that in the 1860s, cyclical fluctuations became less marked, at least in Great Britain.

Nevertheless 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. 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.

Jevons really started to do research on cycles in the 1870s, after he had already a solid reputation as a theoretician, in particular with the publication in 1871 of his *Theory of Political Economy*, which ranked him – together with Walras and Menger – among the initiators of marginalism. In a 1875 writing (1884, pp. 194-205), he 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 [1884, pp. 206-220] – he 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 (1884, p. 215) was in a position to assert that "it becomes highly probable that the two periodic phenomena […] are connected as cause and effect".

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 empiricsal 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).

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

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. We will return to the other great contribution of Persons to the analysis of fluctuations: the construction of the "Harvard barometer".

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.

In 1920, Mitchell became the Director of the National Bureau of Economic Research, an institution which in 1921 launched a statistical research programme on economic cycles. This programme resulted in another book by Mitchell called *Business Cycles: The Problem and its Setting* [1927]. In it, Mitchell criticised the use of statistical techniques – periodogram or decomposition of time series – applied by Moore and Persons; he considered that these techniques did not directly measure the business cycle. Moreover *Business Cycles* presented a synthesis of research works on the cycle undertaken in the 1920s and ended with a proposed plan for measuring economic fluctuations. Hence, as Morgan (1990, p. 50) wrote, the book "fully established Mitchell's reputation as the preeminent figure in statistical business cycle research of the interwar period".

Another book resulted from Mitchell's research programme, *Measuring Business Cycles*, written in collaboration with A.F. Burns, published in 1946. In addition to a definition of the cycle, which we will come back to later, the two authors proposed – among others – a series of measures of fluctuations, or more precisely of what he called the reference cycle on the one hand and the specific cycles on the other. The latter were connected with specific variables and were obtained by dating turnaround points of the variable under study. The reference cycle is the global, aggregated economic cycle defined on the basis of a set of relevant variables.

However, in the 1920s, Mitchell was not the only economist preoccupied by the statistical analysis of swings. The aforementioned Persons was entrusted by the Harvard Committee for Economic research in 1917 with initiating a study of the "methods for collecting and interpreting economic statistics". Two years later he published the results of his work as a monthly business barometer in the *Review of Economic Statistics*, created in 1919 by the Harvard Committee and which became in 1949 the *Review of Economics and Statistics*. This barometer relied on three cycle indicators representing the movement of the economy and covering respectively the stock market, industry and the monetary conditions. These indicators led to the famous curves called Harvard A-B-C which were supposed to represent the dynamics of economic fluctuations and therefore to forecast crises. Harvard barometers did not survive the Great Depression; however, see Samuelson [1987] for a reappraisal of the Harvard work.

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. Thanks to his support, Hayek was its director until he left Vienna for London in 1931, when he was hired by the London School of Economics. Morgenstern succeeded him until 1938, when he immigrated to the United States after *Anschluss*.

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"

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. Of course such a criticism implicitly questioned the works of the cycle analysts which were based on the calculation of high correlation coefficients to provide evidence of the relations between variables. The following year, Yule (1927) published another article in which he compared the cycle to a "pendulum bombarded with green peas", the swings being due to random shocks, represented by the green peas.

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".

Ragnar Frisch, the first Nobel Prize winner in economics together with Tinbergen, is the third author who had a significant influence on the Dutch economist. 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. The attempt was completely in the *Zeitgeist*, as the 1929 crisis had focused economists attention somewhat.

Without going into details, we can say that Frisch's model combines deterministic dynamic relations and random shocks. We could almost call it an econometric model, except that its structural parameters were not evaluated but "calibrated". Nevertheless with this type of calibration, Frisch's system proposed solutions for the three main variables and these solutions were composed of a trend and three cycles, one of which – primary – had a 8.57 year duration. This matched reality quite well.

Following up on these three authors, Jan Tinbergen designed and assessed the first econometric model of the cycle. He did it at the request of the *Vereniging voor de Staathuishoudkunde en de Statistiek*, the association of Dutch economists which convened in

October 1936 a congress on the topic “Out of Depression”. Tinbergen (1936), addressing an audience not very knowledgeable in quantitative methods, left out the most technical aspects of his presentation. However, one year later he published with Hermann in Paris a complete presentation of the “Dutch econometric model” and identified the quantitative effects of a large scope of measures of economic policy. Plainly, it was for the time both a major intellectual and numerical performance: the model used 31 variables and 22 equations; among the latter 16 were behavioural or technical relations which Tinbergen evaluated for the period 1923-1935 [Tinbergen, 1937, pp. 14-15].

The Dutch economist took an early interest in the issue of economic fluctuations, as evidenced in particular by his contribution to *Econometrica* [Tinbergen, 1935]. It is therefore not surprising that the future Nobel laureate was asked in 1936 by the League of Nations to test empirically the business cycle theories as they were to be presented in Haberler (1937). Tinbergen worked two full years on this issue and published the result of his work in 1939 as two volumes entitled *Statistical Testing of Business-Cycle Theories*. The first one contained a methodological part in Chapters 1 and 5 as well as three case studies (investment swings, residual construction and net investment in the railways); the second volume proposed an econometric model of the American economy aimed at assessing the various analyses of the business cycles.

This dynamic macro-economic model, even more than the Dutch model of 1936, was a real achievement: it contained 71 variables, 48 equations and covered the period 1919-1932; moreover it was of a higher empirical interest as Tinbergen was able to express in equations a series of theories expressed in purely verbal terms and to test them later following a three-step procedure. Of course the assessment of these various models depended on the data used (it was not very good) as well as on the specific character of the period under study (the “great depression”). But Tinbergen could not be held responsible for those.

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” [1939, vol. I, p. 15]. 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 R^2 of modern econometricians –, whose value varies from 0 to 1. The closer to unity the correlation coefficient, the better the statistical fit.

The last step in this approach consists of testing the statistical significance of coefficients. From that viewpoint, Tinbergen [1939, vol. I, p. 28] did not refer to the Neyman-Pearson theory but to what he called the “classical method”, the “final formula (of which) was provided by R.A. Fischer”. In practice, the method amounts to applying a *t*-test to each coefficient divided by its standard error. Tinbergen used also another testing method created by Frisch (1934) the method of the *bunch maps*, which has since not been used for a very long time and which we will therefore not comment on here. (The interested reader can check Tinbergen, 1939 vol. I, pp. 29-31, or Valavanis 1959, pp. 146-150 for further information.)

Tinbergen’s work raised different types of comments. Allen (1940), for instance, was a strong supporter but Milton Friedman (1940) was much more critical, although his review of *Statistical Testing* concerned only volume II. The severest review is without doubt Keynes’ (1939). In addition to divergences on the epistemological value of Tinbergen’s work, the author of the *General Theory* raised six points of criticism of the econometric methodology used: the need to determine all “causes”, i.e. all explanatory variables present in a multiple regression; the inability to take into account non measurable qualitative variables; the possibility of connecting explanatory variables, which we would call today multicolinearity; the non-checking of the linearity assumption; the difficulty to correctly determine the number of lags in the assessed equations; the dependence on these estimates on the time coverage.

Tinbergen (1940) replied to the Cambridge economist; however the true reply came later with the development of the econometric theory and practice, which made it possible to solve the – real – problems raised by Keynes. For instance, it is nowadays usual to estimate non-linear equations or models with qualitative variables.

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.

Mises initiated a theoretical representation of the channels of influence of money on the real economy in *The Theory of Money and Credit* (1912); it explains economic disturbances as the effects of money creation on the relative prices structure. He developed this analysis between the wars (see the collection *The Manipulation of Credit and Money* (1978a) and the section of *Money, Method and the Market Process* (1990) on monetary questions (pp. 55-109)) then in successive editions of *Human Action* (1949, 1963, 1966).

Hayek's first economic research was on trade cycle theory in the middle of the 1920s. Following a research trip to the USA (1923-1924), he wrote several articles on the problems of fluctuations in the market economy (1925-1929), the most important of which were translated into English and were published in a 1985 collection, together with later texts, entitled *Money, Capital and Fluctuations, Early Essays*. Hayek's first full length book, in a similar vein, was entitled *Monetary Theory and Trade Cycle* (1928b). He especially developed his ideas during a cycle of four conferences at the London School of Economics, on Lionel Robbins' invitation. They were immediately published under the title *Prices and Production* (1931). This is undoubtedly at the very centre of Hayek's theories – and the most stylistic – on the subject. It unleashed a barrage of arguments from such illustrious figures as Keynes, Sraffa and Hicks; but even today is the work of reference on Austrian cycle analysis.

Prices and Production stressed the issue of agents' success in their expectations, or in other words, coordination of their plans. Hayek thus concentrates his analysis of modes of interaction between the producers/entrepreneurs and the employees in the shape of consumers/savers, studying procedures of finding compatibility and adjustment between the producer/entrepreneurs' plans and the employees' inter-temporal consumer choices. Coordination requires consumers' plans and producers' strategies to be mutually compatible so that the saved part of consumers' incomes will equal the volume of investments generated by firms. Conversely, crisis is described in theoretical terms as the expression of generalized discoordination between, firstly, entrepreneurs' choices in factor allocation for producing consumer and investment goods and secondly, employees' preferences in directing income to consumption or saving.

The theory presents a trilogy between interest rates, relative prices and capital seen as a structural, heterogeneous whole. Money plays a sustained, central role. The distribution of credit initiates the cycle – with an expansion phase – and ends it by producing depression. The creation of liquid assets separates technical processes from subjective choices: it makes the organisation of the production structure incoherent with regard to agents' inter-temporal preferences in terms of orientation of resources.

Sudden adjustments by quantity occurs when credit distribution and its consequence, raised income, dissipates monetary illusion and empowers consumers to once again make their point of view heard when production choices are being made. However, the inevitable move from boom to bust is based on a concept of the rapport between reality and the monetary; it requires the thorough application of a strict timetable.

Hayek does not try to determine a relation between the general price level and an aggregate production level. He studies the consequences of monetary expansion on the distribution of resources between the sectors of investment goods and consumption goods. For him, money enters the real system at specific points, in a sequential way, and has an impact on the structure of production through the interest rate. This relation between capital and interest is one of the characteristics of the Austrian approach. The fall of the monetary interest rate below the natural rate (or equilibrium rate, reflecting the inter-temporal preferences of the wage-earners-consumers) starts the cycle. Considering the strong sensitivity to interest rates of the relatively more capitalised sectors upstream of the production structure, investment there is artificially stimulated ("mal-investment").

The Austrian theory of cycles tells a story of linked distortions; distortion between the equilibrium rate and the monetary rate, distortion of investment within the production structure, distortion of the relative prices between investment goods and consumption goods, distortion between monetary credit supply and real savings supply. But in the development of the Austrian cycle, chronology is of major importance. The dialectics of money and capital, governed by the game of relative prices, is organised around certain time-lines, characterised by the notions of sequence, lag and, above all, rigidity. The expansion of credit leads to time bugging, not only because its produces false information (money illusion) but also by encouraging specific forms of rigidity: rigidity of interest, as during the boom phase the pursuit of monetary expansion prevents the money rate from reaching the rate balance; price rigidity, for if errors are made and it takes time to correct them, this is due to prices not adapting immediately to the subjective data and not performing their informative and predictive function;[2] rigidity of inter-temporal agent-preferences, considered as given and

[2] Hicks noted: "When the market rate is reduced below the natural rate, what will happen to the quantities of inputs and outputs? The correct answer, on these assumptions, is very simple: the effect will be nil. Prices will

constant from the beginning to the end of the cycle. If agents were to change their inter-temporal consumption choices during the period of analysis, the second phase of the cycle, the crisis, would not occur.

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. For Keynes [1936, pp. 313-311], the latter is the main explanatory factor of trade cycles. We should recall here that for a given type of capital good, marginal efficiency is defined as "that rate of discount which would make the present value of the series of annuities given by the returns expected from the capital-asset during its life just equal to its supply price" [Keynes, 1936, p. 135]. The supply price of a capital good could also be called its "replacement cost", i.e. the fair price high enough to incite the manufacturer to produce an additional unit of this good. This price is determined during the current period. This does not apply to expected returns which by definition are calculated by taking the near and distant future into account. The new investment results from a comparison between global marginal efficiency and the actual interest rate; it takes place only if the former is higher than the latter.

One point should be made about the "subject" who calculates the expected efficiency of various types of capital. This subject does not actually exist, according to Keynes; it is in fact the stock exchanges which assess (and re-assess) daily the value of most investments. To use the *General Theory*'s words [1936, p. 151], "certain classes of investment are governed by the average expectation of those who deal on the Stock Exchange as revealed in the price of shares, rather by the genuine expectations of the professional entrepreneur". It should be added that this average expectation relies on a pure convention, the essence of which is to assume that the present state of affairs will continue indefinitely unless there are very good reasons to expect a change. Keynes states that such a conventional assessment basis is "the outcome of the mass psychology of a large number of ignorant individuals". But the essential task of professionals and speculators active on the financial markets is to anticipate modifications of the conventional assessment basis before the general public does.

rise uniformly; and that is that. When the Wicksell model is taken strictly (as it was being taken strictly), it is in Neutral equilibrium … Thus there is no room for a prolonged discrepancy between market rate and natural rate if there is instantaneous adjustment of prices. Money prices will simply rise uniformly; and that is that" (Hicks, 1967, p. 206). [Hicks, 1967, p. 206].

Consequently these markets function in a rather hectic way and with great volatility, as they are subject to unreasonable waves of optimism and pessimism.

All this said, let us turn now to Keynes' explanations of economic cycles and consider the question from the viewpoint of the economic boom's last stages. As is well known, the interest rate is in upward trend as a consequence of an increased demand for money to meet both commercial and speculative needs. This is not, however, the main point: what actually characterises the end of the boom is the traders' expectations and their estimations of the stock market yields being so optimistic that they neglect the increasing production costs and the increasing interest rates which characterise this phase of the cycle. The crisis then coincides with a sudden collapse of the marginal efficiency of capital. It is easy to explain why this reversal has to be large scale and brutal, since financial markets, as noted by Keynes [1936, p. 316], are under the double influence "…of purchasers largely ignorant of what they are buying and of speculators who are more concerned with forecasting the next shift of market sentiment than with a reasonable estimate of the future yield of capital-assets". Uncertainty about the future and the collapse of the marginal efficiency of capital leads to an increase of the preference for liquidity and hence a new rise of the interest rate, which in turn further damages confidence levels. The drop of the interest rate would certainly later constitute a prerequisite to economic recovery during the recession phase but once the crisis has started, the drop in marginal efficiency continues and is sustained.

Time is therefore needed (three to five years according to Keynes) before trust is restored and marginal efficiency of capital recovers, a period during which the decrease in interest rates may – in extreme cases - even prove insufficient to revive an anaemic marginal efficiency. All the more time to recover is needed as the collapse of marginal efficiency has a negative impact on the propensity to consume, through the simultaneous collapse of stock markets and of speculators' income. Demand as a whole falls off.

The recession only really ends when capital marginal efficiency curves upwards once again, a phenomenon objectively linked to the fact that capital has become sufficiently rare; a new cycle can then begin.

It is best left to Keynes to conclude this analysis [1936, p. 320], "…in conditions of *laissez-faire* the avoidance of wide fluctuations in employment may, therefore, prove impossible without a far-reaching change in the psychology of investment markets such as there is no reason to expect. I conclude that the duty of ordering the current volume of investment cannot safely be left in private hands."

… and the Thirty Glorious Years

Keynes' analysis of the cycle was in line with the public works policies of the 1930s, the New Deal etc., all of which were attempts to get out of the Great Depression by stimulating effective global demand. As for Hayek's theory of economic fluctuations, it was much less in line. Lawrence R. Klein's appreciation – a future Nobel Price laureate – clearly explains this difference: [1949, p. 52] "Hayek's description of the economic process just does not fit the facts". It is therefore not surprising that the economists who were studying the cycle turned to Keynes' theory and that Hayek's analyses comparatively disappeared from the public eye for a long while. Moreover, 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 (1939), Hansen (1941) and Hicks (1950).

Harrod [1936, p. 102] considered that the cycle could be explained by the interactions between the Multiplier and the "Relation" (author's capitals). By "Relation", he meant nothing else but the acceleration principle, i.e. the influence of spending or income variations on investments. This principle as such was nothing new as one can date back its origins to Aftalion (1913), or even Marx. It gave rise to numerous discussions after World War I: J.M. Clark, A. Spiethoff, S. Kuznets, A.C. Pigou, W.C. Mitchell, D.H. Robertson are some of the names which come to mind in that respect. What was new with the author of *Trade Cycle*, is on the one hand his really dynamic concept of the effects of acceleration and on the other the study of interconnections between the multiplier and the accelerator: Harrod [1936, p. 70] even claimed that with this study he had "revealed the secret of the trade cycle". It should be noted however that although Harrod really dynamized the acceleration effect, like Keynes he continued to conceive the multiplier as an instantaneous – hence static – relation between investment and income.

Alvin Hansen's book published in 1941 is important not so much on the theoretical level – it does not add much to Harrod's analysis – as on the economic policy level: it is a true manifesto in favour of a Keynesian full employment policy. It is therefore not surprising that Hansen's objective [1941, p. 292] was for instance "to minimize the cycle movement by a system of fluctuating tax rates." Generally speaking, he favoured a budget policy as a means to compensate for the impact on employment of private investment variations, as well as to ensure the boosting of the economy: this is the “pump-priming”.

Samuelson [1939], although he would not acknowledge it, was totally in keeping with the Harrodian analysis[3]. His contribution was twofold: on the one hand he explicitly included governmental expenses in global demand; on the other he developed a dynamic cycle model which can be expressed in three equations:

$$\begin{cases} Y_t = C_t + I_t + G_t \\ C_t = \alpha Y_{t-1} \\ I_t = \beta (C_t - C_{t-1}). \end{cases} \tag{1}$$

The notations are explicit enough; hence we will only specify that I represents exclusively private investment, α the marginal propensity to spend and β the acceleration coefficient.

If we assume that governmental expenditure G is exogenous to the model, we have the difference equation of second order:

$$Y_t = G_0 + \alpha(1+\beta)Y_{t-1} - \alpha\beta Y_{t-2}. \tag{2}$$

The solution to (2) – which remains simple since its coefficients are constant and there are only two lags to take into consideration – depends on the roots of the characteristic equation $x^2 + \alpha(1+\beta)x + \alpha\beta = 0,$ themselves functions of the parameters α and $\beta.$ The set of possible values of α et β is divided into four areas, each of which gives different sample paths for the national revenue[4] : in synthesis, there are cyclical fluctuations (damped, regular or explosive) when the roots of characteristic equation are complex conjugate numbers, i.e. when $\alpha < (4\beta / (1+\beta)^2).$ In other terms, national revenue swings temporally if the marginal propensity to consume is weak and the acceleration coefficient is large or *vice versa*.

Samuelson’s model makes it possible, under specific circumstances, to create fluctuations which differ from real cycles from three points of view: 1) the oscillations of the model are regular only in a very specific case, i.e. when the marginal propensity to spend equals the reversed coefficient of acceleration; 2) as opposed to the observed cycles, these

[3]Samuelson [1939] claimed the merit for the study of multiplier-accelerator interactions was all Hansen’s, who was also his PhD supervisor. A quick reading of Samuelson’s article shows the obvious influence of Harrod, although Samuelson mentioned it not once. For instance he used repeatedly the typically “Harrodian” term “relation” to name the acceleration principle.

[4]For a comprehensive analysis of the model and its solutions, see Chiang et al. [2005, pp. 578 sq].

oscillations are perfectly symmetrical; 3) their magnitude depends on the initial conditions of the model whereas, the magnitude of real cycles varies and should at least be explained. (Samuelson's model was long-lasting ; we should note Selten and Guth's (1982) contribution to it, their originality being to introduce Nash's bargaining solution in the frame of a simple multiplier-accelerator model.)

In 1950 Hicks took up again the issue of the oscillator to which he added his personal touch, so that soon one started talking about the 'Samuelson-Hicks model". However, although Hicks [1950, p. 83] considered the case where the model experienced explosive oscillations, the Oxford economist modified Samuelson's analysis on three major points:

1. He substituted the framework of a « progressive » economy – and hence growth at a constant rate - for that of a stable economy.
2. He introduced a cyclical ceiling in that at each period, the national income could go beyond a certain level defined by full employment of production factors.
3. Finally he introduced also a cyclical floor which limited the downward variations of revenue; the existence of such a floor is plausible since the disinvestment following this drop is at any time necessarily limited by the tempo of throwing out equipment; in other words, the accelerator stops releasing these effects from the moment the floor is reached.

All in all, Hicks provided an overview of economic dynamics which showed that economies experiencing a cyclical growth movement and fluctuations were constrained by the full employment ceiling and the very progressive disuse of capital goods. As such his model is much closer to real life than the simple multiplier-accelerator model.

Samuelson's and Hicks' approaches are based formally on linear equations systems; however, it is possible to introduce nonlinearities in the analysis while keeping the same conceptual framework. One of the first to explore this path was Nicholas Kaldor. In fact, he supposed that the values of the marginal propensity to consume and the accelerator were not stable but varied with the production level. It was therefore possible to generate a cycle endogenously – Kaldor [1940, especially pp. 89-92] – so that the magnitude of the fluctuations would not depend on the initial conditions or random shocks.

The method used by Kaldor was mainly graphic. This was not true of the two other "Keynesian" economists who both constructed a true mathematical model, namely Kalecki and Goodwin.

The former wrote several articles and books – Kalecki [1935a, b, 1943a, 1954] – which developed a model with a remarkably stable nucleus even if it gave rise to different kinds of interpretations. We will focus here on one single interpretation, that given in 1935. We will however modify Kalecki's notations and we will neither take up his assumption that workers' savings were non-existent nor his distinction between capitalists and workers.

Kalecki reasoned within a closed economy, in which the income or product could be split into consumption *C*, investment (net expenditure) *I* and autonomous expenditure *A*. Since *A* is constant and $C = cY,$ income is determined, via the instantaneous multiplier, by:

$$Y(t) = (I(t) + A) / (1 - c). \tag{3}$$

Orders of equipment goods at time *t*, denoted by *B*, generate corresponding deliveries and finally investment outlays $I(t)$, defined net of replacement, after a fixed lag $\theta.$ In mean, we have:

$$I(t) = \frac{1}{\theta} \int_{t-\theta}^{t} B(t)\, dt. \tag{4}$$

denotes $K(t)$ the capital stock. Its derivative with respect to time $K'(t)$ is the rate of deliveries of new capital goods, so that

$$\frac{d}{dt} K(t) = B(t - \theta). \tag{5}$$

By assumption $B(t)$ is positively related to the saving rate and negatively to the current capital stock[5] :

$$B(t) = a(1 - c)Y(t) - kK(t), \quad a, k > 0. \tag{6}$$

The relations (3), (4), (5) and (6) form a system of four equations with four unknowns. : $Y(t), I(t), K(t)$ and $B(t).$ After some substitutions, we obtain a mixed difference-differential equation:

$$\frac{dK(t)}{dt} = \frac{a}{\theta} K(t) - \left(k + \frac{a}{\theta} \right) K(t - \theta). \tag{7}$$

The mathematical treatment of equation (7) has been given by Frisch and Holme [1935]. It yields the following conclusions: the model admits as unique solution a sinusoidal function;

[5]One could insert an additional variable in function (6) which would represent a trend, possibly a variable trend in the long run.

the period of oscillation is several times the length of the lag θ; the oscillations may be regular or damped according to the values of coefficients *a* and *k*.

Goodwin [1951] has developed a model which combines dynamic multiplier and non linear accelerator. As in Kalecki, there is a fixed-time delay θ in the accelerator; then θ is an average lag between investment decisions and outlays, i.e. $I(t) = B(t-\theta)$. The accelerator is defined as a relation between total outlays $B(t)$ and the rate of variation of national product $dY(t)/dt$:

$$B(t) = \varphi\left(dY(t)/dt\right), \tag{8}$$

where $\varphi(.)$ is a non linear function. Furthermore this accelerator is restricted by upper and lower limits, respectively denoted by *U* and *L*.

In fine, the Goodwin model also yields a mixed difference-differential equation; its solution consists of a stable limit-cycle, not of sinusoidal form, depending on the *U* and *L* values.

The future Nobel Prize-winner Maurice Allais [1953, 1955, 1956] also developed a very original non-linear model of the cycle. It differs from Kalecki's or Goodwin's in that it is founded on essentially monetary dynamics. In fact, the whole effort of the French theorician consists of explaining stable cycles' autogeneration on the basis of interactions between preferences for cash, defined as the opposite of the speed of money's circulation, and the quantity of bank money.

The model's fundamental equation is:[6]

$$D(t+T) - D(t) = \frac{1}{T}\left[M(t) - M_D(t)\right], \tag{9}$$

where $D(t)$ represents global expenditure at the instant *t*, *T* is the time lag between revenue and spending, $M(t) - M_D(t)$ is the difference between actual money balances and desired money balances in *t*.

Then it is supposed that the money supply is a positive monotonically increasing function, denoted by *g*, of what Allais called "the psychological expansion rate", noted as $v(t)$:

[6]All the notations used are Allais's (1955).

$$M(t) = g(v(t)). \tag{9}$$

In the same way, the desired reception is by hypothesis in the form:

$$M_D(t) = D(t)\, f(u(t)), \tag{10}$$

where f is a positive monotonically increasing function of $u(t),$ i.e. of the rate of economic expansion. Taking into account (10) and (11), (9) then becomes:

$$T\left[D(t+T) - D(t)\right] = \left[g(v(t)) - D(t)\, f(u(t))\right]. \tag{11}$$

This mixed difference-integral equation is only dependent on $D(t)$ and permits us to determine the path of the global spending (equal to revenue) in time. Its analysis shows that the model may have two types of solution: either converging towards stable or unstable equilibrium, or else towards a limit-cycle, the properties of which must be numerically computed.

In the end, as Allais indicated (1947, 1998, p. 124), “The longer past memory is, the stronger is the tendency to stability and the longer the limit-cycle period.”

The models described above constitute a very diverse set; however, they share, except Allais’, a common spine made of the Keynesian corpus, whether properly understood or not. In its own way each provides evidence that the business cycle theory had become Keynesian.

This Keynesianism was bound to permeate in the end the whole macro-economic field. We have already mentioned above that the author of the *General Theory* was very critical of the pioneering work of Tinbergen. In the 1940s however, Haavelmo (1944) gave a new direction to econometrics by encouraging a “probabilistic revolution”. The word “revolution” was used, among others, by Morgan (1990), because his approach provided a frame, a theoretical (probabilistic and statistical) structure which made it possible to test competing economic theories. It is worth noticing that Haavelmo (1943) defended Tinbergen against Keynes. In fact Haavalmo’s programme was to take shape in the work of the Cowles Commission, in particular in Koopmans’ (1950) and Hood and Koopmans’ (1953) monographs.

Hence, when Lawrence R. Klein prolonged Tinbergen’s work (1939) for the United States, he did it under different conditions characterised by the hegemony of Keynesian macro-economics and the “probabilistic revolution”. His *Economic Fluctuations in the United*

States[7] – Klein [1950] – developed the first Keynesian macro-economic model. It was followed by many others, in particular Klein-Goldberger's (1955) and large-scale ones, such as Brookings'.

However, this type of model did not succeed in endogenously creating an oscillatory behaviour of the economy. As Adelman and Adelman (1959) showed using the example of Klein-Goldberger's system of equations, it is only by introducing random shocks that one could generate cycles, the characteristics of which could be compared to those of the American economy.

Applying Keynesian policies to support economic activity was to prove very efficient, as the period of the Thirty Glorious Years did not experience any significant general recession. Full employment seemed to have become a permanent state of the economy. Moreover, as noted by Hicks (1981, p. 344), the few recessions which occurred in some specific countries, resulted most of the time from "political pressure".

These *post festum* findings were anticipated by Kalecki (1943b) who talked of a "political business cycle" which would substitute the traditional cycle. His main argument is that it is technically impossible for the State to bring the economy to the point of full employment and to maintain it there. Industrial leaders in fact opposed such a level since "their class instinct tells them that lasting full employment is unsound from their point of view". And Kalecki therefore devised the typical political cycle[8]: during recessions, under the pressure of the workers, governments used to increase public investment based on loan in order to avoid mass unemployment. The consequence was economic recovery which led to full employment. Should public authorities use the same "Keynesian" techniques to maintain a high employment level, the pressure and opposition from the business circles would become so strong that they would lead governments to revert to budgetary orthodoxy. As a result, recession would be back and would require new state intervention, etc.

[7]Here is Klein's [1966, p. 227] description of the origin of his *Fluctuations…*: "[…] I was stimulated by J. Marschak to build a Tinbergen type model for the United States economy, just after completing the original version of the *Keynesian Revolution.*"

[8]Later on the meaning of the term "political cycle" evolved and was used for a purely electoral cycle: see for instance Nordhaus [1975].

Long cycles

The almost continuous growth period of the Thirty Glorious Years aroused renewed interest for long cycles of the Kondratieff type (1926). Generally speaking, since the discovery of the Kondratieff cycles for prices and production, at the beginning of the 20th century, the definition and interpretation of economic fluctuations gave rise to numerous statistical and theoretical studies.

Kondratieff long cycles

Long Cycles	Direction of the cycle	Periodicity
I	Expansion Depression	1793/1797-1817/1823 1817/1823-1847/1850
II	Expansion Depression	1847/1850-1869/1873 1869/1873-1894/1897
III	Expansion Depression	1894/1897-1914/1920 1914/1920-1944/1947
IV	Expansion Depression	1944/1947-1968/1973 1968/1973-?

Today all contributions can be typically distributed into two categories according to whether their authors propose exogenous or endogenous causes to explain the economic growth of nations. Among the theories which call on exogenous causes, one should distinguish between monetarist explanations, those which consider that wars play an essential part and those which rest on the movement of agricultural prices. Initially the most numerous, the exogenous explanations are seldom considered nowadays as fundamental causes of long cycles.

By devising a theory of long investment cycles, Kondratieff (see table above) was the first to propose the idea that long cycles stem from the very functioning of the economic system. Increased savings raise the investment opportunities of available capitals and lead to the lasting upwards period. The decrease of savings reduces investment and leads to a decline.

Schumpeter [1939] enriched the scope of interpretation of long cycles by introducing the role of innovations, which were clustered in time and concentrated in some industrial sectors determined regular cycles. In a first step, they tended to attract capital. But the diffusion of innovations to the economy as a whole modified the economic balance and increased the risks of failure of the innovations following. It became then necessary for the economy to assimilate, through the recession process, the progress of the upwards phase, before the system could strive toward equilibrium and allow the implementation of further innovations.

From 1945 to 1970, research on long cycles experienced a certain loss of interest due to the sustained growth of the economies of developed countries and the predominance of Keynesian approaches. Since the economic downturn in the early 1970s, the theses developed by Schumpeter have experienced wide distribution [Kleinknecht, 1987, Mensch, 1977, Freeman, 1996]. From our point of view, the major works in that respect favour the role of investment tempo and innovation. The idea which underlies neo-schumpeterian logic is that the emergence of new products and processes during the long depression phase induces an investment flow connected with the renewal of equipment which in turn leads to the recovery of economic activity. When this renewal ends, the investment flow decreases again which leads to a new depression phase.

If the neo-Schumpeterian analysis provides a first approach of reality, it still ignores the major role played by the social variables in economic dynamics. However, it unfortunately pays no attention to the intermediary cycle, Kuznet's cycle which was supposed to last some 20 years and referred to the cursory but famous dating of the author (1930).

We should also mention the school of the social structure of accumulation. It appeared towards the end of the 1970s, with Gordon's pioneering work, followed by numerous other contributions [Gordon, Weisskopf, Bowles, 1991]. This research work proposes an interpretation of the long cycles of economic activity allocating a major role to the institutional transformations which punctuated contemporary history in the developed capitalist countries. The succession of different social structures of accumulation, following a process of construction and later decline of each of the social structures of accumulation, allows us to interpret the cycles of economic and social activity.

From the decomposition of 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. Joan Robinson was probably right to name this trend "neo-neoclassical", since the marginalists are themselves neo-classics compared to the Ricardian school and its successors. However, such complicated wording is just impossible to use.

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*. To these two names should be added Patinkin [1956], although he played a smaller role. Two other notables, Samuelson and Solow [1960] completed the macro-economic Keynesian model with a Phillips curve. To these, we can add Friedman and his 1964 "plucking model" (see the revised 1993 version). It is an original treatment of the natural output rate. In Friedman's model, output holds steady at a maximum value, ie the full employment value, and is occasionally plucked downward through a negative demand shock. It is an asymmetric alternative to the self-generating symmetric cyclical process often used to explain contractions and subsequent revivals. Friedman likens the path of output to a string attached to the underside of an upward sloping board, to represent the path's feasible ceiling, which is plucked downward at irregular intervals. However, the neo-classical synthesis was strongly questioned at the turn of the 1970s. The reasons are a mixture of increased inflation, the return of recessions and financial accidents, stagflation, a hybrid of a simultaneous increase of the unemployment rate and the inflation rate, the breaking up of the Bretton Woods system, etc. All these factors gave rise to a groundswell against Keynesian macro-economics and to a blossoming of new explanations of the cycle.

Thus the monetarist school opposed Keynesian interventionism; money started to play a predominant role in the analysis of economic fluctuations. Following his theory of permanent revenue, Friedman put forward an explanatory principle of the cycle, which applied to any asset; the specificity of money is its exogenous offer. In case there was an increase in the quantity of money, the agents who tried and maximised their utility adjusted their portfolios between the various assets, thus following the principles of the permanent income theory.

As money creation would have induced an unbalance in agents' assets, money had real effects on the economy because of the agents' will to get back to an optimal patrimonial structure. The analysis of the cycle relied entirely on the disconnection of permanent income and observed income. Hence this monetarist trend questioned the long term arbitration between inflation and unemployment, except if one was to continuously increase the inflation growth rate. Only in the short run are agents sensitive to money illusion. In the long run, monetary stimulus (expansion) entails only a shift of the Phillips curve. The curve is vertical and defines the natural unemployment rate. It is impossible to arbitrate between unemployment and inflation with such a curve.

Friedman's development of this idea was further investigated by the school of rational expectations (*equilibrium business cycles*). Lucas, Sargent and Wallace provided the theoretical foundations of the criticism against the Phillips curve. It was obviously Lucas (1976) who expressed the most severe attack against all current macro-economic models. Lucas criticised the lack of micro-economic foundations in the Keynesian based models. Economic variables resulted from individual choices conditioned by expectations on the future state of the economy. It was essential to take into account the way people constructed these expectations, otherwise it would be impossible to devise any economic policy.

As early as 1973, Lucas devised a model based on imperfect information and rational expectations. The Walrasian paradigm was abandoned; agents were supposed to have an imperfect vision of prices, after all. The starting point of the analysis rested on a big scale economy and decentralised markets. Hence agents took part in micro-markets and had only very imperfect information on the other markets and the price system. Their perception of random shocks could lead them to false interpretations of the price signals and to undertaking actions which would disturb the whole economic system.

Lucas' supply curve defined the product as a decreasing function of the price surprise, i.e. the unexpected rise of the general price level; it was Lucas' criticism of the Phillips curve. As a consequence, non-anticipated inflation could lead an individual to believe that the relative price of his output had increased and therefore be tempted to increase production. The result was a money-based cycle around a long term growth path which characterised an economy at equilibrium. The money supply caused shocks to the system, leading to cyclical fluctuations, here, equilibrium cycles, where the propagation of the cycle can only originate in the agents' optimizing behaviour, in reaction to shock. It was not enough to introduce shocks in the Keynesian system to describe fluctuations: economic movements had to be deducted from the agents' responses to these external impulses. In fact, Lucas' analysis showed how an equilibrium model with decentralised markets and imperfect information could account for the effects of nominal shocks and real shocks on output. As for demand shocks, they had an impact on output only if they were not anticipated.

Although it was favourably received, Lucas' theory proved incapable of explaining the persistence of output gaps (see for instance Modigliani's criticism). Lucas later introduced the costs of capital formation to account for this phenomenon of persistence. But Lucas' position was not sufficiently convincing for the supporters of the theory of cycles at equilibrium, who called on other types of shocks to reproduce persistence in the observed fluctuations, namely technological shocks.

The supporters of this new line of thought, called *Real Business Cycle* (RBC), defined it as the result of an optimal adaptation of the economy to equilibrium. They revived the neo-classical explanation of economic fluctuations. Following Lucas' initial path, they aimed at integrating the concept of cycle into the Walrasian paradigm to express economic phenomena in terms of equilibrium. However they reversed Friedman's and Lucas' monetarist analyses, as they tried and showed that most fluctuations could be explained without introducing a monetary disturbance. These fluctuations were supposed to result from optimal reactions of economic agents to shocks of the total factor productivity (the overall productivity of factors). As these shocks were exogenous and random, the evolution of the cycle had to be of stochastic nature (quasi-cyclical). The economic cycle was in that case an oscillatory motion of the natural output and not the gap to the trend, since the factors which caused it were also at the source of growth. Hence the usual dichotomy between the sources of growth and the sources of fluctuations was not justified as the latter corresponded to the very variations of the natural growth rate, to the variations of productivity.

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.

The RBC founding authors' project is in fact clear to the keen observer; it is to understand the cyclic evolution of the economy. To do this, the model associates a constant scale-of-economies production function with an equation of capital accumulation, added to various constraints. Concretely, the RBC theorists construct a model of calculable equilibrium. They introduce chance shocks so that the product resulting from the model's equilibrium fluctuates, as does GDP in real terms.

Concordance between the simulated fluctuations and those of the real economic variables is tested. Where it is found, the model is considered to represent the economic dynamic with a strong argument: that the cycles are thoroughly exogenous, with productivity variations coming from climate or international events.

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.

… to a plurality of theories

Questioning the neo-classical synthesis led also to a multiplication of non-orthodox trends. From the point of view of the cycle theories, two deserve special attention: the post-Keynesians with Hyman P. Minsky and the neo-Austrians, who continued the analyses of Hayek and von Mises.

Minsky is known today for his "financial instability hypothesis" of capitalism; in the press this was also referred to as 'Minsky moment". His first book *John Maynard Keynes*, Minsky [1975], questioned the neo-classical interpretation of the *General Theory*, which Joan Robinson called "bastard Keynesianism". From then on the author was considered as one of the major figures of the post-Keynesian movement essentially defined as "return to Keynes".

Minsky took an interest in the analysis of the business cycle at an early stage. In one of his first articles on this question, [Minsky, 1957, p. 859], he was already critical that "the authors who have constructed these accelerator-multiplier models have paid little, if any, attention to the monetary prerequisites and effects of the assumed processes." From then on his research programme was all set: he would show how entrepreneurs and bankers motivated by the sole search for profit turned the initially robust financial system into a system subject to repeated financial crises. This programme was developed progressively, in successive steps, to reach the final synthesis to be found in Minsky [1986].

The starting point of the analysis lay with the acknowledgement of two price systems: the first one applied to current output of goods and services and the other to financial assets. These two sets of prices were linked, since on the one hand investment goods were part of the output of the period of reference and on the other hand they had a current price which had to be coherent with their prices as capital assets.

The prices of the goods produced during the on-going period were determined “à la Kalecki”, by applying the mark up of the various costs, in particular the labour factor. Supply prices for the different kinds of investment goods represented a sub-group of these current prices. As for the capital assets, they were determined by supply and demand in specific markets: their supply was fixed during the current period and their demand depended on the expected cash flows during their life time. In the economy under study, there was a set of financial assets which could be considered as capital assets, since they also produced a flow of further liquid assets. For price determination see, for instance, Minsky [1986, pp. 200s].

The fact that there was a price for a capital asset or a financial asset did not automatically entail the actual corresponding investment. This investment needed also to be funded! From this point of view, Minsky distinguished between two essential sources of funding of firms: internal funds, i.e. the profit reserves of these firms on the one hand; external funds on the other hand resulting from bank loans or the emission of bonds or stocks. Loans (as bank loans or bonds) meant payment commitments; hence they corresponded to a cost, similar to paying salaries or buying intermediate goods and this cost had to be taken into account in the supply prices of the different wares. Hence – Minsky [1986, p. 207] – “the decision to invest therefore involves a supply function of investment, which depends upon labour costs and short-term interest rates, a demand function for investment, which is derived from the price of capital assets, and the anticipated structure and conditions of financing.”

Firms’ positions in terms of capital assets were financed by a combination of stock shares and debts. In that respect Minsky distinguished three possible regimes: hedge financing, speculative finance and Ponzi finance[9].

By reference to Minsky [1986, appendix A, pp. 371-379], one could be tempted to formalize these three financial regimes as follows: Denote by C_i the repayments, during

[9]Charles Ponzi was a swindler of Italian origin, living in the United States, who, in 1920, offered an investment with a 50% return within 45 days; actually he did not invest the money he was entrusted with or only a small part of it; he only paid the interests of his earlier customers with the money provided by the newcomers and so on.

period *i*, consequent to the agreements contracted at borrowing; Q_i the anticipated quasi-rents or profit for the same period, resulting from a particular investment and by $\sigma^2_{Q_i}$ the corresponding variance. Hedge financing of a position requires that:

$$C_i < Q_i - \lambda\sigma^2_{Q_i}, \quad \text{for all } i, \tag{12}$$

where λ is such that the subjective probability associated with $Q_i < C_i$ is very small. In other words, the bigger the gap between the left-hand element of (13) and the right-hand one, the wider margin of security for the investor. It follows that any unit in financing by hedging will need enough cash flow from the treasury to repay the whole debt, both principal and interest.

Conversely, if the inequality:

$$C_i > Q_i - \lambda\sigma^2_{Q_i}, \tag{13}$$

holds good for any period near *i*, at least in the short term, the unit in question will not have enough cash flow to be able to reimburse its debts. In that case, two behaviours are possible for the unit considered: either the liquid assets cover only the interest payment and it adopts a speculative finance mode; or it does not even have the capacity to cover the interest payment and it is compelled to call on loans, which Minsky called a "Ponzi finance" mode[10].

In an economy, the heavier the weight of speculative finance and Ponzi finance, the more this economy is bound to be subject to financial crises. From a general point of view, capitalist economies experience an alternation of periods of financial robustness and fragility, according to the prevailing combination of the three types of funding. According to Minsky "serious" recessions occurred during the latter periods (Minsky, 1986, p. 194].

Minsky's proposed explanation of cyclical fluctuations can be summed up as follows. During the periods of financial peace – for instance the period which followed WWII until the American "credit crunch" of 1996 – characterised by an absence of speculative boom as well as by the predominance of hedge funds, the management of global demand and the intervention of central banks are sufficient to avoid very large variations in investment demand. Because of the robustness of financial structures one may be inclined to think that this state will last, which encourages the proliferation of financial innovations and of speculative behaviours. Progressively the financial structures become fragile, accidents increase, speculative and Ponzi behaviours become widespread and so does the debt. Then a

[10]Minsky [1986, p. 377] specified that this type of funding "is not necessarily fraudulent".

period of instability starts, enhanced by the speculative boom of the stock markets. A stock market crisis follows, pulling down in its fall banks and financial institutions. The investment demand collapses and consumption declines following the fall of stock quotes and the need to reduce debts. Recession follows, which might lead to an even deeper slump… as was the case in the 1930s.

Hayek received the Nobel Prize for his theory of economic fluctuations which had been criticised and marginalised for a long time by post-war economic thought. This reward encouraged a number of Austrian authors to pursue his analysis and bring their own contributions, e.g. Rothbard [1975] or Garrison [1986, 1989, 1997, 2001]. The latter's work inspired many contemporary applications of Hayek's perspective. However these developments did not make it possible to remove some ambiguities to be found in the Austrian analysis of economic fluctuations.

The members of the Austrian school were characterised by their focus on ignorance, historical time and the subjectivism of expectations. They favoured qualitative reasoning and condemned the use of quantitativism in economics. Legend has it that Hayek was refused a position at the Chicago economics department because he was hostile to statistics, which caused Knight to veto him (Hayek gave a laconic comment on this event: "I was proposed first to the faculty of economics, but they turned me down", Hayek, in Kreisge [1994, p. 128]). The theory of economic fluctuations is in fact one of the rare incursions of the Austrians into the macro-economic area; its contemporary repercussions raise certain questions.

How can we in fact define the cycle parameters without referring to quantitative macro-economic variables? How can we identify and measure capital, express the relations of substitution and complementarity? Similarly, by which method can the shocks of monetary policy on interest, relative prices and the length of production steps be measured? Finally, how can the gap between the monetary rate and the equilibrium rate be identified and measured, since in theoretical economics this gap is only a theoretical reference which cannot be assessed? As noted by Bismans and Mougeot: "Use of econometrics, a statistical tool, requires some flexibility in pure Austrian theory" [Bismans and Mougeot 2008, p. 83].

Recent empirical applications of the Austrian cycle theory [Keeler 2001; Mulligan 2002, 2006; Cwik 1998; Hugues 1997; etc.] reflect this relaxing which sometimes is hard to reconcile with the original theory. The authors' concern is not so much to identify fluctuations using the Austrian tools, as to examine the relevance of the Hayekian explanation on the basis of stylised facts from other theories.

There is also some ambiguity at the normative level, which brings to mind the origin of the cycle. Are we dealing here with an exogenous or endogenous approach of fluctuations? Following his Nobel Prize, Hayek developed theses [1976 and1978a] which aimed at freeing money from political manipulations. However in *Prices and Production*, he described the general architecture of credit as a pyramid-shaped structure composed of different layers, one of which was internal organisation which was difficult to regulate via direct tools. Even if the quantity of fiduciary money remained stable, it might happen that the other parts of the structure favour an increase of the issue of credit, following mechanisms which the authorities could hardly monitor. The increased supply of money in the widest sense of the term and the development of cycles are not always automatically linked to an expansionist attitude of the central banks.

There is also ambiguity about the status of equilibrium. Hayek [1928b] gave some thoughts very early to the logics of intertemporal equilibriums, so that Lucas saw there an anticipation of his own work. But how can we identify empirically equilibrium from an Austrian point of view since there is no method to guarantee that all known opportunities are exploited? More fundamentally, for the Neo-Austrians (cf. Kirzner 1973, 1979, etc], the ignorance paradigm makes it impossible to consider that all available opportunities are known and exploited. Hence there is always disequilibrium but it is not possible to know either its size or its source. From that point of view, is there really an Austrian epistemology of the cycle? How can one account for growth, or conversely for the crisis, while respecting the Austrian paradigm? The Austrians are theoreticians of disequilibrium and they provided a specific and measurable definition of the improved quality of coordination only in a negative way as the absence of intervention.

The last ambiguity concerns the explanatory or predictive status of the Austrian theory of the business cycle. Most studies elaborated after Hayek's Nobel Prize gave a retrospective view of events. Rothbard (1975) tried an Austrian reading of the 1930s crisis and the monetary phenomena which occurred before. O'Driscoll and Shenoy [1976], Garrison [2001], Cwik [1998] and Hugues [1997] used various indicators at various times and in various countries to test the explanatory capacity of the theory. Powell (2002) adopted the same approach when he applied the Austrian tools to examine the Japanese recession of 1990. Theory and history were jointly called upon to explain specific moments. Should one then give up forecasting? However, in *The Pretence of Knowledge*, a text which corresponded to the speech he gave at the Nobel Prize ceremony, Hayek himself claimed: "I am anxious to repeat, we will still achieve predictions which can be falsified and which therefore are of empirical significance" [Hayek 1974, p. 33]. But things are not as clear cut; in the same text, Hayek condemned empirical facts and specified that "because we (…) cannot know at which particular structure of prices and wages demand would everywhere equal supply, we also cannot measure the deviations from that order; nor can we statistically test our theory that it is the deviations from that 'equilibrium' system of prices and wages which make it impossible to sell some of the products and services at the prices at which they are offered" [ibid., p. 27].

… and a renewal of econometric approaches of the cycle

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. Formally, if y_t is the observed value in *t* of the *y* series, then an ARMA (*p*,*q*) model will be represented by:

$$y_t - \phi_1 y_{t-1} - \cdots - \phi_p y_{t-p} = \varepsilon_t - \theta_1 \varepsilon_{t-1} - \cdots - \theta_q \varepsilon_{t-q}, \tag{14}$$

where (ε_t) is a series of random disturbances, distributed identically and independently. The left-hand member of (15) is the autoregressive part of the model and the right-hand member is its moving average part. It is immediately obvious what separates such essentially atheoritical models from simultaneous equation systems, characteristic of the Cowles Commission approach.

Nelson [1972], using Box-Jenkins' methodology, showed for the period 1956-1966 that the forecast developed with univariate models of the AR(I)MA class most of the time outclassed those resulting from the "big" FMP model (FMP is the abbreviated name of the macro-econometric model devised by the Federal Reserve, MIT and the University of Pennsylvania).

The Box-Jenkins root gave birth to Time Series econometrics which brought about a new way of looking at business cycles. The conference sponsored by the Federal Reserve Bank which took place in Minneapolis in 1975 and the proceedings of which were published two years later was quite representative of this tendency. Christopher Sims [1977, p. 1], who edited the proceedings, declared straight away that[11] "the methods now used for most quantitative macroeconomic policy analysis are fundamentally deficient." In addition to this, the author specified that there were two main ways both out of the pitfalls of macro-econometric deficiencies and to identify the cycle models correctly: 1. To use more elaborate statistical methods to take into account the dynamic dimension of these models, a dimension which was largely ignored by the "static" economic theory; 2. To pay much more attention to the logic of optimal behaviour under uncertainty and hence not to exclude "any variable in the system from the equation on the basis of *a priori* theory, because all variables in the system will in general affect expectations."

Sims sided of course with the second approach, which induced him to suggest the use of "vector auto-regressions" (VAR) which was nothing but a multidimensional generalisation of autoregressive models (cf. Sims [1980a]. In fact their shape came down to a system of dynamic equations:

$$\mathbf{y}_t = \mathbf{A}_1\mathbf{y}_{t-1} + \cdots + \mathbf{A}_p\mathbf{y}_{t-p} + \mathbf{u}_t, \tag{15}$$

where $\mathbf{y}_t = (y_{1t}, \cdots, y_{Kt})$, the $\mathbf{A}_i, i = 1, \cdots, p,$ are $K \times K$ matrices of coefficients and $\mathbf{u}_t = (u_{1t}, \cdots, u_{Kt})$ is a white noise vector or innovations of average $\mathbf{0}$ and of variance-covariance matrix $\mathbf{\Omega}_u$. By Wold's theorem, any VAR model – stationary, we will come back to this later – allows an infinite moving average representation:

$$\mathbf{y}_t = \sum_{j=0}^{+\infty} \Theta_j \mathbf{u}_{t-j}. \tag{16}$$

In this case, if we interpret innovations as shocks to endogenous variables, they are propagated dynamically throughout the system. The effect of shock $\mathbf{u}_t$ on the vector $\mathbf{y}_{t+s}$, $s > 0$ is then given by the matrix of general element:

$$\theta_{ij,t+s} = \frac{\partial y_{i,t+s}}{\partial u_{jt}}. \tag{17}$$

We can directly interpret (18) as follows: the multiplier θ_{ij} measures the response of the *i*-th endogenous variable to an impulse, a shock in *j* happening *s* periods previously. From these multipliers we obtain what are called impulse response functions.

[11]Sims hid cautiously behind the opinion of "economists who were experiencing new statistical methods".

Thus is the type of model Sims [1980b] used to compare the American (and also the German) cycle between and after the wars.

One can see, however, where the rub is in modelling: a VAR is by principle atheoretical. Hence, as Cooley and Le Roy [1985] noted, the tool was incapable of testing theories (of the cycle, for instance) but also of analysing the impact of economic policy measures. Another criticism, of a statistical type, cannot be discarded: the construction of response functions and the estimation of parameters of the model by least squares rely on the assumption of time series stationarity.[12]

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. Nelson and Plosser's seminal article (1981) 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 denoted as $y_t = y_{t-1} + \varepsilon_t$, where ε_t is a white noise, i.e. a stationary process. It was then possible to oppose the two classes of processes as follows:

$$\begin{cases} y_t = \alpha + \beta t + \varepsilon_t \\ y_t = y_{t-1} + \varepsilon_t . \end{cases} \tag{18}$$

Obviously in order to stationarise the first process in (19), one should simply deduct the straight line $\alpha + \beta t$ de y_t. This is the reason why Nelson and Plosser [1982, p. 141] called such processes *trend-stationary* (TS). On the other hand, differencing the random walk yields $\Delta y_t = y_t - y_{t-1} = \varepsilon_t$. As ε_t is stationary, so is Δy_t. Consequently, such a process can be made stationary by simple; it is then called DS (*difference stationary*). The distinction is important: if the process is TS, the cycle is represented by a set of transitory and regular fluctuations of the growth path around the deterministic tendency; on the other hand if a process is DS, the underlying tendency is stochastic, which implies that shocks have a permanent impact on the series, which will not come back to its original trajectory.

[12]Intuitively a series is stationary (of the second order) if the mean and the variance are constant and if the autocovariances do not depend on time.

The problem then comes down to testing the null hypothesis of a DS process as opposed to the alternative hypothesis of a TS process. Unit root tests developed first by Fuller (1976) and Dickey-Fuller (1979, 1981) are used to that end. Nelson and Plosser reached the conclusion that of the 14 macro-economic series they studied, all but one, the unemployment rate, have unit roots and consequently are affected lastingly by shocks of a permanent character.

On the basis of this analysis, many research works - Beveridge and Nelson [1981], Campbell and Mankiw [1987], Perron [1988], Harvey [1989], etc. – developed new extraction methods of the business cycle. A note of caution is needed here: several of these studies, including Perron (1989), Zivot and Andrews [1993], Lumsdaine and Papell [1997], based on the existence of structural breaks in Nelson and Plosser's (1982) series, had to relativise and qualify the results obtained by the latter: for instance Plosser (1989) counted only three series with unit roots, Lumsdaine and Papell [1997] eight, etc. The debate on that issue is far from being closed.

What is the business cycle?

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".

This complex, very balanced wording contains three essential elements to define recessions and also expansion phases: 1) the decline of economic activity must be sufficiently marked; 2) it must have an impact on many sectors of the economy at stake; and 3) the contraction must last long enough, even if its duration is much shorter than the expansion phases and there is asymmetry between expansions and contractions.

However, the problem is to be able to transcribe this definition into reality, and in particular to identify the one or several series which provide for a measure of aggregate economic activity and then for identifying their turning points. For Burns and Mitchell [1946, p. 72], "aggregate activity can be given a definite meaning and made conceptually measurable by identifying it with gross national product at current prices". However the two authors specified immediately – in 1946 – that this series frequency was neither monthly nor quarterly; consequently they suggested using a set of replacement series which could be used to determine the aggregate reference cycle, essentially through graphic methods, i.e. by observing clusters of turning points.

This type of approach raised two main criticisms: on the one hand the cycle was one component which had to be extracted from the reference series and not the chronicle as such; on the other hand the graphic analysis of Burns and Mitchell was exclusively empirical and did not rely on techniques of statistical inference.

The latter criticism was to be found mainly in the trend which tried to construct "coincident indicators" of the economic cycle on a probabilistic basis. The pioneering article in that area is Stock and Watson's (1991); the approach was generalised by Forni *et al.* (2000) with their general dynamic factor model.

The other criticism of Burns and Mitchell's approach came from all those who were trying to isolate the cyclical component in the series, using many, many methods. We are dealing here, however, with nothing more than updated versions of statistical decomposition methods of chronicles, launched, as we saw above, by Persons. They go from the determination of the "phase average trend", disseminated by the researchers of the American NBER [cf. Boschan et Ebanks, 1978] to the use of multiple filters developed during the previous twenty years.

The approach common to most of these methods consists of firstly removing the trend from the series under study then isolating the cycle. Here we have left out the issue of seasonality. There are three main methods to remove the trend:

1) estimating a linear and deterministic trend and then deducting it from the series

2) differentiating the series to eliminate the stochastic trend

3) applying the Hodrick-Prescott (1997) filter

The first two methods which, following DeJong (2007), we call respectively detrending and differencing, are based on the implicit assumption that the series under study, y_t, grows at an approximately constant rate. If we take the logarithm of the series in question, the temporal variations of $\ln y_t$ are equivalent to the growth rate of y_t. Indeed: $\partial \ln y_t / \partial t = (\partial y_t / \partial t) / y_t = \dot{y}_t / y_t = g_y$.

The "detrending" process supposes that the series has a *deterministic* trend, thus obeying a process which generates data in the form of:

$$y_t = y_0(1+g_y)^t e^{u_t}, \tag{16}$$

where u_t is a second-order stationary stochastic process. In logarithms, (16) becomes:

$$\ln y_t = \ln y_0 + t\ln(1+g_y) + u_t = \ln y_0 + g_y t + u_t, \tag{19}$$

as $\ln(1+g_y)$ can be approximated by g_y. It is easy to estimate g_y in (17) by ordinary least squares, then simply subtracting this trend from $\ln y_t$. The series is then said to be trend stationary.

In comparison, the differentiation method supposes that y_t has a stochastic trend and that the process generating y_t is given by:

$$\begin{aligned} y_t &= y_0 e^{\varepsilon_t}, \\ \varepsilon_t &= \delta + \varepsilon_{t-1} + u_t, \end{aligned} \tag{20}$$

where u_t is once again a second-order stationary stochastic process. By taking the logarithms, (21) becomes:

$$\ln y_t = \ln y_0 + \varepsilon_t. \tag{21}$$

The first difference of $\ln y_t$ in (22), taking into account (18) is given by:

$$\ln y_t - \ln y_{t-1} = \varepsilon_t - \varepsilon_{t-1} = \delta + u_t. \tag{22}$$

As we have already mentioned, the $\ln y_t$ series is then said to be *difference stationary*. The δ estimator is equal to the average of $\ln y_t - \ln y_{t-1}$, which you then simply need to subtract from (20).

The choice between these two procedures occurs exclusively according to the decision whether the generating process is given by (20) or by (23). It is a difficult choice to make, since, as we have seen, the controversy initiated by Nelson and Plosser (1982) on the existence of a unit root is not quit conclusive.

The third approach to remove the trend of a series is Hodrick-Prescott's. It starts with the decomposition of $\ln y_t$ in the form:

$$\ln y_t = g_t + c_t, \tag{23}$$

where g_t is the growth component in $\ln y_t$ and c_t its cyclic component. The following step consists to estimate the values of c_t and g_t in minimising:

$$\sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T} \left(g_t - 2g_{t-1} + g_{t-2} \right)^2, \tag{24}$$

λ being a given parameter (generally taken as equal to 1600 for quarterly series).

Suppressing the trend leads in the end to:

$$\ln y_t - \hat{g}_t = \hat{c}_t. \tag{25}$$

In addition to these three techniques, there are filters called "band-pass filters" which do not require to remove first the trend of a series in order to extract the cyclical component; the general principle of these filters – Baxter-King [1999] et Christiano-Fitzgerald [2003] – is to eliminate all the cycles located outside a defined frequency spectrum (between 6 and 40 semesters). By proceeding in such a way, one would obtain an "optimal" filter; however in practice one can only get an approximation.

In the end there are as many different cycles as there are filters and even more, if one varies the specific parameters of each of these filters. This is the main criticism which can be addressed to this type of approach. One could add that it leads to fallacious fluctuations: see on that point Cogley (2006). Furthermore, when the aim is to identify the cycle, one always comes back to Burns and Mitchell's definition.

Measuring and dating the business cycle

We close this synthesis with a major issue, i.e. the problem of dating the economic cycle. The National Bureau of Economic Research (NBER) played a major role in that respect by drawing up an official monthly chronology of the American cycle implemented by its Business Cycle Dating Committee, composed of seven specialists in economic fluctuation analysis. Their role is to identify the economic peaks and troughs that constitute the turning points in economic activity, in this case the periods of expansion and contraction. The chronology they were able to draw up on this basis – cf. NBER (2009) - goes back to 1854; the latest recession started in December 2007 and was announced by the Committee one year later on 11 December 2008. Ferrara (2009) contains a synthesis of similar attempts to date the cycle of the Euro zone.

The methodology used by the NBER relies on the analysis of eight economic series, namely, GDP, unemployment rate, industrial output, etc. However, it is not possible to see the specific weight allocated to each of these series by the Dating Committee releases, nor which decisional procedure is used, except that they are consensual. Moreover, as indicated by Romer (1994, p. 574), a former member of the Dating Committee, the methods evolved over time, in particular because the cyclical profile of the economy before 1927 was based on detrended data, which was not the case later. All in all, one is forced to the conclusion that the NBER dating process was largely subjective.

In order to make the method more objective, several competing approaches arose. They can be gathered into four big categories: univariate procedures to detect the turning points, either automated or based on a parametric model; multivariate procedures, either automated or model-based.

Computing the peaks and troughs of a time series to determine the cycle is an old game which dates back to the pioneering work of Bry-Boschan (1971). A complete description of the method used and its programming (in fortran) was given by the two authors: see in particular Bry-Boschan [1971, pp. 19-29]. Here is a simplified version:

Let y_t be a monthly series. If it is a continuous function, its peaks (and its troughs) are local maximums (minimums) of this function. To transpose this criterion to y_t, in fact discrete in economics, we introduce the indicator function $\mathbf{1}_A$ which has a value of 1 with event A and a value of 0 without it. If P_t *et* C_t are binary variables equal to the unit respectively when a peak and a trough are reached and equal to zero in all other cases, then:

$$P_t = \mathbf{1}_{\{y_t > y_{t\pm j},\ j=1,\cdots,k\}} \tag{26}$$

$$C_t = \mathbf{1}_{\{y_t < y_{t\pm j},\ j=1,\cdots,k\}} \tag{27}$$

Bry-Boschan's (BB) algorithm goes through three stages:

1. Smoothing the series using a rolling average over a 12 month period and determining a number of turning points with (24) and (25) and $k = 5$.

2. Eliminate the return points which do not represent a complete cycle (from peak to peak or from trough to trough) of at least 15 months.
3. Make sure that the peaks and troughs alternate by removing successive repeats (e.g.: if two peaks follow each other, only use the one of higher value).

The computer programme used by Bry-Boschan gave way to much faster algorithms, such as James Engel's (written in MATLAB and in GAUSS, available at www.ncer.edu.au). Harding et Pagan [2002] devised a quarterly version (called BBQ) which can be applied to the quarterly GDP series; it is essentially the same except that there is no preliminary smoothing of the series, that *k* is taken equal to two quarters, and a complete cycle has to cover at least five quarters.

The algorithm which has just been described is independent of any model. However, following Hamilton (1989) one can express the hypothesis that the trajectory of y_t is governed by a Markov regime-switching model. More concretely let us assume that y_t can be modelled by an AR(1) process:

$$y_t = c_{s_t} + \phi y_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim IID(0, \sigma^2), \tag{28}$$

where s_t is a non-observed (latent) random variable, with a value of 1 or 2 depending on whether the economy is expanding or contracting.

How do we get from $s_t = 1$ to $s_t = 2$ and vice-versa? The simplest probabilistic specification is to suppose that the trajectory of s_t is governed by a first order Markov chain with two states so that the transition probability from state *i* to state *j* is:

$$P(s_t = j \mid s_{t-1} = i) = p_{ij}, \quad i, j = 1, 2. \tag{29}$$

Because there are only two regimes, the corresponding matrix of transition probabilities is written thus:

$$\mathbf{M} = \begin{pmatrix} p_{11} & 1 - p_{11} \\ 1 - p_{22} & p_{22} \end{pmatrix}.$$

The next stage requires the estimation of the vector of the parameters: $\boldsymbol{\theta} = (c_1, c_2, \phi, p_{11}, p_{22}, \sigma^2)$, which most frequently is achieved by maximum likelihood. When this is done, the cycle in question is associated to a binary variable ξ_t, which takes a value of

1 during expansions and 0 during contractions. To construct ξ_t, one needs to adopt a rule comparing the probability of being in expansion with a critical value (equal to 0.5 in Hamilton). So, if $P\left(s_t = 1 | \Omega_k = \{y_k\}_{k=1}^{t}\right) \geq 0,5$, ξ_t is positioned equal to one and the economy is expanding; it retracts when this probability is inferior to ½.

The model can be made more complex if we envisage more than two regimes, or even by making the transition probabilities dependent on the length of expansion and contraction phases. The essence of the method would still be expressed by the model (26)-(27).

Now let us consider a column vector $\mathbf{y}_t$ which consists of *n* time series, meant to represent global economic activity. Automating the selection procedure of the turning points common to these series requires leaving the subjectivity of the NBER's choices. To this end, Pagan and Harding (2006a; 2006b, p. 75 et sq.) have perfected a non-parametric algorithm of extraction from the common cycle. Without going into too many details, we can say that the heart of the procedure comes from the evaluation of a characteristic of proximity for the clusters of turning points. The algorithm, although calibrated on Australian data, is able to closely reproduce the dating of the reference cycle by the NBER.

Alternatively, many authors base themselves on a model to determine a given cycle with the series $y_{jt},\ j = 1, \cdots, n.$ The process used is easily expressed, it simply uses the representation:

$$\Delta y_{jt} = \alpha_j \Delta f_t + \varepsilon_{jt}, \tag{30}$$

where f_t is a common component to the whole series – it can be similar to a index of coincident indicators – and ε_{jt} is a random term specific to each *j* series. Of course, several hypotheses can be constructed on Δf_t and ε_{jt}, which would result in as many different models. Stock and Watson's (1991), quoted above, is one example. Forni et al (2001) are based on a generalised dynamic factor model (GDFM) to construct a synthetic coincident indicator for the Eurozone. Chauvet (1998), on the other hand, combines a GDFM with a Markovian regime-switching model, which results in a chronology of the American cycle very similar to the NBER's.

***

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.

Bibliography

Adelman, I., Adelman, F.L. [1959], « The Dynamic Properties of the Klein-Goldberger Model », *Econometrica*, 27, pp. 596-625.

Aftalion, A. [1913], *Les crises générales et périodiques de surproduction,* 2 vols, M. Rivière et Cie, Paris.

Allais, M. [1953], « Illustration de la Théorie des Cycles Economiques par des Modèles Monétaires non linéaires », *Econometrica*, 20, pp. 116-120.

Allais, M. [1955], « Explication des Cycles Economiques par un Modèle Linéaire à Régulation Retardée », *Metroeconomica*, 8, pp. 4-83.

Allais, M. [1956], "Explication des cycles économiques par un modèle non linéaire à Régulation retardée", in *Les Modèles Dynamiques en Econométrie,* CNRS, vol. 62, Paris, 1956, pp. 259-308.

Allais, M. [1947, 1998], *Economie et Intérêt*, second edition, Clément Juglar, Paris, 1998.

Allen, R.G.D. [1940], « Review of Jan Tinbergen, *Statistical Testing of Business Cycle Theories,* Vols I and II », *Economica,* 7, pp. 335-339.

Bairoch, P. [1997], *Victoires et déboires. Histoire économique et sociale du monde du XVI siècle à nos jours*, Gallimard, Paris, tome 2.

Baxter, M., King R.G. [1999], « Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series », *Review of Economics and Statistics,* 85, pp. 575-593.

Beveridge, S., Nelson, C. [1981], « A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the Business Cycle », *Journal of Monetary Economics,* 7, pp. 151-174.

Bismans, F., Mougeot, C. [2008], « La théorie autrichienne du cycle économique : un test économétrique », *Revue française d'économie*, 22, pp. 73- 102.

Boschan, C., Ebanks, W.W. [1978], « The Phase-average Trend: A New Way of Measuring Growth », in American Statistical Association, *Proceedings of the Business and Economic Statistics Section*, pp. 332-335.

Bouniatian, M. [1935], *Dépression, progrès technique et dévaluation*, Librairie générale de droit et de jurisprudence, Paris.

Box, G.E.P., Jenkins, G.M. [1970], *Time Series Analysis, Forecasting and Control*, Holden Day, San Francisco.

Bry, G., Boschan, C. [1971], *Cyclical Analysis of Time Series*: *Selected Procedures and Computer Programs*, NBER, New York.

Burns, A., Mitchell, W. [1946], *Measuring Business Cycles,* NBER, New York.

Campbell, J.Y., Mankiw, N.G. [1987], « Permanent and Transitory Components in Macroeconomic Fluctuations », *American Economic Review*, 77, pp. 111-117.

Cassel, G. [1927], *Theoretische Sozialökonomie*, A. Deichertsche Verlagsbuchhandlung, Leipzig.

Chauvet, M. [1998], « An Econometric Characterization of Business Cycle Dynamics with Factor Structure and Markov Switching », *International Economic Review*, 39, pp. 969-996.

Chiang, A.C., Wainwright, K. [2005], *Fundamental Methods of Mathematical Economics*, Mc Graw-Hill, New York, fourth edition.

Christiano, L., Fitzgerald, T. [2003], « The Band Pass Filter », *International Economic Review*, 44, pp. 435-465.

Cogley, T. [2006], « Data Filters », article écrit pour le *New Palgrave Dictionary of Economics*, 10 pages.

Cooley, T.F., Le Roy, S.F. [1985], « Atheoretical Macroeconomics », *Journal of Monetary Economics*, 16, pp. 283-308.

Cwik, P. [1998], « The Recession of 1990: A Comment », *The Quarterly Journal of Austrian Economics*, 1, pp. 85-88.

DeJong, D.N., with Dave, C. [2007], *Structural Macroeconometrics*, Princeton University Press, Princeton-Oxford.

Dickey, D., Fuller, W. [1979], « Distribution of the Estimators for Autoregressive Time Series with a Unit Root », *Journal of the American Statistical Association*, 74, pp. 427-431.

Dickey, D., Fuller, W. [1981], « Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root », *Econometrica*, 49, pp. 1057-1072.

Diebold, X., Rudebusch, G.D. [2001], « Five Questions about Business Cycles », *Economic Review*, Federal Reserve Bank of San Francisco, pp. 1-15.

Domar, E. [1946], « Capital Expansion, Rate of Growth and Employment », *Econometrica*, 14, pp. 65-77.

Dupriez, L. [1947], *Des mouvements économiques généraux*, 2 vols, Nauwelaerts, Louvain.

Ferrara, L. [2009], « Caractérisation et datation des cycles économiques en zone euro », *Revue économique*, 60, pp. 703-712.

Fisher, I. [1930], *The Theory of Interest. As Determined by Impatience to Spend Income and Opportunity to Invest It*, Macmillan & Co., New York.

Forni, M., Hallin, M., Lippi, M., Reichlin, L. [2000], « The Generalized Dynamic-Factor Model : Identification and Estimation », *Review of Economics and Statistics*, 82, pp. 540-554.

Forni, M., Hallin, M., Lippi, M., Reichlin, L. [2001], « Coincident and Leading Indicators for the Euro Area », *Economic Journal*, 111, pp. C62-C85.

Freeman, C. (ed.). [1996], *Long Wave Theory*, E. Elgar, Cheltenham.

Friedman, M. [1940], « Review of Jan Tinbergen, *Statistical Testing of Business Cycle Theories*, Vol. II: *Business Cycles in the United States of America, 1919-1932* », *American Economic Review*, 30, pp. 450-54.

Friedman, M. [1968], « The Role of Monetary Policy », *American Economic Review*, 58, pp. 1-17.

Friedman, M. [1993], « The ‘Plucking Model’ of Business Fluctuations Revisited », *Economic Inquiry*, 31, pp. 171-177.

Frisch, R. [1933], « Propagation Problems and Impulse Problems in Dynamic Economics », in Koch, K. [Ed.], *Economic Essays in Honour of Gustav Cassel*, Allen & Unwin, London, pp. 171-205.

Frisch, R. [1934], *Statistical Confluence Analysis by Means of Complete Regression Systems*, Universitetets Ökonomiske Institutt, Publ. n° 5, Oslo.

Frisch, R., Holme, H. [1935], « The Characteristic Solutions of Mixed Difference and Differential Equation », *Econometrica*, 3, pp. 225-239.

Fuller, W.A. [1976], *Introduction to Statistical Time Series*, Wiley, New York.

Garrison, R. W. [1986], « Hayekian Trade Cycle Theory: A Reappraisal », *Cato Journal*, 6, pp. 437- 459.

Garrison, R.W. [1989], « The Austrian Theory of the Business Cycle in the Light of Modern Macroeconomics », *The Review of Austrian Economics*, 2, pp. 3-29.

Garrison, R.W. [1996], « Central Banking, Free Banking and Financial Crises », *The Review of Austrian Economics*, 9, pp. 109-127.

Garrison, R. W. [1997], «Austrian Theory of Business Cycles», in GLASNER D. (ed), *Business Cycles and Depressions: An Encyclopaedia*, Garland Publishing, INC, New York and Mondon, pp. 23-27.

Garrison, R. W. [2001] *Time and Money. The Macroeconomics of Capital Structure*, Routledge, London-New York.

Goodwin, R.M. [1951], « The Non-linear Accelerator and the Persistence of Business Cycles », *Econometrica*, 19, pp. 1-17.

Goodwin, R.M. [1967], « A Growth Cycle », in Feinstein, C.H. [ed], *Capitalism and Economic Growth*, Cambridge University Press, Cambridge, pp. 54-58. Edition augmentée et revue in Hunt, E.K., Schwartz, J.G. [Eds.], *A Critique of Economic Theory. Selected Readings*, Penguin, Harmondsworth, 1972, pp. 442-449.

Gordon, D., Weisskopf, T., Bowles, S. [1983], « Long Swings and the Nonreproductive Cycle », *American Economic Review*, 73, pp. 152-157.

Granger, C., Newbold, P. [1974], « Spurious Regressions in Econometrics », *Journal of Econometrics*, 2, pp. 111-120.

Haberler, G. [1937], *Prosperity and Depression*, League of Nations, Geneva.

Hamilton, J.D. [1989], « A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle », *Econometrica*, 57, pp. 357-384.

Hansen, A.H. [1941], *Fiscal Policy and Business Cycles*, W.W. Norton & Company, New York.

Harding, D., Pagan, A. [2002], « Dissecting the Cycle: A Methodological Investigation », *Journal of Monetary Economics*, 49, pp. 365-381.

Harding, D., Pagan, A. [2006a], « Measurement of Business Cycles », *Research Paper*, University of Melbourne, 966, 12 pages.

Harding, D., Pagan, A. [2006b], « Synchronisation of Cycles », *Journal of Econometrics*, 132, pp. 59-79.

Harrod, R.F. [1936], *The Trade Cycle. An Essay*, Reprints of Economic Classics, Augustus M. Kelley, New York, 1965

Harrod, R. [1939], « An Essay in Dynamic Theory », *Economic Journal*, 49, pp. 14-33.

Harvey, A. [1989], *Forecasting. Structural Time Series Models and the Kalman Filter*, Cambridge University Press, Cambridge.

Haavelmo, T. [1943], « Statistical Testing of Business-Cycle Theories », *Review of Economic Statistics*, 25, pp. 13-18.

Haavelmo, T. [1944], « The Probability Approach in Econometrics », supplement à *Econometrica*, 12.

Hayek, F. A. [1928a], *Monetary Theory and the Trade Cycle*, Jonathan Cape, London.

Hayek, F. A. [1928b], «Equilibre intertemporel de prix et mouvements de valeur de la monnaie», *Revue française d'économie*, 6, 1992, pp. 105-149.

Hayek, F. A. [1931], *Prices and Production*, London, UK : George Routledge and Sons Ltd.

Hayek, F. A. [1974], «The Pretence of Knowledge», in HAYEK F. A. [1978b], *New Studies in Philosophy, Politics, Economics and the History of Ideas*, Routledge and Kegan, London, pp. 23- 34.

Hayek, F. A. [1976], *Denationalisation of Money, An Analysis of the Theory and Practice of Concurrent Currencies*, the Institute of Economic Affairs, London.

Hayek, F. A. [1978a], *Denationalisation of Money - The Argument Refined. An Analysis of the Theory and Practice of Concurrent Currencies*, the Institute of Economic Affairs, Hobart Special Paper 70, London.

Hayek, F. A. [1978b], *New Studies in Philosophy, Politics, Economics and the History of Ideas*, Routledge and Kegan, London, pp. 23- 34.

Hayek, F. A. [1984], *Money, Capital and Fluctuations, Early Essays*, Routledge and Kegan, London-Melbourne-Henley.

Hicks, J. [1937], « Mr Keynes and the "Classics": A Suggested Interpretation », *Econometrica*, 5, pp. 147-159.

Hicks, J. [1939], *Value and Capital. An Inquiry into Some Fundamental Principles of Economic Theory*, second Edition, Clarendon Press, Oxford, 1946.

Hicks, J. [1950], *A contribution to the Theory of the Trade Cycle*, At the Clarendon Press, Oxford.

Hicks, J. R. [1967], «The Hayek Story», *Critical Essays in Monetary Theory*, Oxford University Press, Oxford, 1972, pp. 203-215.

Hicks, J. [1981], « Are there Economic Cycles? », in Hicks, J. [1982], *Collected Essays on Economic Theory*, vol. II, *Money, Interest and Wages*, Harvard University Press, Cambridge [Ma], 1982.

Hicks, J. [1989], *A Market Theory of Money*, At the Clarendon Press, Oxford.

Hodrick, R., Prescott, E. [1997], « Post-War U.S. Business Cycles: An Empirical Investigation », *Journal of Money, Credit and Banking*, 29, pp 1-16.

Hood, W.C., Koopmans, T.C. [eds] [1953], Studies in Econometric Methods, Cowles Commission Monograph 14, Wiley, New York.

Hughes, A.M. [1997], «The Recession of 1990: An Austrian Explanation», dans *The Review of Austrian Economics*, 10, pp. 23-40.

Jevons, W.S. [1884], *Investigations in Currency and Finance*, Macmillan and co, London.

Juglar, C. [1862], *Des crises commerciales et de leur retour périodique en France, en Angleterre et aux Etats-Unis*, Guillaumin et Cie, Paris.

Kaldor, N. [1940], « A Model of the Trade Cycle », *Economic Journal*, 50, 1940, pp. 78-92.

Kaldor, N. [1957], « A Model of Economic Growth », *Economic Journal*, 67, pp. 89-106.

Kalecki, M. [1935a], « A Macrodynamic Theory of Business Cycles », *Econometrica*, 3, pp. 327-344.

Kalecki, M. [1935b], « Essai d'une théorie du mouvement cyclique des affaires », *Revue d'économie politique*, 49ème année, pp. 285-305.

Kalecki, M. [1943a], *Studies in Economic Dynamics*, Allen & Unwin, London, reproduit in *Collected Works of Michal Kalecki*, vol. II, Clarendom Press, Oxford, 1991.

Kalecki, M. [1943b], « Political Aspects of Full Employment », *Political Quarterly*, 14[4], pp. 322-331, reproduit in *Collected Works of Michal Kalecki*, vol. I, Clarendom Press, Oxford, 1990, pp. 347-356.

Kalecki, M. [1954], *Theory of Economic Dynamics* : *An Essay on Cyclical and Long-run Changes in Capitalist Economy*, Allen & Unwin, London, reproduit in *Collected Works of Michal Kalecki*, vol. II, Clarendom Press, Oxford, 1991.

Keeler, J.P [2001], «Empirical Evidence on the Austrian Business Cycle Theory» *The Review of Austrian Economics*, 14, pp. 331-351.

Keynes, J. [1936], *The General Theory of Employment, Interest, and Money*, Harvest/Harcourt, New York, 1991.

Keynes, J.M. [1939], « Professor Tinbergen's Method », *Economic Journal*, 49, pp. 558-568.

Kirzner, I. [1973], *Competition and Entrepreneurship*, University of Chicago Press, Chicago.

Kirzner, I [1979], *Perception, Opportunity and Profit*: *Studies in the Theory of Entrepreneurship*, University of Chicago Press, Chicago.

Klein, L.R. [1949, 1966], *The Keynesian Revolution*, The Macmillan Press Ltd, London, second edition, 1966.

Klein, L.R. [1950], *Economic Fluctuations in the United States 1921-1941I*, Cowles Commission Monograph 11, Wiley, New York.

Klein, L.R., Goldberger, A.S. [1955], *An Econometric Model of the United States 1929-1952*, North-Holland Publishing Company, Amsterdam.

Kleinknecht, A. [1987], *Innovation Patterns in Crisis and Prosperity. Schumpeter's Long Cycle Reconsidered*, The Macmillan Press Ltd, London.

Kondratieff, N. [1926], « Die langen Wellen der Konjunktur », *Archiv für Sozialwissenschaft und Sozialpolitik*, 56, pp. 573-609.

Koopmans, T.C. [ed], *Statistical Inference in Dynamic Economic Models*, Cowles Commission Monograph 10, Wiley, New York.

Kresge S., Wenar, L. (éd.), [1994], *Hayek on Hayek. An Autobiographical Dialogue*, The University of Chicago Press, The Bartley Institute, Chicago.

Kuznets, S. [1929], « Random Events and Cyclical Oscillations », *Journal of the American Statistical Association*, 24, pp. 258-275.

Kuznets, S. [1930] *Secular Movements in Production and Prices. Their Nature and their Bearing upon Cyclical Fluctuation*, Houghton Mifflin Co, Boston.

Kydland, F., Prescott, E. [1982], « Time to Build and Aggregate Fluctuations », *Econometrica*, 50, 1982, pp. 1345-1370.

Lederer, E. [1925], « Konjunktur und Krisen », *Grundriss der Sozialökonomik*, 4, J.C.B. Mohr, Tübingen, pp. 354-413.

Long, J., Plosser, C. [1983], « Real Business Cycle », *Journal of Political Economy*, 91, pp. 39-69.

Lucas, R. [1972], « Expectations and Neutrality of Money », *Journal of Economic Theory*, 4, pp. 103-124.

Lucas, R. [1974], « Some International Evidence on Output Inflation Tradeoffs », *American Economic Review*, 63, pp. 326-334.

Lucas, R. [1976], « Econometric Policy Evaluation: A critique », in Brunner, K., Meltzern A. [Eds.], *The Phillips Curve and Labor Markets*, Carnegie-Rochester Conference Series on Public Policy 1, North Holland, Amsterdam, pp. 19-46.

Lumsdaine, R.L., Papell, D.H. [1997] « Multiple Trend Breaks and the Unit Root Hypothesis », *Review of Economics and Statistics*, 79, pp. 212-218.

Malthus, T.R. [1820], *Principes d'économie politique considérés sous le rapport de leur application pratique*, Calmann-Lévy, Paris, 1969.

Marx, K. [1894], *Capital. A Critique of Political Economy*. Volume III. *The Process of Capitalist Production as a Whole*, International Publishers, New York, [n.d.].

Mensch, G. [1977], *Das technologische Patt. Innovationen überwinden die Depression*, Fischer Taschenbuch Verlag, Frankfurt am Main.

Minsky, H.P. [1957], « Monetary Systems and Accelerator Models », *American Economic Review*, 47, pp. 860-883.

Minsky, H.P. [1975], *John Maynard Keynes*, Mc Graw-Hill, New York, 2008.

Minsky, H.P. [1986], *Stabilizing an Unstable Economy*, Mc Graw-Hill, 2008.

Mises, L. v. [1912], *The Theory of Money and Credit*, Yale University Press, New Haven.

Mises, L. v. [1966] (third revised edition), *Human Action, a Treatise on Economics*, New Haven, USA: Yale University Press.

Mises, L. v. [1934/1978], *On the Manipulation of Money and Credit*, Free Market Books, New York.

Mises, L. v. [1990], *Money, Method and the Market Process*, Kluwer Academic Publishers, Dordrecht.

Mitchell, W.C. [1913], *Business Cycles and their Causes*, California University Memoirs, Berkeley.

Moore, H.L. [1914], *Economic Cycles. Their Law and Cause*, Macmillan, New York.

Morgan, M.S. [1990], *The History of Econometric Ideas*, Cambridge University Press, Cambridge.

Mulligan, R. [2002], « An Hayekian Analysis of the Term Structure of Production », *The Quarterly Journal of Austrian Economics*, 5, pp. 17-33.

Mulligan, R. [2006], « An Empirical Examination of Austrian Business Cycles Theory », *The Quarterly Journal of Austrian Economics*, 9, pp. 69-93.

NBER [2009], « Business Cycles Expansions and Contractions », disponible sur internet http://www.nber.org/cycles.html

Nelson, C.R. [1972], « The Prediction Performance of the FRB-MIT-PENN Model of the U.S. Economy », *American Economic Review*, 62, pp. 902-917.

Nelson, C.R., Plosser, C.I. [1982], « Trends and Random Walks in Macroeconomic Time Series », *Journal of Monetary Economics*, 10, pp. 139-162.

Nordhaus, W.D. [1975], « The Political Business Cycle », *Review of Economic Studies*, 42, pp. 169-190.

O'Driscoll, G., Shenoy, S.R. [1976], « Inflation, Recession and Stagflation », in Dolan, E.G. (ed), *The Foundations of Modern Austrian Economics*, Sheed and Ward, Kansas City, pp. 185-211.

Patinkin, D. [1956], *Money*, *Interest and Prices*: *An Integration of Monetary and Value Theory*, Row Peterson, Evanston.

Perron, P. [1988], « Trends and Random Walks in Macroeconomic Time Series: Further Evidence from a New Approach », *Journal of Economic Dynamics and Control*, 12, pp. 297-332.

Perron, P. [1989], « The Great Crash, the Oil Price Shock and the Unit Root Hypothesis », *Econometrica*, 57, pp. 1361-1401.

Persons, W.M. [1919], « Indices of Business Conditions », *Review of Economic Statistics*, 1, pp. 5-110.

Powell, B. [2002], « Explaining Japan's Recession », *The Quarterly Journal of Austrian Economics*, 5, pp. 35-50.

Ricardo, D. [1817, 1819, 1821], *On the Principles of Political Economy and Taxation*, in Sraffa, P. (ed), *The Works and Correspondence of David Ricardo*, Cambridge University Press, Cambridge, Vol.1, 1951. [Trad. franç.: *Des principes de l'économie politique et de l'impôt*, Flammarion, Paris, 1992.]

Romer, C.D. [1994], « Remeasuring Business Cycles », *The Journal of Economic History*, 54, pp. 573-609.

Romer, D. [1990], « Endogenous Technical Change », *Journal of Political Economy*, 98, pp. S71-S102.

Rothbard, M. [1975], *America's Great Depression*, Sheed and Ward, Kansas City.

Samuelson, P.A. [1939], « Interactions between the Multiplier Analysis and the Principle of Acceleration », *Review of Economic Statistics*, 21, pp. 75-78.

Samuelson, P.A. [1948], *Foundations of Economic Analysis*, Harvard University Press.

Samuelson, P.A. [1987], "Paradise Lost and Refound:The Harvard ABC Barometers", *Journal of Portfolio Management*, 4, pp. 4-9.

Samuelson, P.A., Solow, R.M. [1960], « Analytical Aspects of Anti-Inflation Policy », *American Economic Review*, 50, pp. 177-194.

Say, J.-B. [1815-1821] *Cours d'économie politique et autres essais*, Flammarion, Paris, 1996.

Schumpeter, J. [1939], *Business Cycles. A Theoretical, Historical and Statistical Analysis of the Capitalist Process*, 2 vol., McGraw-Hill Book Co., London.

Schumpeter, J. [1954], *History of Economic Analysis*, Oxford University Press, Oxford.

Selten, R., Güth, W. [1982], "Game Theoretical Analysis of Wage Bargaining in a Simple Business Cycle Model", *Journal of Mathematical Economics*, 10, pp. 177-195.

Sims, C.A. [ed.] [1977], *New Methods in Business Cycle Research*: *Proceedings from a Conference*, Federal Reserve Bank of Minneapolis.

Sims, C. [1980a], « Macroeconomics and Reality », *Econometrica*, 48, pp. 1-48.

Sims, C. [1980b], « Comparison of Interwar and Postwar cycles: Monetarism Reconsidered », *American Economic Review*, 70, pp. 250-257.

Sismondi, L. [1827], *Nouveaux principes d'économie politique*, Delaunay, Paris, 2ème édition.

Slutsky, E. [1937], « The Summation of Random Causes as the Source of Cyclic Processes », *Econometrica*, 5, pp. 105-146.

Spiethoff, A. [1955], *Die wirtschaftlichen Wechsellagen. Aufschwung, Krise, Stockung*, 2 vols, J.C.B. Mohr, Tübingen.

Solow R. [1956], « A Contribution to the Theory of Economic Growth », *Quarterly Journal of Economics*, 70, pp. 65-94.

Stock, J.H., Watson, M.W. [1991], « A Probabilistic Model of Coincident Economic Indicators », in Lahiri, K., Moore, G.H. (eds) *Leading Economic Indicators: New Approaches and Forecasting Records*, Cambridge University Press, Cambridge, pp. 63-90.

Stuart Mill, J. [1848, 1871], *Principles of Political Economy with Some of Their Applications to Social Philosophy*, Augustus M. Kelley, Fairfield, 1987.

Tinbergen, J. [1935], « Annual Survey: Suggestions on Quantitative Business Cycle Theory », *Econometrica*, 3, pp. 241-308.

Tinbergen, J. [1936], « Kan hier te lande, al dan niet na Overheidsingrijpen, een verbetering van de binnenlandse conjunctuur intreden, ook zonder verbetering van onze exportpositie », *Prae-adviezen voor de Vereniging voor de Staathuishoudkunde en de Statistiek*, 's Gravenhage, pp. 62-108; traduit en anglais sous le titre « An Economic Policy for 1936 », in Klaassen, L.H., Koyck, L.M., Witteveen, H.J. [Eds], *Jan Tinbergen: Selected Papers*, North-Holland, Amsterdam, 1959.

Tinbergen, J. [1937], *An Econometric Approach to Business Cycle Problems*, Hermann, Paris.

Tinbergen, J. [1939], *Statistical Testing of Business-Cycle Theories*, Vol. I: *A Method and its Application to Investment Activity*; Vol. II: *Business Cycles in the United States of America*, *1919-1932*, League of Nations, Genève.

Tinbergen, J. [1940], « On a Method of Statistical Business Cycle Research: A Reply », *Economic Journal*, 50, pp. 141-154.

Tugan-Baranowsky, M. [1901], *Studien zur Theorie und Geschichte der Handelskrisen in England*, G. Fischer, Jena.

Valavanis, S. [1959], *Econometrics*. *An Introduction to Maximum Likelihood*, Mc Graw-Hill, New York.

Wicksell, K. [1898], *Geldzins und Güterpreise*, G. Fischer, Jena.

Yule, G.U. [1926], « Why Do Sometimes Get Nonsense Correlations between Time Series? A Study in Sampling and the Nature of Time Series », *Journal of the Royal Statistical Society*, 89, pp. 1-64.

Zivot, E., Andrews, D.W.K. [1992], « Further Evidence on Great Crash, the Oil Price Shock and the Unit Root Hypothesis », *Journal of Business and Economic Statistics*, 10, pp. 251-270.

WORKING PAPERS DE L'AFC

Année 2012

La liste complète des Working Papers est disponible sur le site www.cliometrie.org

WP2012-1	Luca PENSIEROSO "The Great Depression in Belgium: an Open-Economy Analysis"
WP2012-2	Amélie CHARLES, Olivier DARNÉ, Claude DIEBOLT, Laurent FERRARA "A New Monthly Chronology of the US Industrial Cycles in the Prewar Economy"
WP2012-3	Charlotte LE CHAPELAIN "Allocation des talents et accumulation de capital humain en France de la fin du XIXe siècle"
WP2012-4	Claude DIEBOLT, Mamoudou TOURÉ, Jamel TRABELSI "Monetary Credibility Effects on Inflation Dynamics: A Macrohistorical Case Study"
WP2012-5	Thi Hong Van HOANG "Has Gold been a Hedge against Inflation in France from 1949 to 2011? Empirical Evidence of the French Specificity"
WP2012-6	Georges PRAT "Equity Risk Premium and Time Horizon: What do the U.S. Secular Data Say?"
WP2012-7	Suchit ARORA "Understanding Aging during the Epidemiologic Transition"
WP2012-8	Alexandru MINEA, Antoine PARENT "Is High Public Debt Always Harmful to Economic Growth? Reinhart and Rogoff and some Complex Nonlinearities"
WP2012-9	Claude DIEBOLT, Antoine PARENT "Property Rights and Early Colonization in Algeria: The Astonishing Travel Stories of Two Precursors, Tocqueville (1837, 1841) and Juglar (1853)"
WP2012-10	Mamata PARHI, Claude DIEBOLT, Tapas MISHRA, Prashant GUPTA "Convergence Dynamics of Output: Do stochastic Shocks and Social Polarization Matter?"
WP2012-11	Thierry AIMAR, Francis BISMANS, Claude DIEBOLT "Economic Cycles: A Synthesis"
WP2012-12	Claude DIEBOLT "The Cliometric Voice"