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Structural change and paradigm shifts: identifying two Kondratieff waves from the
Great Depression to the Great Recession.

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Abstract

The explanation of economic crises and their recurrence has puzzled economists since the very inception of industrial capitalism. Usually, those are treated as mere financial crashes and their implications over production are given little importance. Here, we try to provide a theoretical framework that can be used to explain economic evolution through a scheme of long-term economic cycles, identifying two Kondratieff waves from the Great Depression to the Great Recession. Furthermore, each of these cycles present its own distinctive scientific, institutional and technological characteristics that form a paradigm. Following Schumpeter, economic crises are triggered by innovation and technological change, the latter being related to changes in scientific and institutional contexts. Thus, we also determine the characteristics of this techno-economic paradigm and its structural changes, put in motion at the end of a cycle when a long wave crisis emerges. This supports and completes our identification of the two long waves.

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1. Introduction

The economic crisis that started in 2008 puzzled the Academia in many ways. Before this event occurred, economists thought that economic crises had been eradicated: those were the years of the so-called ‘Great Moderation’, a period of stability in the fluctuations of output and other macroeconomic variables throughout all the developed countries. The statement of Nobel Memorial Prize laureate in Economics Robert Lucas, few years before the crisis ensued, could be used as a representative example of this view:

‘Macroeconomics was born as a distinct field in the 1940s, as a part of the intellectual response to the Great Depression. The term then referred to the body of knowledge and expertise that we hoped would prevent the recurrence of that economic disaster. My thesis in this lecture is that macroeconomics in this original sense has succeeded: Its central problem of depression prevention has been solved, for all practical purposes, and has in fact been solved for many decades’.

ROBERT E. LUCAS, Presidential Address delivered at the one-hundred fifteenth meeting of the American Economic Association, January 4, 2003, Washington DC.

From our point of view, this mistake came from an orthodox school of thought that neglected – and still does – the existence of long-term economic cycles. Our hypothesis is that the re-telling of the economic evolution as a succession of long waves or fluctuations could have helped to predict the arrival of a crisis and to reduce its impact. Furthermore, a deeper understanding of the evolution of capitalism is required. Namely, the explanation of the Great Recession as a financial crisis adds to the confusion: real economy and financial economy have been traditionally treated as two separated

realities. We think that this distinction has traditionally contributed to muddle up the relations between money, banking and economic crises. From our point of view, the productive sphere and the financial sphere are seen as two faces of the same coin, so the explanation of a crisis cannot be merely financial.

In this paper, we try to construct an economic history of recent capitalism, using economic cycles (see graph 4). Traditionally, cycles are defined as the alternation of phases of economic prosperity and crisis, the latter determining the end of such cycles. Following Schumpeter (1939), we defend the identification of two Kondratieff waves – long waves, with an average length of 50 years – since the 1929 crisis: the first one, starting in the 1930s and ending in the 1970s, with the oil crisis; and the second one, starting in the 1970s and ending towards 2010, in the context of the Great Recession. This also means that a new wave should have started during the second decade of the 21st century. As for the explanation of this cyclical evolution, as Schumpeter did too, we believe that the alternation of phases of prosperity and crisis are due to innovation and technological change. Radical innovations are clustered around periods of crisis, where former technologies have reached an exhaustion point. Then, technological change takes place, producing a mismatch between current productive arrangements and these new technologies, and unraveling a depression. Hence, Schumpeter's definition of 'creative destruction'. Finally, these innovations will promote growth and economic recovery, setting a new phase of prosperity and the beginning of a new cycle.

This new set of radical innovations, which shapes the profile of economic evolution, form what Dosi (1982) calls a 'technological paradigm'. This way, each long cycle will have its own particular technological characteristics. But, how is this paradigm determined? We hypothesize that each cycle present its own scientific and institutional characteristics, and that these are interrelated with technology. In other words, each economic crisis brings about some structural changes that can be explained as follows: first, the evolution of science can be viewed as the succession of scientific revolutions and synthesis (Kuhn, 1970 [1962]), so an intellectual revolution has to take place every now and then; then, as institutions reflect society's ideas and beliefs, (North, 2005), we propose that those changes in the scientific context should unleash institutional changes; finally, this change in institutions will accommodate technological change. In short, each long wave is going to be defined by a particular set of characteristics that form a global paradigm, that can be defined as the interaction and

dynamic evolution of three sub-domains: i) a scientific paradigm; ii) an institutional paradigm; and iii) a technological paradigm¹ (see table 2).

To carry out this analysis, the paper is going to follow this structure: in section 2, data are presented, and the identification of two long waves is proposed; in section 3, the phases of each cycle are explained, and subjacent business cycles are identified; in section 4, the paradigms of each cycle, and its changes, are described; finally, in section 5, some conclusions are drawn.

2. Data and methodology

Concerning the statistical confirmation of cycles – that has to go hand in hand with a historical confirmation -, we follow Schumpeter's analysis in *Business cycles* (1939). Here, the length and shape of a cycle can be described by the mere observation of the output and prices growth rates from several countries - our sample include United States, Germany, France, Italy, Spain, United Kingdom, Japan, and China². Our times series are constructed by quarterly data extracted mainly from the World Bank Database, completed with Eurostat data for European countries and with the Bureau of Economic Analysis Database for American data between 1930 and 1947. Data are not available for all countries for the period 1930-2010, except for the United States. That justifies putting our focus, mainly, in this country and completing the historical analysis with data from other countries, when available. Focusing on the US can be reasonable, as it is the economic leader during this period, and we can consider that it is going to determine a big part of the cycle's shape in developed countries.

With respect to the methodology used in the treatment of cycles, we have to clarify the following aspects:

- a) First, cycles are composed of two alternate phases, prosperity and crisis. These two phases correspond to what Schumpeter calls the primary wave. In addition, there exists a secondary wave, consisting of economic agent's behavior, who tend to be optimistic during prosperity phases and pessimistic during crises. This

¹ This definition is inspired in that of a 'National System of Innovation and of Production' (NSIP), given in Freeman (2008).

² We believe that the countries selected can provide a good representation of developed countries and its evolution. China is an example of a developing country during the 20th century, having a main role in the present wave, so its inclusion is justified, though data are not available until the 1990s.

generates a sort of cumulative effects, which cause prosperity and crisis phases to be longer. Hence, the profile of economic evolution is altered, and two new phases appear, so the cycle can be divided in the phases that follow: prosperity is divided into i) recovery and ii) expansion; while crisis is divided into iii) recession and iv) depression. Although Schumpeter considers that a cycle begins after the recovery phase, we prefer to assume that it starts after the depression phase. We think that this criterion is more reasonable, because new technologies cluster around the crisis phases, so these should have matured by recovery phases. Furthermore, the lowest point of the cycle, that corresponding to the depression phase, is easier to identify than that where recovery ends.

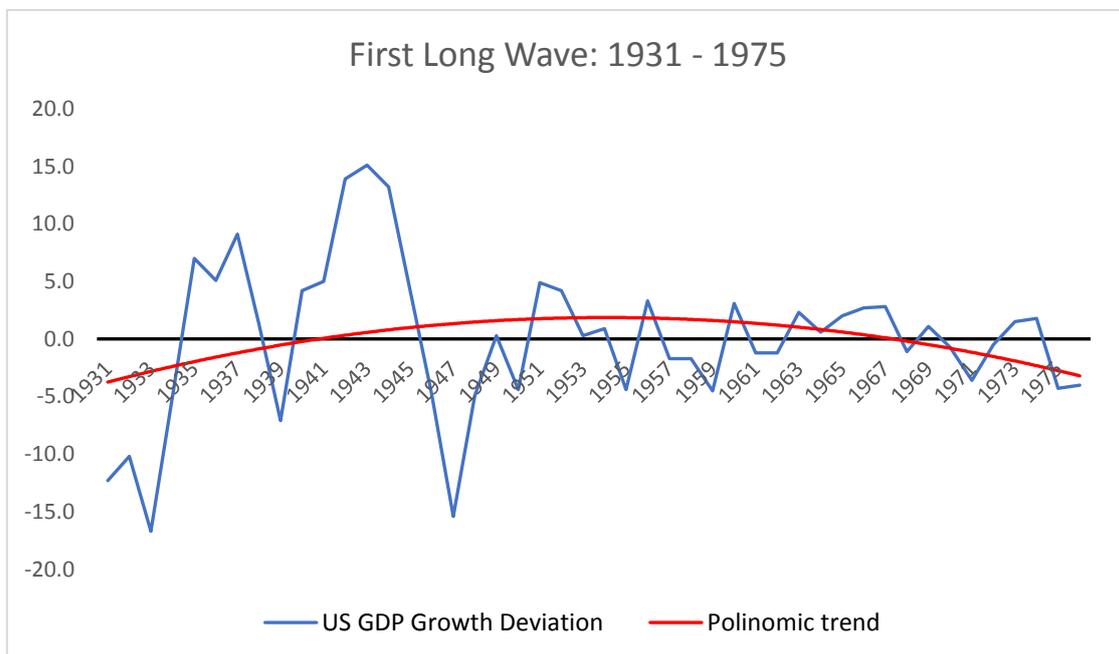
- b) Second, Schumpeter identifies three different types of cycles, according to its length: 1) Kitchin cycles, with an average length of 12-18 months, associated with inventory cycles; 2) Juglar cycles, with an average length of 7-11 years, associated with fluctuations in investment³ – usually related to the development of incremental technologies; and 3) Kondratieff cycles or long waves, with an average length of 50-60 years, related with radical innovation, which transforms the whole economic structure. We will focus on the latter, as we are interested in this structural changes and in paradigm shifts. Subsequent Juglar cycles will also be important in defining economic evolution, but Kitchin cycles will be obviated.
- c) Third, despite trying to locate a regular pattern in the description of cycles, we don't defend these are unavoidable processes. We refuse determinism with respect to the length and periodicity of cycles, which are emergent processes of capitalism. In fact, a deep study and a better understanding of cycles, is needed to try and reduce its duration and eliminate its recurrence.
- d) Fourth, cycles are generated endogenously: innovation and money play a key role. In relation to the explicative causes, the co-evolutionary links among productive and financial activities are really important. Real economy and financial economy cannot be separated. This being said, the influence of exogenous causes is not denied.
- e) Finally, the economic development is an evolutionary and dynamic process, both at intersectoral and at international levels. The notion of change is

³ According to Keynes (1936), investment is the most volatile component of aggregate demand.

fundamental to analyse and understand capitalism. Thus, each long wave is going to be defined by its own institutional, technological and scientific characteristics. The interaction of these three sub-domains will determine the global paradigm that will change from one cycle to another.

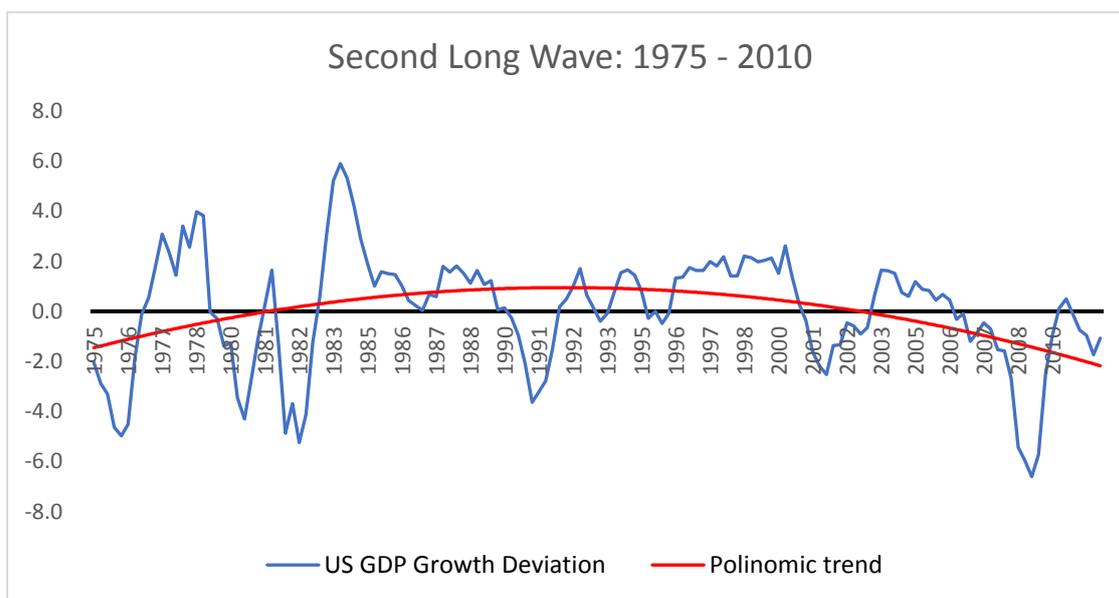
As we said earlier, our main objective is to identify two long waves along the years that go from the Great Depression to the Great Recession, as it may be enough to support our view, concerning the existence of economic cycles. By definition, this long cycles must end amid a depression, so those waves might be separated by the oil crisis, around the mid-70s. Before starting our analysis in the next section, we can confirm if the time delimitation is correct, by a simple graphic representation. According to Kondratieff (1979), we can construct a long wave graph using GDP growth deviations from mean growth for a determined time period. Then, we draw a second-order polinomic trend, so the data can be adjusted to the parabolic shape of a cycle. By doing this for the USA, for our two *a priori* time periods, we obtain some interesting results.

Graph 1: First Kondratieff wave.



Source: own elaboration based on Bureau of Economic Analysis and World Bank data

Graph 2: Second Kondratieff wave.



Source: own elaboration based on World Bank data

As the graphs above depict, the time delimitation of the two long waves is clear. Taking this into account, we are going to proceed, in the next section, to describe the phases of each long wave and its subjacent Juglar cycles. There, we will prove how historical facts adjust to the data, allowing for a justification of every fluctuation.

3. Long waves and business cycles: historical and statistical analysis

Bearing the graphs above in mind, we proceed to a detailed description of the waves' profiles. For achieving this, we focus on the identification of Juglar cycles and their position along the long cycles.

3.1. First long wave, 1931-1975.

1. 1931-1939: We start our analysis after the American crash of '29, a long wave crisis that ended the previous Kondratieff. We can consider that the recovery phase of the first long wave started around 1931 and, thus, so did the first Juglar. The hard economic recovery accelerated in 1933 – starting the expansion phase of the Juglar -, with the expansionary fiscal policies from Roosevelt's New Deal. Growth lasted until 1938, when a brief recession ensued. Nonetheless, we can consider that this first Juglar ended around September 1939, with the German invasion of Poland, the beginning of the WWII, and the social crisis that followed. In contrast with Schumpeter, we cannot

obviate wars, as these were exogenous events. The global character of the conflict and its socioeconomic implications are way too important to be passed over. Furthermore, war economy was an important cause to explain the start of the expansion phase of the Kondratieff around 1939, and the beginning of the second Juglar. As we will see shortly, wars played a very important role for the American economy through this whole Kondratieff, and the subjacent cycles. In the end, wars constitute a mechanism for investment allocation, driving resources and innovation towards the arms industry: this is a decision of efficiency that can be justified in the case of a leading country that controls the international process of income distribution, as is the United States.

2. 1939-1949: As it was said before, the expansion phase consolidated through the WWII. After a little crisis around 1945, growth restarted after the Paris Peace Treaties were signed in 1947. Europe also started the post-war recovery when the Marshall Plan was put in motion. This period of growth was brief and lasted until the second quarter of 1949. American growth rates were negative until the last quarter of 1949, so we consider this date as the end of the second Juglar. An explanation of this crisis could be that the end of the WWII caused a downturn in fixed investment, whose revival was incentivized with the Korean War. The failure of Truman's package of policies, known as the Fair Deal, which was a sort of a renovated New Deal, can offer another explanation.

3. 1949-1958: The 1949 crisis was brief, as usual in the case of a Juglar cycle that is located within the prosperity phase of the Kondratieff. American growth rates were higher than 10% during the first years of the 1950s. However, negative rates returned during the first three quarters of 1954, with stable growth rates being resumed in 1955, until the last quarter of 1958, denoting the end of the third Juglar. As for the 1954 recession, we do not consider it as a Juglar crisis: we consider it as a signal that the economy was moving into the inflection point, from the expansion phase of the Kondratieff to its crisis phase (see graph 1). Again, the ending of the Korean War in 1953 could have hampered investment; it is also noteworthy that growth was reenacted in 1955, when another conflict started, namely, the Vietnam War.

Concerning the 1958 recession, it can be partly explained by a crisis in the automotive industry – a key industry in this wave –, after Ford launched the Edsel model, which was a failure, and whose sales didn't live up to its expectations. In fact,

the American automotive industry as a whole experimented a bust: automobile production decreased roughly a 33% between 1957 and 1958 (Haig, 2003). This can be an evidence of a change in the consumption patterns that promoted recovery and expansion, which can be assumed as another signal that a change in the economic structure was taking place. To sum up, we can take what happened during this Juglar as a supply problem, caused by the automotive industry reaching an exhaustion point, but also as a demand problem, as a reversion on the growth of aggregate demand – to which the tax-financing of the War budget and the monetary tightening derived from the wars could be cause.

4. 1958-1968: This Juglar is located in the crisis phase of the Kondratieff. As a result, growth is more stable and lower – which contributes to make long wave crises more unexpected -, as can be seen taking a look at the American growth rates during the 1960s. In Europe and Japan, we can see higher growth rates, though. This can reflect the fact that, mainly due to the WWII, this countries joined the evolutionary path depicted by the United States later. During this period, the anomalies appear in the prices series, rather than in the output ones: the European countries – except Germany - and Japan started to experiment inflation towards 1962, whereas in the United States it started to appear around 1968. At the time, high inflation didn't represent any danger, as the faith in the Phillips Curve was so strong, that growth in prices was thought to be incompatible with decreasing employment and output – and, thus, with a productive crisis. As we will see in the description of the fifth and final Juglar, this thought proved to be wrong when high inflation and decreasing output – in other words, stagflation - came hand in hand and unleashed the depression phase of the Kondratieff.

Although we don't see negative growth rates of output during this period, there are a few facts that can be taken as signals of a breaking point. On the one hand, the American space race against the USSR, which was a great technological stimulus during this fourth Juglar, was reaching its end, as it did in July 1969, the date of the moon landing. In fact, the aeronautic industry was a key one during the whole wave. On the other hand, a very important social crisis was taking place at the moment in different parts of the world: in America, the social mobilizations in Berkeley, associated with the Vietnam War protests and Counterculture; and in Europe, the French May events and the Prague Spring. This period of social unrest shattered the United States and the Old

Continent, where, in fact, France experimented a short productive crisis, towards the second quarter of 1968.

5. 1968-1975: The United States started the 1970s showing signs of stagnation in the output growth rates, whereas Europe and Japan were enjoying high rates. The American path of growth was recovered in 1971, lasting until the second quarter of 1974, when negative rates appeared. Since the end of the 1960s, as we explained above, prices were growing at high rates in all developed world, which wasn't a problem while output was also growing. Towards 1974, though, an unprecedented economic event took place, that is, the simultaneous appearance of inflation and negative growth – stagflation. To what extent inflation was an aggravating issue is shown by the fact that, during 1974, inflation reached rates higher than 10% in the United States, France and Spain, and even higher than 20% in Japan, Italy and the United Kingdom. As it turns out, Germany, although experimenting inflation rates of around 7%, didn't reach those levels. This is easy to explain, as controlling prices has been a priority in Germany since the hyper-inflation episode of the inter-war period: this being so, this concern was even moved later into the European Central Bank policy's main objective.

Following our scheme, we should have arrived by now to the long wave crisis that ended the first Kondratieff. This crises tend to have stronger effects over the economy than the previous Juglar ones, because structural changes are being put in motion, and also because this Juglar takes place in the depression phase of the Kondratieff. Between the first quarter of 1974 and the third quarter of 1975, we find negative growth rates in every country of our sample, and the aforementioned high inflation rates. This spectacular increase in prices has been traditionally explained through the increase of the oil prices that then took place, triggered by the Arab-Israeli conflict, the Yom Kippur War and the OPEC reaction. According to FRED data, the oil price index increased more than 10% between November 1973 and March 1975, reaching a peak in 1981; by then, the oil price index was 80% higher than in 1974. Due to the importance of fossil fuels as inputs in power production during this wave, taking the role that electricity had had during the previous one, these increases contributed to a cost inflation process that aggravated the structural crisis that was taking place.

To sum up, we can again to Graph 1 to check that this historical re-telling can be adjusted to what we saw there. A long wave is proposed for the period 1931-1975, from

the Great Depression to the oil crisis. This can be disaggregated into four phases: i) recovery, along the 1930s, corresponding to the Great Depression period; ii) expansion, starting with WWII and lasting until the mid-1950s; iii) crisis, from around 1954 to the social collapse of 1968; and finally, iv) depression, from the late 1960s to approximately 1975, when depression ends and a new recovery phase is set in motion, starting, thus, a new Kondratieff wave.

3.2. Second long wave, 1975-2010.

We now proceed to replicate our previous analysis for the second Kondratieff wave.

1. 1975-1983: We continue our analysis from 1975, when the recovery phase of the new Kondratieff started. Although production recovered early, inflation rates were still high at the moment. Related to the need of controlled inflation, some measures were set. Namely, Federal Reserve Chairman, Paul Volcker's restrictive monetary policy was successful in achieving a decrease in prices: towards the first quarter, American inflation was lower than 4%, for the first time in ten years. Maybe because of this restrictive policy, the United States growth rates were negative during 1982. The Iranian Revolution of 1979 could also be related to this recession; this once again affected the production of oil and caused a brief energetic crisis.

2. 1983-1992: After the 1982 recession, the American economy started to show stable growth rates of output and prices, so we can consider here the beginning of the expansion phase of the Kondratieff. As for European countries, they struggled with inflation for a few years more, as stable rates of around 2-3% didn't appear until 1986. After price stability was reached, deflation appeared in some countries, as Germany and Japan – the latter has even been struggling with deflation during the last decades, being this a structural characteristic of Japan's economy. This second Juglar, as is usual in expansion phases, was a period of spectacular growth in the developed world: between 1984 and 1990, national output grew on average at rates higher than 3% in France, Germany, Italy, Spain, Japan, United Kingdom and the United States. After some years of growth, negative rates appeared around the last quarter of 1990 in the UK, during the first three quarters of 1991 in the United States, and in the rest of the countries of the sample from the last quarter of 1992 to the last quarter of 1993. These are enough signs for the confirmation of a Juglar recession at the beginning of the 1990s. The end of this

second Juglar would correspond to the inflection point of the long wave, the downturn where the recession phase of the Kondratieff starts (see graph 2 above).

Several economic and political causes could have contributed to this recession. First, the effects of the restrictive monetary policies that were applied in the United States and Europe to achieve inflation control throughout the 1980s. In the latter case, these were more important, in the context of monetary convergence criteria that were being set as foundations for the Maastricht Treaty and the European Monetary Union. Second, the Berlin Wall being tore down in November 1991, the unification of Germany and the conversion of the Eastern Europe countries and Russia to model of private capital accumulation. Third, the Gulf War and the invasion of Iraq in 1990, creating a new conflict in OPEC territory. Fourth, the Savings & Loan (S&L) institutions crisis, that started in America, related with the deregulation of the banking sector that started to take place during the previous decade: to summarize, President Carter's Depository Institutions Deregulation and Monetary Control Act of 1980 enabled S&L institutions to lend adjustable-rate mortgages; the restrictive monetary policies and the rise in interest rates that followed made this mortgages unpayable, which resulted in the bankruptcy of around 1000 institutions, resulting in bailouts by the Financial Institutions Reform Recovery and Enforcement Act of 1989 (Curry et al., 2000).

3. 1992 – 2002: Here, we enter a phase of stable and slow growth of production and prices – with the exception of Japan's deflation. As we mentioned earlier, this is a characteristic of the downswing phases, which makes it difficult to anticipate an economic bust. With the coming of the new century, signs of stagnation and a new crisis reappear mainly in the United States, but some effects are shown also in Germany, Italy and Japan. The crisis that started around 2001 corresponds to the end of this third Juglar and to a move in our long wave scheme, moving into the depression phase of the Kondratieff. This recessive episode has traditionally been explained through the burst of a financial bubble related with Internet companies and, hence, with a key technology of this wave. This Juglar crisis, which has received the name of 'bubble.com', clearly shows the influx of technology on the fluctuations of investment, which shape this decennial cycles.

We cannot ignore other historical events that happened: we refer mainly to the 9/11 terrorist attacks and the beginning of the Afghanistan War in 2001. We insisted above in the importance of wars for American investment and its growth model, denoting it as a characteristic of the previous wave. The appearance of new conflicts from the 1990s onwards, makes us wonder if wars are still an important feature of the American economy.

4. 2002 – 2010: Towards the middle of 2002, stable economic growth returned, marking out the beginning of the expansion phase of the fourth Juglar. Nonetheless, growth was interrupted in every part of the developed world around the last two quarters of 2008. Usually, Lehman Brother's bankruptcy in September 2008 has been used as the event to explain the beginning of the Great Recession, but from our point of view, this cannot be taken as the main explanatory cause of the crisis. This is considered to be a long wave crisis, as a Juglar crisis takes place inside the depression phase of the Kondratieff, and as we have said before, long wave crisis are not intrinsically financial, as those have very important effects over production, employment and society in general – take as example the case of Spain, where unemployment rates reached values higher than 25% during the hardest years of the crisis. During the second half of 2008 and the entirety of 2009, all the countries in our sample, except for China, experimented great losses in quarterly growth rates, being in much cases higher than 5%. In 2010, negative growth disappeared, though not for long, as it reappeared in 2012. However, we take 2010 as the end of the depression phase and, thus, of this long wave. Following our scheme, a new long wave should have started around 2010, but its analysis requires further investigation and can constitute a future line of research.

Returning to the explanation of the Great Recession, following our reasoning, the main causes are related to the exhaustion of a technological paradigm that was the impulse for economic recovery from the previous crisis and for the following expansion. However, as it happened in the Great Depression and the oil crisis, another simultaneous events take place that trigger the depression. As it turned out with the Great Depression, a financial crash took place and worsened the situation that arose during the technological transition. To this extent, financial innovation was crucial, as the creation of new assets called 'securities' (CDOs, SPVs...) contributed to make the financial system more opaque and to extension of risks throughout the entire world.

This securities consisted of several financial assets, including subprime mortgages or toxic assets related with mortgage loans conceded to low income borrowers and, thus, with low probabilities of being returned. This toxic assets were mixed with other assets in packages that were valuated as low-risk assets by rating agencies. On the contrary, instead of dissipating risks, they were being spread through other assets around the world, increasing the probability of contagion of asset toxicity. Under this complicated scheme, there is no wonder why nobody could see the bubble burst coming.

To sum up, we have seen another scheme of a second long wave. Returning to Graph 2 above, we can see its shape: a recovery phase from 1975 to 1983, an expansion phase from 1983 to 1992, the end of the upswing and the beginning of a recession phase that lasted until 2002 and, finally, a depression phase that ended in 2010 with the Great Recession. According to our hypotheses, 2010 should have been the beginning of a new long wave, and so the last decade should have been characterized by a strong structural change and a paradigm change in developed economies. We might be able to determine a first Juglar cycle ending around 2018 that should correspond to the recovery phase of a new Kondratieff that should last until around 2050. However, this topic would require further research and is an open line of future investigation.

Furthermore, we have to insist that, although the statistical and historical analysis is consistent and can be used to prove our point, further empirical tests are needed as a continuation of this work. The narration developed above has to serve as a background for a broader empirical research. In future research, following Jarne et al., (2007), an empirical analysis, using differential equations, will be carried out to confirm the existence of the structural breaks that are proposed in this paper and, hence, to prove that the consideration of the long waves can be valid.

4. Describing the techno-economic paradigm and its changes through time

Our main hypothesis is that every Kondratieff cycle has its own scientific, institutional and technological characteristics that determine economic evolution. These characteristics determine each other reciprocally and form a paradigm, which could be defined as ‘a privileged level of analysis of the interactions and co-evolutionary dynamics among [these three] sub-domains [...]’ (Freeman, 2008). In fact, this concept could be defined in a similar way as List’s (1909 [1841]) National System of

Innovation, which the inclusion of a socio-institutional context. In this section, we intend to describe the characteristics of each of these sub-domains and we underline the differences that arise from one cycle to another, so we can assert that structural change is a key process of economic evolution.

4.1 Scientific context.

Following T.S. Kuhn⁴ (1970 [1962]), science – Economics, in our particular case - is structured around ‘paradigms’ that evolve and change through time in a succession of scientific revolutions and synthesis. ‘[The] transformations of these paradigms [...] are scientific revolutions, and the successive transition from one paradigm to another via revolution is the usual developmental pattern of mature science’ (ibid.: 12). Bearing this in mind, we move to the description of the two different paradigms that arose when each of the long waves described above started.

4.1.1. *First long wave, 1931-1975.*

We start our analysis after the crash of 1929, and we can designate the publication of John Maynard Keynes’ *General Theory of Employment, Interest and Money* (1936) as a milestone in Economics during this cycle. This book was a reaction against the previous scientific paradigm, that is, the Marginalist Revolution and supply Economics. Confronting Say’s law, according to which economic crisis are always a result of insufficient production, Keynes identified the Great Depression as an under-consumption crisis, provoked by a decrease in investment and, consequently, in aggregate demand. Hence, an increase in public expenditure could increase demand and be a solution to the crisis. In addition to this theoretical framework, the success of Roosevelt’s New Deal of 1933, a package of expansionary fiscal measures, at the economic recovery from the Great Depression, contributed to the formation of a new academic vision with demand in the center of its analysis. Another example of expansionary fiscal policies during this period is the Marshall Plan, which was American funding for the reconstruction of the post-war Europe.

⁴ Besides Kuhn, we can take another examples of competitive conceptions of scientific development, as a critique to the cumulative notion and logic positivism: namely, Lakatos (1968) and Feyerabend (1975).

During the late 1930s and the 1940s, a scientific revolution took place in Economics. Keynesian theories were adapted by neoclassical economists, which derived in the formation of a new paradigm: the ‘neoclassical synthesis’ (Roncaglia, 2006). We find here, on the one hand, neoclassical microeconomics based on the marginalist concept of utility and an atomistic view of individual rational optimization, as were von Neumann-Morgenstern (1945) contributions, that inspired Arrow-Debreu’s (1954) general equilibrium model. On the other hand, we find Keynesian macroeconomics, that is to say disequilibrium models for the explanation of short-term unemployment with the inclusion of price and wage rigidities. To this extent, Hicks’s (1937) simplification of Keynes’ scheme, the IS-LL simultaneous equilibrium model, constituted a pioneer work.

We cannot end this discussion without talking about the Phillips curve, which is important in the explanation of the exhaustion of the paradigm and its subsequent change. The Phillips curve was an instrument used during the synthesis years for predicting inflation. This model showed an inverse relation inflation and unemployment variation, with was invalidated with the coming of stagflation during the 1970s crisis. Phelps’ (1968) and Friedman’s (1968) critiques proved to be more adequate for the existing economic conditions: the Phillips curve would only be valid in the short run because workers suffer from money illusion; but, in the long run, workers adapt their expectations about the price level, and there exists a trend towards a natural rate of unemployment that is compatible with any price level and, hence, with a stable inflation rate – this was called the ‘non-accelerating inflation rate of unemployment’ (NAIRU)⁵. Stagflation created suspicion around Keynesian-synthesis theories and, as will be explained later, the monetarist revolution led by Friedman revealed to be an attractive academic *corpus* in the hands of neo-liberal politicians.

Here, we have seen a typical evolution of a Kuhnian scientific paradigm: first, we see a revolution, a synthesis, and the formation of a new paradigm; later, a new phase of intern coherence with the paradigm’s basic axioms; then, the opposition

⁵ The monetarist critique of the Phillips curve is a clear example that economic theories can be falsified - in Popper’s sense -, despite its social character. This is important for the vindication of Economics as a science.

from heterodox scientists arises, until a new revolution takes place and a paradigm change is forced. This process constitutes the mechanism of scientific progress, as the succession of revolutions and synthesis contribute to fortify the hard core of scientific knowledge.

4.1.2. Second long wave, 1975-2010.

Towards the mid-1970s, inflation was the new economic foe. Monetarism, led by Milton Friedman, proposed to give battle to price growth and revealed itself as the foundations of a new economic orthodoxy. The setting of inflation objectives through monetary policy and interest-rate manipulation gained importance during the following decades. In turn, fiscal policy, so important during the previous wave, fell into a second place, as public expenditure effects on aggregate demand were supposed to be anticipated by the rational economic agents, so, in the end, it would only contribute to generate inflation. Rational expectations⁶, thus, were revealed to be an important instrument to the monetarist critique of expansionary fiscal policies. Following this rationale, here is no wonder why almost nobody would recognize the signals that the economy was giving, especially from the year 2000 onwards: an unsustainable investment pattern, a predomination of product innovation over process innovation, irrational payments for management jobs, low productivity increases in the public sector, corruption, etc.

Another theory characteristic of this orthodox paradigm is that of capital market efficiency (Malkiel et al., 1970; Fama, 1991). According to this, perfect and complete information prevail in financial markets, so they would be efficient in the sense that assets market values would coincide with their real values in every moment, so speculation and bubbles would be denied to exist. This theory would also be used to justify financial deregulation and liberalization.

Public Choice theories constitute another important feature of this intellectual paradigm (Buchanan et al., 1962). According to this, a paradox would arise when the Government intervenes to solve a market failure. As it turns out, these interventions

⁶ We do not support rational expectations as an adequate methodological assumption, as we believe that limited rationality would be a more realistic one. For a critique of rationality in uncertain conditions, see Tversky and Kahneman (1974).

could generate, in turn, Government failures. These theories contributed, then, to increase the bad conception of public policies that arose during the downswing phase of the previous wave. The Hobbesian *Leviathan* was reviving. Also related with public economics, was the birth of Supply Economics, whose more relevant instrument was the Laffer curve. This indicates that, after reaching an optimal point of taxation, there is an inverse relation between the marginal tax rate and tax revenue, as rich people would evade taxes to avoid paying more. The idea behind this curve is so simple that it could be drawn in a napkin. In fact, it was presented that way to president Reagan, who adapted it to explain how tax cuts for rich people can increase equality, as they could spend more and money would ‘trickle down’ and benefit low-income people.

As it usually happens, for economic ideas to become a new paradigm, they have to be adapted by politicians. This happened in some kind of way with Keynesian ideas and Roosevelt’s New Deal, and so did happen with all the theories that appear above. In fact, all those theories were consistent with the neoliberal school of thought. Were it because of the economic situation, social discontent or a conjunction of both, neoliberalism rose to politics towards the late 1970s, being the two main examples Reagan’s Republican Government in the United States and Thatcher’s Conservative Government in the United Kingdom. Here, Anti-war and Counterculture movements played an important role, as this discontent message was received by neoliberal parties that promised to end oppression and war, caused by a large public sector, and to bring about liberty. The opposition to the URSS growth model in the context of the Cold War could also serve as a part of the explanation.

Monetarist postulations were attractive for these governments – Reagan ironically dedicated public funds to support Chicago University, one the main liberal think-tanks of America. Soon, the control of inflation turned to be the main objective of economic policy, and during the 1990s the Taylor rule started to be implemented. Besides this, neoliberal agenda also orientated towards the restoration of class power and structure that existed before WWII, which reverted the trend in distribution and so inequality started to increase from the 1980s (Harvey, 2005).

To sum up, the scientific paradigm of this wave consisted of neoliberal ideas. Besides, the USA and the UK, we have some examples in Europe, as the German Federal Republic; in Asia, as Japan and the Asiatic tigers – Taiwan, Singapore, South

Korea and Hong Kong -; Russia after the USSR being dismantled; in South American, Chile; and even in some developing countries that had to follow the ‘Washington Consensus’ principles in order to obtain conditioned aid from the IMF.

4.2. Institutional context.

From an evolutionary perspective, based on Veblen (1934 [1898]), we intend to analyze the institutional characteristics of each wave and institutional change as a key feature of cycles’ structure. We focus on three institutional aspects: i) monetary and financial system; ii) the role of Government; and iii) labor market.

4.2.1. Monetary system

First long wave, 1931-1975

After WWII, post-war reconstruction was a global concern in many aspects, the design of a new international monetary system being one of them. The gold standard had been abandoned by the United States in 1933 due to the restrictions that limited gold reserves imposed over the expansion of money supply and, thus, over real exchanges. International conversations to decide the new monetary order that had to substitute the gold standard ended in 1945 at the Bretton Woods Conference. Here, two main proposals were confronted, Mr. Keynes’ in behalf of the British, and Mr. Harry White’s as the American representation⁷. The White Plan was the victor: the American proposal was based mainly in the convertibility universal convertibility of currencies into dollars, and the convertibility of dollars into gold. Hence, this ended being a new version of the gold standard. The difference is that the victory of the American Treasury contributed to the concentration of financial power in Wall Street, as dollar was the central currency of the system and was its value was backed by gold. In addition, a fixed exchange-rate system was set, with the dollar as reserve currency.

In relation with the financial system, its main characteristics can be described as follows. The crash of 1929 revealed a series of failures in American banking and finance. The Glass-Steagall Act of 1933 was approved in order to separate commercial banking from investment banking, to prevent the former to invest in securities and to

⁷ For a detailed explanation of the proposals that were confronted at Bretton Woods, see Skidelski (2005).

prevent the unleashing of another speculative bubble. Another important law in this direction was the Bank Holding Act of 1956 that regulated financial holdings' activities and tried to reduce market power concentration. Basically, it tried to avoid that holdings could be integrated by different companies that dedicated to commercial activities and investment activities at the same time. The efforts towards achieving this separation between different banking activities by regulating the financial system constitute a characteristic feature of this wave. For this reason, this period has been called 'regulated capitalism' (Bertocco, 2017). As it would be seen up next, there is a clear contrast with what happened during the next wave.

Second long wave, 1975-2010

Through the mid-1970s, clear changes can be noted in the monetary context. At the beginning of this decade, in anticipation of the end of the Vietnam War, President Nixon suspended gold convertibility, freeing the dollar from the 'golden straitjacket', in order to devalue it. This fact put an end to the Bretton Woods system that had been running for the last three decades. Exchange rates started to float and gold disappeared as back-up value and commodity money evolved into fiat money, whose value consists in the power of monetary authorities to print it. Furthermore, fiat money consisted mainly of bank money, which was allowed by financial innovation – for example, credit cards, ATMs, securities, etc.

This change in the definition of money was an opportunity for the development of the financial system. With the rising importance of bank money, a demand for financial deregulation arose, because regulation was constraining its activities. '[I]n the four decades following the Great Depression, few changes were made to the regulatory framework. However, in the next three decades, technological advances, as well as shifts in ideology and political power, would all help to transform the system of financial regulation in America' (Sherman, 2009: 4-5).

As it has been explained above, the rise of neoliberal Governments saw these demands as an opportunity to liberalize and deregulate the banking system. In America, the Garn-St. Germain Act of 1982, which authorized the expansion of S&L activities, was a first step into breaking the separation between commercial and investment banking. As a result of the approval of the Gramm-Leach-Bliley Act of 1999 the Glass-

Steagall Act was repealed, which eliminated the main obstacle in the way to liberalization. Finally, the Commodity Futures Modernization Act of 2000 revoked regulation concerning financial derivatives. The rationale behind this wave of deregulation was that ITCs would help to make risk monitoring easier and more efficient, so that regulation would apparently be unnecessary.

Another justification for deregulation was the urge for globalization. The liberalization of capital markets caused a huge intensification in international capital movements. During this wave, Wall Street continued to be the global financial center and dollars still were the international currency. In the case of the United States, concerns about maintaining a strong and healthy currency are of a very important nature: the massive reception of international financial inflows allows the country to finance its huge commercial and fiscal deficits. Actually, capital receptions help to ensure American economic and geopolitical leadership, because this way expenditure in innovation and militarization can be expanded. Another economic paradox is constituted by the fact that a country that has been liberal by tradition, subsists by maintaining two huge deficits, despite not being destined to social expenditure.

To conclude, a brief comment about monetary changes in Europe is mandatory. Namely, the formation of the Economic and Monetary Union in 1992 and the implementation of a new order based on a common currency, the euro. This way, member countries returned to a system that was similar to the gold standard, in the sense that these nations lost their sovereignty on printing money, which was translated to a new monetary authority, the European Central Bank. The emergence of the euro idea brings up the question that a sort of monetary reference and common back-up value has been historically needed, as was the case with gold during several centuries.

4.2.2. The role of Government

First long wave, 1931-1975

Once again, post-war reconstruction played an important role in the determination of institutions. In Europe, a new social agreement was built around the figure of the Welfare State to confront recovery from war destruction. Even in the United States, a paradigmatic case of liberalism and enemy of State dirigisme, the public sector had a

main role in the economic recovery from the Great Depression, though a Welfare State was never implemented. Along this wave, the expansion of the public sector constitutes an important institutional feature. This is even clearer if we take the extreme case of the rise and expansion of communism in the USSR.

In building a Welfare State, the United Kingdom and Germany were pioneer countries. On the one hand, Germany was the first country that implemented a mandatory social insurance system towards the end of the 19th century that inspired modern Social Security. On the other hand, UK's National Health Insurance Act of 1911 introduced the novelty of two contributory schemes for sickness and unemployment insurance coverage. It also was the first country to have a universal education system (Butler Act of 1944), which is one of the foundations of the Welfare System as we know it (Briggs, 1961). Welfare State, then, spread from these two countries through the rest of the Old Continent, and started its development after WWII, based around three principles: 1) Unemployment, sickness and disability insurance; 2) Public pension funds for retired workers; 3) Benefits in kind related mainly to health and education.

In short, we think that Governments had an active role during this period, in solving a humanitarian crisis that transcended the economy. We can consider this, even though this expansion of the public sector took different forms: either as the configuration of a strong Welfare State in Europe, as a military-oriented expenditure and a focus on cash transfers over in-kind benefits in the United States, or even as central planning to promote forced industrialization and development in the USSR.

4.2.2. Second long wave, 1975-2010

As we have seen earlier, neoliberalism rose through the 1980s, having in its political agenda the objective of reducing the weight that Governments have had during the previous four decades. This was not an easy task, as Welfare State is seen as one of the most important social achievements of 20th century, so a dismantling couldn't take place without high political costs. Although a true retrenchment cannot be perceived, there is a change in trend in comparison with the other wave, as the expansion of the public sector was stopped.

We can take as examples some measures that followed this direction. In the UK, some privatizations took place as was the case of the public council housing. Here, expenditure retrenchment was focused on public pensions, whose indexation changed in order to promote private pension funds. Finally, a regressive poll tax substituting local property taxes was implemented in the late 1980s, seeking to reduce local administration revenues and constrain their expenditure. In the United States, some measures that affected low income groups were approved, as the cutbacks in the Aid to Families with Dependent Children program and in unemployment insurance. Nonetheless, Reagan's measures to dismantle Medicare and Medicaid didn't pass, as they affected a greater part of population and shower more opposition.

Those two countries are paradigmatic cases of liberalism, but to show that these changes were general, we can see the examples of two countries of social democratic tradition (Pierson, 1996). In the German Federal Republic, some fiscal adjustments took place that were justified by demographic reasons; in anticipation of the growth of population that would take place after the German unification, some cutbacks were applied to the public pensions system in 1989. It is worth saying that, besides neoliberalism, German conception of public spending was influenced by their phobia to inflation ever since the hyper-inflation episode of the inter-war period. Our other example is Sweden, where the neoliberal backlash of the 1990s was even more surprising. Again, public pensions system was reformed and some measures concerning public employment were approved. Consulting available data, a clear decreasing trend since the 1990s can be appreciated in global public spending for the four countries highlighted (OECD, 2019).

To end our point here, we must make a comment about a second wave of retrenchment that took place after the Great Recession, especially in Europe. We refer to what was called the 'sovereign debt crisis' episode in Portugal, Ireland, Italy, Greece and Spain, and the measures of 'expansionary austerity' that were applied and that, instead of promoting growth, worsened the economic situation. These measures were inadequate as public debt levels in these countries in 2010, except for Greece, were high as a consequence of bailing out banks after the crisis, and not caused by excessive spending (Blyth, 2013).

4.2.3. Labor market

First long wave, 1931-1975

Concerning labor relations, the period that followed the Great Depression was based on the dialogue between trade unions and employers. In America, the Wagner Act of 1935 pursued the enforcement of trade union's bargaining power to balance negotiation. After WWII, the position of trade unions improved even more, as their role in the mobilization of workers during the war was a key one. But the growth of trade unions was not the only feature of labor market during this period.

This period was characterized by high growth rates of real wages and labor productivity, and low unemployment. Between 1947 and 1966, output and wages grew at a compound annual rate higher than 3% in countries like the United States, UK, German Federal Republic and Sweden. Labor supply experimented important structural changes. First, women's incorporation to labor market consolidated during WWII and was of great importance, as men were in the battlefield and factories needed to continue their activities; this trend continued after the war, as American women participation over total labor supply increased from 28% in 1947 to 41% in 1977. Second, labor supply rejuvenated, as the percentage of workers between 55 and 64 decreased from 90% in 1947 to 74% in 1977 in America; the expansion of the Welfare State and public pensions incentivized workers to retire earlier, as wages are less expected to improve at the end of professional careers. Third, labor supply started to be more qualified, as the percentage of American workers with a university degree duplicated through these years and workers with secondary education degrees increased in a 30%; this change corresponded to a change in labor demand too, as it also started to focus more in qualified job positions (Freeman et al., 1980).

Wage composition also experienced some changes, as many developed countries started to include fringe benefits like pension plans, paid leaves, health insurances and security social provisions; towards the 1980s, these benefits supposed a third of total compensation in the United States, almost two thirds in Germany and Sweden, and more than two thirds in Italy and France (ibid.).

This period, thus, was characterized by the cooperation of trade unions and employers, and a general improvement of worker's conditions. Some of these trends will start to change towards 1975, as we will see shortly.

Second long wave, 1975-2010

A first characteristic of this period is the decreasing importance of trade unions. Labor market is not easy to deregulate, because of workers' opposition, so changes in labor market often take place through other paths – however, there are some examples of direct labor measures during the previous wave, as American Harley-Taft Act. Indeed, Peoples (1998) asserts that American trade unions lost importance because of product market liberalization and the increase in competence, as trade unions find it harder to organize a higher number of workers in a higher number of companies. However, American trade unions never were that important to begin with. Nevertheless, in Europe, where trade unions have a greater role, a similar decrease in trade union density has taken place through these years in practically every country, according to OECD data. Trade union coverage, though, is still high in several countries as Belgium, Norway, Denmark, Finland and Sweden.

Another important change in comparison with the previous paradigm, is the stagnation of real wages and the reversion of distribution trends. Indeed, labor shares have been decreasing in the G20 countries since the 1980s, even though productivity has been increasing (ILO and OECD, 2015). Although the less relevance of trade unions could be part of the explanation, this fact can be better explained by the new wave of globalization that had been taking place during this period. As a result of higher competence at a global level and the irruption of developing countries, developed countries need to be more competitive. If this cannot be achieved by productivity increases, this has to be achieved by the reduction of production costs in order to increase margins. The changes in distribution along the two long waves and the identification of cyclical patterns leave us with an interesting topic for further research.

4.2.4. Recapitulation

By studying these three main aspects of the institutional framework, we arrive to some clear conclusions. Concerning the first wave, it can be assessed that institutions

developed around the concept of regulation, with Governments taking a big part in the economy. With respect to the second wave, a paradigm change can be inferred, as evolutions evolved towards the concept of liberalization. Economic barriers to globalization were eliminated, starting with capital and money. An important change took place in the competence processes as well, as companies started to compete at international levels and multinationals were constituted. This high context of competence also intensified with the emergence of developing countries, which constrained wage growth and labor conditions in developed countries.

4.3. Technological context

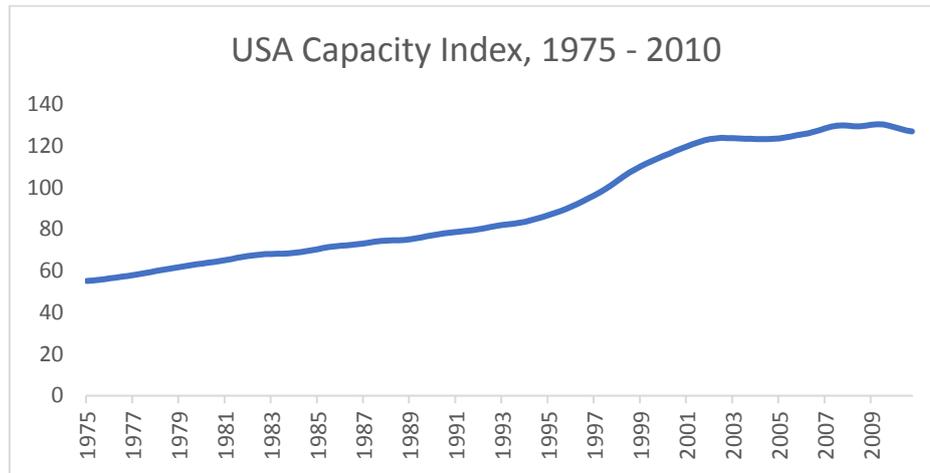
A 'scientific paradigm' could be approximately defined as an 'outlook' which states the relevant problems, a 'model' and a 'pattern' of inquiry [...] In broad analogy with the Kuhnian definition of a 'scientific paradigm', we shall define a 'technological paradigm' as a 'model' and a 'pattern' of solution of *selected* technological problems, based on *selected* principles derived from natural sciences and on *selected* material technologies (Dosi, 1984: 14).

Hence, an evolutionary conception of technical progress implies the assumption of a hard core of technologies that cluster in time and develop through a life cycle that ends in a saturation point; when this point is reached, this set of technologies would be progressively substituted by a new wave of innovations, forming a new paradigm. For this to happen, a change in institutions is needed, to accommodate technological change.

Graph 3 below provides a representation of this technological evolution for the second wave, which can be considered to have the shape of a logistic curve (Sánchez-Chóliz et al., 2008). Using USA global industrial capacity index⁸ as an indicator for technological change, we can draw an 'S-shape' or sigmoidal curve, where we can identify a technological leap during the recession phase (towards the late 1990s), followed by signs of exhaustion at the end of the cycle, during the depression phase. This graph can be used to depict the process of innovation inside our cyclical scheme.

⁸Board of Governors of the Federal Reserve System (US), Industrial Capacity: Total index [CAPB50001SQ], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/CAPB50001SQ>, February 26, 2019.

Graph 3: Technological evolution for the second wave.



Source: own elaboration based on FRED data

4.3.1. First Long Wave, 1931-1975

A key technological change was a process innovation in the automobile industry, named Fordism, as it was first put in practice in Ford's Highland Park Assembly Line, being the Ford T model the first car to be mass-produced in 1908. Cars ceased to be luxury goods, as more people began to have access to cheaper model, as a result of production cost savings. As happens with paradigm-changing innovation, mass production soon had pervasive effects over the economy and spread over other sectors, as the food industry and other durable consumption goods, as television and domestic appliances. The availability of new products at low costs caused another change in demand patterns: namely, mass consumption. This was allowed by expansionary income policies that were applied for the promotion of economic recovery from the Great Depression and WWII. The New Deal in the United States and the Welfare State in Europe were assembled in order to favor low and middle-income groups, which resulted in the consolidation of a consumerist middle class. This was a key process in determining this long wave's growth pattern.

Another important change that contributed to rising life standards, was the discovery of penicillin by Fleming in 1928, which later would result in the commercialization of antibiotics. These soon became mass consumption products with a huge social diffusion, and were very important in the consolidation of a healthier

consumerist class. Medicine can also be considered to start developing a more technological focus from here onwards.

Concerning energy, oil substituted electricity as the main productive input. Cracking processes made oil extraction easier. Also, the development of the automobile and aeronautic industries created a higher oil demand as fuel for combustion engines, displacing coal. Related to this is the development of the petrochemical industry during the 1930s, and of organic chemistry and synthetic materials; all these constituting key factors of the cycle's technological base.

4.3.2. Second Long Wave, 1975-2010

Here, the technological paradigm was based mainly on information and communications technologies (ICTs). Concerning information, the main innovations were computers. Its intellectual base can be attributed to Turing's (1936), Max Newman's and von Neumann's contributions in their works with algorithms and computers' design. The invention of integrated circuits in the 1950s, IBM's punched cards in the 1960s, and Intel's microprocessor in 1972, were all important milestones. From here onwards, computers entered their maturity phase.

As it happened in the previous wave with automobiles, mass-production of computers was a key event. The first personal computer was launched by Commodore in the late 1970s; then, computers ceased to be used exclusively for scientific purposes. Furthermore, the space race and the technological battle against the USSR was important in the development of an important radical innovation, the Internet. In this context, the US department of defense launched the Advanced Research Projects Agency, which developed the first interconnection web for federal computers, ARPAnet, towards 1967. This was the immediate antecedent of the Internet, whose expansion ended in the creation of the World Wide Web by Tim Berners-Lee in 1991, which allowed the interconnection of personal computers and the exchange of information at a global level.

With respect to telecommunications, the key invention was the mobile phone. In 1973, Motorola developed the first completely portable telephone. From here onwards, mobile phones have been experiencing rapid incremental innovations, from first

generation analogic mobiles to fourth generation phones, which allow the use of data to establish Internet connection everywhere.

Concerning energy, the oil crisis made developed countries re-think their energetic mix to reduce their dependence to crude. During this period, the initial development of renewable energy sources was important. Despite this, these sources have not reached their maturity phase, except for maybe wind energy, and they would be more a feature of the next wave. However, the change in the perception of energy that started to take place is important enough to be commented: along this wave, especially towards its end, costs have decreased and capacity and installations have increased notably in almost every source; oil is still the main energy source, but its weight in the energetic mix have decreased along the wave. Energetic transition, thus, has not been completed, but a global trend has started to show: in 2015, renewable sources were around a fifth of total energy in all the world, and a 17% in the European Union (IRENA, 2018).

As for intermediate inputs, the use of plastics has been paradigmatic. The development of the petrochemical industry during the past wave and of chemical components like polymers took a big part on the proliferation of plastics, and its constitution as a fundamental input during this wave. The substitution of metals by plastics was an important productive feature, as it contributed to decreasing costs and to accelerating production times – and, thus, to the development of new processes, as Just-in-Time.

In medicine, the improvement of internal surgery was a characteristic feature of this period, hearth surgery being a paradigmatic case. In addition, further improvements took place in relation with transplants and diagnosis, as for example, endoscopy and magnetic resonance imaging. To name another innovation on this field, the use of laser technology in surgery can also be underlined, contributing to consolidate the increasing technological character of medicine.

Finally, a comment has to be made about what was named as the ‘Green Revolution’. Between the 1960s and the 1980s, new technologies started to be applied on agriculture, which resulted in high growths on productivity in the following years. We refer to the use of new pesticides, fertilizers and irrigation processes, and the even

the polemic inclusion of genetically modified food. A remarkable fact was the introduction of new high-yielding varieties of rice and wheat in developing countries.

5. Concluding remarks

As we have seen above, the explanation of recent economic evolution as a succession of long waves of about 40 years seems reasonable. Replicating Schumpeter's (1939) analysis from the 1930s, we see that data and historical events go hand in hand (see graph 4 below). As we are analyzing social and economic facts, though, we cannot expect this evolution to be determinist, as it is composed of multi-faceted and complex processes.

Although we take the same steps that Schumpeter did in his research of long waves before the Great Depression, we can establish some differences between his results and ours. First, our Kondratieff cycles reveal to be shorter than his (of about 60 years): this could be related with a progress in economic science that increases our understanding of capitalism and results in a shortening of fluctuations; otherwise, it could be due to the nature of technological change and the development of technologies that accelerate cycle phases. Then, as a consequence of this reduced length, we cannot accept Schumpeter's hypothesis of a Kondratieff consisting of six Juglar cycles. As we are not following a determinist scheme, we find five Juglar cycles in the first Kondratieff, and four in the second one (see table 1 below).

Furthermore, a temporal extension of our scheme would suggest that a new long wave should have started around 2010, and a paradigm change might be taking place as well. The analysis of the techno-economic features that are going to characterize the new paradigm leaves another path to follow in future research. China is an example of change posited by our data: before 2010, stable high growth rates are the norm; however, after this year, growth is alternated with explosive high negative rates that only last a quarter, returning then to high growth. A change in growth model can, thus, be inferred for China, from a foreign technology-adapting country to an innovation-developing one, sacrificing stability to the vagaries of technology. This change in China's model could have some interesting geopolitical implications, as this country could be really disputing American economic leadership for the first time since the Cold War.

Table 1: Structure and length of the long waves.

Long wave	Approximate length	Juglar cycles	Approximate length	Long wave phase
c. 1931 – 1975	44	1931 – 1939	8	Upswing: recovery
		1939 – 1950	11	Upswing: expansion
		1950 – 1958	8	Downturn around 1954
		1958 – 1968	10	Downswing: recession
		1968 - 1975	7	Downswing: depression
c. 1975 - 2010	35	1975 – 1983	8	Upswing: recovery
		1983 – 1992	9	Upswing: expansion
		1992 – 2002	10	Downswing: recession
		2002 - 2010	8	Upswing: depression
c. 2010 – ?		2010 - 2019	9	Upswing: recovery

Source: own elaboration

In section 4, we described paradigms and their changes (see summary in table 2 below). We used three sub-domains – scientific, institutional and technological – and their interrelations to determine a pattern for long-term economic evolution. Therefore, for the first wave we established a link between public sector expansion for the promotion of post-war growth, the achievement of an adequate distribution and the consolidation of a mass-consumption middle class, and a technological paradigm based on mass production and the use of oil as energetic base. Meanwhile, for the second wave, we found a relation between the coming a new wave of globalization and liberalization and the development and diffusion of ITCs, as international interconnection and global information exchanges could only take place in such an unrestricted institutional context.

Finally, we should make another comment about something that was anticipated in the Introduction. We refer to the traditional distinction between real and financial economy. As we saw in section 4, the evolution of monetary and financial systems' institutional features is clearly related to economic fluctuations of output and, then, to

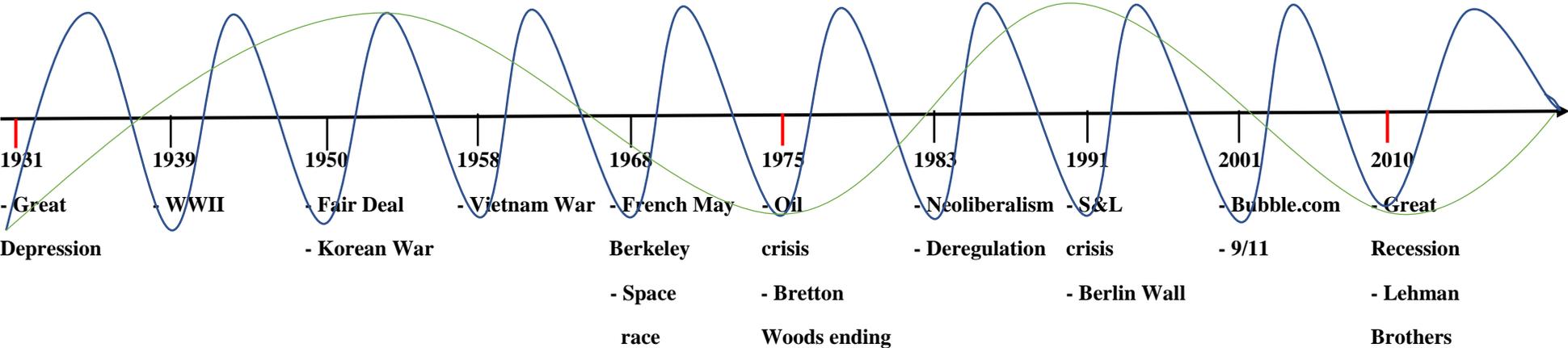
productive crises, so the relation between production and finance cannot be denied. This way, money and finance have to be included as additional explicative causes in the explanation of economic crises, and not as mere background. By doing so, we could work towards the construction of a money theory of production, which Keynes and Schumpeter defended to be a correct framework for a correct interpretation of economic facts.

Table 2: Paradigms and their characteristics.

Long wave	Paradigm characteristics				
	Scientific	Institutional			Technologic
		Monetary system	Role of Government	Labor market	
Oil cycle (c. 1931 – 1975)	<ul style="list-style-type: none"> • Neoclassical synthesis 	<ul style="list-style-type: none"> • Gold standard abandonment • Bretton Woods agreements (1944) • Financial regulation: Glass Steagall Act (1933) 	<ul style="list-style-type: none"> • New Deal • Welfare State and public sector expansion 	<ul style="list-style-type: none"> • Employment and wage growth • Role of trade unions • Supply changes: women incorporation 	<ul style="list-style-type: none"> • Mass production and consumption: Fordism and middle class • Oil • Penicillin (1928) and antibiotics
ICTs cycle (c. 1975 – 2010)	<ul style="list-style-type: none"> • Neoliberalism 	<ul style="list-style-type: none"> • Bank money • Liberalization • Objective: inflation 	<ul style="list-style-type: none"> • Government retrenchment 	<ul style="list-style-type: none"> • Wage stagnation • Trade union density decrease • High qualification related to ITCs 	<ul style="list-style-type: none"> • Computers • Telecommunications • Green revolution • Surgery • Plastics

Source: own elaboration

Graph 4: Historical events delimiting cycles.



Source: own elaboration

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