Structural change, long waves and inequality in income distribution

Angelo REATI [*]
av. Emile de Beco 55 – 1050 Bruxelles
angelo.reati@skynet.be

Abstract

The purpose of the paper is to study the mechanisms which generate inequality in income distribution in the course of structural change. Relying on the long wave theory, the stylized facts to be explained are that inequality (*i*) is high during the depression phase of the long wave, (*ii*) is progressively and substantially reduced during the prosperity phase, (*iii*) it starts increasing again during the recession phase.

The paper argues that the fundamental cause of inequality is to be found in the state of power relations among social classes. The description of their evolution during the phases of the long wave is supplemented by statistical evidence on the long-term fluctuations in the degree of inequality and by historical illustrations on the long-wave pattern of social struggles. Attention is devoted to the present situation, where inequality attained unprecedented peaks.

The paper concludes by a formal illustration showing how the evolution of inequality can be reduced to the relative strength of social classes, as formalized by the dynamics of employment and the state of the institutional setting in which the power relations of society are grounded.

Keywords: Structural change; long waves; income distribution; social struggles

JEL Classification: O30, E32, O11, D3

I. Aim

1.   The purpose of this paper is to study the mechanisms which generate inequality in income distribution in the course of structural change. My theoretical enquiry will look, particularly, to the economic and social evolution in Western world during the second half of the 20th century having, as a general source of inspiration, long wave theory and Pasinetti's (1981) model of structural dynamics.

The history of capitalism since the industrial revolution shows that structural change is an uneven phenomenon punctuated by periodic technological revolutions – i.e. radical changes in the way of producing and consuming. "Each technological revolution drives a *Great Surge of Development*, which takes more than half a century to yield its full potential in terms of growth, productivity increases, product range, geographic spread and social benefits" (Perez 2009, p. 780-781; see also Perez 2002,

pp. 20-21 and chap. 6). Sooner or later these "great surges of development" impinge on macroeconomic variables, generating a sequence of long-term expansionary periods of about 25-30 years followed by long stagnations of similar length. They are the so called long waves – a theory that was developed by the neo-Schumpeterian school of technological paradigms and systems of innovations (Dosi, Freeman, Perez, Lundvall).

As noted by Schumpeter (1939), each long wave develops in four phases: (a) prosperity, whereby growth is high; (b) recession, whereby growth decelerates; (c) depression, whereby growth is near zero or even negative; (d) recovery, whereby growth is modest.
Prosperity and recession represent long expansion while depression and recovery form long stagnation (Van Dujn, 1983).

Structural change and long waves entail strong movements in income distribution, whose stylized facts are summarized in fig. 1. It appears that, usually, inequality in income distribution is
(a) high during the depression phase of the wave
(b) it slightly decreases during the recovery phase
(c) it is progressively and substantially reduced during the prosperity phase
(d) finally, inequality starts to increase during the recession phase of the wave.

Before proceeding to explain these stylized facts on inequality, it is convenient to address some controversial aspects of the long-waves approach.

(Insert figure 1 here)

II. Background: the long wave theory

1.   Historical evidence shows that, in Western countries, structural change materialized in five technological revolutions[1]. The date of their beginning can be identified by the appearance of a highly visible, technically successful and profitable innovation playing the role of an "attractor" for a new set of technologies – the "big bang" in Perez's terminology (Perez 2002, p. 11). The *first technological revolution* started in England with the industrial revolution: it was the first mechanisation of industry and the diffusion of water transport. The "big bang" initiating this radical change was the Arkwright's mill opened in Cromford in 1771. The *second* technological revolution produced the age of steam and railways. The "big bang" was the Liverpool-Manchester railway in UK from 1829; then this structural change spread to the Continent and USA. The *third* technological revolution was the age of steel, electricity and heavy engineering; the attractor was the 1875 Carnegie"s Bessemer steel rail plant in USA, subsequently diffused to UK and Germany. The *fourth* technological revolution was the age of oil, the automobile and mass production. It started in 1908 in the US with Ford's model T and gradually extended to Europe. The *fifth* technological revolution was the age of computerization and information

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[1] Cf. Perez 2002, pp. 14 and 18; Freeman and Louçã 2001, p. 141 and part II for a thorough analysis

technologies. It was initiated by the Intel's microprocessor in USA in 1971, then covering Europe and Asia.

Each technological revolution passes through a gestation period which can be very long, and this explains why its repercussions in macroeconomic variables take place only after a considerable time lag. According to Freeman and Louçã (2001, p. 141) we have the following long-waves chronology, where the timing of the phases is approximate:[2]

- First long wave: 1780s – 1848
  * upswing: 1780s – 1815
  * downswing: 1815 – 1848
- Second long wave: 1848 – 1895
  * upswing: 1848 – 1873
  * downswing: 1873 – 1895
- Third long wave: 1895 – 1940
  * upswing: 1895 – 1918
  * downswing: 1918 – 1940
- Fourth long wave: 1941 – 1990s
  * upswing: 1941 – 1973
  * downswing: 1973 – (1992)[3]
- Fifth long wave: from the 1990s
  * upswing: (1992) ....

The last long wave deserves a comment because in Europe there is no evidence of a long expansion and in the US the situation is uncertain. A fact has been clearly established: the technological revolution in computer and information technologies is quite advanced and has produced a deep structural change in Europe, the US as well as in China, India, Brazil and other emerging economies. In these latter countries we observe a marked upswing in total output, and we can safely argue that, for them, the fifth long wave is under way. The present slowdown is just an accident which does not compromise the underlying trend.

For the US and Europe, however, the situation is different and raises a serious problem of diagnosis. In the US, the exceptional expansion of the business cycle initiated in 1992 was, most probably, the sign of the beginning of the new long wave although its impetus was broken by the financial bubbles of the 1990s on the high-tech

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[2] Van Duijn (1983, pp. 143) gives a slightly different chronology of the first and third Kondratiev (or long) waves. Concerning the latter one, his dating differs from Freeman and Louçã because, for Van Duijn, the 1920-29 period is the final part of the long expansion (the recession), instead of being part of the downswing. Note that the expansionary feature of the 1920-29 period is confirmed by the data on industrial production presented on page 255 of Freeman and Louçã (2001). Perhaps the contradiction can be solved because Freeman and Louçã (2001, p. 151) define the downswing as the "structural crisis of adjustment" which "characterize...the turbulent periods of transition from an old technological regime to a new one". In the US, this transition to a new technological regime was put into motion by the production chain. First introduced in 1913 in the automobile sector, it rapidly spread to other industries from 1920, marking the advent of Fordism (see Rosier and Dockès 1983, pp. 153-158).

[3] I put 1992 as the likely end of the long stagnation because it marked the beginning of the exceptionally long business cycle boom of the US.

securities (the "internet mania") and the 2000s (the sub-prime). This could be interpreted in two ways: as definite "hard landing" of the long expansion or, alternatively, as it happened in the past waves, just as an accident marking the turning point between the installation and the deployment periods of the wave (Perez 2001, p. 73 ff.).

The European economy, on the other hand, never attained a long-term expansionary path. Europe too suffered from the effects of the financial crises, although the most negative factor was caused by the austerity policies implemented since the 1980s, at first to prepare and subsequently to put into effect the European Monetary Union and, more recently, to tackle the problem of public debt. In any case it would not be surprising if, in the process of structural dynamics at world level, countries that had the leadership lose their position.

2.   While the pendular phenomenon of structural change is not controversial, the empirical evidence on the existence of long-waves in aggregate output is inconclusive. Some studies find a statistical support for long-term upswings and downswing in real variables while others reach the opposite conclusion.[4] Two reasons explain these deceiving results, one relating to the very nature of the long-wave phenomenon, the other to the method of enquiry.

Long waves, in fact, cannot be appraised as regular cycles. They involve, indeed, not only the economic but also the institutional structure of society, and we know that a new institutional setting does not come out from a smooth process but crucially depends on social struggles, whose outcome is not foreseeable in advance. In addition, many events determining the social evolution are exogenous, and this excludes the possibility to predict the precise moment of their occurrence: each long wave is unique.[5] This is not contested by those arguing that the long-wave has a quasi-cyclical nature but they observe that, in spite of the peculiarities and the unrepeatable character of each wave, it is possible to single out some common causes for the upswings and the upper turning points of the long waves that we have experienced since the industrial revolution. The driving forces and mechanisms of this stable causal structure provide the theoretical framework for analyzing the economic development of the last two centuries.

Then there is a question of the statistical method. Econometric models identify long waves by separating the cycles from the trend on the basis of several techniques, and the problem is that the detrending procedures are not neutral with respect to the results relating to the existence of cycles: "the smoothing techniques may create artefacts" (Freeman and Louçã 2001, p. 99).[67]

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[4] What complicates the picture is that most of the econometric studies cover the same countries for similar periods. See Freeman (ed.) 1996, part IV; Louçã and Reijnders (eds.) 1999, vol. I, part II; Metz (2011)

[5] However, radical technical change is not necessarily exogenous. See Fusari and Reati (2013) and Fatás-Villafranca et al. (2012) for attempts to endogeneize the appearance of technological revolutions.

[6] This criticism also applies to spectral analysis – one of the most sophisticated techniques to study long-waves.

[7] A thorough discussion of this topic goes beyond the limits of the present paper. See Freeman and Louçã (2001), who address the methodological questions raised by the empirical verification of long-

Considering that we are in deadlock on purely quantitative grounds, I sympathise with Freeman and Louçã's model of "reasoned history" – an approach that does not reject quantitative analysis but that goes far beyond it by adopting a complex determination approach, in which the purely statistical evidence is put on the same footing as social, institutional and political factors. In other words, history provides the final criterion for the detection of the turning points of cycles and for the interpretation of results. This also means that for a complete explanation, it is necessary to supplement a statistical identification of long waves with an explanation of how institutional constraints and economic processes give rise to particular statistical outcomes. Note, however, that this does not undermine the possibility of constructing a *theory* of growth since the reasoned history model is indeed capable of identifying and explaining recurrent phenomena, as well as special cases (Freeman and Louçã 2001, p.122).

The paper is organised as follows: section III identifies the fundamental cause of inequality and describes the factors determining it. Section IV provides a formal illustration of this analysis and section 4 concludes.

III. Analysis

1. *Inequality: an inverted S-shaped pattern*

(a) In the depression phase of the long wave the inequality of income distribution presents a somewhat paradoxical feature. In fact, owing to the unfavourable economic situation, total output, income and wages are low and the average rate of profit on productive activities reaches its cyclical trough, even becoming negative.[8] How is, then, that in spite of all this income distribution is very unequal ?

Two main reasons can explain this situation. The first one refers to the fact that, because of the series of bankruptcies produced by the depression, what remains of industrial and financial profits is concentrated in few hands. In addition, the general negative situation does not exclude that some activities still flourish – particularly those dealing with luxury goods – and this contributes to the profits of the rich. Secondly, the people who became rich during the previous long expansion, while being reduced in number, have not disappeared, and they continue to benefit of the income produced by their accumulated wealth. In addition, the increased power of the capitalist class stemming from the depression offers the possibility for top managers to benefit of very high remunerations, while the other wages are either stuck at their bottom level or decline.

In the second phase of the long stagnation (the recovery) the degree of inequality remains more or less the same or is just slightly reduced. This is because the system is experiencing only the first, timid, effects of the technological revolution,

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waves by considering two classes of models: (*i*) the traditional statistical and econometric analysis, and (*ii*) the simulations from formal models.

[8] This low level of profitability could trigger radical technical change. In fact, in this gloomy environment enterprises are faced with a dramatic choice: either they innovate and by this way can bring the rate of profit to an acceptable level, or they perish (Mensch 1979).

with a small increase in productivity which creates little room for possible wage growth.

When the system enters into the long expansion the virtuous circle of the productivity-wage link gains momentum. The diffusion of radical innovations frames its way, innovations cluster, productivity takes off and profits and wages increase. Depending on the relative strength of social classes, wage growth could exceed productivity growth – something that usually happens toward the end of this phase, when inequality attains its cyclical minimum. Finally, recession marks the end of the decreasing trend of inequality and prepares the ground for its reversal.

(b) Let us now compare these stylized facts with the empirical evidence. Unfortunately, as far as I know, there are no systematic enquiries going back to the first long wave.[9] Thus I had to focus essentially on data starting just before the First World War (Piketty and Saez 2003; Atkinson 2005; Atkinson, Piketty and Saez 2011).

Considering that the long wave does not manifest itself in a uniform way in all countries, to obtain meaningful indications from the historical examples we should focus on the technologically leading countries and, at this purpose, the US case is paradigmatic. The evidence for this country presented by Piketty and Saez (2003) and Atkinson *et al.* (2011) for the third, fourth one and the beginning of the fifth long waves broadly confirms the stylized facts. Indeed, measuring inequality by the pre-tax top deciles of income and wages shares from 1913 to 2007, it appears that:

• during the downswing of the third long wave inequality was very high, particularly in the depression phase of the 1930s (See figure 2 below, from Atkinson *et alii.* 2011, p. 6; see also Piketty and Saez, 2003, fig. I p. 11 and fig. VIII, p. 28). The war period marked a sharp decline of the indicator of inequality;

• for the fourth long wave the evidence partly confirms the stylized facts.
In fact, in the upswing of the 1950s and 1960s, the top deciles income share remained substantially flat; this contrasts with the stylized facts, suggesting a fairly stable level of inequality. However, from the early 1970s – when the long term expansionary trend of the economy changed direction – top income shares started increasing, modestly at the beginning then very sharply, particularly from the 1980s. This is in agreement with the stylized facts.

The top *wage* income shares initiated their ascending movement a bit earlier, with a moderate increase from 1956, and a marked upsurge from the mid-Seventies (Piketty and Saez 2003, p. 28). As a matter of fact, "the increase in top income shares in the last [four] decades is the direct consequence of the surge in top wages. ...[T]he working rich have now replaced the coupon-clipping rentiers" (Piketty and Saez cit., p. 3)

• as it appears from figure 2, this soaring movement of the top incomes continued in the 1990s and 2000s, peaking in 2007.

To emphasize the relevance of this somewhat unusual phenomenon, I draw attention to the comparison Atkinson *et alii* (2011, p. 9) make between the two last expansions in the US and the parallel evolution of the degree of inequality. In the years

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[9] Morrisson and Snyder (2000), concerning France, go back to the 18th century, but their evidence is not complete enough to allow to reconstruct the first three long waves.

1993-2000 (Clinton administration) real GDP grew at an average 4% per annum, while for 2002-2007 (Bush administration) GDP annual growth was 3%. During the two periods the real income of the top 1% incomes increased extremely quickly, capturing respectively 58% and 45% of growth.

(Insert figure 2 here)

The evidence for other 21 countries reported by Atkinson *et alii* (2011) confirms, when data are available, the high level of inequality of the Depression of the 1930s as well as the general increase in inequality of the recent decades. The evidence for the 1950-1980 period is mixed, in the sense that in some countries there was a slight decrease of inequality during the long expansion and the beginning of the stagnation (UK, France from 1966 to 1982[10]), while in some others it remained fairly stable.

Let us now see how structural change impinges in this process of evolving inequality. We shall see that there is a direct effect via the changing sectoral composition of the economy and an indirect effect by creating the conditions for changes in social relations.

2. The direct effect of structural change

As we know, structural change means that new sectors appear, some traditional sectors radically change their products, processes and organization and that some other sectors shrink. This dynamics has several repercussions on the degree of inequality.

The first effect results from the reshaping of the sectoral composition of the labour force. At present time, empirical evidence points to the skill-biased nature of new technologies (Vivarelli 2011; Mallick and Sousa 2012) which, among other things, involves above average wage increases in the expanding sectors and inter-sectoral inequality in income distribution. Secondly, the expansionary phase of the long wave provides a fertile ground for an improvement in the bargaining power of workers. In fact, incipient economic growth brings with it a decrease in the unemployment rate and, when expansion approaches its apex, this is followed by tight labour markets. The result is a decrease in inequality. Third, the diffusion throughout the economy of radical process and product innovations entail increases in productivity and, if the institutional rules of society allows it, a corresponding increase in wages. At this purpose, the systematic link of the wage rate with the "standard rate of growth of productivity" suggested by Pasinetti (1981) that will defined below is particularly useful as it satisfies the double criterion of efficiency and social fairness. Efficiency because this policy guideline guarantees the stability of the general price level; fairness since it allows to the workers of all sectors to benefit of technical progress. At the macroeconomic level this link between productivity and wages keeps constant the profit share in value added and, when productivity increase is coupled with a corresponding growth of output (i.e. the level of employment is maintained), the mass of profits also increases (see section IV below).

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[10] See also Atkinson (2005) for UK and Piketty (2003) for France

However, this direct relationship between structural change and inequality is less important than the indirect effect of structural change, on social relations.

3. The fundamental cause of inequality

(a) Power relations.....

The fundamental cause of inequality is to be found in the state of *power relations* in society. Structural change enters into play by creating the objective conditions for the unfolding of social struggles that put into question the *statu quo*.

Formally, the evolution of social relations (*SR*) could be represented as depending on two variables which reflect the respective power of social classes: the degree of unemployment, in absolute and relative terms (*U* and *u* respectively), and, more generally, the institutional set of society (*IS*):

$$SR = f(u \; ; IS) \qquad\qquad (1)$$

Unemployment impinges directly on the bargaining power of workers, while the institutional setting has an indirect, but equally powerful, effect. This second factor is defined here in a broad sense, covering all legal, administrative and regulatory measures which protect workers and their Unions – including the legal framework for collective bargaining – as well as the customary rules governing the organization of the production process at the shop floor.

(b) ...and their evolution during the process of structural change

As can be expected from the above description of the evolution of inequality, the *depression phase* of the long wave marks a period where social relations are very unfavourable to workers. Unemployment reaches its peak, Unions are very weak and the institutional setting is designed to support the interests of the ruling classes. Of course if, thanks to the struggles of the past, workers have succeeded in obtaining a satisfactory social protection, the pillars of the system will remain. However, long stagnation is the typical period when the capitalist class strive against workers' rights.

In the *recovery phase* the general economic situation is less gloomy, but there is no shift in the relative power of social classes: unemployment remains high and social relations persist to be inimical to labour.

The *prosperity phase* marks the advent of a substantial shift in the power relations. As a direct consequence of the general economic expansion, demand for labour grows and the ensuing progressive decrease in unemployment boosts the Union's strength. It follows a revival of workers militancy and social conflicts which affect wages as well as institutions. Toward the end of this phase enterprises are confronted with tight labour markets; as noted above, this implies that wages can increase more than productivity.

The social movements characterizing this phase also have implications on the institutional set: workers improve their position in the enterprise – recovering the rights they lost during the long stagnation – and the labour legislation become more progressive. The overall result of this movement is that the end of long expansion the

balance of powers is in favour of the working class and, consequently, inequality reaches its minimum.

In the *recession phase* the balance of powers begins to shift in favour of capitalists.

The dynamics of social relations just outlined is substantially confirmed by the history of social struggles during the first four long waves in the main capitalist countries.

(c) Historical evidence: a long-wave pattern of social struggles

Putting together data from about 30 different sources on the history of the workers' movement from the 19th century in France, UK, USA, Germany and Italy, Screpanti (1987b, p. 96) identifies four major proletarian insurgencies which coincided with the upper turning point of the long wave:
- (*i*) 1809-20
- (*ii*) 1869-74
- (*iii*) 1909-23
- (*iv*) 1967-73.[11]

In all these cases social unrests started in the second part of long expansion, peaked at the turning point of the wave, prolonged their activity during the initial period of the depression and finally faded following the defeat of the workers' movement resulting from the political and economic conditions of the depression.

Long stagnation was thus characterized by almost no social conflicts except for some outbreaks around the lower turning point of the wave, which ended with further defeats of the working class. These (minor) revivals of conflicts appeared in 1842-49 (2nd long wave), 1885-94 (3rd long wave), and 1943-48 for the 4th long wave (Screpanti 1987 b, p. 97).

According to Screpanti (1984, pp. 516-517), the common features of the four major waves of insurgency were: (a) proletarian in character, because the working class detained the political hegemony of the movement; (b) general, as they burst up simultaneously in all parts of the world capitalist system; (c) autonomous, in the sense that they were spontaneous movements from the rank and file; (d) radical, as their aim was to put into question the capitalist logic.[12]

The outcomes of these long term movements in social struggles exhibited ups and downs, which would be too long to recall here (see, on this, Rosier and Dockès 1983). However, in spite of the attacks to the workers' conditions and social rights particularly during the stagnation phases of the long waves, the prevailing long term trend was positive, with substantial improvements in the material conditions of the working class in terms of wages, length of the working-day and changes in the institutional set. Unions were officially recognized and, during the fourth long wave,

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[11] The historical evidence used by Screpanti covers the following periods: 1800-1980 for France and UK, 1820-1880 for the US, 1840-1980 for Germany and 1860-1980 for Italy.
See also Screpanti (1987a) for an enquiry of the strike movements and Screpanti (1984) for a theorization

[12] For a detailed chronology of the proletarian insurgencies in UK, France, USA and Germany during the 19th and 20th century see Screpanti (1987 b, pp. 102-118). See also Rosier and Dockès (1983).

they even became an essential instrument of the *régulation* of the system (Aglietta 1976), social security was established in all Western countries, workers conquered new social rights. A typical example of this changing institutional setting was the Italian "Statute of workers" (Statuto dei lavoratori) conquered by the workers' movement at the end of 1960s, which granted strong legal protection to labour. It was precisely for these social advances that capitalism succeeded to survive in spite of its exploitative nature.

The recent evolution deserves a comment because it appears at odds with the usual outcomes of the long wave dynamics.

(d) The present period: inequality and the attack to workers' rights

Two intertwined factors are at the roots of the situation of the last two decades: one is economic, the other comes from the class and power relations.

On the first side, the economic policy of both the US and the European Union produced an insufficient effective demand, which meant that the material conditions that would have led to a decrease in inequality were missing. As we have seen in section I, in Europe the upswing of the fifth long wave never started because of the austerity policies, while in the US the incipient expansion of the 1990s was not only broken by two financial crises but, more fundamentally, the high inequality made the existing lack of effective demand even more acute. In fact, the share in value added of the wages of the production workers exhibited a constantly declining trend since 1948, while the share of the supervisory workers, particularly that of top managers (the "super stars"), was strongly increasing (see Mohun 2013, table 1 and fig. 3).[13] This brings us to the second aspect. To understand it we should go back to the long stagnation of the fourth long wave.

The defeat of the working class resulting from the depression of the 1970s had profound implications going well beyond the mere economic aspect. It materialized in an ideological offensive to put back the clock of the history by a new institutional setting detrimental to workers and by a new course of economic policy that, among other things, facilitated a change of Western capitalism, whose focus shifted from production to finance. Let us start with the economic policy.

The depression of the 1970s was a typical outcome of structural change: the technological revolution of the Fordist era had exhausted its possibilities and the system was unable to grow at the previous pace. Consequently, the structural and the short-term Keynesian policies that were very effective when the underlying economic trend was growing were inadequate for the new situation.[14] Neoclassical economists did not understand the nature of the changing trend and simply attributed it to the first oil crisis. Such a wrong diagnosis led to wrong policies that exasperated inequality.

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[13] US statistics disaggregate the employment data according to whether supervisory functions above shop-floor level are a part of the job.
The downward trend of the production workers wage share passed from 53.5% in 1948 to 37.6% in 2007, with a particularly steep decline in the 1970s and the 1980s. Note that this evolution is not primarily due to a reduction of the number of production workers. In fact, production workers comprised 88.6% of all employment in 1948; this figure fell slowly to 82.3% by 1973 and remained around that level thereafter (Mohun 2013, pp.   ).

[14] On the economic policy for structural change see Reati (2012).

Instead of recognizing that the inadequacy of the Keynesian policies to control the business cycle (the "fine tune" policies) was simply due to structural change, they attributed the slowdown to a failure of the Keynesian *theory* and policy. In addition, the workers' movement was held responsible of the massive unemployment generated by the depression because – the neoclassical argued – labour markets suffered from excessive rigidities. Thus, an all-out flexibilisation was put at the top of the political agenda, which meant easy dismissals, wage cuts, precariousness – a policy that it has been pursued until now with disastrous results in terms of inequality and general economic performances.[15] [16] The Unions saw their power seriously undermined and, in many Western countries, we also assisted to repeated attempts by the governments to cancel, or to erode, the social rights of the workers: cuts in the unemployment benefits and restrictions to their access, attacks to the guarantees of the "Statute of workers" in Italy, pressures to reduce wage indexation in Belgium, etc.. A synthetic measure of this deteriorating situation for workers is given by the employment protection legislation index (EPL) elaborated by OECD (1999), which is declining in most of the OECD countries: it was, on average, 2.34 in the late 1980s, it fallen to 2.03 in the late 1990s to reach 1.94 in the 2008 (http://stats.oecd.org/; see also Tridico 2012, p. 30).[17]

Within this social context, the managerial class strengthened its power, the gap between their salary and the wages of the ordinary worker jumped and inequality climbed. This process was also favoured by the changing nature of capitalism, a political phenomenon which was also facilitated by structural change.

The neoclassical driven policy also implied privatisation of public services, liberalization and the abolition of controls on the international movements of capitals, to favour globalization. Structural change in information and communication technologies provided the technical basis for these capital movements.

The direct effect of the privatisations and liberalisations was a further increase in inequality, while the measures to support globalization produced a progressive de-industrialisation in Europe and in the US.

Since the industrial basis in the West was shrinking, the large corporations looked at financial activities as a source of profits. This went hand in hand with the

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[15] See, for instance, Tridico (2012).

[16] We should make a distinction between a "labour-controlling flexibility" and a "growth-enhancing flexibility". The first type of flexibility – that is the kind of market flexibility preached by neoclassical theory – is a spanner in the works of the diffusion of the new technological style. The second kind of flexibility is instead an essential prerequisite for such diffusion. See on this Reati and Toporowski (2004, pp. 425-427)

[17] EPL is a cardinal summary indicator covering all types of employment protection measures resulting from legislation, court rulings, collective bargaining or customary practices. The overall EPL indicator is a summary of a set of 22 indicators, which is obtained on the basis of a rather complex procedure. It ranges from 0 to 6, with higher scores representing stricter regulation.

In the EU, the highest EPL in the late 1980s appeared in the Southern countries: Portugal (4.19), Spain (3.82), Italy (3.57) and Greece (3.56). In Germany the EPL was 3.17 and in Sweden 3.49. UK had the lowest level (0.6). In the late 2000s there was an appreciable decline in all these countries. In 2008 the EPL indicator was: 3.15 for Portugal (2.88 in 2009), 2.98 for Spain, 1.89 for Italy and 2.73 for Greece. In Germany the EPL for 2008 was 2.12 and in Sweden 1.87.

This declining trend did not appear in the UK, where in 2008 the EPL indicator was 0.75. In the USA the indicator in question was the lowest of the OECD area, remaining at the 0.21 level all the time (source http://stats.oecd.org/, accessed on 26 April 2013)

ideological offensive exalting individualism and, at the corporate level, the shareholders' interest (as opposed to stakeholders). The success of managers was measured by their ability to increase the market value of the shares of the company and, more generally, to draw short-term profits from financial transactions, instead of caring for the production side of the enterprise. The phenomenon of the "super stars" consolidated and, with it, the huge level of their remunerations.[18]

My analysis will now be formalized considering a simplified model of the private sector a closed economy.

IV. A formal illustration

Following the long wave theory, I consider an economic system driven by the diffusion of radical product and process innovations. These innovations are assumed pervasive, which means that, over the time span of the wave, they cover almost all the manufacturing sector and a substantial share of services. I also assume that the dynamics of sectors involved with the technological revolution exhibits an S-shaped path − the typical pattern of the long-wave. The rest of the economy − i.e. the small part of manufacturing and of services as well as part of the agricultural sector which do not experience radical technical change − grow at the trend rate of the economy. Incremental technical change is taken into account only in the sense that it contributes to the trend increase of productivity and output.

In the illustration below, the economy is composed by n sectors, n being variable because of the appearance of new activities and the disappearance of some old ones (Pasinetti 1981).

1. Definition of the main variables

♦ *Inequality (INEQ)*

Considering the general approach of this paper, I suggest to measure inequality by the corrected *profit share* with respect to value added (VA) at current prices, instead of the Gini coefficient which would not be easy to compute. Thus:

$$\text{INEQ} \equiv (\text{VA} - \text{W})/\text{VA} \equiv 1 - (\text{W}/\text{VA}) \qquad (2)$$

where   W is corrected for the imputed wage of the self employed, minus the (imputed) rent-taking and profit component of the wages of top managers.

This last correction is important because, as we have seen in section II, the rent and profit component of the managerial wages has now become really huge. In fact, during the 3-4 decades following World War II, in Western countries the wage salary of top managers was about 10 times the average blue-collar wage, while at present this ratio is around 500 (Petit 2010). Thus, if we take the share of total wages with respect to net value added, the evolution of inequality is concealed because the

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[18] For a thorough analysis of the systemic nature of the rising inequality of the last decades in Western countries see Petit (2010)

macroeconomic wage bill encompasses *all* wages and salaries, including top management and all supervisory workers.[19]

♦ *Value added*

$$VA \equiv D_c + D_k \equiv D_T \qquad (3)$$

where

D_c demand for consumption; D_k gross investment; D_T total demand

♦ *Institutional setting*

To quantify this variable is not an easy task.[20] A useful way would be to rely on the OECD (1999) index of the Employment Protection Legislation (EPL). Failing to dispose of such an index on a yearly basis and for a sufficient time span (data start in 1986), one could assume that the corrected wage share is a reasonable proxy, as it reflects the evolving relative strength of social classes. To take into consideration that institutions change only slowly, it is necessary to introduce a time-lag (θ) and a discontinuity.[21] Considering, in a first approximation, only the former element we have the following:

$$IS(t) = a \frac{W}{VA}(t - \theta) \qquad (4)$$

where *a* is a scale parameter

Formula (4) can also be written in another way, to show the link between the the institutional setting and the degree of inequality of the past

$$IS(t) = a[1 - INEQ(t\text{-}\theta)] \qquad (4 \text{ bis})$$

2. *Evolution over time* (*t*)

♦ *Productivity*

(a) *sectors experiencing radical process innovation* ($\pi_{(R)i}$)

(a.1) The productivity function of the individual innovator
Following Reati (1998), it is assumed that, for the individual innovator, radical process innovations entail a sudden and substantial increase in its productivity level (e.g. a 50–70% increase) and, then, that the productivity of the innovator evolves around its slow trend growth, under the effect of incremental innovations (fig. 2)

(Insert figure 3 here)

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[19] See, on section II.3.d above, Mohun's evidence on the US case

[20] For a broad analysis of this problem see Voigt (2013), and also the discussion in the same issue of the *Journal of Institutional Economics*.

[21] The time-lag θ could be quite long because changes in the institutional structure occur only when the new power relations have been firmly settled.

(*a.2*) The productivity function of the sector

Radical process innovations spread within the sector according to a logistic path, with the result that the productivity curve of the sector will reflect the shape of the diffusion function. The greater the intensity of the technological revolution (quantified by the leap of productivity of the individual innovators), the more the sectoral the changes in productivity will replicate the shape of the diffusion function.

The productivity function of the sector is:

$$\pi_{(R)i}(t) = \pi_i(0)[1 + \Delta_i \, D(t)] \exp(\rho_{tr} \, t) \tag{5}$$

where

subscript R refers to the sector adopting radical process innovation

Δ_i is the percentage leap of productivity of the firms of the sector

$D(t)$ is the diffusion function of radical technical change within the sector [22]

ρ_{tr} is the trend increase of productivity when there is no radical innovations (e.g. 1% per year)

(*Insert figure 4 here*)

(*b*) *whole economy* ($\prod$)

The productivity level of the economy is the sum of the sectoral levels of productivity, i.e. the *i* sectors involved with radical process innovations and the remaining *j* sectors;

$$\prod = \Sigma_{i+j}\pi_{i,j} = \Sigma_i \, \mu_i\pi_{(R)i} + \mu_j \, \pi_j \tag{6}$$

where μ are the weights

Positing a linear and low trend growth for the productivity of the *j* sectors

$$\pi_j(t) = \pi_j(0)\exp(\rho_{tr} \, t)$$

and taking into account that the shape of the productivity function of the *i* sectors is the sum of a set of logistics (one for each sector), I assume that the evolution of the productivity of the system at any period *t* can be reasonably approximated by an "augmented" logistic (Lgs1), i.e.:

$$\prod(t) = \prod(0) \exp(\delta_1 \, t) = \prod(0) \exp(\rho^* \, t) \tag{7}$$

where δ_1 is the percentage rate of change of Lgs1 from time 1 to time *t* [23]

ρ^* is the "standard" rate of growth of productivity[24].

---

[22] $D(t)$ – which is an S-shaped function (a logistic or a Gompertz) – shows the cumulative share of total production of the sector affected by the technological revolution at period *t*. It varies from 0 to 1.

[23] Considering that I use differentiable functions, what I call "percentage" rate of change is indeed an "instantaneous" rate of change.

Moreover, in what follows, to simplify notations, I use the same symbol to refer to the double meaning of the percentage rates of changes, i.e.:

(i) the change with respect to the previous period (year), or

(ii) the average change from time 1 to time *t* when they are part of the exponential function *e*.

The context will show unambiguously which one of the two meanings applies. When, on the contrary, ambiguity is possible, the percentage rate of change with respect to the previous period is indicated by a dotted variable.

More explicitly, at any time t the rate of growth of the "standard" productivity with respect to the previous period is:

$$\rho^* = \Sigma_i \; \mu_i \; \rho_{(R)i} + \mu_j \; \rho_{tr} \qquad (8)$$

The shape of ρ^* differs according to the relative importance of the sectors involved with radical technical change. If these sectors cover a substantial and growing part of the economy – as in the case of pervasive new technologies – the evolution of ρ^* could be either constantly declining, as it is the case of the "pure" logistic curve, or, alternatively, bell shaped if the weight of the traditional sectors remains relatively important.

♦ *Total demand (value added)*

As we know, the output of the system is driven by the effects of radical product and process innovations. Concerning the former, we should distinguish the case of radical *product innovations* in existing industries from the case of innovations giving rise to new industries. In the first case the (completely) new product satisfies a need which was already met by another commodity. The old commodity is progressively substituted by the new one, and the contribution of the sector to aggregate output is the difference between the expanding output of the new commodity and the declining output of the old one. In the second case, product innovations which coincide with the creation of new industries satisfy a new need: therefore their output represents a net addition to aggregate output.

The effects of radical *process innovations* on demand are also positive and originate from a complex endogenous mechanism involving productivity, prices as well the price and income elasticities of demand for the products in question. Let us consider, at this purpose, the case considered above of a sector i which adopts a radically new technology. The productivity of the sector has a twofold effect on the demand for commodity i:

• a *specific*, or price effect: when productivity in sector i grows more than the average productivity of the system, the relative price of commodity i will decline and this will produce and increase in the demand for the commodity in question.[25] The price elasticity of demand for commodity i (ε_i) plays a crucial role because it reduces (when $\varepsilon_i < 1$), increases (when $\varepsilon_i > 1$) or does not affect (when $\varepsilon_i = 1$) the stimulus to demand as a result of a decrease in price;

• a *general*, or income, effect: the increase in productivity of the innovating sector pushes the average rate of change of productivity of the system upwards and, if wages are indexed to this average productivity, incomes and consumption rise. Each commodity will benefit from the increased purchasing power in a different way according to an Engel curve path (represented by the income elasticity of demand η_i)

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[24] For the construction of index numbers to compute the rates of change of the "dynamic standard commodity" see the interesting essay by Yagi (2012)

[25]   This basic relation between productivity and prices is based on the hypothesis that there are no monopolistic market structures and practices preventing downward price change.

(see Pasinetti 1981).[26] Obviously, the macroeconomic importance of the income effect depends on the share of total output taken by the sectors involved in the technological revolution. If this share is small the income effect will play a secondary role and the price effect will dominate.

In conclusion, and taking stock of previous research (Reati 1998; Fusari and Reati 2013), it could be posited that, all in all, total demand evolves according to an S-shaped path (the logistic function Lgs2)

$$D_T(t) = D_T(0) \exp(\beta_2 t) \tag{9}$$

where β_2 is the average percentage rate of change of Lgs2 from time 1 to time t

♦ *Wage rate (w)*

The previous analysis has already identified the factors determining the relative strength of social classes that enter into play for the process of wage fixing. Thus we can write

$$\dot{w} = f(\dot{L}; \rho^*; \dot{p}; IS) \tag{10}$$

where, to simplify, the wage rate is assumed uniform and, as already noted, a dot
  indicates the percentage rate of change over the previous period
  L is employment, and p is the index of the general price level

Comparing the equation above with the usual Phillips curve one observes that changes in the unemployment rate (with minus sign) are replaced by the percentage change of employment. To see the meaning of this substitution let us define the level of unemployment (U)

$$U = L_T - L \tag{11}$$

where L_T is total labour force

Assuming L_T constant, the percentage rate of change of the unemployment rate (u) is

$$\dot{u} = -\dot{L} \tag{12}$$

For Screpanti (1996; 2000) this substitution has a deeper meaning. He argues that wage claims are fixed by insiders (those who have a job), not by outsiders (the unemployed) and that the workers' bargaining strength is inversely related to the fear of losing their jobs. This fear increases when business is going badly and employment decreases, even if unemployment is low. In the same way, even with high unemployment the probability for a worker to be fired would be low if business conditions were improving (Screpanti 1996, p. 96). Thus the relevant variable to explain the wage dynamics is the fluctuations of employment rather than the changes in the unemployment rate. To this one could add that, dynamically, the increase in employment can lead to tight labour markets which favour wage increases.

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[26] To be complete, we should consider that the rate of change of demand is also influenced by the rate of growth of population, which increases the demand for each commodity in a uniform way. This element is not considered here for sake of simplicity (in European countries, for instance, the population is fairly stable).

Formula (10) can be specified as follows:

$$\dot{w} = b\dot{L} + c\dot{\rho}^* + d\dot{p} + IS \tag{13}$$

Parameter b is the elasticity of wages with respect to employment change; parameter c shows the degree to which workers benefit from productivity increases and parameter d refers to the importance of the link between wages and inflation. All change over time because they depend on the state of power relations between social classes. Consider, for instance, parameter b. During the depression phase of the long wave – when the workers' movement is very weak – b approaches to zero; it increases substantially during the long expansion, reaching its maximum level toward the end of this phase. Parameters c and d deserve a comment.

For the purpose of the present investigation, it would be convenient to assume that the dynamic of the wage rate is associated with the growth of the "standard" rate of productivity, for two reasons. First, if, as already noted, there are no monopolistic market structures and behaviours, this hypothesis implies that the general price level remain stable: the prices of the sectors having a productivity growth higher than the "standard" one will decline, and viceversa for the sectors with a productivity growth less than the average (Pasinetti 1981). Thus real and nominal wage rates coincide. Secondly, as said before, this systematic link between wages and the "standard" growth of productivity conforms to social fairness. In practice this means that, in equation (13), parameter $c = 1$ and $d = 0$. Thus, the specification of formula (10) that I will retain here is:

$$\dot{w} = b\dot{L} + \rho^* + IS = \sigma \tag{14}$$

and its evolution is:

$$w(t) = w(0) \exp(\sigma t) \tag{15}$$

Let us recall here that in formula (14) σ refers to the percentage change with respect to the previous period while, in formula (15) it concerns the average rate of change from time 1 to t. This also holds for the components of σ (form. 14).

♦ *Employment (L)*
For the economics system – as well as for individual sectors – the percentage change of employment is the difference between the changes in demand and productivity:

$$\dot{L} = \dot{D}_T - \rho^* = \beta_2 - \rho^* = \Lambda \tag{16}$$

The evolution over time is obtained on the basis of formulae (9) and (7):

$$L(t) = L(0) \exp(\Lambda) t = L(0) \exp[(\beta_2 - \rho^*) t)] \tag{17}$$

As such, equation (17) cannot predict the final outcome in terms of employment. In fact, the rates of change of total demand are always positive (demand grows under the double effect of radical product and process innovations), giving a positive impulse to employment, but the productivity effect will compensate this effect. However, some conclusions can be drawn by considering the different kinds of radical innovations during the phases of the long wave (Reati 1998, pp. 69-70).

Consider first *process innovations*, under the hypothesis that the new technology is pervasive. This technological revolution has two effects on the level of employment in the economic system: a general effect, with positive repercussions on employment, and a specific effect, with neutral or negative repercussions.

Concerning the latter, the sectoral analysis carried on elsewhere (Reati 1998, cit.) has shown that total employment displays a long-term positive trend only when the price and income elasticities of demand are high (greater than one). Since empirical evidence indicates that such high values of the elasticities appear only in a few cases, one can expect that, for the whole economic system, the trend will be flat or at best slightly positive, with a more or less pronounced cycle due to the capital goods sector.

The general effect stems from the increase in aggregate demand resulting from the positive influence of the technological revolution on the "standard" growth rate of productivity and on wages. In such circumstances, total employment will be underpinned by the sectors not concerned by radical technical change. In fact, their demand will increase, but this will not be offset by an analogous increase in productivity, which continues to grow at the trend rate. The magnitude of this effect depends on the relative importance of the sectors in question with respect to the total economy.

For *product innovations* the outcome is well defined, in the sense that, even when process innovations also extend to the manufacture of new products, we can expect a positive effect on employment.

In conclusion, one can tentatively say that, during the long stagnation, the "specific" (or price) effect will prevail while, during the long expansion, the main stimulus will come from the demand side. To be more precise :

- in the depression phase of the long stagnation employment will be roughly stationary, for three reasons:
  - process innovations in existing industries will not contribute appreciably to the growth of employment;
  - the same will be true of product innovations in existing industries. The new products, in fact, replace some old ones and, in any case, their relative importance is rather weak because they are at the beginning of the product life-cycle;
  - the demand effect is also rather weak, especially during the first years of the phase;
- during the recovery phase employment will increase under the impact of product innovations in new industries, which will be reinforced by the same type of innovations in existing industries. To this has to be added the demand effect, which has meanwhile gained momentum.

3. Results: social relations and inequality

To derive an analytical expression of the evolution of inequality let us start from formula (2). Inserting formula (3), at time t we have:

$$INEQ(t) = \frac{VA(t) - W(t)}{VA(t)} = 1 - \frac{W(t)}{VA(t)} = 1 - \frac{w(t)\,L(t)}{D_T(t)}$$

Write now the equation for the *wage bill* (W)

$$W(t) = w(t)\,L(t) = w(0)\,\exp(\sigma\,t) \bullet \{L(0)\,\exp(\beta_2 - \rho^*)\,t)\} \qquad (18)$$

and consider first the wage share (W/VA). Taking into account formulae (9) and (18) we have

$$\frac{W(t)}{VA(t)} = \frac{w(0)\exp(\sigma t)\,L(0)\exp(\beta_2 - \rho^*)t}{D_T(0)\exp(\beta_2 t)} = \frac{w(0)\,L(0)\exp(\sigma t)\exp(\beta_2 t)\exp(-\rho^* t)}{D_T(0)\exp(\beta_2 t)} =$$

$$= \frac{W(0)\,\exp(\sigma - \rho^*)}{D(0)}$$

The inequality index becomes:

$$INEQ(t) = \frac{D_T(0) - W(0)\exp(\sigma - \rho^*)t}{D_T(0)} \qquad (19)$$

To develop this further, take formula (14) and, instead of expressing it in terms of percentage rates of change with respect to the previous period, extend it to the percentage change from time 1 to time *t*. On the basis of my previous convention, I have just to replace the term $b\dot{L}$ with bλ, i.e.

$$\sigma(t) = b\lambda(t) + \rho^*(t) + IS(t)$$

Substituting into formula (19) and simplifying by ρ* we finally obtain

$$INEQ(t) = \frac{D_T(0) - W(0)\exp(b\lambda + IS)t}{D_T(0)} \qquad (20)$$

This result is remarkable, because it shows analytically that the evolution of inequality depends exclusively from the relative strength of social classes, as formalized by the dynamics of employment and the state of the institutional setting in which the power relations of society are grounded.

It is also worth noting that productivity does not enter directly into play. In fact, if the link between the wage dynamics and the "standard" productivity holds, productivity growth affects in the same way output and wages, with the result that it neutral with respect to the dynamics of inequality. This emphasizes the importance of having an institutional set favouring the implementation of the link in question for the already mentioned reasons of social justice and equilibrium.

V. Conclusion

In this paper I have tried to explain the mechanisms which generate inequality in income distribution in the course of structural change. As it emerges from the history of capitalism, structural change results essentially from the technological

revolutions that have generated "great surges of development" – a sequence of long-term expansionary periods of about 25-30 years followed by long stagnations of similar length. They are the so called long waves. These economic movements are accompanied by large fluctuations in income distribution which can be summarized as follows: (i) during the depression phase of the long wave inequality in income distribution is high, (*ii*) inequality is progressively and substantially reduced during the prosperity phase, (*iii*) inequality starts increasing again during the recession phase of the wave. These stylized facts are confirmed by the statistical evidence presented in section II.

To identify the causes of the level and long-term fluctuations of inequality, I argue that we should look at the power relations in society, where structural change creates the objective conditions for the unfolding of the social struggles that put into question the *statu quo*. Formally, the evolution of social relations – and the degree of the inequality that results – could be represented as depending on two variables which reflect the respective power of social classes: the degree of unemployment and the institutional set of society (section III).

More precisely, in the *long stagnation* social relations are very unfavourable to workers. Unemployment reaches its peak, Unions are very weak and the institutional setting is designed to support the interests of the ruling classes. This is also the typical period when the capitalist class strive against workers' rights. The *upswing* marks the advent of a substantial shift in the power relations. As a direct consequence of the general economic expansion, demand for labour grows and the ensuing progressive decrease in unemployment boosts the Union's strength. It follows a revival of workers militancy and social conflicts which affect wages as well as institutions. Toward the end of the long expansion enterprises are confronted with tight labour markets, a situation which implies that wages can increase more than productivity. The social movements characterizing this phase also have implications on the institutional set: workers improve their position in the enterprise – recovering the rights they lost during the long stagnation – and the labour legislation become more progressive. The overall result of all this movement is that the end of long expansion the balance of powers is in favour of the working class and, consequently, inequality reaches its minimum. At the end of this phase (the recession) the balance of powers begins to shift again in favour of capitalists. This dynamics is substantially confirmed by the historical evidence on the first four long waves in the main capitalist countries, which shows a long-wave pattern of social struggles.

The present situation is particularly worrying. In the European Union and in the US we had a technological revolution that ought to have preluded to the fifth long wave. However, the long upswing never appeared in Europe because of the austerity policy implemented, with different motivations, since the 1970s while in the US the situation does not yet allow to reach a firm conclusion. As a result, in both Europe and the US inequality has now reached unbearable levels (see fig. 2, for the US case). Poverty is widespread and, from an objective point of view, many European countries are in a pre-revolutionary situation.

Workable proposals to reform capitalism are numerous, and they spring not only from radicals but also from a fraction of the enlightened bourgeoisie.

Unfortunately what is terribly lacking is the class consciousness, the only mean that could produce actions to go out of the present deadlock.
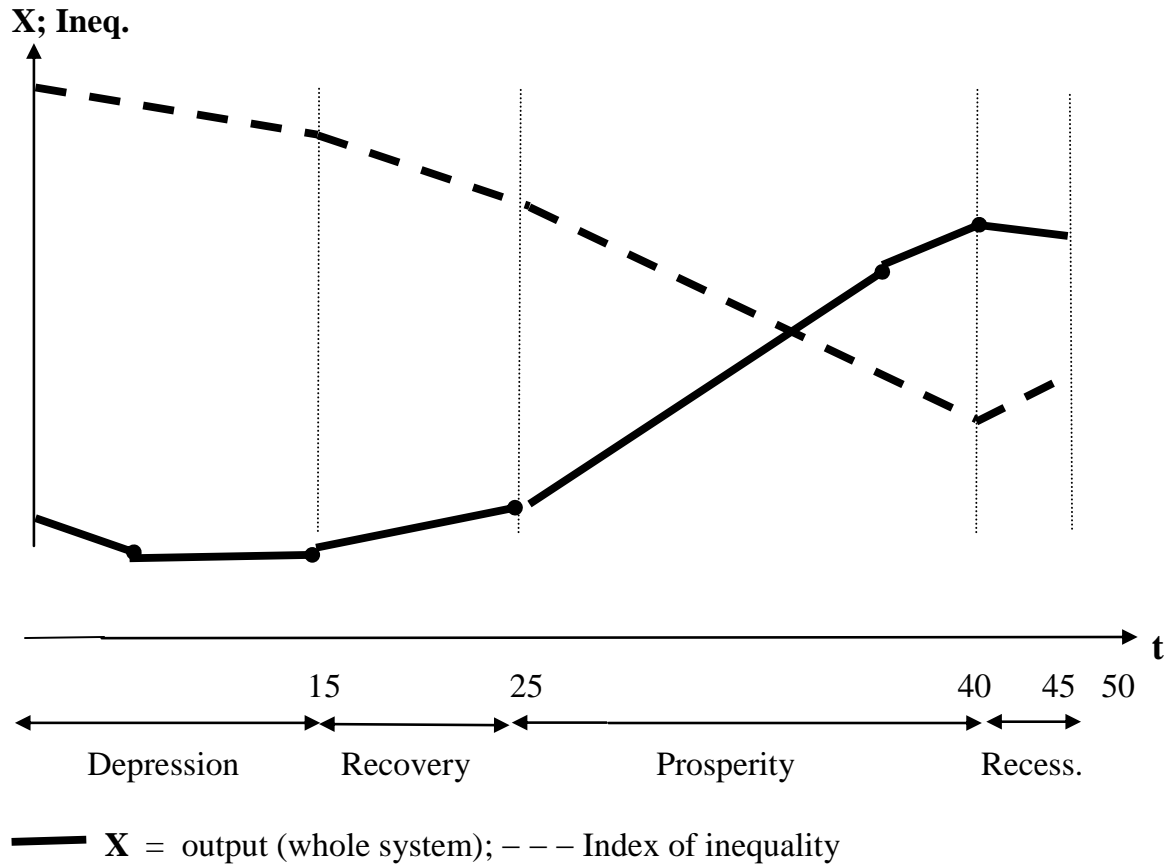
References

Aglietta, Michel 1976. *Régulation et crises du capitalisme. L'expérience des États-Unis*, Calmann-Lévy, Paris. 2nd edition 1997, published by Odile Jacob, Paris

Aizenman, Joshua, Lee, Minsoo and Park, Donghyun 2012. Thee Relationship between Structural Change and Inequality: A Conceptual Overview with Special Reference to Developing Asia, *Asian Development Bank Institute Working Paper* No. 396, November

Atkinson, Anthony B. 2005. Top incomes in the UK over the 20th Century, *Journal of the Royal Statistical Society*, vol. 168, Part 2, pp.325-343

Atkinson, Anthony B., Piketty, Thomas. Saez, Emmanuel 2011. Top incomes in the Long Run of History, *Journal of Economic Literature*, vol. 49, n. 1, pp. 3-71

Dosi, Giovanni 1984. Technological paradigms and technological trajectories. The determinants and directions of technical change and the transformation of the economy, in: Freeman, Christopher (editor) 1984. *Long Waves in the World Economy*, F. Pinter, London

Falkinger, Josef 1987. Technological unemployment: a note on Pasinetti, *Journal of Post Keynesian Economics*, Fall, vol. X, n.1 pp. 37-43

Fatás-Villafranca Francisco, Jarne Gloria and Sánchez-Chóliz Julio 2012. Innovation, cycles and growth, *Journal of Evolutionary Economics* vol. 22, n. 2 April, pp. 207-233

Freeman, Christopher (editor) 1996. *Long Wave Theory*, E. Elgar, Cheltenham

Freeman, Christopher and Louçã, Francisco 2001. *As Time Goes By. From the Industrial Revolutions to the Information Revolution*, Oxford University Press, Oxford

Fusari Angelo and Reati Angelo 2013. Endogenizing technical change: Uncertainty, profits, entrepreneurship. A long-term view of sectoral dynamics, *Structural Change and Economic Dynamics*, vol. 24, March, pp. 76-100

Louçã Francisco and Reijnders Jan (editors) 1999 *The Foundations of Long Wave Theory. Models and Methodology*, E. Elgar, Cheltenham

Lundvall, Bengt-Åke (editor) 1992. *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*, Pinter Publishers, London

Mallick, Sushanta K. and Sousa, Ricardo M. 2012. Is Technology Factor Neutral? Evidence from the US Manufacturing Sector, Universidade do Minho, Nucleo de Investigação em Politicas Economicas, Working Paper Series NIPE WP 26/2012

Mensch, Gerhard 1979. *Stalemate in Technology. Innovations Overcome the Depression*, Ballinger, Cambridge (Mass.)

Metz, Rainer 2011. Do Kondratieff waves exist? How time series techniques can help to solve the problem, *Cliometrica*, vol. 5, n.3, pp. 205-238

Mohun, Simon 2013. Rate of Profit and Crisis in the US Economy: A Class Perspective, in: Taylor Lance, Rezai Armon, Michl Thomas (Eds) 2013. *Social
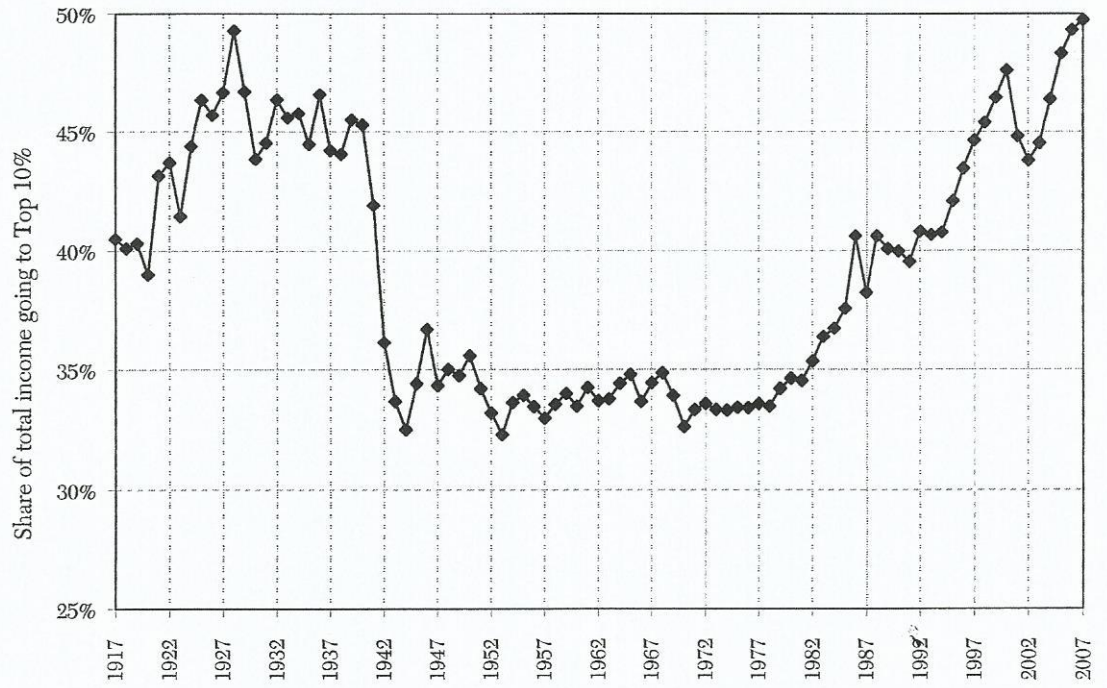
Fairness and Economics. Economic Essays in the Spirit of Duncan Foley, Routledge, London

Morrisson Christian and Snyder Wayne 2000. Les inégalités de revenus en France du début du XVIIIe siècle à 1985, *Revue Economique*, vol. 51, n. 1, January, pp. 119-154

OECD 1999. *Employment Outlook*, June, OECD, Paris, chapter 2

Pasinetti, Luigi L. 1981. *Structural change and economic growth. A theoretical essay on the dynamics of the wealth of nations*, Cambridge University Press, Cambridge

Perez, Carlota 2002. *Technological Revolutions and Financial Capital. The Dynamics of Bubbles and Golden Ages*, E. Elgar, Cheltenham (UK)

Perez, Carlota 2009. The double bubble at the turn of the century: technological roots and structural implications, *Cambridge Journal of Economics*, vol. 33, n. 4, July, pp. 779-805

Petit, Pascal 2010. The systemic nature of the rise in inequality in developed economies, *International Review of Applied Economics*, vol. 24, issue 3, pp. 2051-267

Piketty, Thomas 2003. Income Inequality in France, 1901-1998, *Journal of Political Economy*, vol. 111, n.5, pp.1004-1042

Piketty, Thomas and Saez, Emmanuel 2003. Income inequality in the United States, 1913-1998, *The Quarterly Journal of Economics*, vol. CXVII, Issue 1, February, pp. 1-39

Reati, Angelo 1998. A Long-Wave Pattern for Output and Employment in Pasinetti's Model of Structural Change, *Economie Appliquée*, tome LI, n. 2, pp. 29-77

Reati, Angelo 2012. The economic policy for structural change. An outline and the missed opportunities, paper presented at the Cambridge Conference in honour of L. Pasinetti, Cambridge 12-13 September

Reati, Angelo and Toporowski, Jan 2004. An economic policy for the fifth long wave, *Banca Nazionale del Lavoro Quarterly Review*, vol. LVII, n. 231, December, pp. 395-437

Rosier, Bernard and Dockès, Pierre 1983. *Rythmes économiques. Crises et changement social, une perspective historique*. La Découverte/Maspero, Paris

Schumpeter, Joseph A. 1939. *Business Cycles. A Theoretical, Historical, and* Screpanti, Ernesto 1984. Long Economic Cycles and Recurring Proletarian Insurgencies, *Review*, vol. 7, n. 2, pp. 509-548, reprinted in F. Louçã and J. Reijnders (editors) 1999, pp. 139-178

Screpanti, Ernesto 1987 a. Long Cycles in Strike Activity: an Empirical Investigation, *British Journal of Industrial Relations*, Vol. XXV, N. 1, March, pp. 99-124

Screpanti, Ernesto 1987 b. Cicli lunghi del conflitto di classe in alcuni paesi capitalistici, 1800-1980, *Rivista di Storia Economica*, vol. 4, n. 1, February, pp. 92-118

Screpanti, Ernesto 1994. *Cicli lunghi del conflitto di classe*, Edizioni Punto Rosso, Milano

Screpanti, Ernesto 1996. A Pure Insider Theory of Hysteresis in Employment and Unemployment, *Review of Radical Political Economics*, vol. 28, n. 4, pp. 93-112

Screpanti, Ernesto 2000. Wages, Employment, and Militancy: A Simple Model and Some Empirical Tests, *Review of Radical Political Economics*, vol. 32, n. 2, pp. 171-196

Thompson, William R. 1990. Long waves, technological innovation, and relative decline, *International Organization*, vol. 44, n. 2 pp. 201-233

Tridico, Pasquale 2012. Financial crisis and global imbalances: its labour market origins and the aftermath, *Cambridge Journal of Economics*, vol. 36, n. 1 January, pp. 17-42

Van Duijn, Jacob J. 1983. *The long wave in economic life*, Allen and Unwin, London

Vivarelli, Marco 2011. *Innovation, Employment and Skills in Advanced and Developing Countries. A Survey of the Literature*, Inter-American Development Bank, Science and Technology Division, Social Sector, Technical Notes No. IDB-TN-351, December

Voigt, Stefan 2013. How (Not) to measure institutions, *Journal of Institutional economics*, vol. 9, n. 1, March, pp. 1-26

Yagi, Takashi 2012. Structural change and invariable standards, in: Arena, Richard and Porta, Pier Luigi (Eds): *Structural Dynamics and Economic Growth*, Cambridge University Press, Cambridge, pp. 241-263

You, J.-I. 1994. Macroeconomic structure, endogenous technical change and growth, *Cambridge Journal of Economics*, vol. 18, n. 2 pp. 213-233

Zweimüller, Josef 2000. Schumpeterian Entrepreneurs Meet Engel's Law: The Impact of Inequality on Innovation-Driven Growth, *Journal of Economic Growth*, n. 5, June, pp. 185-206

Fig. 1 – Inequality during the long wave

X; Ineq.

Depression   Recovery   Prosperity   Recess.

X = output (whole system); − − − Index of inequality

Fig. 2 – The Top Decile income share in the United States 1917-2007

Source: Piketty and Saez 2011, p. 6

Fig. 3 – Radical process innovations

Productivity level of the individual innovator
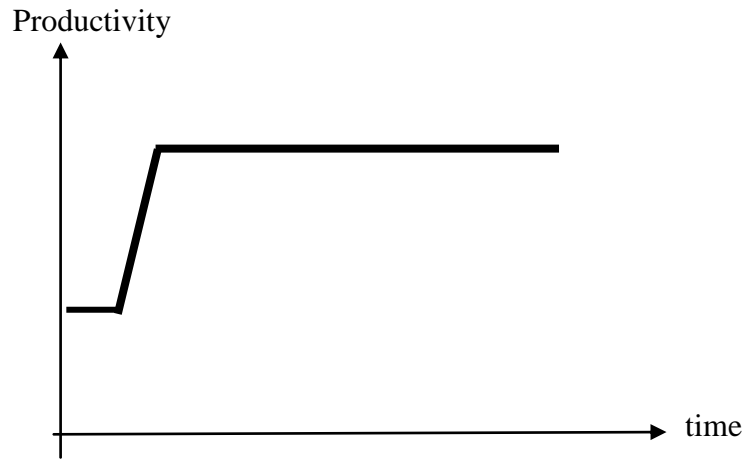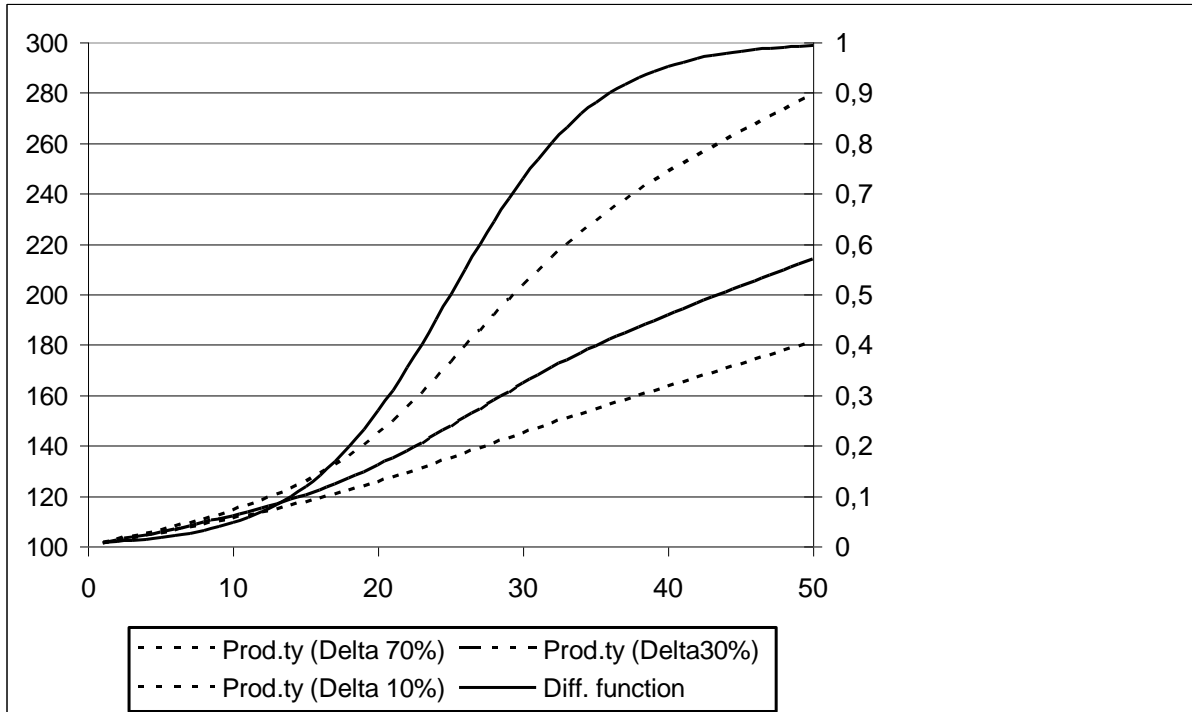
Productivity

time

Fig. 4 – Diffusion function and productivity of labour in sector *i*
according to the different strength of the technological revolution

D(t) = diffusion function (logistic)