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An economic policy for the fifth long wave

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In the first part of this paper we recall the main features of the long-waves theory, a theory that, at the present stage of development of economic thought, is in our view the most valuable to understand the present situation and, consequently, offers the best guidance for economic policy. In the second part we shall outline some possible policy implications that can be derived from such an approach.

1. The long waves in economic development

1.1 The facts

A growing number of economic historians agree that long-term economic development of capitalist economies is an uneven phenomenon: periods of sustained growth of output and trade of about 25 to 30 years are followed by periods of slow or stagnating growth of analogous duration. Similar movements also appear in prices and other monetary variables. Up to now Western economies experienced four long waves

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TABLE 1 - *Condensed summary of the Kondratiev waves*

Constellation of tecnical and organisational innovations (1)	Examples of highly visible, technically successful, and profitable innovations (2)	'Carrier' branch and other leading branches of the economy (3)	Core input and other key inputs (4)	Transport and communication infrastructure (5)	Managerial and organizational changes (6)	Approx. timing of the 'upswing' (boom) 'downswing' (crisis od adjustment) (7)
1.Water-powered mechanisation of industry	Arkwright's Cromford mill (1771) Henry Cort's 'pudding' process (1784)	Cotton spinning Iron products Water wheels Bleach	Iron Raw cotton Coal	Canals Turnpike road Sailing ship	Factory systems Entrepreneurs Partenership	1780s-1815
						1815-1848
2. Steam-powered mechanisation of industry and transport	Liverpool-Manchester Railway (1831) Brunel's 'Great Western' Atlantic steamship (1838)	Railways and railway eqipment Steam engines Machine tools Alkali industry	Iron Coal	Railways Telegraph Steam ships	Join stock compagnie Subcontracting to responsible craft workers	1849-1873
						1873-1895
3.Eelectrification of industry, tran sport, and the home	Carnegie's Bessemer steal rail plant (1875) Edison's Pearl St. New York Electric Power Station (1882)	Electrical equipment Heavy engineering Heavy chemicals Steel products	Steel Copper Metal alloys	Steel railways Steel ship Telephone	Specialized professional management system 'Taylorism' Giant firms	18985-1918
						1918-1940
4. Motorisation of transport, civil Economy and war	Ford's Highland Park assemby line (1913) Burton process for cracking heavy oil	Automobiles Trucks Tractor, Tanks Diesel engines Aircraft Refineries	Oil Gas Synthetic materials	Radio Motorways Airports Aairlines	Mass production and consumption 'Fordism' Hierarchies	1941-1973
						1973-[(1992)]*
5. Computerisation of entire aconomy	IBM 1401 and 360 series (1960s) Intel microprocessor (1972)	Computers Software Telecommunication equipment Biotechnology	'Chips' (integrated circuits)	'Information Highways' (Internet)	Networks: internal, local and global	[(1992)]* …….

and at present we entered into the fifth one. Table 1 summarises these movements.[1]

Long waves start in some "core" countries, or technological leaders, and then spread to other economies, reaching the less developed regions only later on. As table 1 indicates, the first long wave originated from the early mechanisation (the industrial revolution); the technological leaders were Britain, France and Belgium, followed by the German states and the Netherlands. The second long wave was the era of steam power and railways, the technological leaders being the same as the first long wave plus Germany and the USA, and the followers were Italy, the Netherlands, Switzerland and Austria-Hungary. The third long wave was the era of electrical and heavy engineering. The earlier leaders succeeded in keeping their position, a position that they shared with Switzerland and the Netherlands that were thus "upgraded" with respect to the previous wave. Italy and Austria-Hungary continued to play the role of followers, joined by Canada, Japan, Russia and two European Nordic countries (Sweden and Denmark). It was during this wave that Taylorism appeared. The fourth long wave was the era of mass production (the Fordism).[2] that spread all over Western Europe, the USA, USSR, Japan and Australia. The followers were located in Eastern Europe, Asia (Korea, China, India Taiwan), as well as in Central and South America (Mexico, Brazil, Argentina, Venezuela). The present fifth long wave is produced by the computerization of the entire economy and the information and communication technologies (ICT). The technological leaders are Japan, the USA, the European countries, Canada, Australia, Korea and Taiwan. The followers are numerous and include all those of the previous wave plus some other Asian countries (Indonesia, Pakistan) and very few African countries (Nigeria, Algeria, Tunisia).

Of course, each historical period is unique but, in spite of these peculiarities, "there is a certain sequence of events that recurs about every half century" (Pérez 2002, p. 17) – i.e. technological revolutions,

[1] See also Freeman and Pérez (1988, Table 3.1, pp. 254-61).

[2] The "Fordist" system originates from Henry Ford's intuition that, to make profits, the best customers for his products should be his workers. The system combines mass production with mass consumption. See later.

financial bubbles, collapses, golden ages, political unrests. This opens the possibility to construct a theory that explains the causes and mechanisms of the common characteristics of each long-term movement, and that also offers guidance for economic policy. We shall come back to this after discussing some theoretical and methodological aspects.

1.2 The Classical roots of the long-wave theory

Growth – and its uneven unfolding – was one of the main concerns of classical economists (Smith, Ricardo, Malthus, Marx), but the long-term oscillatory pattern of prices and output also attracted the attention of some of the founders of marginalism, such as Jevons (who in 1884 analysed the long-term fluctuations in prices) and Clark. They were joined by other exponents of the marginalist school (particularly, in 1913, Pareto, Bresciani Turroni, Aftalion) so that, at the beginning of the 20th century, there was a consensus among many economists on the reality of what was later called the long wave.

However, the gradual ascendancy of the neoclassical theory – culminating with the model of general equilibrium – diverted attention from growth and its irregularities. When the theory of growth returned to the forefront of interest in the 1950s, the focus was on conditions for regular growth (the "steady state"). The business cycle was not ignored, but it was treated within the conceptual framework of equilibrium, on the basis of the "rocking horse" metaphor. According to this metaphor, the economic system tends spontaneously to equilibrium. Cycles are exogenous perturbations produced by random shocks (impulse generation), which trigger an endogenous propagation mechanism with stabilizing properties. This provides the rationale for separating growth and fluctuations, that is, for decomposing the movement of an economic system into trend and cycle. Trend is conceived as the loci of equilibria – a moving centre of gravitation – while cycle is restricted to the analysis of the stochastic error term of series and to the properties of the equilibration mechanism.[3]

[3] For a thorough discussion see Louçã (1997).

Long-wave theory – also known as the Kondratiev's long cycles – sprang from the classical approach, particularly from Marxian analysis, whose focus on the general laws governing capitalism in the long run provided a fertile ground for its appearance. Thus it is not by chance that the pioneers (Parvus, 1901, van Gelderen, 1913; de Wolff, 1924) belonged to such a school. Although the long-wave phenomenon was already acknowledged in the 19th century, Kondratiev amassed the first substantial empirical evidence in 1925. Kondratiev's contribution on the causes of the "long cycle," was rather weak. Schumpeter, in his Business Cycles, filled the gap in 1939. The systematic explanation he gave is based on technological revolutions and their diffusion. Radical process and product innovations − noted Schumpeter − do not appear at random, but they bring together a bundle of other incremental and fundamental innovations, triggering a "creative destruction" that generates growth while renewing entirely the structure of society.

The last three decades saw a flourishing literature that developed Schumpeter's insights, studying particularly the motives and mechanisms of innovations as well as their systemic and institutional components.[4] Three features of the system, which interact with one another, are at the roots of the recurring sequence of waves:

− the fact that technological change occurs by clusters of radical innovations forming successive revolutions that modernise the whole productive structure;

− the functional separation between financial and production capital, each pursing profits by different means; and

− the much greater inertia and resistance to change of the socio-institutional framework in comparison with the technoeconomic sphere, which is spurred by competitive pressures (Pérez, 2002, p. 6).

1.3 The debate

Economists are divided on the nature and interpretation of the long-

[4] See, for instance, the collected readings in Freeman (1996) and Louçã and Reijnders (1999). See also Tylecote (1992 and 1994).

wave phenomenon, and for many of them this is a matter that has still not been settled. Two areas are object of intense debate. First, on the facts – are long waves a real phenomenon? Second (given the first), what is the nature of the long-term movement?

a) The first problem arises because econometric research from the 1980s onwards does not give unambiguous support to the existence of long waves in output. A long list of empirical works leading to contradictory results could be cited.[5] Studies by Metz (1992) illustrate the difficulties of drawing sustainable conclusions from the available data. In 1992, using new filtering techniques, this author presented robust evidence on the existence of long waves. In 1996, relying on different econometric techniques, he was unable to detect a long wave movement in the same data he used for his 1992 research (output series for Germany; Metz, 1996).

Freeman and Louçã (2001) discuss this methodological question by considering two classes of models: i) the traditional statistical and econometric analysis and ii) simulations from formal models. The first type of models identifies long waves by separating the cycles from the trend on the basis of several techniques (moving-average smoothing techniques, growth rate computation, spectral analysis). Freeman and Louçã criticize this approach on two grounds – theoretical and technical. On the theoretical level they observe that the rationale for separating growth and fluctuations is based on the general equilibrium paradigm and the "rocking horse" metaphor – something that implies a number of strong and unrealistic assumptions on the nature of the trend (trend is deterministic and is related to equilibrium; it is stable over very long periods; trend and cycle are independent). However, if the trend is stochastic and/or influences the cycle, then the breakdown is indeterminate (Louçã, 1997, p. 192).[6]

At the technical level the influence of a trend needs to be removed

[5] See Freeman (1996, part IV) and Louçã and Reijnders (1999, part II).

[6] This latter point has been demonstrated by Pasinetti (1981, pp. 232-36), who showed that the structural dynamics of the economy (technical change and new patterns of demand) – which establishes the trend – also generates the cycle as an inevitable consequence.

from time-series data, since the usual statistical techniques to identify long waves require that series be stationary. The problem is that the detrending procedures of the original data are not neutral with respect to the results on the existence of cycles: "the smoothing techniques may create artefacts" (Freeman and Louçã, 2001, p. 99). This criticism also applies to spectral analysis – one of the most sophisticated techniques to study long waves.[7] There are other, specific problems with spectral analysis. They result, for instance, from the relative shortness of the available data series (that usually cover 200-250 observations, which is insufficient for a correct application of the method in question), and from the requirement in the analysis for a regular amplitude of cycles. This last is not found in reality and is not necessary for the existence of long waves.[8]

The second type of models (the simulation models) was developed in the 1970s by Forrester (1977), from MIT, and consists of constructing a mathematical model that mimics the evolution of real aggregate economic series. The resemblance between the computed and the historical series is deemed sufficient proof of the causal links identified by the long-wave theory. Although recognizing the interest of this approach, one can argue that it suffers from serious limitations

"since simulation is not demonstrative proof […] Models are useful

[7] Spectral analysis is a method to discover the hidden periodicity of a time series. This kind of series can be thought as the sum (or "spectrum") of a large number of independent sine functions with different amplitudes. In economics, these superposing trigonometric functions refer to cycles of different length. For output, for instance, we have short-term cycles of 3-5 years (the Kitchin, or inventory cycles), the medium-term cycles of 7-11 years (the Juglar, resulting from investments in machinery), the longer 15-25 year cycles (the Kuznets, resulting from investment in construction), the 50-60 years long waves (the Kondratiev). Each cycle contributes to the total variance of the series. Spectral analysis consists in decomposing the total variance of the series into the contribution of individual cycles (the frequencies of the sine function), thus allowing the simultaneous estimation of the relative importance of cycles of different duration.

[8] Within this context Freeman and Louçã address the question of the a priori elimination of the impact of the war periods, that can be seen as "disturbances" in the normal structure of data. According to some empirical studies (e.g. Metz, 1992), only the interpolation for these periods allows the existence of long waves to be confirmed. Freeman and Louçã condemn such a procedure since "erasing part of history is not a method to study history" (Freeman and Louçã, 2001, p. 116).

> metaphors for the creation of hypotheses in order to analyze reality, but they are not the reality itself, nor can they reproduce it" (Freeman and Louçã, 2001, p. 117).

Thus we 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 the 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: "the fundamental [...] [laws] still apply as time goes by" (Freeman and Louçã, 2001, p. 122), even though each period has its own unique characteristics that Kronos swallows forever.

b) The second problem concerns the alleged quasi-cyclical pattern of long waves. Some maintain that what are called long waves (or long cycles) are instead phases of capitalist development – i.e. structural change – that, as such, have unique and unrepeatable characteristics (Maddison, 1981; Solomou, 1987). In particular, long waves would be correlated with the rise and decline of an international hegemonic power: UK in the 19th century and the beginning of the 20th, the US afterwards (Arrighi, 1994).

All 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 four long waves that we experienced since the industrial revolution, and that are summarized in Table 1. The driving forces and mechanisms of this stable causal structure provide the theoretical framework for analyzing the economic development of the last two centuries.

1.4 The unifying characteristics of long waves

In fact, two recurrent phenomena justify the concept of "wave" rather than simply "stages" of capitalist development: *i)* the technological revolutions that are at the root of each wave (see table 1) and *ii)* the structural crises of adjustment. On the first point, historical experience allows the following generalizations (Pérez, 1983 and 2002; Freeman and Louçã, 2001, pp. 147-48):

− each long wave relies on the availability of one or more key factors − or "core inputs" − (iron, coal, steel, oil, electronic chips) that are supplied at low and falling relative cost in almost unlimited quantities over long periods and have a potential for use in many products and processes throughout the economic system. The sectors producing these core inputs (the "motive branches") became major industries with each successive wave;

− the new products based on the core inputs and some complementary inputs stimulate the rise of other new industries ("carrier branches"), whose rapid growth and great market potential give a strong impetus to the growth of the entire economy. A process of cumulative growth can start, reinforced by the other branches that follow in the wake of the leading sectors (the "induced growth branches");

− new infrastructures are needed to serve the new industries and this, in turn, stimulates the further growth of both motive and carrier branches;

− the structural change arising from the technological revolution requires organizational innovations needed to design, produce, use and distribute the new products and processes. Gradually new "common sense" rules for managing and organizing the new technology emerge through trial and error and extend from new industries to the old ones. It is what is called a new "techno-economic paradigm," or "new technological style."

The second point (the crises of adjustment) relates to the fact that the take-off and the generalization of the new "techno-economic paradigm" are far from being a smooth process, as they entail acute social conflicts. In fact, the new paradigm starts its diffusion during the long stagnation – when the old paradigm has exhausted its possibilities. During this period,

strong vested interests, habits, routines, cultural norms and regulations associated with the previous paradigm oppose change. The downswing of the long wave is thus a period of great turbulence and conflict, characterized by a mismatch between the techno-economic subsystem and the institutional structure.[9] Tylecote (1994, p. 484) distinguishes three types of mismatch: *i)* microeconomic, if the organisation of the firm is unsuited to the new technological paradigm; *ii)* macroeconomic, when the diffusion of the new technological style goes together with the development of imbalances, particularly income inequalities that prevent the required expansion of consumer demand; *iii)* sociopolitical mismatch, such that a sociopolitical crisis arises out of the diffusion of the new style. The downswing is overcome only when a new institutional structure replaces the old one, bringing the system towards a period of stability and growth.

This is really a crucial point – a point that echoes the Marxian analysis of the contradictions of capitalism as sources of crisis,[10] and that distinguishes the long-wave theory from technological determinism. In the uneven process of structural change that characterizes the incipient long wave at the international level, the winners are the countries that adapt their institutions more rapidly to the requirements of the new techno-economic paradigm. The countries that do not succeed in adopting the appropriate institutional changes would be excluded from the benefits of the new techno-economic paradigm; others that adapt slowly or insufficiently would delay the appearance of the new long wave.[11] In this sense the long wave theory is not a forecasting tool, social evolution

[9] The term "institutional structure" should be understood in a broad sense, including not only regulation, norms and standards, but also the system of social relations, the national and international financial structure, etc. It corresponds to what the French school of régulation call a "régime de régulation" (Aglietta 1997; Boyer and Saillard, 1995).

[10] See on this Screpanti (1984); Rosier and Dockès (1983). In his Marxist interpretation of long waves Mandel (1995) too puts great emphasis on the social conflicts resulting from the contradictions accumulated during the long expansion as one of the main causes of the upper turning point of the wave.

[11] On the risks of a failure of the "new economy," see Freeman (2001). O'Hara (2002 and 2003) explains that a new long wave upswing has not yet emerged in the US because appropriate institutional adaptations are still lacking.

being an open-ended process.

To facilitate the understanding of the proposals of part 2 of this paper, it is useful to explain the role of financial capital and give more details on the different phases of the longwave.

1.5 Technological revolutions and finance capital[12]

Pérez (2002) pushes forward the theoretical frontier of long waves by investigating the financial aspects – a task that is fulfilled by combining economic analysis, sociology and history. In this way she is able to clarify the mechanisms explaining why, at a certain period of the installation phase of the new technological paradigm, financial capital progressively abandons its instrumental role with respect to productive capital and becomes the dominant player of the game. Instead of being a facilitator for the accumulation of productive assets, financial capital assumes an independent life, decoupled from productive activity, and directs the economy according to its interests and criteria. The complex – and sometimes conflicting – relationships between financial and productive capital can be better understood by referring to the four phases of each technological revolution as are depicted in Figure 1.

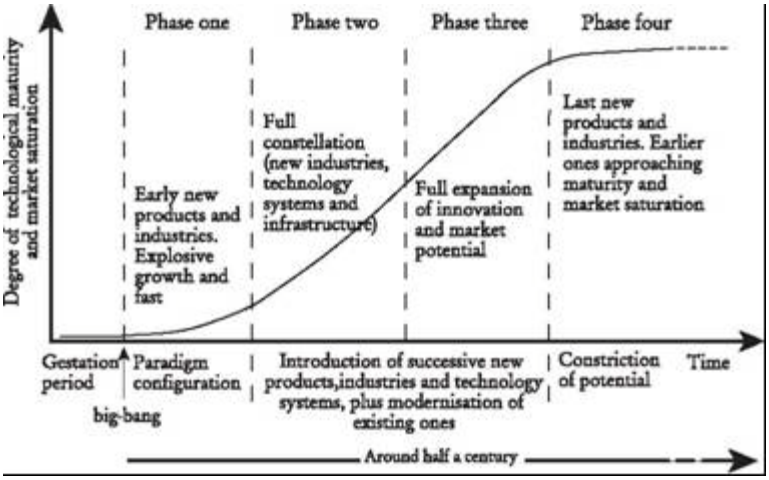
− Phase 1 marks the early establishment of the new paradigm. Pérez (2002) calls it irruption– a period of contrast, as the beginning of the technological revolution surges amidst a world threatened with stagnation. The decline of old industries as well as high and increasing unemployment juxtaposes the intense activity of entrepreneurs operating within the new technological style. In Pérez characterisation, it is a "time for technology." A mass of money capital, still generated by the firms of the old paradigm, is available and looks for opportunities.

There is also a marked revival of the stock market, first in relation to the new industries and soon after with new financial instruments and speculation.

− Phase 2 is when the technological paradigm has framed its way and has become fully apparent. It is also the time where

[12] This paragraph summarizes Pérez (2002).

Figure 1 – *The life cycle of a technological revolution*



Source: Pérez (2002, p. 30).

> "financial capital takes over; its immediate interests overrule the operation of the whole system. The paper economy decouples from the real economy, finance decouples from production while there is a growing rift between the forces in the economy and the regulatory framework, turned impotent" (Pérez, 2002, p. 50).

It is the frenzy phase, a "time for finance," characterised by turbulence and large and growing inequalities in the distribution of income. The wealth that has grown and concentrated in relatively few hands is greater than what can be absorbed by real investment; speculation flourishes and the economy tends to become a "casino capitalism," with asset inflation in the stock market. "Late Frenzy is financial bubble time" (*ibid*., p. 52) and financial crashes eventually draw the system into recession. Yet the frenzy phase is also one of intense exploration of all the possibilities opened up by the technological revolution. Through a trial and error process of investment,

> "the potential of the diffusing paradigm for creating new markets and for rejuvenating old industries is fully discovered and [...] installed in the economy and in the mental maps of investors. Hence the productivity explosion reaches more and more activities, inducing a process of

> restructuring [...] where the new or renewed prosper and the old wilt and die. The process is intensified by the availability of the new infrastructure" (*ibid*., p. 51);

− The turning point represents the fundamental change to move the system from the frenzy mode, shaped by financial criteria, to a synergy mode, based on the logic of production. It is the time for "rethinking and rerouting development." As Pérez (*ibid*., p. 52) explains, such a process "can take any amount of time, from a few months to several years," since the structural tensions created by the frenzy phase can be overcome only through institutional recomposition.

> "This essentially means that adequate regulation of financial capital has to be established and an institutional framework favouring the real economy over the paper economy needs to be put in place. Yet financial capital will resist with force" and it "is only likely to accept regulation after much of the rapidly made gains have evaporated in the collapse and when the recession has shown the practical impossibility of reviving the casino" (*ibid*., p. 111).[13]

− If the process of rerouting the system ends successfully, the system enters into the "golden age" of the synergy phase – the time for production (phase 3). Even if the mode of growth continues to be shaped by the interests of financial capital, it is now more directly tied to production than in the frenzy phase. Production becomes the key word, full employment becomes a possibility and social cohesiveness can be established. The logic of the new paradigm permeates every activity, from business to government and education.

− What drives the system to the forth phase – the maturity – is the exhaustion of the technological possibilities of the paradigm: when the diffusion of the technological revolution is complete, productivity cannot grow substantially any more. Markets are saturating and profits feel the productivity constriction as well as the effects of the social struggles that,

[13] Pérez (2002, p. 115) observes that there are three structural tensions that make it impossible to keep the frenzy process going for an indefinite time. There are tensions between real and paper wealth, between the profile of existing demand and that of potential supply in the core products of the revolution, and between the socially excluded and those reaping the benefits of the bubble.

historically, have characterised this phase of the wave.[14] The system enters into stagnation. This switches attention to the next generation of radical technical change, opening the door to the installation period of the new long wave. Maturity is the "time for questioning complacency."

Phases one and two form the installation period of the new paradigm, from the early diffusion of the new technologies to their full visibility. Phases three and four constitute the deployment period, when the technical, organisational and institutional components of the techno-economic paradigm are fully adapted, then reach maturity and start to show inadequacies, announcing the exhaustion of the potentialities of the paradigm.

Pérez calls the early applications of the new technologies the "big bang," taking the form of a highly visible event that symbolises the whole potential of the technological breakthrough and that is able to attract a cluster of pioneers.[15] The "big bang" is preceded by a gestation period that can be very long and operates during the maturity phase of the previous long wave. Thus, at the end of each wave, two distinct processes coexist: on the one hand, the incumbent techno-economic paradigm has to cope with market saturation for its products and with the very limited scope for further innovations; on the other hand, some dynamic entrepreneurs draw on the available stock of inventions and scientific discoveries to transform them into radical process and product innovations. Such a coexistence of the old phase with the incipient one creates a socio-political split as, when the new technological revolution irrupts, the logic and the effects of its predecessor are still dominant and exert powerful resistance. It follows a period of great uncertainty and turbulence, calling for structural and institutional adjustment.

It should be emphasised that there is no mechanical sequence to be found in the re-regulation of society that characterises the long-wave mechanism. In fact,

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[14] For an analysis of the latter aspect see Screpanti (1984) and Rosier and Dockès (1983).

[15] The "big bang" for the present long wave was the announcement, in 1971, of the Intel microprocessor in California. In the fourth long wave it was the production of the first model-T car in the Ford plant in Detroit, etc.

> "nothing guarantees that decision makers will take this route. This is, in fact, a time of indetermination, when the particular mode of growth that will shape the world of the next two or three decades is defined. Its characteristics will be within the range made viable by the potential of the paradigm, but the choice within that wide range will depend on the interests, lucidity, relative power and effectiveness of the social forces participating in the process" (Pérez, 2002, p. 53).

This uncertainty of the final issue does not undermine the possibility of a theory. In fact,

> "what is significant, in terms of the value of the model, is that there are causal chains and identifying features that can help the analysis and the interpretation not only of the regularities but also of some of the deviations from the basic pattern" (*ibid*., p. 123).

2 An economic policy for the fifth long wave. A European view

2.1 An appropriate theoretical reference

Within a long-wave perspective, the main concerns of both macroeconomic and sectoral policies should be the diffusion of the new techno-economic paradigm resulting from ICT. In what follows, some indications in this sense will be given considering, first, two macroeconomic policies from a European point of view – i.e. the conditions for stimulating innovation and growth and the necessity to re-establish the primacy of productive capital (the "de-financialization" of the economy). The two following points will concern the question of the institutional changes in the system of social relations that are required for the full deployment of the new techno-economic paradigm; we shall consider the possible features of a wage nexus appropriate to the new long wave and the labour market policy. Finally, we shall address the controversial question of the regime of intellectual property rights. The policies we suggest should be applied at both European and national level, according to the principle of subsidiarity.

We shall not deal explicitly with some crucial topics of economic policy on which, fortunately, there is public awareness and, consequently,

their significance need not be debated in the present work. They cover: a) the problem of adapting the skills of the labour force to the requirements of the new technological style by public and private investments in vocational training, general education and research – a decisive precondition for the diffusion of the technological revolution; b) the necessity to increase the amount of basic and applied research in the European Union;[16] c) the policy to promote innovation – radical, incremental and organisational.[17]

Two limitations of the analysis presented below must be emphasised. First the arguments to be treated are chosen on the exclusive basis of what is deemed crucial to favour the full implementation of the new long wave in Europe. Thus, they are far from exhausting the list of the most important topics to be dealt with by economic policy in the years to come. Other subjects of equal importance for the general economic policy are left aside and cover, for instance, new forms of taxation, ecological sustainability, the elimination of the gap between the North and the South of the world, a fair international order and, last but not least, the problem of employment.[18]

The second limitation of the proposals below is that they should be considered more as indications of the direction to follow than detailed recipes. The institutional and policy adjustments required for the successful implementation of a new long wave are indeed a societal stake and, as such, they are the object of intense social and political struggles between the forces that oppose change (because they benefit from the status quo) and the forces that want to promote it. In addition, this type of conflict is modulated by the more general struggle for social justice.

[16] For instance, one of the objectives at the European level is to increase the total spending on R&D to 3% of GDP by 2010 in order to fill the present gap with respect to the US and Japan.

[17] See the European Commission (1995). For a thorough analysis see Borrás (2003).

[18] The analysis conducted elsewhere by one of us (Reati, 1998; Michie and Reati, 1998, ch. 5) led to the conclusion that, due to the pervasive character of the present technological revolution in ICT, in the medium to long term the employment trend is likely to be one of stagnation or even decline. It is thus necessary to devise an economic policy to counter this unfavourable trend; in our view such a policy should focus mainly on shorter working time.

Thus, it is obvious that one cannot predict the precise features of the final outcome.

This does not mean, of course, that economic policy has no role to play in this conflictual context. It can, first of all, establish the general economic environment favourable to innovation. Second, it could favour the solution of social conflicts by providing an appropriate regulatory framework assuring that the aspirations and legitimate interests of the weakest components of society are protected. Third, there is a large scope for adapting the existing technical and financial regulations to the needs of the new paradigm. Before dealing with this point, we would like to comment on the policy followed during the last 25 years or so.

Unlike in the US,[19] in most European countries, economic policy in the 1980s and 1990s was more and more inspired by the neoclassical theory, including the Vulgate of the aggregate production function and the Solow growth model.[20] In our view, this is the fundamental reason why, after more than two decades, the results in terms of employment and growth are so poor. Space limitations do not allow recalling our main criticisms to neoclassical theory – something that has already been done by others.[21] We just stick on facts, considering the present of unemployment. From the neoclassical point of view, allowing the free play of market forces could solve such a problem, and the task of economic policy is to remove all obstacles to such a free play of the market, i.e. the "imperfections" and rigidities as well as government interventions. During the 1960s and 1970s, in the European Union there were very rigid labour markets and, at the same time, near full employment (a rate of unemployment around 2%). Now the situation is reversed: European labour markets are rather flexible (even very flexible in some instances, e.g. UK and Italy), but the rate of unemployment is,

[19] See below.

[20] Things substantially improved with the endogenous growth theory, drawing attention on human capital and research to overcome the limits to growth. Unfortunately, this theory too suffers from the conceptual shortcomings resulting by the use of aggregate production functions with the standard neoclassical properties.

[21] See, for instance, the controversy on the theory of capital of the 1960s (Harcourt, 1972; Pasinetti, 2000) and, also, the recent institutionalist thought (e.g. Hodgson, 1988).

apart from some exceptions, four times higher. It is thus evident that the cause of the present unemployment is not to be found in the "rigidities" of labour markets and, if our policy is essentially oriented towards the elimination of such rigidities, we miss the target, with the result that the problem aggravates. In other words, neoclassical theory diverts attention from the essential, that is how to promote the structural change that could make full employment possible. The elimination of some rigidity could help, but these are only details![22]

3 Suggested directions – selected issues

3.1 The case for a Keynesian policy of demand

At present, the new technological paradigm based on ICT has already concluded the first phase of its diffusion in all European countries and in the US, and it is now progressing at different speeds along phase two (Figure 1). For Europe, a full expansion of innovation and market potential crucially depends on good prospects for aggregate demand.

It is worth noting, in this regard, that it is precisely the dynamics of demand during the last decade that explains the different degree of diffusion of the new paradigm in the US and in the European Union. In fact, to fulfil the Maastricht criteria, Europe was constantly submitted to rigid demand restraints, something that slowed down innovation. The US took the opposite route, adopting a very expansionary economic policy with lower and lower interest rates, strong increases in military expenses, generous support to research, very easy credit to consumption. Thus, notwithstanding the official declarations, US economic policy generally did not follow the neoclassical recipe of budgetary orthodoxy, but it was a mixture of Keynesian demand support plus a (not necessarily Keynesian) deficit spending. This resulted in two big deficits: –4.8% of

[22] In a recent empirical study on employment protection legislation and practices in 27 OECD countries, OECD (1999) dismisses the conventional wisdom of a significant positive association between employment protection legislation strictness and overall unemployment.

GDP for the public budget in 2003 and –5.6% of GDP for the current external transactions.[23]

It follows that, at the European level, the problem is to have a macroeconomic policy supportive of innovations, in order to facilitate the full deployment of the new technological paradigm. Here one should distinguish radical innovations – those that establish a new technological paradigm – from incremental innovations, that operate within an existing technological style. The former are those able to provoke a new upswing because they produce a leap in the level of labour productivity of the innovator and sustained growth in the productivity of the economy; the latter can only keep the system on low-growth path, as they prolong the effects of the previous technological revolution. The long-wave literature has shown that the major innovations materialise during the depression phase of the long wave (the "maturity" in Pérez's more neutral terminology); they tend to appear in the existing industries and concern processes as well as products (Van Duijn, 1983). Mensch (1979) explains this somewhat paradoxical fact noting that, when depression reaches its deepest point and enterprises have a very poor (or even negative) profitability, capitalists are faced with a choice: either they innovate, bringing the rate of profit to a normal level, or they disappear. Innovations overcome depression. In Pérez's model this forms the phase one of the installation period.

At this point, for the process of radical innovations to continue, it is necessary that capitalists – or innovatively inclined managers of socially owned firms – foresee good prospects for demand. Were this is not the case, old firms that survived from the depression and newcomers would hardly invest in new processes or engage in the market for new products. This is the "demand-pull" hypothesis, arguing that innovation activity of firms is positively correlated with the growth of demand (Schmookler, 1966). Such a hypothesis holds for both radical and incremental

[23] For the decade 1983-92 the deficit of general government amounted to an average of –4.7% of GDP. The only exception to easy public finance was during the years 1996-2001, when deficit was modest or there was even a surplus (1998 to 2000). See European Commission (2003a, p. 40). It is well known that the US can afford these imbalances thanks to their privilege to control the money for international transactions.

innovations and has found empirical support (see Brouwer and Kleinknecht, 1999, and the references they quote).

To boost aggregate demand we should act on investment as well as on private consumption. Consider first public investment. Accepting the already existing proposal to exclude this type of investment from the 3% deficit criterion could appreciably ease the current constraints on public finance stemming from the Maastricht Treaty. In 1993 public investment in EU-15 amounted to 2.4% of GDP (3.3% in the USA and 4.4% in Japan) while, before the long stagnation, it represented on average 4% of GDP.[24] Comparing the present situation with the relative level attained at the end of the long expansion, we thus see that the suggested modification of the Maastricht criteria would give ample room for boosting growth without perturbing the normal functioning of the system.

It is, in fact, a golden rule of Keynesian economics that, while public consumption expenditure must be covered by fiscal receipts (a balanced current budget), public expenditure for physical capital can also be financed by debt. This does not introduce an unbalancing factor into the system because the liabilities of the public budget (the debt issued to buy the productive capital) find their exact counterpart in the productive assets registered on the other side of the budget. These physical capitals may even produce a flow of income, making it possible to pay interest and gradually refund the debt (Pasinetti, 1995).

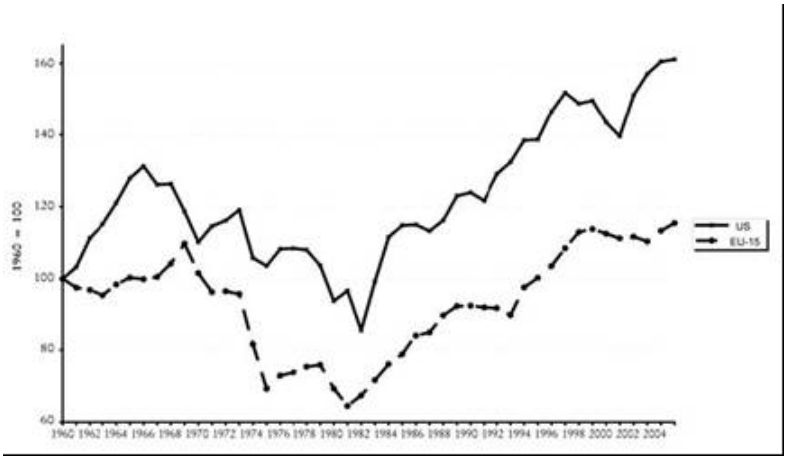
In any case, as was demonstrated by Pasinetti (1998), the sustainability of public finance is realised when there is a decreasing (or at most a non-increasing) ratio of public debt to GDP in nominal terms. Thus, the fact of fixing the targets to 60% for the public debt/GDP ratio and to 3% for the deficit/GDP ratio represents an unnecessary restriction, with no theoretical justifications.

Private consumption can be raised by re-establishing the link between productivity growth and wage increases. This link was one of the institutional settings favouring expansion in the fourth long wave in most European countries (the "Fordist" period) and was broken during the last two decades. In fact, as we can see from Figure 2, the rate of

[24] See European Commission (2003b, p. 120, and 2000, p. 64).

profit in the European Union follows a growing trend since 1980, in such a way that the present level of profitability is higher than the peak it reached during the long expansion of the fourth long wave (year 1969). For the US, the situation is similar.

Figure 2 – *The rate of profit – total economy*



Rate of profit = net operating surplus/net capital stock at current replacement prices

Sources: European Commission, European Economy, no. 63, 1997, p. 28; European Commission, EC Economic Data Pocket Book, several years.

Two polar possibilities to sustain private consumption are open, both being compatible with price stability and the invariance of the profit share: *i*) wage increases of the different industries (or firms) are set by the productivity growth of the respective industry in which they are paid; or *ii*) wage growth is indexed with the average productivity increase of the economic system. Of course, this alternative way to connect wages with productivity can assure a stable price level only if the enterprises experiencing productivity increases higher than the average decrease their prices accordingly, and the opposite for enterprises with productivity growth less than the average. This second possibility is preferable from the point of view of equity because it allows all people to share the benefits of technical change.

Considering that the suggested link of wages with productivity will keep the unit labour cost unchanged, such a policy, if generally adopted in Europe, will not produce, by itself, a delocalisation of productive activities towards low-wage countries.

3.2 Re-establishing the primacy of productive capital

As we noted in section 1.5, a typical feature of long waves is the appearance of excessive financial speculation and financial bubbles during the second phase of the installation period of the new technological paradigm (the "frenzy" phase, in Pérez's words). Such a phenomenon does not happen by chance, but is one of the most conspicuous manifestations of the febrile activity and the process of trials and errors that result from radical structural change. Thus, no wonder that in the recent years there was in the US a financial bubble that pushed the NASDAQ to incredibly high levels and that was followed by a financial débâcle. In economic history all this is a déjà vu, as the destabilising effect that this exerts on the economic system is also déjà vu.

In fact, securing long-term economic expansion underpinned by technological innovation requires appropriate financing mechanisms. Such mechanisms are necessary to ensure that companies can adequately finance their investments and technological improvements, but also to ensure that such financing is directed towards improving the capital stock. However, the physiological relation between productive and financial capital is upset when financial capital is not any more the facilitator of accumulation in physical assets but becomes the dominant driver of the economy and dictates capital accumulation in the entire system (Toporowski, 2003).

In advanced capitalist economies, the mechanisms in question can be broadly divided into those that are speculative and those that are accommodating.[25]

Speculative mechanisms are driven by expectations of refinancing

[25] This corresponds approximately to the distinction made by Keynes in chapter 12 of his *General Theory* between speculation and enterprise (Keynes, 1936).

possibilities in the financial markets. An investment financed by a loan or an issue of securities may be refinanced in the financial markets by the holder of that loan or securities selling them. Obviously, the profit on the sale of the loan or securities is an additional incentive to engage in such financing. It has the advantage that it is not paid out of the proceeds of the investment, which the loan or securities originally financed, but by someone who is willing to buy the loan or securities at a higher price than the original value of the financing. That higher price depends on the liquidity in the financial markets. If there is excessive liquidity, then securities prices will be rising, and there will be a good market for speculative finance. If there is insufficient liquidity in the markets, then it will be difficult or impossible to refinance at a profit.

However, speculative financing mechanisms are ephemeral. If financial markets become less liquid, then the inability to refinance at a profit causes speculative finance to dry up. Existing financings come to rely for their profit on the revenue from the investment financed. This revenue depends on the kind of business in which the investment is being implemented. Usually retail services (shops, trading activities) have good cash flow, even when they are less profitable. Typically, new technology has very uncertain cash flow, which is why investments in it are all the more dependent on refinancing possibilities in the financial markets. Any decline in the liquidity of the financial markets, or in the return from new technology therefore tends to cause speculative finance to shift away from new technology and into established trading activities, which have good or at least predictable cash flow, but offer relatively few opportunities for industrial innovation. Thus speculative finance is an inconstant source of financial support for new technology.

In contrast with speculation, accommodating financing mechanisms are driven by the profit expectations of entrepreneurs. As a check on the realism of these expectations, innovations are best undertaken in existing corporations using their own financial resources. This ensures that decisions to finance particular innovations are made by individuals with knowledge of the industrial potential of innovations, and the market for their eventual output. Adam Smith had argued this over two hundred years ago.

A precondition for accommodating finance is the elimination of financial inflation raising the market value of financial claims. Financial inflation is, as argued above, the condition for speculative finance of innovation. Such inflation affects in particular markets for longer-term financial assets, whose market value is less constrained by imminent redemption. But it also has three other undesirable effects on the capital formation of business corporations. First of all, the speculative gains that may be obtained with financial inflation are the opportunity cost of other investments, in particular in fixed capital formation. Therefore the greater is financial inflation, the less attractive is industrial innovation to business corporations. Firms can make more money more quickly through merger and acquisition or management buy-out activity than from long-term commitment to productive activity. Secondly, speculative positions taken in financial markets by non-financial corporations, most notably through merger and takeover activity, but also through other kinds of purchase and sale of assets for profit, require liquid assets to held in addition to the funds committed to actual investments in financial assets. This is because the ever-changing conjuncture in financial markets increases the risk that assets may not be able to be realised at a profit as planned. This additional liquidity reduces further the amount of its own resources which a company can commit to new technology and fixed capital formation.

Thirdly, the inflation of the market for long-term securities leads to the over-capitalisation of non-financial corporations. Like over-indebtedness, over-capitalisation, or holding capital in excess of the value of productive capital, increases the liquidity preference of companies, and discourages investment in relatively illiquid fixed capital and new technology (Toporowski, 2000, part 1). The result is that large corporations, which account for the vast bulk of private sector fixed capital investment, come to have a different mode of operation to that of previous large companies. The modern, over-capitalised or "financialised" corporation makes money through profitable balance sheet restructuring, for example, mergers and takeovers on the asset side, or profitable refinancing on the liabilities side.

Eliminating financial inflation, without causing a deflation of the

kind that Japan has experienced since 1990, is not easy. The conventional wisdom is that it can be done by interest rate changes and/or by "moral suasion," for example Alan Greenspan's famous pronouncement in 1996 concerning "irrational exuberance" in the markets. The difficulty with interest rate changes is that, to have an effect on the markets, changes in interest rates usually have to be quite large. This precludes fine-tuning of the markets. Moreover, interest rates are nowadays used to target inflation or economic activity. Adding a third target, of financial inflation (however measured), may lead to increased confusion and uncertainty in the markets if, for example, inflation and economic activity are stable or falling, but the stock market is rising strongly (see Goodhart, 2001).

An alternative way is to use open market operations in an innovative way for the purpose of regulating liquidity in the financial markets rather than, as at present, to enforce a target short-term rate of interest in the money markets. In this way, if stock markets were rising so strongly as to encourage speculation in them, central banks would sell bonds to take excess liquidity out of the markets and slow down the growth of share prices. If, on the contrary, the government or companies had new bond issues they want to make and no adequate liquidity is available in the market, the central bank would buy in stocks to ensure adequate liquidity was available in the market to take up those stocks. Such open market operations would therefore facilitate a more active fiscal policy on the part of governments, as well as more accommodating finance for corporations. Indeed, open market operations of this kind were undertaken in the United States by the Federal Reserve after the Second World War, up to 1951. In recent years they have been used to stabilise markets, but not systematically. Intervention of this kind in the capital markets could not eliminate economic instability (Toporowski, 2003). But it would eliminate that part of it which emanates from alternating episodes of excess and deficient liquidity in the markets.

The main institutional difficulty preventing such open market operations is the lack of capital of central banks in relation to the amount of turnover in securities markets. On global scale this could only be remedied by capitalising central banks on an appropriate scale.

Within Europe, such practical and political difficulties have largely

been removed by the institutions of the European Monetary Union and the European System of Central Banks, but at present the scope of open market operations by central banks in Europe is very limited. Much of these operations consist of repurchase agreements, whose purpose is in effect to keep money market interest rates close to the European Central Bank's target rate for short-term interest rates. In continental Europe central banks use 14-day paper (whose maturity is now being reduced to seven days) to regulate the liquidity of banks, rather than to maintain or reduce liquidity in markets for long-term securities. In the UK, a much wider range of securities is used in open market operations, perhaps to less effect because sterling money market interest rates in London seem to fluctuate more widely around the Bank of England's "Repo" rate than do euro money market rates around the ECB's rate.

To expand their open market operations central banks in the European Union could be capitalised by an issue of long-term securities by the European Central Bank (ECB) that would be bought by national central banks, with money borrowed from the ECB at the same rate of interest as is paid on the ECB bonds. In this way the balance sheets of all these institutions could be expanded, but would balance: a national central bank would have its liabilities increased by its borrowing from the ECB, but would have assets corresponding to this borrowing, in the form of the ECB bonds. The ECB would then undertake to buy back these bonds for cash at their issue price at any time from a national central bank. This would give central banks the capital and liquidity to intervene effectively in financial markets.

National central banks would then be in a position to calm excessive stock market speculation by selling their ECB bonds into the market. They should be able to sell them at their issue price, because buyers would have the assurance that these securities would always be liquid at that price (the national central bank could always buy them back and sell them back to the ECB at that issue price). Indeed, if the prices of company securities rise, then by definition the market yield of ECB and government bonds would increase relative to the prices of company securities. This relative advantage may itself be insufficient to persuade

investors to moderate their buying of company securities.[26] In this case, open market operations may be reinforced by compulsory reserve holdings of government and ECB bonds by fiduciary institutions, such as pension funds, insurance companies and investment funds. If the national central banks were given the right to vary such reserve requirements, then merely signalling that the central bank will raise these reserve requirements, forcing fund managers to sell company stocks to buy more ECB and government bonds, may be sufficient to keep markets from rising excessively. If markets fell, and became illiquid, then the ECB could always sell the bonds back to the ECB for cash, and then enter the market with that cash to buy ECB bonds and government securities to provide liquidity. This system would ensure that the market had adequate liquidity for the purposes of financing government bond issues and company securities, but not so much liquidity that the market became speculative. By restricting their purchases and sales to central bank and official (government) paper, central banks could influence the overall liquidity of the market, without having to take a view on the price of corporate securities. This scheme would allow European central banks to pursue systematically what is already done in a partial and unsystematic way by central banks (e.g., in Japan, Hong Kong and the UK).

Our proposal would not need any change in the statutes of the European Central Bank, since it would concern the issue and holding of central bank securities, and their subsequent purchase and sale, rather than, necessarily, government securities. Furthermore, national central banks, rather than the ECB, would conduct the open market operations, since European capital markets are still, and will be for some time yet, nationally organised. Thus, this scheme would underpin the existing arrangements, whereby national central banks have responsibility for financial stability in their respective countries, but with very limited instruments for securing such stability. By

[26] In his *Treatise on Money* Keynes had argued that the central bank could manage the liquidity of capital markets easily by means of open market operations. One of the less noted innovations in his *General Theory* was Keynes's recognition that such management may be more difficult in practice. See Keynes (1930, pp. 371-73; 1936, pp. 205-06). This point is further discussed in Toporowski (2005, ch. 7).

giving assured liquidity to central bank and government securities, central banks would encourage the holding of such securities in financial portfolios. By stabilising portfolios in this way, central banks would discourage forced sales of corporate securities that occasionally deprive markets for long-term securities of the liquidity that they need to function properly. Furthermore, by trading a benchmark stock in all the national markets, such an arrangement would help to bring about an integrated European capital market.

If the scheme was open to national central banks in Europe outside the monetary union (the European Union member countries outside the euro-zone), such arrangements could be extended to support exchange rate stability in Europe. Euros obtained from the resale of ECB bonds back to the ECB could be used to support exchange rates within Europe. In this way a "zone of financial stability" would be created within Europe that would support effective fiscal policy and accommodating finance, whose stability and predictability would focus enterprise on productive activities rather than speculation. The success of such a zone of financial stability in Europe would encourage its emulation elsewhere in the world, and thereby encourage the stabilisation of the global financial system.[27]

Let us now pass to the other topics of economic policy that we address in this paper by considering the system of social relations.

3.3 The employment relationship

Among the institutional changes that are most required for the full deployment of the fifth long wave in Europe there is the reform of the employment relationship. Indeed, we shall see below that the present prevailing set of relations is inimical to labour. Besides the obvious social injustice, this constitutes a positive obstacle to innovation. Of course, the new institutional setting is, more than any other, dependent from the social struggles between workers and employees whose final outcome

[27] For an alternative set of proposals, putting emphasis on taxation and international coordination of policies, see Fontela (1998).

cannot be predicted. What we can do is just to outline the direction in which the reform should go. At this purpose, let us start by considering the "Fordist consensus" that preceded the current situation and its flaking off.

The social consensus that made the long upswing of the fourth long wave in Europe possible (1950-1973) rested on two elements of the regime of regulation: mass consumption and a comprehensive welfare state.[28] The first element of regulation was established by a systematic link between real wages and productivity increases, that provided the demand for mass production. The establishment of a "social norm of consumption" fuelled demand: products that were the prerogative of the rich class became more widely affordable and entered into the consumption basket of the working class (e.g. cars, holidays). Unions played a crucial role with a bargaining procedure at sectoral level that allowed a parallel and foreseeable growth of real wage and productivity. This created favourable business expectations that sustained investment. In parallel, the regular growth of workers' purchasing power was complemented by a pervasive welfare state (the "indirect wage") giving protection against the main risks and the uncertainty of unemployment.

The Fordist technical basis was an automated and dedicated plant and equipment producing standardised commodities with a rather stable product mix. The organisational structure was hierarchical and departmental. Design and implementation stages of production were separated and performed by two different categories of employees.

The typical worker of the Fordist period was male and low skilled. He benefited from a full-time permanent contract to provide a labour activity as defined by his job profile. The various forms of protection were linked to the professional status, defined in terms of a person's occupation and distinctively associated with the continuity of employment throughout the lifetime.

The ICT technological revolution required profound organisational changes that were not compatible with the rigid Fordist organisation and the corresponding employment relationship. However, when assessing

[28] For an interesting description of this wave see Freeman and Louçã (2001, ch. 8).

the changes in the employment relationship of the last two decades, one should consider that they are not just a question of technology, but are also a consequence of the already mentioned unbalanced power relationship between capital and labour.

The ICT style modified the previous technical basis: flexible production systems tended to replace the Fordist dedicated plant and equipment, and this allowed a customisation of output. Also, the general availability of PCs, the introduction of local area networks and the rapid changes in product and process design eroded the old hierarchical structure, making some layers of management unnecessary. At the same time, ICT technology drastically changed the skill requirements of the labour force – instead of the unskilled worker of the Fordist organisation, the new technology demanded medium – to high-skilled workers.[29] Finally to increase profits, enterprises transferred the hazard of demand on their workers by engaging on a temporary basis, and outside, by outsourcing a range of activities. We now have a multiplicity of work relations (part-time, temporary, "on-call," traineeship, false self-employment) that create precariousness, uncertainty about the future and loss of individual and collective rights. This last aspect is particularly relevant with the disintegration of the Fordist professional status, that is not any more unique and whose continuity is undermined by internal and external flexibility, the first referring to the fact that a worker is frequently employed in different jobs with the same employer, the second to casual employment. Also, the concept of single employer sometimes vanishes both in regard to the entity concerned (groups or networks of companies) and over time.

The opposing parties have a common interest in reaching an institutional architecture appropriate for the new techno-economic paradigm, as any delay or inadequacies will defer the benefits of the ongoing long wave. However, things are not simple, as in both fields there are forces that obstruct progress.

On the workers side, those who still enjoy a relatively secure position tend to be reluctant to change, and this creates an obstacle to the

[29] See Tylecote (1992, ch. 2) for further developments and historical evidence.

labour flexibility required by structural change (see section 2.2.4 below). On the capitalists' side, one can detect two tendencies – that we would call "short termism" and "forward looking". The first strategy consists of maximising short-term profits, taking maximum advantage of the power obtained by the defeat of workers that resulted from the depression of the 1970s. In fact, the very high unemployment weakened Unions by reducing the number of their members and undermining the cohesion of those still at work. This made it possible to have real wage growth less than productivity even in the 1990s, when the rate of profit had attained satisfactory levels (Figure 2), to implement various forms of labour market flexibility that discourage technical innovation (the "labour-controlling flexibility," see section 2.2.4 below) and give rise to growing inequalities. The "short-termist" fraction of employers reflects mainly, but not exclusively, the interests of financial capital, and is very much in tune with the "frenzy" phase of the wave that characterised the 1990s in several countries.

The other fraction of employers (the "forward looking") represents the interests of productive capital and believes that, for the long-term viability of the system, it is better to renounce some advantages resulting from the present favourable power situation by giving room to workers' claims for fairness and social justice. In other words, it is preferable to win in the long run than winning all along the line in the short run and risking harming the stability of social order. Keynes and his epigones were the main representatives of this fraction of the bourgeoisie – a fraction that at present covers only a minority. However, it is only by this kind of approach that a new employment relationship favourable to the further diffusion of ICT techno-economic paradigm can be built. Consequently, economic policy should be oriented in this sense.

A reconstruction of the employment relationship appropriate to the ICT technological style that, at the same time, grants to workers the protections typical of a modern society, could be conceived on the lines of a recent report sponsored by the European Commission – the Supiot (1999) report. In this report, the proposals for a reform of the employment relationship are presented under six headings, four of which being most directly linked with the purpose of this paper: *i)* work and private power; *ii)* work and employment status; *iii)* work and collective

organisation; *iv)* work and the State.[30]

The first set of proposals aim at protecting workers from the insecurity resulting from the casualisation of labour, mass unemployment and new management practices that make subordination weigh more heavily (see Supiot 1999, pp. 296 ff.).

Concerning the loss of protection that results from the reduction of Fordist professional status, the report suggests to redefine the employment status in order to guarantee the continuity of a career rather than the stability of specific conditions resulting from a given wage relationship, and to enlarge the definition of professional status, which should no longer be determined on the basis of the restrictive criterion of employment but on a broader notion of works, that include non-marketable forms of work.

To reconstruct the system of collective bargaining, the report recommends, among other things, an active support from public authorities for recasting collective bargaining and, also, centring the negotiations on networked companies and territorial networks whereby businesses and other interest groups join forces (at local or regional level, for instance).

To correct for the current decline of the welfare state, the report advocates a new kind of intervention to be linked to an overall concept of social rights based on solidarity. This solidarity should not be thought of as solidarity facing an individual need, but as solidarity guaranteeing individual and collective security in the face of uncertainty. Rather than the concept of social protection, social citizenship might synthesise the objectives of recasting labour law and social law in general.

Let us now see how the controversial question of labour market flexibility fits within the new system of social relations.

3.4 A targeted flexibility of labour

As already noted, the diffusion of ICT technological style and the ensuing changes in patterns of demand modify substantially the or-

[30] Details are omitted for space limitations and we can only refer to the original report for a very rewarding reading.

ganisation of enterprises as well as the structure of the economy. At the enterprise level, workers should acquire new skills and accept more flexible structures implying, among other things, different working time. At the level of the economy, radical product innovations create new industries, the sectors adopting radical process innovations increase their share of total output, while the traditional sectors decline. This diversified impact of technical change entails a permanent shift in the structure of employment, which calls for a continuous flow of workers from contracting to expanding sectors. The required mobility of labour is not easily obtained, and this provides considerable scope for government action. Besides disseminating appropriate information on labour market opportunities, the most important task for public authorities is to provide constant retraining and skill development for the population. Second, to facilitate the geographical mobility for workers, government should provide the basic infrastructures for families (infant schools, etc.) in the expanding regions and stimulate the supply of lodgings. This kind of labour flexibility that is required by structural change should be actively pursued, as it is growth-enhancing and directly targeted to job creation; it is also a prerequisite for obtaining all the benefits in terms of costs and competitivity which can result from the ongoing technological revolution in ICT.

However, contrary to what is frequently assumed, other forms of labour flexibility represent a positive obstacle to a successful diffusion of the new technological style, and should then be opposed. We are referring here to the forms of flexibility whose principal aim is to submit labour to capital (labour-controlling flexibility), and consist in making jobs more precarious, in imposing part-time working, in reducing social protection by transforming normal employees into self-employed workers, in increasing inequality by cutting wages at the bottom of the scale, in facilitating dismissals.

Consider, for instance, the conditions for a successful implementation of ICT at the enterprise level. It is generally admitted that, to attain such an objective, a close involvement of the labour force is necessary, involving trust and participation. Such conditions are hampered by short-term labour contracts with no guarantee of stability

and by downward wage flexibility. Concerning this latter aspect, one should refer to the theory of efficiency wages, which shows that workers' effort and commitment (hence productivity) is positively correlated to the level of wage; wage reductions can thus reduce workers' involvement and hamper the successful adoption of new technologies (Kleinknecht, 1998, Michie and Sheehan, 2003). Furthermore, the wage flexibility in question increases the propensity to save of workers and the middle classes as a reaction to uncertainty. This would tend to reduce the effectiveness of aggregate demand policy, and the solvency of long-term contractual financial institutions such as pension funds.

Innovation is also discouraged by easy dismissals because, within this institutional framework, enterprises tend to postpone the adoption of labour saving techniques. Thus, productivity is not maximised and, in the long run, this harms the international competitivity of the firms. Finally, in a highly flexible labour market, enterprises have less incentive to train their personnel, since part of the benefits from such investments may accrue to their competitors.

We conclude now our survey of the most suitable policy choices for the incoming fifth long waves by assessing the discussion over the intellectual property rights – a regulation that seems crucial for the further diffusion of the technological revolution (for a more complete treatment see Borrás, 2003).

3.5 A new regime for intellectual property rights

In the current literature, the ongoing fifth long wave is called the "knowledge based society." This inaccurate terminology – all societies of the past were based on knowledge! – nevertheless draws attention to another essential condition for the diffusion of new paradigm, i.e. the necessity of appropriate institutions for spreading information and knowledge in all fields of activities.

The transfer of knowledge that is at the root of innovation can take several forms, following the distinction between codified and tacit knowledge. The first type of knowledge covers both public knowledge – i.e. what is fully disclosed in publications – and the private knowledge protected by patents, and only partially disclosed. Tacit (or uncodified)

knowledge is a typical feature of organisations and it is the main component of the learning process that leads to innovation. However, although tacit knowledge is usually very important, in general it is not the exclusive element for innovation activity, and it is within this context that the question of intellectual property rights can arise.

It is generally accepted that, to stimulate investments in R&D, it is necessary to grant the inventor a reward in the form of a temporary monopoly over the invention (the patent). It is also usually admitted that patents can cover only inventions and not the result of basic research leading to discoveries, as this general knowledge belongs to the common good of mankind.

Patents give rise to two conflicting interests. On the one hand, there is the necessity (or the opportunity) to reward invention by allowing for a monopoly. On the other hand, public interest requires the easy availability of the results of past research in order to make further advances in knowledge and innovation. Public interest is also jeopardised by the well-known monopolistic practice consisting in patenting inventions without exploiting them, the purpose being to exclude competition.

The conflict between private and public interest is particularly relevant in the present situation, as the intellectual property rights regime could either favour the further diffusion of the new technological paradigm or it could delay it. Easier diffusion could be achieved by a system granting a flexible and relatively light protection to the already established interests, while strong protection could lead to opposite result in terms of diffusion. As in all the other fields, the final regulatory setting will result from the outcome of the struggle between groups representing the conflicting interests – a struggle that, among other things, manifests itself into strong pressures on public authorities. In what follows we summarise the current debate, to make apparent what should be the best response of policy makers in Europe.

Developments in the US since the 1980s fuelled discussions and concerns on both ethical principles as well as economic efficiency. On ethical grounds, the principles at stake concern the legitimacy of

− patenting living organisms, micro-organisms, genes and partial

gene sequences;

− privatising elements of common knowledge, such as mathematical algorithms or basic biological processes and phenomena; and

− private appropriation of the results of publicly funded research.

On purely economic grounds, there is the concern that a system granting too strong protection to private interests is not sustainable in the long run because it hampers innovation. Let us make all this more explicit.

The year 1980 represents a landmark in the broad shift of US policy towards stronger property rights. On the legislative side, the Bayh-Dole Act provided blanket permission for performers of federally funded research to file for patents in their own name and to grant licences. In parallel, a Supreme Court Decision (Diamond v. Chakrabarty) enlarged the scope of patentability in the biotechnology industry, to cover objects which were previously excluded from it (Orsi and Coriat, 2003). Thus the frontier between "discoveries" (which were not patentable) and "inventions" was displaced, with the results that it is now possible to patent microorganisms, genes and partial gene sequences. The other sector in which the new approach allows for the private appropriation of general scientific knowledge is computer software, in which it is now possible to patent algorithms for the simultaneous use of equations.

These developments open up the way to a true commodification of scientific knowledge. Moreover, in numerous cases the patents granted in the US cover not only inventions of recognised utility but also a wide range of future applications. To all this, one should add the fact that US patents are granted for extremely long periods (up to 50 years).

The architecture of the system was completed by legislative and regulatory measures for financial activities that supported the commodification of knowledge. One of the most relevant was the modification of the "prudent man" law on pension funds so as to authorise them to invest part of their capitals in risky securities and stocks, something that was previously prohibited (*ibid.*, p. 3).

This stronger protection of intellectual property rights gave brilliant results in economic terms. US university patenting and licensing grew remarkably after 1980 (Mowery and Ziedonis, 2001), the biotechnology

and computer industries developed more than in Europe, innovators found capital to finance their projects. For this reason, large industrial groups urge European authorities to go in the same direction as the Americans,[31] the delicate ethical problems that such an approach would pose notwithstanding.

Nevertheless, even on a purely economic basis, one should question whether the American way is really a good one in a longer-term perspective. Indeed, several authoritative voices raised concern about the dangers of the American practices, which at the end of the day could block innovation instead of furthering it. For instance, Nelson (2003) convincingly argues against the privatisation of scientific commons on the grounds that this creates an obstacle to further progress in science and technology. In fact, the findings of basic science are the inputs for further research and, consequently, should have open access. Attempting to shift the focus of American policy he offers the following guidelines:

i) not to grant patents on discoveries that largely are of natural phenomena, and limiting the scope of patents to elements that are artificial;[32]

ii) give a relatively strict interpretation of the meaning of "utility" or usefulness in granting a patent. If, for instance, the direct usefulness is an input or a focus of research, this generic knowledge should be kept open;

iii) narrow the patent scope. In fact, in the US there is a strong tendency among patent applicants to claim protection far wider than they actually achieved, in order to be able to control a wide range of possible substitutes. Public interest requires that these tentatives to block potential competition be not allowed;

iv) introduce in the legislation a "research exemption," that is, use in pure research is not a violation of a patent. As a counterpart for this exemption, universities or other research organisations should not patent

[31] For an analysis of the European situation see Borrás (2003).

[32] In practice, the identification of what is a substantial transformation from the natural – to be protected by patent – is not always clear-cut. In these cases, Nelson is prone to restrict the coverage of the patent. For instance, in the case of purified natural substances, patents could be limited to the process and not allow the purified product per se to be patented.

anything that comes out of the research in question.[33]

History shows that successful societies are those inspired by a long-term vision, that succeed in tempering the demands for short-term profits with the respect of ethical principles. Thus, European society should resist the pressures to imitate the American system of strong protection of property rights, for a double reason. First and foremost for ethical reasons: it is inadmissible that private interests appropriate the results of a publicly funded activity whose intrinsic purpose is the well-being of society. The same considerations hold for the private appropriation of the basic knowledge that is necessary for research. Secondly, for economic reasons, as the above discussion of the drawbacks of the American system makes clear that such a system is not the most appropriate for the ongoing fifth long wave.

A reform of the European system of property rights should be inspired by the four principles laid down by Nelson, and indicate clearly what is protected and what cannot be protected.

Concerning university research, we think that the best way to stimulate invention is to provide adequate public funds and allow the widest possible exploitation of the results. The current objective of the Union to increase substantially the financing of research goes in the right direction.

Two further steps seem necessary, that we just mention, as their adequate treatment would require another paper. The first is the establishment of the European patent. The second consists of special provisions to combat monopolistic practice, e.g. a regulation stating that if a patent is not exploited, or insufficiently exploited, within a given timeframe, it falls into the public domain.

4 Conclusions

The first part of this paper was devoted to reviewing some recent contributions to the long-wave theory in order to recall the essential

[33] Also Heller and Eisenberg (1998) raise concern about the American approach, as the proliferation of intellectual property rights in biomedical research can seriously hinder progress.

points of a theory that, better than any other, is able to explain the long-term development of capitalist economies. By showing the stable mechanisms that produce the historical sequence of long upswings and downswings, long-waves theory provides the tools for understanding the present "knowledge-based society" and offers guidance for economic policy.

Considering that the present technological revolution is part of the broad phenomenon of a new long wave (the fifth one in the history of capitalism), it follows that the main focus of economic policy – both macroeconomic and sectoral – should be to support the diffusion of the new technological style and to favour the institutional changes required by such an objective. This last point is of paramount importance, as the full deployment of a new upswing materialises if and only if technological and institutional changes proceed together.

In real societies, institutional change cannot be dictated from the top. Rather, it is the outcome of social conflicts and struggles. In fact, the institutional set appropriate for a new regime of accumulation requires very deep changes in the organisation of firms, in social relations, in the financial sphere, in regulations as in government action in general. Thus, it is no wonder that there is conflict between forces favourable to change and forces opposing it. Although the final result is unpredictable, this does not mean that public authorities have no particular role to play – the market assuring spontaneously the necessary adjustment. It is just the opposite. Recent developments on financial speculation, growing inequality and persistent unemployment demonstrate the need for public action to correct for these disequilibria. This raises the question of which theory is most suitable to guide economic policy.

During the last decade or so, in most European countries economic policy was oriented by neoclassical theory. The poor results that were obtained should prove the inadequacy of such a theory to direct economic policy towards full employment, social justice and growth. Indeed, putting excessive reliance on market adjustments within an a-historical theoretical framework, neoclassical theory diverts attention from what is essential, thus impeding reaching the above-mentioned goals. The US experience of the last decades confirms our contention. At the level of

official declarations, one certainly has the impression that US economic policy is the emanation of neoclassical theory, but this is not true. In fact, the US macroeconomic policy was fundamentally a mixture of a Keynesian support of private consumption and deficit spending (something that is not necessarily Keynesian!), the whole supported by the special position enjoyed by the US as the issuers of the currency for international transactions.

Two main factors seem to delay the deployment of the new long wave in Europe. The first is the "short termism" of the majority of the bourgeoisie that, after winning the social conflicts of the 1960s and 1970s, now wants to win all along the line by imposing conditions on workers that are inimical to full employment and growth. The second is the stifling effect of the implementation of the Maastricht criteria. Now that the euro is a reality, it is time to change the general orientation of the European macroeconomic policy, if we really want to foster employment, growth and the diffusion of the new technological paradigm. For this reason the present paper suggests a Keynesian policy to boost private consumption by revitalising the "golden rule" of linking the evolution of real wages to the increases in labour productivity and, also, to ease the Maastricht criteria by excluding public investment from the 3% deficit target.

Another major problem linked with the present phase of the long wave is that we are in an "era of finance," where financial capital has become so important that it dictates the direction of business opportunities and trends in the economy as a whole in a way that diverts from capital accumulation in real assets. To re-establish the primacy of productive capital – with financial capital playing its physiological role of facilitator of the accumulation of physical assets – the paper suggests systematic concerted open market operations to regulate liquidity in the financial markets. If successful, these actions would eliminate the excess liquidity in the markets that are at the origin of financial speculations and bubbles. At the same time, such operations would secure stable finance for those fiscal operations that would be necessary to support public investment.

The paper addresses the question of social relations from a double

perspective: *i)* a new configuration of the employment relationship that, while taking into consideration the requirements of the new technological paradigm, preserves the essential features of the "European social model"; *ii)* the kind of labour market flexibility that favours the diffusion of the ICT technological revolution.

On the first point we suggest to rely on the proposals of a recent report sponsored by the European Commission (Supiot, 1999). On the second point, we make a distinction between a "labour-controlling flexibility" and a "growth-enhancing flexibility." The first type of flexibility – that is the kind of all-out 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.

The paper ends by considering the question of the regime for intellectual property rights that is best suited for the new long wave. Two points are raised. The first one is a warning not to follow the American practice of allowing private appropriation of elements of common knowledge, or privatise the results of publicly funded research as well as to patent living organisms. These practices should be opposed first of all for ethical reasons and, also, because in the long run they are likely to be counter-productive for promoting innovation. The second point is a plea for a European patent that, among other things, indicates clearly what is protected and what cannot be protected.

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