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Beyond the Lisbon Strategy: Information Technologies for the Sustainable Knowledge Society

The first part of the present paper posits the emerging concept of 'nano-bio-info-cogno convergence' as providing a basis for a new cluster of technological innovations for human enhancement and social change in the context of modern developments in information technology. The second part of the paper reviews some deep economic and social trends that pertain to the emerging concept of a 'Sustainable Knowledge Society' (SKS). These trends include the nature of work, global environmental and ecological issues, education and learning, the role of services, and the nature of the welfare state. The final part of the paper is devoted to the economic implications of these new technological and socio-economic scenarios. The paper considers these matters in general terms and in terms of applied policy recommendations.

Keywords: *sustainable, knowledge, society, new technologies*

1. Introduction

Although the time required for a technological development to move from the laboratory to the market is shortening, it still remains true that broad technological change is a long-term affair. For example, the successful implementation of the innovation of mobile phones has required more than twenty years to achieve maturity in the advanced industrial countries.

Although many economists had been interested in the great fluctuations that were observable in prices and rates of economic growth over the first two centuries of the industrial era, it was Schumpeter who associated business cycles with the discontinuous behaviour of technological developments and innovation (Freeman, 1996; Fontela & Pulido, 1991). Schumpeter had been in contact with Walras, and was sceptical of the prevailing notion of 'static general equilibrium'. Since his early doctoral research project, Schumpeter had been of the opinion that economics had to incorporate more dynamic considerations and that economic dynamism was linked to entrepreneurial innovative capacity. He envisaged two possible models for the role of technology in these entrepreneurial innovative strategies. These can be summarised as follows:

- The first was that technology emerged from science without further explanation, and was available o innovating entrepreneurs in a 'pool' of technological opportunities—a view that was, in a sense, coherent with the classical economic idea of small entrepreneurs acting in free competition.

- The alternative model was tha technology resulted from a conscious research investment on the part of the entrepreneurs. This was part of their quests for temporary monopolistic positions that would allow them to increase their profit rates above market-driven averages. This second ('endogenous') model of technological change led to Schumpeter being characterised as a promoter of large corporations with high market power.

In some respects, these two views of the entrepreneur's strategies reflect what are now known as: the 'supply–push' conception of technological change (analogous to the 'pool' of available technologies noted in the first model above); and the 'demand–pull' conception of such change (analogous to the conscious research investments for 'endogenous' technologies noted in the second model above). Although there are no special references in these models to factors that could cause sudden discontinuities, Schumpeter's intuitive belief that technological change is linke to long-term cycles requires analysis that takes into account the essential characteristics of the technological production system—in particular, the existence of links between technological innovative developments and economies of scale and economies of scope (Wolff, 1997). In this regard, the concept of 'clusters of technologies' has been used by neo-Schumpeterians, such as Pérez (2002), in their analyses of cyclical paths and technological discontinuities. Similarly, neo-classical scholars have conceived the notion of technological 'chocks' causing temporary disturbances of the genera equilibrium of economic systems (Adelman, 1965; Verspagen & Werker, 2003).

Allowing for the limits of historical analysis, and assuming that the past existence of these technological 'clusters' ca be established (Bruland, 1998), the question arises as to whether future technological clusters can be predicted for the first half of the twenty-first century. If so, can these clusters provide a reasonable basis for a long wave of economic growth? Moreover, what public policies could support these long-term evolutions in science, technology, and economics?

2. Technology trends and key new technologies

Because technological advances play a central role in shaping the future, the forecasting of technological change has received considerable attention. This has been particularly so since the Second World War, when the rate of economic growth has increased in the advanced industrial countries well above that achieved in the previous two centuries. An influential OECD report by Jantsch (1967) on technological forecasting gave impetus to the concept of 'future scenarios'. This report emphasised the importance of rigorous methodology in achieving consensus among expert opinions on future developments (Delphi, morphological analysis, cross-impact, and so on) if such foresight was to complement the more traditional methods of trend modelling and extrapolation (S-curbs, system dynamic models, causal econometrics, and so on). The future is, and will remain, unknown however, the analysis of alternative futures and the development of hypotheses about trends and events (including purposeful actions) can be of great importance in decision-making processes—including those relating to research investments for the development of new technologies. Jantsch (1967) made a clear distinction between *exploratory scenarios* (possible and more- or-less probable future alternatives emerging from current anticipations) and *normative scenarios* (desirable futures in relation to some set of social values, and often linked to clearly stated policy aims). This distinction, although essential for all exercises in foresight, is not alway made. For example, the Lisbon Strategy of the European Union envisaged the scenario of an SKS', but it is often unclear whether this was intended to be an *exploratory scenario* derived from current trends (and therefore seeking reactive decisions), or a *normative scenario* establishing clear aims for European policies (and therefore seeking proactive decisions).

In the area of technological foresight, research effort in recent years has concentrated on collecting the views of experts, usually through Delphi consultations. The process has thus been essentially *exploratory*. Many countries (including the United Kingdom, Japan, Germany, France, and most other EU members) have engaged in large Delphi exercises in technological foresight or have established groups of experts to identify key future developments in technology. The fact that these various studies have produced many similar results is clearly a consequence of the globalisation of scientific and technological information.

In a recent initiative by the EU Commission, a high-level group of experts synthesised the core of the available foresight information to present a set of 'New Technologies' that were expected to have significant potential for future innovations (EC 2005). This selection of technologies, well adapted to the current practice of EC research policies, included research activities that were both 'supply-pushed (scientific developments likely to lead to new technological proposals) and 'demand-pulled' (social and economic problems that required new technological solutions). The distinction is not always clearcut, but those that can be described as mainly 'supply-pushed' (in which creativity is driven from inside the discipline) include: nanotechnologies, biotechnologies, infotechnologies, cognitive sciences, the methodological area of complexity.

Those that can be described as essentially 'demand-pulled' (in which the more creative aspects rely on the application of available knowledge) include:

manufacturing, agriculture, services, environment, communication, transport, energy, health, and security.

In this schema, the social sciences and the humanities (which are here characterised as part of the 'cognitive sciences') are expected to fulfil the difficult task of establishing bridges between supply and demand of future technologies.

3. Economic and social trends

For a new technology wave to develop, it is not sufficient to have supply-pushed technologies. Nor is it sufficient to have a clear picture of where demands for innovation reside. Rather, the new technologies have to be adopted by society, by culture, and by institutions. Growth and development can be achieved only when a perfect match is achieved between new technologies and the economic and social context in which they are to be applied (Fontela, 1998).

A 'new wave' necessarily concerns the future. It is therefore necessary to investigate the changing nature of the economic and social context, and to identify possible long-term trends. The following account describes the present situation in terms of a 'New Economy' model that appears to be instrumental for the full development of a 'Sustainable Knowledge Society'.

3.1. From the industrial model to the 'New Economy' model

The EU 'Lisbon Strategy' states long-term aims for European growth and employment. In defining an 'SKS', the strategy is stating a desirable and normative future for the economy and for society—a future to be matched with feasible technological developments. The concept of an SKS is not utopian; rather, it is a logical step in a process of social change that started with the Industrial Revolution more than two centuries ago.

The early stages of the industrial process were characterised by growing capital accumulation that fostered workers' productivity and improved living standards. The process was stimulated by public policies and market mechanisms, and by the relative costs of production and prices of goods and services. In general, environmental protection and sustainability were disregarded, and knowledge focused on the capital to be gained through new products and production processes.

Towards the end of the twentieth century, several aspects of this growth process in the advanced industrial countries began to change, and a new direction pointed towards the issues of sustainability and knowledge development.

Labour productivity growth (the ratio of the output of objects per unit of human input), which is an end product of new technologies, contributed to relative costs and prices. The products of highly productive activities were decreasing in price, whereas the prices of stagnant productivity activities were increasing. Sustainability, services, and quality were becoming relatively more expensive in the markets. These deep-seated drivers of relative prices were forcing the advanced industrial economies towards ecological imbalances. Economic growth was dependent on increasing use of non-renewable energy and materials through consumption and accumulation of objects, and environmental decay became apparent through pollution and over-use.

The advanced industrial economies also began to suffer from the so-called 'Baumol syndrome' of unbalanced growth (Baumol, 1967), and from a consequent move of employment towards the less productive services sector. As anticipated by Baumol (1967), this produced a slow down in the overall rates of growth of productivity and of the economy—as activities with high rates of productivity growth lost 'weight' in the total structure, and as the responsibility for growth leadership was transferred to sectors with low average productivity and slow rates of productivity growth. The growth process peaked in the advanced industrial countries at the end of the 1960s.

At the end of the twentieth century, the emerging paradigm of information and communication technologies profoundly affected these long-term evolutionary processes within advanced industrial societies. Three significant effects can be discerned.

First, the new paradigm of information technology *placed information products at the centre of the production and consumption models*. In so doing, energy and resources no longer represented the core factor in advanced industrial models. The new information activities were relatively more intangible than the erstwhile emphasis on the physical production and consumption of objects. Information technology addressed the *information content* of objects, and this came to represent a larger share of their added value. Information technologies generated income and wealth with less pressure on the finite resources of the earth.

Secondly, the new paradigm produced technologies that *enhanced productivity inpreviously stagnant activities*. Information technologies have profoundly changed many basic services in networks (communications, trading, transportation), business services (finance, insurance, consulting, auditing, advertising), and many personal services (medicine, health care).

Thirdly, the new paradigm has *stimulated institutional change by promoting global efficiency in the meeting of supply and demand*. The 'big bang' of financial globalisation is the pre- eminent example of this phenomenon—with the combination of financial market liberalisation and information technology producing a revolution in international financing.

These profound changes fully justify the emergence of the concept of a 'New Economy' at the end of the twentieth century in the USA. The concept came to be erroneously associated with the speculative financial 'bubble' that accompanied numerous failed information and telecommunications ventures. But this erroneous association masked the real (and valid) content of the concept (as will be explored in the following paragraphs).

Under the 'New Economy' model, the 'Baumol disease' seems to have found a cure. After the long (predicted) productivity slowdown of the 1970s and 1980s, US productivity has started to increase. A close analysis of the US model shows that large productivity gains in the industrial sectors have been directly associated with the production of information and communication 'objects'. This has been complemented by a productivity upsurge in many service sectors that were previously part of the 'stagnant' economy, but which have now become highly innovative users of the new technologies.

The growth model of the 'New Economy' synthesises th convergence of the three main schools of contemporary economic thinking:

- *from the Schumpeterians*, the model takes the leading role of entrepreneurial innovation and the functioning of technological systems, and confers high priority to research and development (R&D) policies,
- *from the neo-classicists*, the model takes the 'perfect market' idea for the allocation of the dividends of innovation, and heavily relies on intensive competition, and
- *from the Keynesians*, it takes the driving role of new demands and income multipliers, operating in an expansionary macro- economic context.

Through the new paradigm, hese three economic mechanisms are thus related in what appears to be a virtuous circle' leading to economic growth. The 'New Economy' model suggests that the appropriate use of information and communication technologies can stimulate a new wave of growth and employment in the advanced industrial societies—basically relying on an increase in the efficiency of service activities.

3.2. From the 'New Economy' model to the 'Sustainable Knowledge Society'

The 'New Economy' model is characterised by highly competitive market frameworks, constant flows of innovations, and powerful property rights. In the advanced industrial economies, the model has implied increased liberalisation and deregulation of markets, as well as the privatisation of many public functions.

According to this model, economic growth is associated with increasing disparities in income and wealth, and although this might encourage entrepreneurship it might also induce a loss of social cohesion.

Because the fundamental growth process of this model depends on the rate of innovation (especially in the low-productivity sectors of the early industrial model), the process of capital accumulation that is characteristic of the model of industrial growth has been broadened and includes three additional classes of capital: technological capital, human capital, and social capital.

These three forms of accumulation benefit from flows of research, education, and organisational experience, and are subject to continuous obsolescence. The economic gains from innovations (Carter, 1990; Fontela, 1994), as portrayed by the growth of total factor productivity (the surplus of production over the increased use of manpower, equipment, and material or service intermediate inputs), are a direct result of these three new processes of capital accumulation.

Here again, te processes of accumulation that are characteristic of the 'New Economy' model have the potential to produce disparities in income and wealth that, especially in the case of human capital, are linked to differences in access to knowledge by individuals.

Furthermore, according to this model, there is no inherent reason to adopt policies to protect the environment or to reduce the use of non-renewable energy and materials. At a certain point, price mechanisms are expected to reflect such scarcities, but these same mechanisms cannot anticipate the final substitution costs for these undesirable developments (because the market is necessarily short-sighted).

As a consequence, long-term extrapolation of the 'New Economy' model leads to unsustainability—not so much in economic competitiveness, but in terms of social and environmental problems.

Since the Second World War, with the adoption of the model of the 'Social Market Economy' in Germany (Nichols, 1994; Hieronymi, 2002), and with the successful example of the 'Nordic Welfare State' (Buhigas& Martens, 2005), Europe has shown a preference for a more sustainable development model—a preference that has become more marked in the latter decades of the twentieth century with growing public concern for environmental issues. The 'New Economy' model has thus become oriented in Europe towards a 'Sustainable Knowledge Society' (SKS).

The three pillars of the SKS model are: the economy, society and the environment.

From this conceptualisation, it is possible to derive three long-term objectives for sustainability:

- innovation and growth in the economy,
- creativity and human development in society,
- protection and ecological balance in the environment.

Although these objectives have received considerable attention and have been increasingly incorporated in European policy statements, such as those made at the Lisbon and Barcelona EU Council meetings, there is less clarity regarding the instruments to be used to meet the objectives.

Emphasis has certainly been put on science and technology policies (for example, the importance given to the European Research Area). However, it must be recognised that appropriate *technology* is a necessary, but not sufficient, condition for the successful development of an SKS.

The two other necessary conditions are *values* and *prices*. These are more difficult to define and implement. The term *values* refers to citizens' preferences for cohesion, public services, quality, security, and so on. The term *prices* refers to the relative prices of 'quality' and 'quantity', of 'green' products and 'dark' products, and of 'income' and 'leisure'. Recent trends in 'values' and 'prices' have not necessarily been conducive to an SKS, and policies in these areas are not usually incorporated in the European `political agenda. However, only through a perfect matching of *prices*, *values*, and *technology* can a successful SKS develop. The stark reality is that an SKS is *not* in the mainstream of European society.

3.3. Economic implications and policies for the new technology wave

In the period of reconstruction after the Second World War, the European and Japanese economic models included the active participation of public administrations in the development of productive structures. In a context of market economies, it was still considered necessary that public administration took part, directly or indirectly, in investment processes—to reduce enterprise risks and to guarantee the good operation of infrastructure, basic industrial sectors, and general public services. This intervention was coherent with Keynesian policies of demand management, and with social protection and redistributive fiscal policies.

With the liberalisation of the capital markets from the 1970s onwards, economic policies began to favour privatisation, deregulation, and increasing competition. In these circumstances, the border between market and non-market activities was reconsidered. The institutional evolution of the European Union—with the creation of a single internal market, the Maastricht Treaty, and a single currency—also contributed to the redefinition of public functions. Traditional post-war industrial policies have thus evolved with public intervention being concentrated on keeping a balance in the macroeconomic framework. This public role in the macro-economy continues in all countries of the OECD. However, new micro-economic support policie for some sectoral interests are being increasingly adopted—for example, policies for the promotion of the 'Information Society' (which have many aspects in common with earlier industrial policies). These new microeconomic policies attempt to stimulate the competitive capacity of certain firms, but they do no include financial assistance that distorts the functioning of markets.

In this new context, scientific and technological policies, especially research&development (R&D) policies, have played a central role among public-policy instruments for enterprise development. The justification for these policies can be summarised in the following logical steps:

1. *Globalisation*: The well-being of countries depends on the capacity of companies to compete in global markets.
2. *Competitiveness*: The competitiveness of companies in these markets depends on constantly changing factors—especially rapidly changing supply and demand.
3. *Adaptation*: Success depends on the capacity of companies to promote or adapt to change, and the capacity to take reactive or proactive decisions with respect to innovation.
4. *Innovation*: Access to new processes and new products is the key to innovation.

5. *Technological change and human capital*: The technological changes that are required occur through the accumulation of technological capital and human capital.
6. *Research and higher education*: The scientific and technological policies of government with respect to research and highe education provide generic knowledge for the accumulation of technological and human capital within companies.

The results of 'pure' research in the basic sciences continues to spread without arriers to the scientific community worldwide—as it has always traditionally done. However, as 'pure' scientific research draws closer to applied technological innovation, the results of basic science become capable of being appropriated by individuals or particular groups, and the economic justification of public policies with respect to such appropriation becomes more difficult to establish

OECD countries are presently approaching this subject pragmatically, and there is a certain degree of competition among national systems of incentive to innovation. There are thus constant fluctuations in scientific and technological policies with ministries being created and disbanded, decisions being concen-trated and decentralised, fiscal incentives being introduced and withdrawn, and so on.

In addition to having responsibility for trade policy and agricultural policy, the European Union has policy responsibilities in the area of scientific and technical research. These policies, supported with relatively modest budgets, have promoted greater cooperation among national research institutions, and especially between universities and business. However, there is an increasing awareness that, compared with the United States, Europe has been tardy in developing information technologies and in applying these technologies economically. This has motivated concern regarding the role of science, technology, and innovation in European public policies.

In March 2000, at the Summit of Lisbon, the European Union established, as an objective for 2010, to become "…the most dynamic and competitive knowledge - based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment". In support of this objective, the Lisbon Strategy developed a set of interdependent reforms for an SKS. Although the objective of the projected "knowledge -based economy" was not specifically defined, most interpretations refer, in general terms, to an economy in which innovative companies stimulate dynamism and competitiveness.

However, the reality in 2006 (at the midpoint of the process envisaged by the Lisbon Strategy) was that the situation is not very different from what it was at the beginning: economic growth is slow, unemployment of human resources is high, and there is a large deficit in the technology trade balance. In response to this, the EC has prepared several documents that propose new policies for the future.

In all of these European proposals, it is apparent that there is often confusion between the 'Information Society' and the 'Sustainable Knowledge Society'. Although production information and data-processing are essential ingredients for a 'knowledge economy', a true SKS has other characteristics that have to be taken into consideration in a modern European competitive strategy. These aspects are concerned with the matching of *knowledge* with *quality*, and they require an in-depth revision of the familiar maximisation process that orients economic life.

In an SKS, social cohesion and sustainability are fundamental concepts, and this means that the maximisation of utility and profit must be accompanied by a parallel maximisation of: the quality of life, the creative capacity of individuals and the development of intelligence

Structured on the basis of 'work as a product', rather than 'instrumental work', an SKS thus requires a greater contribution from the social and cognitive sciences, in addition to the expected new technological convergence. In this respect, the concept of an SKS still lacks a comprehensive design.

Nevertheless, because progress towards an economy of knowledge implies technological developments in education, health, security, and protection of the environment sectors that are all part of public responsibilities in European countries a greater public role in R&D policies is justified.

The previous sections have described a long-term future scenario for society (the SKS) and for technology (the 'new wave' of NBIC convergence). For convenience, this can be referred to as the 'SKS–NBIC' scenario. In this long-term scenario (of perhaps fifty years), the Lisbon Strategy can be considered as *the policyagenda for the first decade*.

In line with this scenario, four main policy fields that require consideration (and possibly urgent attention) can be identified:

- socio-technical systems,
- research production structures,
- cooperation processes, and
- measurement issues.

4. Conclusions

The 'Lisbon Strategy' for developing a European 'Sustainable Knowledge Society' (SKS) has to incorporate a long-term design. Such a design must describe aims and objectives that go well beyond the current expectations of the 'Information Society'. An SKS cannot be expected to develop merely through the extrapolation of current trends—which already point to unsustainable long-term social divides and ecological catastrophes.

Nevertheless, the 'New Economy' model *is* oriented towards the objectives of an SKS and it *can* provide an excellent economic framework for long-term growth and employment. But, to be successful, the orientation of the economic system will require conscious public policies in areas such as health, education, environmental protection, and security. Such policies should incorporate the potential benefits of the coming new 'technological wave' induced by nano-bi-info-cogno (NBIC) convergence.

What is often considered to be current European competitive handicaps—such as the lack of market size due to significant cultural diversity or the excessive weight of non-market activities in production and consumption—might turn out to be positive advantages for a post-industrial SKS–NBIC societal design.

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