LONG-RUN ECONOMIC TRANSFORMATION AFTER THE CRISIS:

Technology, globalisation and the environment

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Recent experience teaches us that the future is certainly not an extrapolation of the recent past. Witness the difference between the stagflation of the 1980s and the great boom of the late 1990s. However, the near future is more likely to follow longer-term historical patterns. On the basis of a long-term view, we can say that after the collapse of the global financial bubble in 2007-08, the world is ready for a global Golden Age. Whether the international community wastes or seizes the opportunity to unleash the enormous potential available for the benefit of all is an open question. The technological opportunity space ahead is defined by ICT (information and communications technologies), full globalisation and the environmental imperatives.

With information and communications technologies, globalisation is the logical growth trajectory, but full globalisation is incompatible with the "American Way of Life" (we don't have seven planets), while it is also threatening jobs and incomes in the advanced world. The conversion to sustainable products plus sustainable production and transport systems may well be the most fruitful 'salvation' path for recovery. Widespread renovation provides the best opportunity space for wealth and profit creation in the OECD countries. It also enables full globalisation, increasing job creation and well being in all parts of the globe and widening markets for all countries. And we are at the precise historical moment when such a shift in patterns of production and consumption can – or, perhaps, should – be made.

The lessons of history

What is the basis for making those statements? What we have learned about the regular historical sequences of diffusion and assimilation of technological revolutions. The analysis of how technological revolutions are assimilated in the economy and society shows powerful regularities and identifiable specificities. There is a technological revolution coming together every 40 or 60 years (at maturity of the previous). Each of them drives a great surge of development that is broken into two different periods, one led by finance, the other by production. A major financial collapse marks the beginning of the switch. That is what we are experiencing now for the current ICT revolution.

But each of these regular revolutionary changes in technology is highly specific. The nature of the potential for growth is different each time because of the characteristics of the new technologies and, for that reason, each revolution brings a paradigm shift in the direction of innovation and the criteria for competitiveness. But that is only the available potential, it will be the social forces and their institutions that will define what part of the new opportunity space will be deployed and how.

Thus, each great surge is unique due to historical, political and other contingent factors, but the recurring patterns have fundamental causal explanations that have to do with the way the economy and society assimilate successive surges of technical change.

There have been five technological revolutions in 240 years: the first was the 'Industrial Revolution' (machines, factories and canals) from 1771; then, from 1829, we had the age of steam, coal, iron and railways; from 1875 there was the age of steel and heavy engineering (electrical, chemical, civil, naval); in 1908, with Ford's Model-T, began the age of the automobile, oil, petrochemicals and mass production and in 1971, the year Intel's microprocessor was launched, our current age of information technology and telecommunications was initiated. This information era is only half way through its diffusion path. If history is a guide, it has twenty to thirty years of deployment ahead. The next revolution is likely to bring the age of biotech, bioelectronics, nanotech and new materials, in some combination, depending on unpredictable scientific breakthroughs. Each of these revolutions drives a great surge of development and shapes innovation for half a century or more. Of course, this is a stylised description, because social reality is always much richer than the models that help us understand it.

Yet, why do we call them revolutions? Because they go far beyond the powerful set of new industries; they also transform the whole economy providing a new techno-economic paradigm –or common sense best practice– for all. What is most visible is, of course, the powerful cluster of interdependent new and dynamic industries and infrastructures. These result in explosive growth and structural change including the replacement of the industries that had been the engines of growth during the previous surge. On the other hand, each of these revolutions provides new multi-purpose technologies, infrastructures and organisational principles that are capable of modernising all the existing industries too. The result is a quantum jump in innovation and productivity potential for all. The whole process involves a massive change in the overall direction of change, transforming the opportunity space and the ways of living, working and communicating.

A shift in lifestyles

Each technological revolution provides a new inter-related set of life-shaping goods and services at 'affordable' prices. The age of steam, coal, iron and railways saw the emergence of *Victorian living*. The British 'middle classes' established an industry-based urban lifestyle (different from that of the country-based aristocracy) which spread to new upper classes elsewhere. In the age of steel and heavy engineering, which was the first globalisation, we had the Belle Époque. The British, European and American upper and middle classes established a cosmopolitan lifestyle spreading to the upper classes of the world. In the age of the automobile, oil, petrochemicals and mass production there was the *American Way of Life* adopted at first by the upper and middle classes that established a suburban energy-intensive lifestyle spreading to the working classes of the advanced countries and to the middle classes of the developing world. In the current age of information technology and telecommunications there could be sustainable global lifestyles. The question is whether the affluent educated classes of the developed and emerging countries will establish an ICT-

intensive knowledge society with a variety of environmentally friendly lifestyles and consumption patterns.

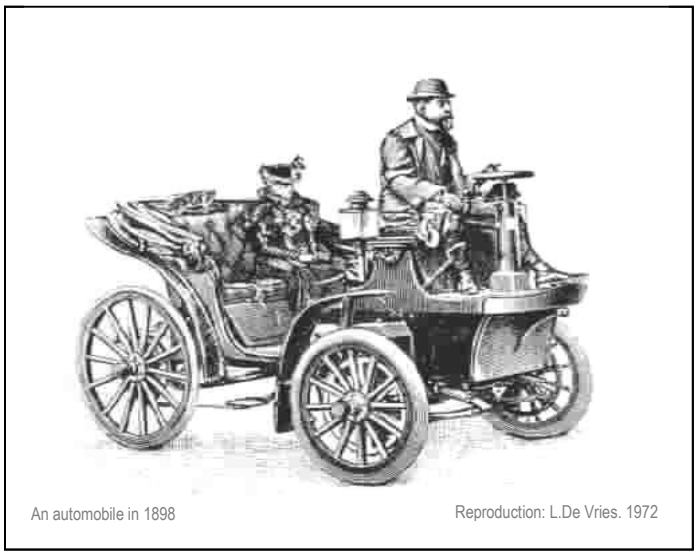
What is important to note is that each of these styles becomes the model of "the good life" and, as such, shapes the desires of the majority and guides innovation trajectories.

To have an idea of the depth of change involved in each of these transitions we can observe the emergence of the 'American Way of Life' as a paradigm shift from the 1910s and its consolidation as the general "lifestyle" after World War II (to a great extent, that lifestyle is still with us). The essential shift was from energy-scarce living when energy was expensive and often inaccessible to energy-intensive homes and mobility, with energy being cheap and its availability seemingly unlimited.

The shift covered every aspect of life: from trains, horses, carriages, stage coaches, ships and bicycles to automobiles, buses, trucks, airplanes and motorcycles; from local newspapers, posters, theatres and parties to mass media, radio, movies and television; from ice boxes and coal stoves to refrigerators and central heating; from doing housework by hand to doing housework with electrical equipment; from natural materials (cotton, wool, leather, silk) to synthetic materials; from paper, cardboard, wood and glass packaging to preference for disposable plastics of all sorts; from fresh food bought daily from specialised suppliers to refrigerated, frozen or preserved food bought periodically in supermarkets and from urban or country living and working to suburban living separate from work. All these changes took time and were strongly aided by advertising, business strategies and government policies.

The intrinsic characteristics of ICT are compatible with "green" production and living. The techno-economic paradigm shift beginning in the 1970s was meant to move society from the logic of cheap energy (oil) for transport, electricity, synthetic materials, etc. to the logic of cheap information its processing transmission and productive use. As a consequence it is possible to shift from preferring tangible products and disposability to preferring services and intangible value; from unthinking use of energy and materials to taking advantage of the huge potential of ICT for savings in energy and materials. Essentially we can shift from unavoidable environmental destruction to potential environmental friendliness, but paradigm shifts confront inertia and contingencies; they are turbulent and take time.

Figure 1



An automobile in 1898 Reproduction: L.De Vries. 1972

The first automobiles looked like horse-driven carriages (see figure 1). The driver sat in the same place as he would have done to hold the reins, the engine below him was measured in horse-power and every other part was made by the same engineering shops that made the carriages. It takes decades to arrive at a design that is consistent with the essence of the new technology. But, once it happens, you know it! Today's automobiles, for all their sophistication, are not fundamentally different from a Model-T Ford.

And so it is that in spite of the potential of ICT for changing the way we live, mass production disposability and high use of

energy and materials are still prevalent. Why? Because, in the crucial 1990s –precisely when ICT producers were defining their growth strategies– there was cheap oil and cheap Asian labour. So it was not necessary to change the old marketing habits of planned obsolescence through fast "fashion" changes. Yet to continue on this route we would need seven planets!

A major transition

Nevertheless, conditions may now be changing in the direction of favouring the full shift. Two main events are leading us there: on the one hand, the financial crisis showing the need to find an opportunity space to guide the recovery and, on the other, the threat of global warming (combined with the limits to availability of natural resources).

The recent financial meltdown marks a structural shift in the economy that is typical of the way technological revolutions have propagated and been assimilated by business and society. Each great surge of development has seen a major financial crisis mid-way along the diffusion path of the technological revolution driving it.

Due to natural human resistance to radical change and the difficulty of social absorption of revolutions and new paradigms, each great surge is broken into two different periods. They can be called Installation and Deployment and each lasts about 20 to 30 years.

The installation period is led by financial capital, which is mobile and can rapidly shift investment from the mature and declining industries to a major experiment with the new technologies, making fast millions in the process. It is a time of *laissez faire*, of Schumpeterian "creative destruction", when the new paradigm battles against the old, when investment concentrates in new-tech and finance and income is polarised making the rich richer and the poor poorer. This period leads to a major financial bubble and ends with its collapse.

What follows can be called the "turning point" (even though it can last more than a decade, as it did in the 1930s) because the State comes back actively and because control of investment shifts back to the hands of production capital. By this time, some of the small companies led by bold engineer-entrepreneurs have turned into giants that can serve as engines of growth of the economy and take long-term decisions without short-term pressures from the stock market. Of course, this shift can only happen because there is a fundamental change in the social mood. From admiring the success of the financial "masters of the universe", public opinion turns to demanding strict control of finance. The losses incurred by people who had never before engaged in financial gambles together with the ensuing recession and loss of jobs and the revelations about the irresponsible and even fraudulent behaviour of the financial world cause popular indignation which puts pressure on politicians to bring the State back into the picture.

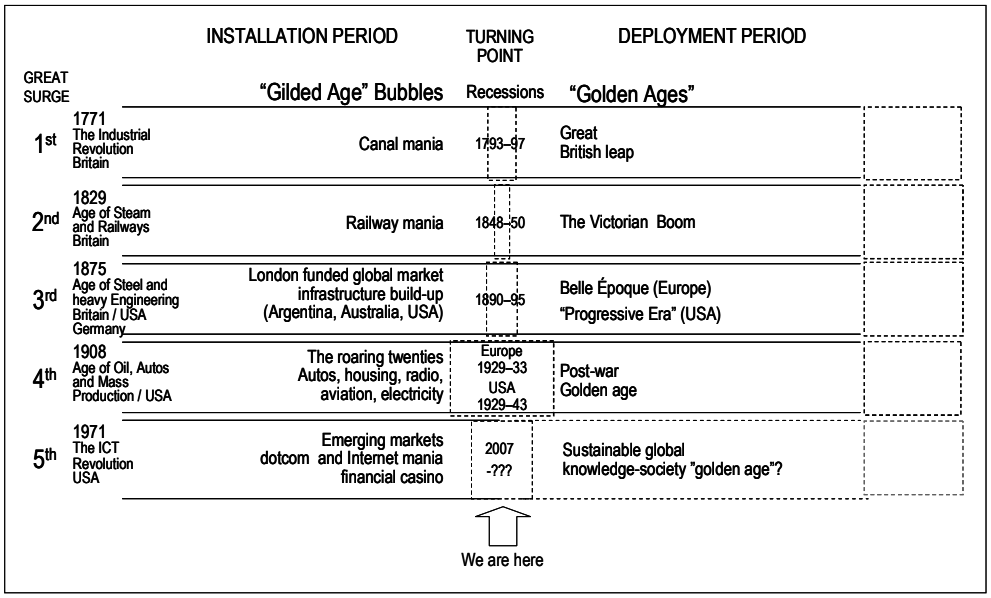
If and when the appropriate changes in the institutional framework are made, the 20 or 30 years of the Deployment period will begin. It will depend on measures to restrain the casino behaviour and guide finance towards funding the real economy as well as on policies that will expand demand through State expenditure, income distribution and regulatory guidance towards the most promising and most socially rewarding technological opportunity spaces. This brings a time of "creative construction" and widespread application of the new paradigm for innovation and growth across the economy and of spreading of social benefits. Deployment is led by production capital and spans from a "golden age" of increasing growth and well-being to the maturity and exhaustion of that paradigm. Then the cycle repeats itself with the next revolution

We can see the sequence in the historical record, where golden ages have regularly followed the boom and bust episodes that end the installation periods. Figure 2 puts the five surges in

parallel in a stylised way. The pattern is in reality much less mechanical than shown; there are overlaps and delays and various other unique features in each case, but the basic sequence follows a fundamental causal chain.

Figure 2

The historical record: Bubbles, recessions and Golden Ages



The "Industrial Revolution" produced canal mania and panic in the 1790s in England, which were followed by the great British leap during the Napoleonic wars. The age of steam and railways saw the railway mania and panic of the late 1840s in the U.K., followed by the Victorian Boom. The age of steel and heavy engineering, which witnessed a battle for world hegemony, where the USA and Germany challenged the British leadership, saw the great crashes in the Southern Hemisphere of the London-financed global market infrastructure build-up in Argentina, Australia (and also the USA). After that, we had the Belle Époque in Europe and the "Progressive Era" in the USA. By the time the "roaring twenties" built up the installation bubble of mass production, the USA had taken the lead with the new technologies (after intensive growth supplying Europe in WWI). The crash of 1929 brought the longest "turning point" yet. It lasted through the 1930s and until almost the end of WWII. What was installed in the 1910s and 20s was the basis for the age of automobiles, oil, plastics and mass production. After the war, the so-called "Western World" saw the greatest boom in history and the emergence of a fully established Welfare State. Those technologies had matured and exhausted their innovation and productivity growth potential, by the end of the 1960s. It was then that the microprocessor gave birth to the Information revolution in 1971 in Silicon Valley, USA. By the 1990s, there were bubbles and crashes in the emerging markets of the globalised economy, there was the boom and collapse of the dotcom and Internet mania and finally the financial casino boom of the 2000s, which collapsed in 2007 and has sent the whole world into recession. Will this lead to a sustainable global knowledge-society "golden age"? That will depend on enabling regulation and policies geared to favouring the real economy over the paper economy, to shaping and widening markets and to insuring social stability.

The return of an active State

The structural shift also involves a shift in the agents of innovation. During Installation, the drivers and innovators are finance and the new entrepreneurs, with the State in a facilitating service role. During Deployment, production and the State move to the driver's seat as innovators and agents of growth, while finance returns to a facilitating service role. Under present circumstances, it will not be easy to tame the enormous power of the financial world however much it may have been weakened by the losses and the scandals. The conditions for moving finance out of the casino and into backing innovation in production will depend on having enough political pressure for effective policy change. This time the role of civil society could be crucial. This particular paradigm has empowered people far more than political organisations had in the past.

At present, all the conditions are there for unleashing a truly global golden age of growth. The Installation period has left a powerful legacy: The new paradigm has been learned by both producers and consumers; the new industrial giants are ready and able to serve as engines of growth; most of the old industries are rejuvenated; the new infrastructure (Internet) has widened and deepened access to consumers and suppliers and a huge potential for innovation and growth is installed but needs a direction. Its deployment in the next two or three decades will be shaped and guided by three forces: Government policies; consumer values and business strategies. To bring about a golden age the three must be: (a) consistent with the potential of the paradigm; (b) mutually compatible and reinforcing and (3) a positive-sum game for all participants.

The post war Golden Age (in the OECD countries) was shaped by: The Welfare State policies; the values of the "American Way of life" and the strategies of economies of scale, disposability and planned obsolescence. The "Third World" did not fully participate; it produced cheap energy and raw materials and provided additional peripheral consumers. This time, sustainable globalised growth across the whole planet can do for world population what social democratic policies did for North America and Europe during the fourth surge. The revamping of infrastructures, production systems and consumption patterns can do for investment what the post-war reconstruction did in the 1950s. And full access to telecommunications can guide consumption towards services and intangibles as much as universal electricity, suburban housing and automobiles did for guiding consumption towards energy intensive lifestyles. The profile of the dynamics of demand will shape the "golden age" to come. And it is policies that ultimately define that profile.

Is this utopian or realistic? It would have sounded utopian to say in the mid-1930s depression that Blue collar workers would have lifetime jobs and fully equipped suburban houses with a car at the door. Yet, it proved realistic because increasing wages created many more millions of consumers for mass production and intensive growth. It also sounded utopian to say that most colonies would gain independence, yet it was realistic because, they did so (with peaceful or violent means) and then the rising middle classes in the developing world adopted the "American Way of Life" widening world markets for mass production. Similarly, it would have sounded utopian or rather outlandish to have said in the late 1960s that some of the values of the hippie movement (back to natural materials, organic food, etc.) would become the luxury norms. Yet it proved realistic. Innovations in natural textile fibres have transformed the world of fashion, while innovations in distribution logistics have made organic foods the premium segment in supermarkets. Indeed, major shifts in consumption patterns are possible and viable, especially when they also shift profit-making opportunities and can lead to enduring positive-sum games.

Consumption patterns are guided by the values defining luxury and the "good life". These usually emerge at the top of the income scale and spread down by imitation. Part of the paradigm shift to sustainability is already happening among the wealthier and more educated classes: small is seen as better than big; natural materials are better than synthetic; multipurpose is better than single function; 'gourmet' food is better than standard; fresh organic fruit and vegetables are healthier; exercise is important for well being; global warming is a real danger; not commuting to work is possible and preferable; solar power is luxurious and Internet communications, shopping, learning and entertainment are better than the old ways, etc. Environmentally friendly values will spread by desire and aspiration (not by guilt or fear!). But business interests and government policy must converge. Will they?

Full globalisation is only possible in practice if it is environmentally sustainable. The current globalisation pattern with materials- and energy-intensive production centred in Asia and consumption concentrated in the developed countries has obvious limits that will be reflected in market prices and lead to behavioural changes.

There is an almost unavoidable path of the current patterns that will result in rising prices of oil and raw materials as the economy recovers. This will in turn increase the costs of packaging (which is done with energy-intensive cardboard and plastics) and of freight (by oil fuelled trucks, trains, ships and planes). The continuing increase of CO_2 intensified by globalised growth will augment the visible effects of greater global warming, leading to a rise in the climatic risk premia of insurance and in the cost of projects for facing or avoiding catastrophes. The overall effect will be a change in the economics of the production, transport and distribution of tangible goods that will in turn lead to changes in business strategies and in government policies. This will result in the massive relocation and geographic re-specialisation of physical production into optimal local, regional and global networks, in the gradual shift from tangible to intangibles in the composition of world production and in the redefinition of the consumption patterns for the "good life"

Choosing the future

Of course, the future is open to socio-political decisions and the range of the possible is very wide. On one extreme, there is the option of letting finance continue deciding on investment, with its short-term gambling focus and we can end up with a "Gilded Age" of shining prosperity on the surface and with continued polarisation of income within and between countries. That will mean confronting violence and migratory pressures along a bumpy road of successive booms and crashes. Alternatively, policies can be set up to favour the growth and expansion of the interests of production, facilitating long-term job-creating investment across the globe. This would lead to a global "Golden Age"; a positive-sum game with increasing prosperity for all, a major expansion of world demand and trade, providing healthy profits for business (in both production and finance) all in a more peaceful atmosphere. The choice is in the hands of every country, region and company, but especially in the hands of the international community.

Indeed, the technological stage is set for the global golden age of the 21st Century. It will require imagination, determination and knowledge to get all the welfare potential they offer while preserving the planet for future generations. The forces favouring a sustainable route to growth are coming together while the resistance of the financial world is still very strong. It is up to government, business and society to agree on the convergent actions to bring forth the best of the possible futures. Successfully effecting this transition is the major task of our time.