LONG WAVES IN GLOBAL DYNAMICS

TECHNOLOGICAL REVOLUTIONS AND THE ROLE OF GOVERNMENT IN UNLEASHING GOLDEN AGES

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The world is currently at a crucial turning point. As in each of the five previous technological revolutions, the major bubble collapse and the ensuing recession mark the swing of the pendulum, from finance-led to production-guided capitalism. The first decades of installation of a new set of enabling technologies and infrastructures create an enormous potential for innovation across all sectors, at the same time as they lead to a strong polarization between the richer rich and the poorer poor, among people, industries, countries and regions. Reversing those processes and successfully taking advantage of the new wealth creating potential cannot be achieved by markets alone but with the help of intelligent government action. The opportunities are there in the new technologies, in the modernization of traditional industries and in preparing for the next technological revolution. It is a question of well informed industrial policy rooted in a consensus vision, shared by government, business and society.

Keywords: *technological revolutions, innovation, financial crisis, industrial policy, modernization, golden ages.*

The world is currently going through a recurring turning point in history. The technological potential is there to unleash a global sustainable golden age, but the political vision seems to be lacking. The future – golden, gilded or recessive – is now being defined globally and in each country. Those with a better understanding of the nature of the transition ahead are more likely to be successful.

This is the fifth time the world has gone through such a transition moment, when politics defines the future of each society and of the world, from the wide range of the possible in terms of wealth creating potential.

Capitalism has indeed experienced successive full pendular swings of about half-a-century, which can be associated with Nikolay Kondratieff's insights and attributed to the fact that, in market economies, technical change occurs by revolutions. It is the difficulty of assimilation of such major changes that defines the differences between the two halves of the process. First, the system goes through the Installation Period led by finance for two or three decades, with unfettered free markets in order to force the propagation of the technological revolution. Then it swings to the Deployment Period, a Golden Age of two to three decades led by production, aided by government, in order to fully spread the new potential across the economy and its benefits across so-

ciety. In between, a major financial crash marks the swing of the pendulum. It is the subsequent recession that creates the conditions and the social pressures for the return of an active State to propel growth and social welfare.

Fig. 1 presents the historical record with the recurring sequence of periods of installation and periods of deployment for each revolution, with the post-bubble collapse recessions in between. The shift from deployment to the installation of the next revolution occurs when the wealth creating potential of the prevailing technologies has been exhausted and decline has set in. The shift from financial mania and collapse to Golden Ages occurs when enabled by government regulation and policies to shape and widen markets. The recessive interval – or Turning Point – lasts for a longer or shorter period depending on the capacity of governments, consciously or intuitively, to establish an institutional framework capable of unleashing the installed potential.

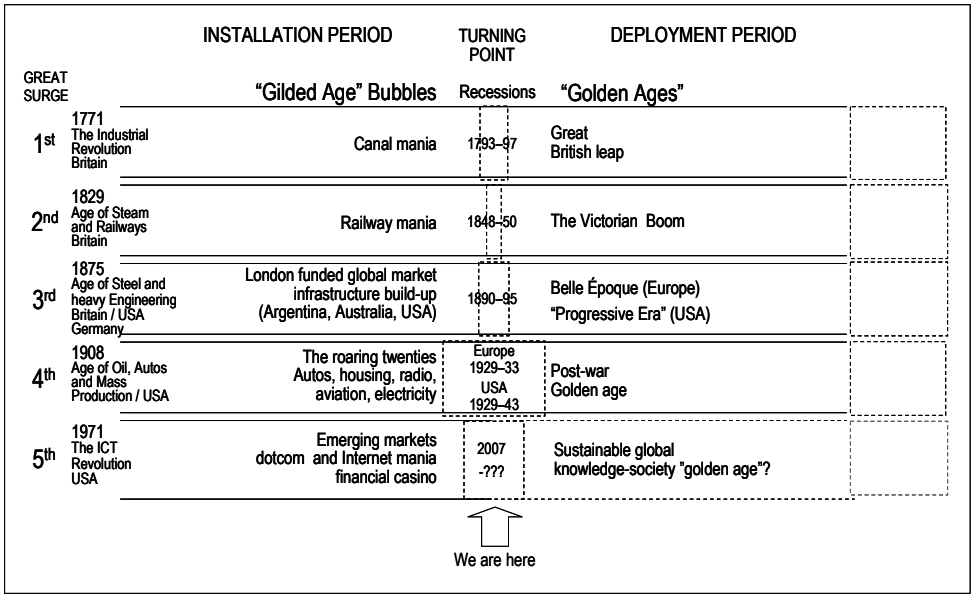

Fig. 1. The historical record: bubble prosperities, recessions and golden ages

Source: Perez 2011a: 107, fig. 1.

Thus, each technological revolution drives a great surge of development understood as the turbulent process of assimilating the wealth creating possibilities of that set of technologies across the originating economy and society and of its uneven expansion across the world.[1]

The first great surge of growth was driven by the so-called 'Industrial Revolution' in England from the 1770s, with the introduction of textile machinery, the factory system, water power and canals. The excitement led to canal mania, ending in the canal panic of 1793, which, after a short recessive interval, brought the great British leap in the first decades of the 19th century. The exhaustion of that revolution was followed, from the 1830s, by the Age of Steam and Railways. That installation period saw railway mania and the subsequent railway panic of 1848. Two years later, the Victorian Boom began. The advent of cheap Bessemer steel, from the 1860s and 70s, opened

the way for a surge of innovation in the Age of Heavy Engineering – civil, chemical, electrical, naval – and for the first globalization. The panics that happened in Australia, Argentina and other Southern hemisphere newcomers hit the financial promoters in London. The revival brought the Belle Époque in Europe and the so-called 'Progressive Era' in the USA. In 1908, Ford's model-T inaugurated the Age of the Automobile and Mass Production in the United States.[2] The great crash of 1929 ended the Roaring Twenties frenzy and led to the longest post-collapse recessive period to date: the 1930s. Resistance to the New Deal may be seen as one of the root causes of the prolonged stagnation. It took the experience of government-industry collaboration during World War II to enable acceptance of the full Welfare State and the Keynesian policies and institutions that facilitated the greatest economic boom in history.

The pendulum swings back to Installation in the early 1970s, when the potential of the mass production technologies with cheap oil approached exhaustion and markets became saturated. Conditions are then set for finance to search for other opportunities in both the global space and with the new technological entrepreneurs. Once more, the installation of a technological revolution, this time based on cheap microelectronics, required the State to be moved aside in order to let the markets do the choosing, driven by high-risk finance. Now, after the double collapses of the NASDAQ in 2001 and the 2007–2008 meltdown, the pendulum is ready to swing back. Adequate enabling policies are again necessary to unleash the deployment of the innovation potential created by the diffusion of the information and communications revolution (ICT). Power needs to be returned to production capital and a more patient financial world must be induced and encouraged to support it.

To understand why the assimilation process takes this shape and requires at first unfettered finance and then market-shaping by government, we need to ask why these constellations of radical new technologies warrant the term 'revolution'. Each of these Surges of Development encompasses and transforms the whole economy and is not limited to the new industries. Each can be called a revolution because it has a double character. On the one hand, it is a set of new products and new dynamic technologies and infrastructures with increasing productivity and decreasing costs that are therefore capable of explosive growth and structural change. Those are what most people will see as a technological revolution. On the other hand, each of them provides a new *techno-economic paradigm* that, together with the all-pervasiveness of the new technologies and the widening of markets by the new infrastructure, offers a quantum leap in productivity for all other activities and sectors (Perez 2010). In practice, therefore, it will enable a massive process of rejuvenation. But for the majority of existing companies the acceptance of such transformations is quite difficult. It is a complete change of 'common sense' for competitiveness and a radical shift in best engineering and managerial practice. The natural resistance of all those that had been successful with the previous paradigm will require Schumpeterian 'creative destruction' not only in products and processes but also in the behaviours and institutions. It is an intense process of learning the new and unlearning the old, by producers, consumers and governments. The inertial forces resisting such profound transformations are at the root of the pendular swings.

Yet to understand the role of the State in unleashing the Golden Age of the Deployment Period, we need to further understand the nature of the Installation period as an intense process of polarization that needs to be reversed. Some industries, regions and countries enjoy accelerated and explosive growth while others experience stagna-

tion, dismemberment and decline. Personal income polarizes into increasing unlimited wealth for some, and ever more unacceptable unemployment and poverty for many others. Some firms and institutions are spectacular successes; many others live through demoralizing deterioration.

Fig. 2 shows how the polarization of income occurred in the USA during the two great surges of development for which it was the core country. One can observe the marked contrast between periods. In the two installation periods – before 1929 and before 2007 – nearly half or total income went to the top ten percent of the population (Picketty and Saez 2003) whereas this share was reduced to one third during the Deployment Period of the 1950s and 60s.

Naturally, when the major crashes expose this unfair distribution of the gains of the bubble and the many fraudulent activities that accompanied it, the politicians will be subjected to powerful opposing pressures: On the one hand, there will be the anger of the majorities left behind and, on the other hand, the pressure of the privileged defending the status quo. The capacity of politicians and policy makers to understand what is really at stake will determine the success or failure in controlling finance, favoring the flourishing of production and employment and benefitting the great majorities of the population. Unleashing the potential Golden Age is likely to depend on the capacity to reverse the polarization of incomes, regions and industries.

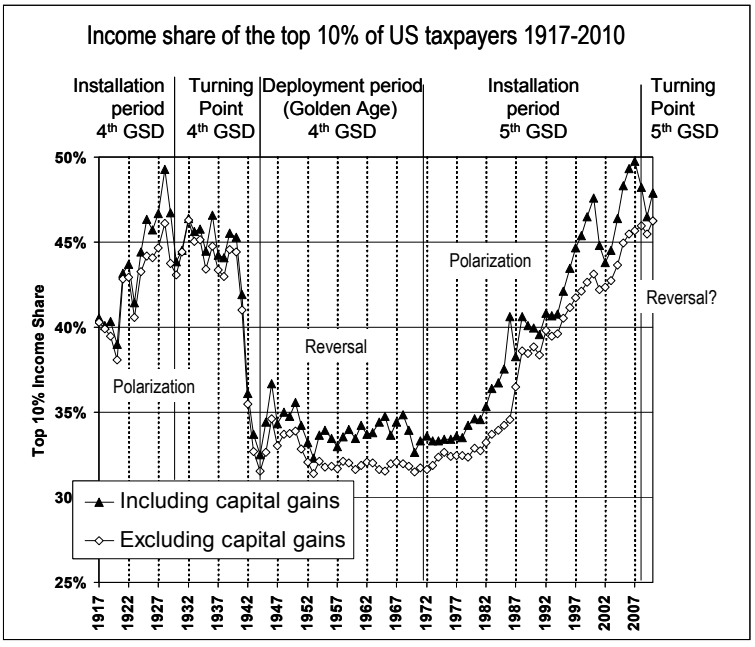

Fig. 2. Pendular polarization of income along each Great Surge of Development in capitalism

Source: Piketty and Saez 2003 with our period indications.

Note: In 2010, top 10 % includes all families with income above $108,000.

Yet, the conditions to achieve the reversal are available. Technological revolutions divide the production world between new and old industries, between new and obsolete skills (in management, engineering and labor), between new advantages and disadvan-

tages, and between new dynamic regions and declining ones. But they also bring new tools, new infrastructures and a new paradigm to rejuvenate and revive all activities. The whole economy – not just the new industries and technologies – can become modern and achieve high productivity. That is the power of each new paradigm; that is the positive legacy of the installation period.

Therefore, in the Deployment Period (after the major bubble collapse) the polarization can be reversed and full employment, prosperity and social justice can be achieved. But free markets alone cannot do it; regulating finance and government spending are necessary but not sufficient. The newly installed potential for innovation and growth must be guided by well informed industrial policy.[3]

The potential of each paradigm is rich enough that it can be guided in quite different directions. The mass production paradigm gave technological support to three types of different regimes – Keynesian democracies, Nazi-fascism and Soviet socialism – with a great variety of specializations within each type. Once a general direction is chosen and favored by government policy, the convergence of innovation, investment and demand in certain sectors will create synergies that will enhance the efficiency and profitability of all those that follow along the same lines.

Today, there are three major spaces for innovation: First, the current revolution: information and telecommunications (ICT); secondly, the future revolutionary technologies: biotech, nanotech, new materials, *etc.*; and, finally, all the other industries shaped by previous revolutions, from agriculture to services. Which of these should be encouraged by public policy? It depends on the conditions of the country or region, its resources, its capabilities, its location in the global economy and many other factors. However, a country as large as Russia in territory and population can aim at supporting the development of all three spaces but each with a different purpose and with different expected employment and income results.

Enhancing the installed capacity in information and communications technologies (ICT), providing low-cost universal access and increasing the capabilities in software, instruments, telecom and networking, provides synergies for the whole economy. That is because ICT forms the basic technical infrastructure for innovation and growth in any sector.

The development of radically new products and processes in biotech, nanotech and other future technologies cannot lift the whole economy but is the guarantee of a self-reliant future. However, rather than growing in isolation, these new technologies would flourish best if developed in connection with the upgrading of the natural resource industries and the enhancement of other industries and services. This would maximize synergies to the mutual benefit of users and producers of the new technologies.

The modernization and rejuvenation of all other industries, from agriculture to services, could become the main source of employment and the best form of income distribution and healthy economic growth, especially in a country as big as Russia, with a potentially huge domestic market. But in order to generate significant synergies, this wide ranging support of the whole production spectrum needs a clear direction for innovation. In the current conditions of the world economy, the obvious direction is towards a ‘green’ knowledge economy. This implies energy and materials saving at all stages of the value chain and fostering creative organizations capable of continuous improvement (Lorenz and Lundvall 2011).

Each industry (and each company) needs to analyze its best market targeting: local, regional or global; massive or segmented; customized or specialized; taking advantage of the size of domestic demand and so on, in order to define the type of price-quality relationship required.

Equally, they must define the main challenges for innovation, whether responding to environmental, demographic or other requirements; whether innovating around the natural resource endowment or catering to the peculiarities of domestic markets (traditions, preferences, climate, distance, *etc.*) or aiming for radical innovations (such as in biotech and nanotech), interconnected with high growth sectors and rooted in existing strengths.

But such complex and multiple decisions cannot be made by the government alone from above, nor can the markets act in isolation and disconnected from government and stakeholders (consumers, workers, shareholders, communities, *etc.*)

In a globalized economy, after the crisis, each country, each region, each locality must collectively define a clear direction for production and innovation, together with the business sector, and support it with adequate government policies.

The conditions are there to bring a period of growth and welfare for all but, in the current global context, this aim is more likely to be achieved if there is a shared consensus vision between business, government and society.

NOTES

[1] See Perez 2002: chs 2 and 6. This article is based on the model of capitalist behaviour presented in that publication.

[2] This happened a decade before the third revolution reached maturity in Europe and that is how hegemony shifted from the UK to the USA.

[3] See Erik Reinert (2008, 2011) on the role of government in growth and development. See also Drechsler (2009) and Drechsler and Kattel (2011) on the importance of a well informed government.

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