



# BTTR

BEYOND THE TECHNOLOGICAL REVOLUTION

WP 2017-01

## Is Smart Green Growth the Solution? Lessons from History

Carlota Perez

April 2017

### WORKING PAPER SERIES

---

The aim of this Working Paper Series is to gradually make available the results of the research project Beyond the Technological Revolution (BTTR): The Role of the State in Shaping Innovation and Growth.

#### BTTR

Beyond the Technological Revolution is a four-year research project led by Carlota Perez, as a continuation of the work done for her 2002 book Technological Revolutions and Financial Capital.

#### CONTACT

[info@beyondthetechrevolution.com](mailto:info@beyondthetechrevolution.com)

#### SUPPORTED BY



anthemis | group



**Is Smart Green Growth the Solution? Lessons from History**

**Abstract..... 3**

**Introduction..... 3**

**How did the Great Depression lead to the Post-War Golden Age?..... 6**

**Why can ‘smart green growth’ be a successful direction now? ..... 10**

**The role of relative prices in shaping and accelerating the transition ..... 12**

**The fear of technological unemployment may be unwarranted ..... 14**

**The lessons of the transition from the 1930s to the post-war boom..... 16**

**Inequality and ‘differential recession’ as obstacles to visibility and action ..... 18**

**Why would full global development be in the interest of the advanced world? .....20**

**Creating the conditions for the best of possible futures.....22**

**Bibliography .....23**

# Is Smart Green Growth the Solution? Lessons from History

Carlota Perez

## Abstract

*This paper takes a historical perspective to argue for the possibility of a global sustainable Golden Age, unleashed by the application of a set of policies that takes environmental threats as opportunities and combines smart green growth with full global development. It discusses why both of those policy directions would create dynamic demand to promote investment and create new jobs to compensate technological unemployment. The paper first looks at the historical patterns in the diffusion of technological revolutions, focusing on the ways in which state action in combination with technological potential has created 'golden ages' after periods of depression in the past. It analyses the boom that began in the US following the Great Depression and World War II, and holds that the key to prosperity was the setting of a direction to 'tilt the playing field', creating dynamic demand for the set of products and services typical of the mass production revolution. It then discusses that, each time around, the tilting implies a redefinition of the 'good life' through accelerating the already visible trends in demand and social values that can be catered to and fulfilled by the current technological potential. An analysis of the demand-pull effect of post-war national and international policies follows, before the argument is made that we now need an equivalent raft of measures to address the inequality that is creating social unrest today. It ends with a discussion of some of the institutional innovations and policies that would be required.*

## Introduction

In the immediate wake of the 2008 collapse and credit crunch it became commonplace to make parallels with the crash of 1929, with the need to avoid a 1930s-type recession repeatedly cited as one of the primary reasons for using public money to save the banks. However, the continued growth of China and other emerging economies gradually blurred reference to those times, centring attention instead on the fiscal consolidation of the ailing economies of Europe and of the US and on saving the still insecure banking system through extreme measures such as massive money printing for the so-called quantitative easing.<sup>1</sup> After the slowing down of Asia and the years of recessive trends in the advanced world, the IMF and other organisations are celebrating

---

<sup>1</sup> The Fed statistics indicate that the amounts accumulated reached \$3.5 trillion between 2008 and 2016 (more than 20% of the GDP of that last year) and QE reached similar proportions in the UK).

the feeble growth prospects as a revival with Asia once again leading the way).<sup>2</sup> Others point to jobless growth, while some point to the risk of a Japanese style no-growth scenario,<sup>3</sup> while some have been talking about secular stagnation or arguing the lack of technological drive for growth.<sup>4,5</sup>

And it is true that the political atmosphere is beginning to evoke the mood of the 1930s. Unemployment is stubbornly high in some of the advanced countries and extremely high in Southern Europe; inequality has reached unacceptable levels; and populist, nationalist, xenophobic and anarchist leaders and movements are growing in popularity and winning elections. The Brexit vote in the UK and the rise of nationalist populism in other countries are making the break-up of the European Union a real threat. The lack of dynamism of the advanced world threatens the market prospects of the vibrant Asian economies and the slump in raw materials prices has stopped in their tracks those of Africa and Latin America. Meanwhile, finance remains decoupled from the real economy, concentrated in a global casino aimed at short-term gains. Although the new technology giants may be indeed investing long-term from their huge profits and their mountains of untaxed wealth, for the financial world itself most innovations seem risky, their markets uncertain. Futures, debt instruments, derivatives and other ways to make money with money without investing in the real economy still appear safer bets to financiers today, despite their recent downfall.

Most commentators are making the historical comparison with the 1930s as a warning – yet I see it as a positive step towards informing choices for a brighter future. Understanding how and why that depression was followed by the greatest socio-economic boom in history holds lessons for the current situation – lessons that can move finance towards productive investment in a way that quantitative easing has not. And the 1930s is not the only period from which we can draw precedents. My research,

---

<sup>2</sup> See a recent IMF report: <https://www.imf.org/en/News/Articles/2017/05/08/NA050917-Asia-Dynamic-Economies-Continue-to-Lead-Global-Growth>, an article in The Economist <https://www.economist.com/news/briefing/21718866-despite-anxieties-green-shoots-global-recovery-are-real-world-economy-picking-up> and an article in the Financial Times : <https://www.ft.com/content/db15441a-5bee-11e7-9bc8-8055f264aa8b>

<sup>3</sup> See Asian Review <https://asia.nikkei.com/Features/FT-Confidential-Research/Job-insecurity-rises-in-ASEAN-despite-economic-recovery>

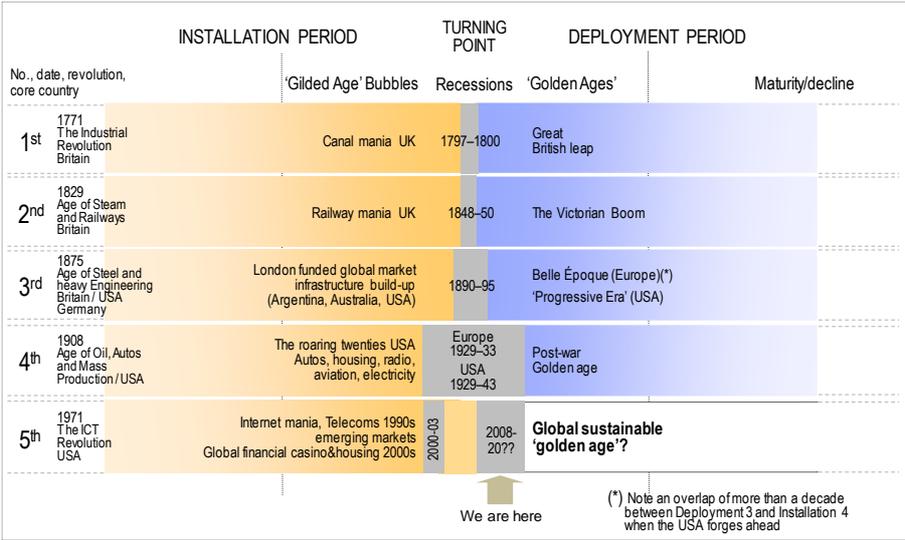
<sup>4</sup> Summers, L. (2013) 'Why stagnation might prove to be the new normal,' *Financial Times* December 15, 2013; following Hansen, A. (1938) *Full Recovery or Stagnation?* New York: W. W. Norton.

<sup>5</sup> Gordon, R. (2012) 'Is U.S Economic Growth Over? Faltering Innovation Confronts The Six Headwinds', Working Paper 18315, National Bureau of Economic Research, August 2012. <http://www.nber.org/papers/w18315>

following Schumpeter,<sup>6</sup> has identified five technological revolutions which have led to five 'great surges of development' since the late 18<sup>th</sup> century (see Figure 1).<sup>7</sup>

Figure 1

The historical record: Bubbles, Recessions and Golden Ages



Source: based on Perez 2002 and 2009<sup>8</sup>

Each surge has gone through a financialised supply-push period of two or three decades, when the new technologies establish themselves through ferocious competition, ending up in a major bubble that inevitably collapses (with ICT we have seen two bubbles and may well be on our way to a third<sup>9</sup>). The recession that follows these bubbles is a time when the installed potential is ready in the wings to transform the rest of the economy. Such a transformation only ensues if and when the adequate

<sup>6</sup> Schumpeter, J.A. (1939:1982) *Business Cycles*. Philadelphia: Porcupine Press.

<sup>7</sup> It is important to point out that with the term 'great surges', we are not referring to long waves or cycles observable in GDP figures, but rather to processes of technical change across the economy and society and to the way they are assimilated. See Perez, C. (2002) *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham: Edward Elgar, Ch. 7; and Perez, C. (2015) 'From long waves to great surges: continuing in the direction of Chris Freeman's 1997 lecture on Schumpeter's business cycles', *European Journal of Economic and Social Systems*, Volume 27 – N° 1-2, pp. 69-79.

<sup>8</sup> Perez, C. (2002) *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham: Edward Elgar; Perez, C. (2009) 'The Double Bubble at the Turn of the Century: Technological Roots and Structural Implications', *Cambridge Journal of Economics*, 33:4, 779-805.

<sup>9</sup> Perez (2009), *ibid*.

context is created to facilitate its unleashing in a synergistic direction. When this has happened, Golden Ages have followed the major bubble collapses. Such was the great British Leap with the 'industrial revolution' after the canal panic; the Victorian boom in the UK in the mid-19<sup>th</sup> century, after the railway panic; the Belle Époque in Europe and US at the turn of the 20<sup>th</sup> century, after the Baring Crisis and many other collapses in the Southern Hemisphere and America in the 1890s; and such was the more recent Post-War Boom in the Western democracies, after the crash of 1929, the long depression of the 1930s and WWII. In contrast, the prosperities associated *with* the major bubbles – such as the roaring Twenties or the recent NASDAQ bubble of the 1990s and the credit boom of the 2000s – can be seen as Gilded Ages, because they have been characterised by income polarisation rather than by the spreading of the benefits of the new wealth-creating potential across society.

My assertion is that the combination of the information and communication technologies (ICT) with a globalised context requiring sustainable growth, points to a future in which what I call 'smart green growth' is probably the only direction that can bring the next Golden Age. Other chapters in this book have noted that the trends of 'dematerialisation' and a 'weightless' economy, which would support such a claim, are already pointing in that direction. That has been the case with each revolution: what ends up as a positive-sum game for business and society is initiated with early niche developments in certain regions and sectors.<sup>10</sup> Each revolutionary set of technologies has been unique, as has the context wherein each surge of development has taken place. Yet there are clear patterns of diffusion, and of how socio-political choices affect the potential of each set of new technologies to spread across the entire socio-economic fabric to benefit most of society. In this chapter, I will explore how and why this has happened in the past, and suggest what policy makers can learn from these historical patterns.

### **How did the Great Depression lead to the Post-War Golden Age?**

It was in a similar context to the present that Keynes insisted on the need to prop up demand to revive investment and growth. On that occasion, he did not refer explicitly to the available technological potential. But he was implicitly recognising a particular

---

<sup>10</sup> Geels, F.W. (2002) 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and case study.' *Research Policy*, 31, 1257-1274.

direction that innovation could take when he advised President Roosevelt to 'put all the eggs in the housing basket'.<sup>11</sup>

The automobile was the centrepiece of the mass production revolution, together with the cheap oil that served as the energy source fuelling it, and which also provided universal electricity and unleashed innovation in a myriad of petrochemical materials. Keynes was correct in his prescription: it was suburbanisation that became the demand-pull mechanism to bring forth the multiple innovations inherent in the mass production technologies that sustained the post-war boom. The new vehicles brought a profound change in the use of territory. The possibility of constructing a road network to use the cheap land around the urban centres for building cheap houses in great quantities was a radical break from the urban-rural divide that had characterised the world of railways and horse carriages. Suddenly it was possible to overcome the high costs and restrictions of city land and the need to cram workers into lodgings within walking (or tram) distance of the factories. And each new development, each new home was a source of demand for what became a sort of electrically-driven factory for the housewife. Home ownership and the mushrooming of suburbia opened a world of innovation – and demand – in energy-intensive appliances and plastic objects, in building materials and disposable packaging, in home entertainment devices and processed and frozen food.

But this explosion of consumer-pulled growth could not be imagined at the start of the mass production paradigm, which had 'begun' decades before, marked by Ford's Model-T. The threat of massive job losses due to the assembly line and the mechanisation of agriculture led to warnings about secular stagnation and structural unemployment, not dissimilar to warnings about the threat of robotics and AI that are prevalent now.<sup>12, 13</sup> The Golden Age of that paradigm only began after the war effort revealed the innovation potential of mass production and the benefits of state procurement and public-private partnerships, and when the subsequent measures of the welfare state made it possible for growing numbers of the population – including blue collar workers – to aspire to a suburban home. In addition, the fact that so many women worked in factories during the war made it easy for them to welcome electrical appliances in the home. In the middle of the depression it was difficult to recognise

---

<sup>11</sup> Keynes, J.M. (1938) 'Private letter to Franklin Delano Roosevelt,' February 1<sup>st</sup> 1938. In Moggridge, D.E. (1992) *Maynard Keynes: An economist's biography*. London: Routledge.

<sup>12</sup> Hansen, A. (1938) *op cit*.

<sup>13</sup> Higgins, Benjamin (1950) The Theory of Increasing Under-Employment. *The Economic Journal*, Vol. 60, No. 238, pp. 255-274; Backhouse, R. E., and Boianovsky, M. (2016), 'Secular stagnation: The history of a macroeconomic heresy', *The European Journal of Economic Thought*, Vol. 23, Iss. 6.

this vast range of innovations, together capable of creating a consumerist way of life that could fuel economic expansion for decades.

The importance of a direction for innovation was also key to the occurrence of Golden Ages in the deployment phase of each of the previous revolutions – and each time this direction, while inherent in the combination of new technological innovation and the specific historical context, was enabled and brought to flourishing by the actions of the State. Each time this typically included both the setting of policies that encouraged a favourable context for the new innovations, and providing demand—either directly as procurement or indirectly via income distribution, public employment or access to export markets. The growth of mechanised industry, and particularly of cotton, in the ‘Industrial Revolution’ was facilitated by the creation of new transport infrastructure (authorising canals and toll roads, building ports and docks), the exemption of exports from taxes and enabling credit for investment despite growing debt for the Napoleonic Wars.<sup>14</sup> The directions which unleashed the potential of steam and the railways in the Victorian boom were urbanisation, mechanisation and global exports – Britain became the ‘workshop of the world’. Municipal governments provided the urban infrastructure while the national government removed all barriers to trade nationally and internationally, including the use of gunboats to force Japan and China to open to commerce. The Belle Époque, which was the deployment of the third surge, with the primary technologies of steel and heavy engineering, saw extremely active and protective governments in Europe (Germany in particular) and in the USA, the carving up of the undeveloped world into commercial empires, all facilitated by a British government which promoted the growth of global infrastructure – networks of railways, telegraph, ports and steamships – provided the gold standard and supported the financial and commercial services that interconnected the world.

We see this pattern of state-assisted directionality at its most complex and successful in the establishment of the Welfare State (following precedents from the previous surge) and the new Keynesian forms of economic intervention which led to the deployment of the mass production potential. Those decades after 1945 are what the French call ‘les trente glorieuses’; it is perhaps the only period to date when capitalism could justly claim to be a system in which the pursuit of individual wealth benefitted the many. It was also the first time when an international group of governments got together to establish a set of institutions aimed at a stable context for international investment and trade. The Bretton Woods agreements on the US dollar as gold

---

<sup>14</sup> The government suspended the obligation of convertibility in gold by the Bank of England, facilitating the expansion of credit for both public and private ends.

standard and the creation of the IMF, the World Bank (originally the International Bank for Reconstruction and Development, or IBRD), and, eventually, the United Nations, allowed mass production technologies to reach their full flourishing in what became 'the advanced world' - although left the developing world behind.<sup>15</sup>

At the same time, the Cold War provided complementary demand to domestic expansion: an enormous growth of military procurement, and multiple routes for advances in science and technology in aerospace and advanced electronics, which led to the early computers, instruments, semiconductors and other technologies that would eventually come together to form the information revolution. The Cold War was, indeed, the other important direction provided by governments for innovation and investment.

Today an equivalent, perhaps even greater, technological potential to that of the *trente glorieuses* is yet to be unleashed – and its consequences are as difficult to prefigure as all the previous golden ages have been. We are only at the midpoint of our present revolution: the technologies have become normalised, new dominant industries built and a new infrastructure (the Internet and cellular communication) established, yet the capacity of information technologies to transform every single industry and activity has only barely been applied. And whereas in the 1930s, deployment of mass production occurred primarily in the context of national economies, a golden age of the knowledge society today would be operating in a globalised economy. What is lacking is a direction that will tilt the playing field as effectively as suburbanisation and the Cold War did in the post-war boom. It is the combination of dynamic demand and synergistic direction that will provide the conditions for innovation and investment to thrive, bringing a global economic boom.

---

<sup>15</sup> The then-called 'Third World' did not benefit from the new possibilities. 'Third World' countries typically experienced either a peaceful or violent process of decolonisation, while becoming a space for waging by proxy some of the battles between East and West. They remained primarily a supplier of cheap energy and raw materials for the Western economies until, in the 1960s and 70s, import substitution policies (ISI), with very strong protection, were introduced. Despite the many valid criticisms levelled at ISI since, they did create a positive-sum game at the time between the mature industries of the 'First' World and the governments of the 'Third', with a legacy that is potentially more positive than critics believe; see C. Perez (2010) "Technological dynamism and social inclusion in Latin America: CEPAL Review no. 100, pp. 121-141 and Perez, C. with A. Marín and L. Navas-Aleman, (2014) 'The possible dynamic role of natural resource-based networks in Latin American development strategies' in Dutrénit, G. and J. Sutz (eds), *Innovation Systems For Inclusive Development: The Latin American Experience*, Ch. 13. Cheltenham: Edward Elgar.

## Why can 'smart green growth' be a successful direction now?

There are many reasons to hold that the most promising direction for such a global boom is 'smart green growth'. Mass production can no longer be considered a viable direction for growth; not only because ICT brings a profoundly different set of technologies but also because we are burdened by the legacy of an intensely polluting and wasteful mode of consumption. It is now widely recognised that there are simply not enough resources on the planet – raw materials, water, air, land – to support it.<sup>16</sup> The fact that full global development is an avowed target of businesses, nations and our supranational bodies makes the natural limits on resources even more pressing.<sup>17</sup> This goal is not only a challenge to the limits of natural resources; if we remain on the same environmentally unfriendly growth pathway, it will be accompanied by huge financial burdens, from insurance pay-outs to massive public health costs.

Yet at the same time as innovation and development are clearly needed in addressing resource scarcity and environmental degradation, the technologies of the ICT revolution are making such innovation and development possible in a way that was inconceivable (to all but the prescient science fiction writers) fifty years ago. Data harvesting and sharing, combined with the precision in design and production possible with ICT technology, and the optimisation of logistics, is leading to sophisticated, demand-responsive production processes and supply chains models that reduce energy and materials use. Making the transition to clean energy, revamping all buildings and infrastructures, and the redesign of products, services, distribution and maintenance systems, has the potential to not only overcome the dangers of climate change and scarcities of food, water and raw materials, but also to reduce the jobless rate in each country and lead to a global respecialisation – with enough markets for all to grow.<sup>18</sup>

Just as the automobile redefined the use of territory, so the Internet can lead to a modern form of urban-rural relationship, where cities are much more concentrated,

---

<sup>16</sup> Rockström, J. et al. (2009) 'Planetary boundaries: exploring the safe operating space for humanity.' *Ecology and Society* 14:2, 32.

<sup>17</sup> UNDP (2011) *Sustainability and Equity: A better Future for All*. Summary. Human Development Report 2011, New York:  
UN [http://www.undp.org/content/dam/undp/library/corporate/HDR/2011%20Global%20HDR/English/HDR\\_2011\\_EN\\_Summary.pdf](http://www.undp.org/content/dam/undp/library/corporate/HDR/2011%20Global%20HDR/English/HDR_2011_EN_Summary.pdf)

<sup>18</sup> See, for example, the flourishing of Germany's *Energiewende*, or low-carbon transition, which sites the transition at the heart of the Federal Ministry for Economic Affairs and Energy – a pairing that indicates how key the *Energiewende* is perceived to the country's economic future;  
<http://www.bmwi.de/Redaktion/EN/Dossier/energy-transition.html>

while towns and villages can be relatively self-sufficient in many services and yet strongly integrated with the cities and the global economy. The issue that will require much imagination is what to do with suburbia. While developers are practically expelling the poor from the cities through the so-called 'gentrification', it could be that suburban communities will need to incorporate economic activities and turn into more integrated spaces for living, working and entertainment.

This is to be expected, because, as in previous surges, the transition to 'smart green growth' would also involve a redefinition of 'the good life'. Historically, every technological revolution has led to a radical change in consumption patterns, consonant with the range of products shaped by the new technologies. There were no disposable plastics in the Belle Époque (only brittle coal-based Bakelite was available and was not for wasting), while the disposable Gillette steel razor blades used then would have been inconceivable in the iron-gated Victorian lifestyle of the 1850s. At that time the steel for the barber's sharpened blades was as precious as platinum. Similarly, the mobile phones and computers seen as indispensable today might have been considered unnecessary office gear by consumers in the 1950s and 60s.

The 'American Way of Life' that drove the mass production boom cannot realistically remain the aspirational motivation for the new billions of middle-income consumers in the emerging world. If it did, they – and their western counterparts – would soon stumble against resource scarcity and soaring prices. Yet just as the technologies of ICT make sustainable production *feasible*, they are also changing the possibilities and aspirations of what makes up a 'good life'. The rise of personal ICT devices has led to the long-predicted reduction of paper consumption. And these technologies have already changed the proportion of tangible and intangible goods and services in the patterns of both consumption and production. Rental and collaborative economies are lengthening the life of each product and encouraging a multi-user model of distribution, further diminishing the amount of materials and energy required to satisfy individual consumption needs. Smart electric grids are allowing the interactive production and consumption of energy. Experiments in the circular economy are slowly becoming not only acceptable but desirable 'back stories' to the products that consumers choose to buy. Small-scale production is now commercially viable as it becomes demand-responsive and can count on specialised retail stores, on-line sales and flexible transport and logistics. 3D printing is set to revolutionise the supply chains, from initial production to the supply of replacement parts in a re-use and repair economy. The 'good life' is visibly shifting from heterogeneity to custom – and viewed from the supply side, from the mass consumer to a plurality of consumers and from wasteful 'planned obsolescence' to truly durable products that can move from hand to

hand in good condition. This only looks set to intensify, with nanotechnology, biomaterials, artificial intelligence and other advances promising that durable goods will be durable, that non-durable ones will be biodegradable and that an increasing number of needs –old and new– will be fulfilled with intangible services.

Today's luxury life, among the rich, the educated and the young, increasingly includes unprocessed, natural, food, minimalist design, electric cars, exercise, extreme sports, bicycling and other expressions of the new notion of 'healthy living'. Recycling and maintaining, sharing, collaborating, and renting or accessing rather than possessing, are also part of the new 'good life'.

However, as with every other aspect of the paradigm shifts brought by each technological revolution, the changes are slow and uneven and only intensify when the context is reshaped by government to give a clear impulse to the transformation in an appropriate direction. So, the question is whether the current playing field is favouring or hindering a faster evolution of such changes towards sustainability in production and lifestyles.

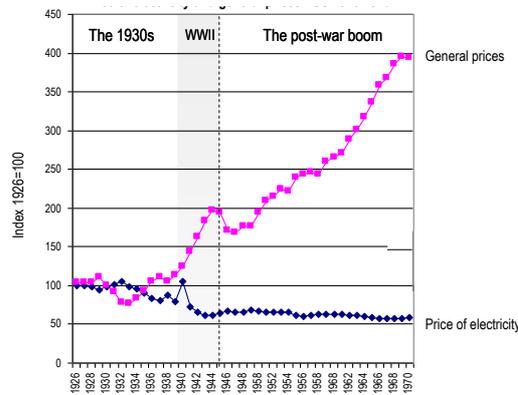
### **The role of relative prices in shaping and accelerating the transition**

The provision of cheap energy was a fundamental driver of the consumption pattern during the post-war boom. Both the production and the use of automobiles and electrical appliances were energy- and materials-intensive. During that time, the price of fuel and electricity in the US actually decreased, while all other prices increased significantly (see Figure 2).

By contrast, the cost of labour was going up through the pressure of the officially recognised labour unions and the reduction of the working day, week and year. Those changes increased consumption demand and spurred increases in scale and productivity in manufacturing, which were basically obtained through replacing expensive labour with machinery moved by cheap energy.

Figure 2

Price of electricity and general price level – US 1926-1970

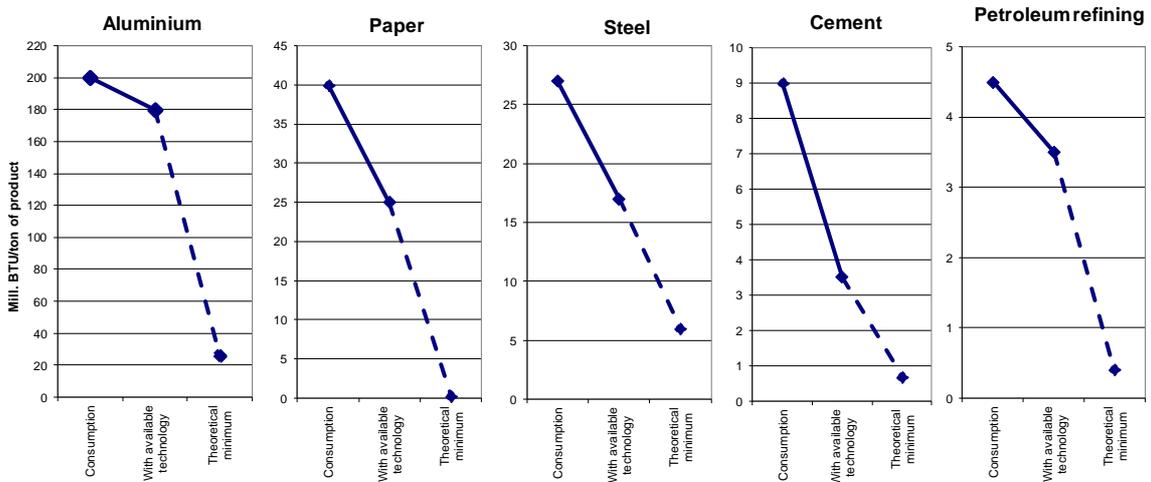


Source: US Dept. of Commerce

The rapid reduction of industrial energy consumption achieved after the hike in oil prices of the 1970s and 80s was not due to great innovation. Aluminium, paper, steel, cement and petroleum refining represented 60% of industrial energy use in the United States. Each could have saved between 10 and 60% using technologies that were readily available, but were not applied before because – as they frankly declared – energy was ‘too cheap to worry about’ (see Figure 3).

Figure 3

The six industries with maximum energy consumption in the United States in 1974, potential reduction with available technology in the 1970s and theoretical minimum



Source: *Fortune*, March 1974, pp. 110-111

As the figure suggests, the potential for energy reduction is still significant<sup>19</sup> and industry can move in that direction if the price of energy is made to reach a level where it is profitable to do the necessary research and the innovative investment. Markets do work, but the direction they take depends on the context, and that includes relative prices and relative taxes.

As to the consequences of expensive energy for low-income consumers, it is obviously a challenge for policy makers. Solutions should be found in some form of direct or indirect compensation that will, nevertheless still encourage personal energy-saving.

### **The fear of technological unemployment may be unwarranted**

The fear of structural unemployment that became widespread in the 1930s and 40s, in view of labour displacement by mass production in manufacturing and the mechanisation of agriculture, proved to be mistaken; so could be the case with the current fear of robotics and artificial intelligence. The incorrect analysis then, as now, is that the new technology sectors will be the sole source of new jobs. This is not the case.

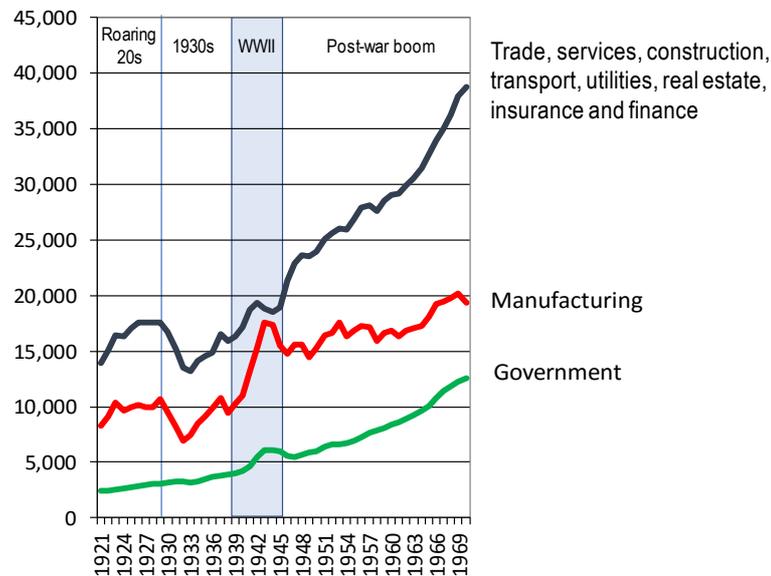
In the US, throughout the post war boom, manufacturing led in volume and productivity growth while employment numbers in that sector barely grew. As shown in Figure 4, full employment was achieved through job creation in services and government. While real manufacturing product grew 2.5 times in 25 years, employment in the sector increased only 30%. In the same period, employment in all the other less productive sectors – government, trade and services; retail trade, construction, transport, utilities, finance, insurance and real estate – nearly tripled. That is how full employment was achieved. The wealth created in the high productivity, higher tech sector spreads across the economy to enable the creation of many other services, usually catering to the new lifestyles. These jobs provide relatively well-paid employment, with wage levels defined by the expected standard of living, given by the average productivity.

---

<sup>19</sup> Grubler, A., Riahi, K., 2010. Do governments have the right mix in their energy R&D portfolios? Carbon Management, 1(1): 79–87.

Figure 4

Evolution of non-agricultural employment by sector. US 1921 - 1970



Source: US Dept. of Commerce (with period indications by the author)

Likewise, the ICT sector may continue to lead in growth and productivity in the upcoming decades, while reducing employment in many of the mass production industries and activities. However, it is already leading to the creation of previously unimagined jobs, with the promise of more yet to come. A whole range of personal services is already replacing the machines of the mass consumption era and the staff of the previous ones, while health provision, education, training and coaching are becoming increasingly individualised. The creative industries and information intermediation continue to flourish. Maintenance, recycling, rental services, energy conservation, the development of new sustainable materials and other climate and resource related activities have huge potential for both economic growth and employment, if intelligent policies encourage them.

Unleashing that complex potential worldwide requires a range of policies in convergent systems with the clear intention of enticing investment and innovation in the 'smart green' direction. This can be done through making it more profitable, less risky and possibly less costly to go green than to continue along the old energy and materials-

intensive ways and to make it also more profitable to invest long-term in the real economy than to remain in the short-termist casino mode.

**The lessons of the transition from the 1930s to the post-war boom**

If we are currently in the ‘turning point’ of the ICT revolution, as I assert, now is the time for the state to step in to promote such a direction. It is not easy to steer such change. It requires deep understanding and a bold leadership. Both business and politicians need to be persuaded that it is in everybody’s interest – medium and long-term – to build a positive-sum game. However, it was not any easier to set up the conditions for the flourishing of the previous mass production revolution. And at that moment in time, one can assume that the leaders did not have the advantage of being fully conscious of the technological underpinning of the policies that they applied. Socio-political conditions created by the war and by the Soviet threat helped create an acceptance, both by individuals and business, of the need for a Welfare State and its high tax regime, accompanied by a very active role for government. But if we analyse the measures taken then, we can see how, next to tax-funded military innovation, they all created the demand conditions for mass consumption and the corresponding innovations (See Table 1 for an abbreviated form of our research).

Table 1

An interpretation of the post-war policies  
as creating demand and directing innovation

NATIONAL POLICY	DEMAND-PULL EFFECT
State involvement in the economy plus strong regulation of finance	Demand and interest rate management to induce full employment, stable growth and regular short- and long-term investment within national borders
Significant income tax	Progressive redistribution of demand capacity (for consumption and public expenditure)
Unemployment insurance Social security	Stability of the consumer credit system for homes and durable goods: Mortgage and credit payments could continue over recessions and job loss or shift; each month’s salary could be fully spent, thanks to retirement pensions
Public services and defence	Massive State employment State demand for mass and high tech products

	Massive funding of R&D in universities and special agencies and institutes
Massive investment in roads and other infrastructure	Enabling suburban home construction and ownership at affordable prices, which brought demand for autos, appliances, super-market shopping, etc.
Government backing for mortgages (Fannie Mae in the US from 1938)	Reducing risk for banks when lending to salaried persons for home buying
Mass education and health systems	Basic cost covered by the State (freed for consumption) Melting pot for homogeneous public sector demand
Official labour unions	Turning higher productivity into higher salaries and higher consumption
Shorter working time	Time for enjoying (and buying) products and services
Farm subsidies	Equalising industrial and agricultural profits. Lowering food costs, freeing consumer money for manufactured products and services Market for mechanised equipment and petrochemicals in agriculture
<b>INTERNATIONAL INSTITUTIONS:</b>	<b>TO ACHIEVE :</b>
Bretton Woods Marshall Plan, IMF, World Bank GATT Political independence for colonies United Nations 'Cold War'	Orderly trade and investment between stable national economies, with the US as main coordinator  World political tensions in relative, though unstable, equilibrium (requiring constant defence spending and innovation)  International funding for European reconstruction and for infrastructural investment in the increasingly independent Third World (importer of manufactures and exporter of low cost materials and energy)

In the turning point of this particular revolution, the policies for demand creation and directing innovation have equally daunting objectives: overcoming jobless growth (or no growth) in the advanced world, decreasing inequality within countries, achieving growth in the lagging countries, reducing excess economic migrations, combatting climate change and resource scarcity, and producing enough food for the global

population. And the challenge is even greater because no isolated national economy can bring stable growth long-term; the context is now global and needs to be confronted as such. National consensus is not enough; a basic global consensus will be required. Finally, to even begin discussing a path out of stagnation, market fundamentalism needs to be overcome and the role of the State recognised in building that consensus. During the 'creative destruction' period of the first half of each technological paradigm, unfettered, competitive business can and does make an impact (although, even here, Mazzucato and others would argue that business is riding on the coattails of 'entrepreneurial' states<sup>20</sup>). But structural change in a green direction for a global positive-sum game will not be enabled by 'free' markets alone. Markets function in response to the opportunities provided by the immediate context, but their capacity to change that context is not only very limited, it can often lead in socially undesirable directions. Only government can redefine the playing field, preferably through a consensus-building process with all the stakeholders. As the experience of the post-war era shows, it is not simply a question of removing obstacles, but of 'creative construction' – providing incentives and synergies in a direction that opens and generates clear and multiple innovation and profit opportunities while bringing social benefits to all.

### **Inequality and 'differential recession' as obstacles to visibility and action**

The main obstacle confronted in both the 1930s and now is the income polarisation created by the bubbles. The elites cannot grasp the situation. They do not suffer the recession like those whose skills and jobs have been destroyed and whose old hopes for themselves and their children have been demolished. The Great Gatsbys of today are close to power and do not see the urgency of change.

Today's western corporations have grown by moving production to countries with lower labour costs, and, more recently, by catering to the fast-growing markets of China and other developing nations, rather than the stagnant (in demand terms) markets of their own backyard. In fact, one could say that the interests of the global corporations no longer coincide with those of the populations of their countries of origin.

At the same time, many economists and statisticians, who estimate 1 or 2% of GDP growth, believe it is equivalent to the same percentage in the 1960s, when society was

---

<sup>20</sup> Mazzucato, M. (2013a) *The Entrepreneurial State: debunking private vs. public sector myths*, London: Anthem Press.

fairer both in wage levels and in the safety net provided by the – now semi-dismantled – Welfare State. They cannot understand why people resent immigrants or why they would vote for populist leaders whose promises are obviously impossible to fulfil. We are in fact, as in the 1930s, in a world of ‘differential recession’. When the top 1% of society receives 84% of all the increase in income, the growth of the economy as a whole cannot reach the bottom of society.<sup>21</sup> Never, since it was invented for WWII, had the expressions ‘GDP’ or ‘GDP per capita’ meant so little in the advanced countries.<sup>22</sup>

The anger and hopelessness that today lead to violence and the rise of populist figures is generated by the same factors that led to the election of Hitler and communist leaders in the 1930s. Indeed, both Nazi-fascism and communism shaped the mass production potential to their ends well before social democracy was able to usher in the post war Golden Age. It was only the experience of the war that convinced business that working with government and the demand of mass markets was an advantage. When Roosevelt first tried to apply Keynesian-type policies in the 1930s business ferociously opposed him, accusing the government of both communism and fascism; It was not until post-war, when they brought constantly growing demand that those same policies were accepted and applauded. Organs of the welfare state, such as Britain’s NHS, were considered vital to the health and therefore prosperity of a nation in the post-war years. And it was all paid for by a massive redistribution of wealth, which counteracted the income polarisation rife at the time of the Great Depression.<sup>23</sup> The top rate of income tax in the 1950s in the United States was above 90%, an unbelievable figure today but one accepted in its time.

So the policy changes that are necessary to bring an economic boom for the benefit of all are as ambitious and bold as the ones set up after the war and confront equally daunting ideological and political obstacle. Could the electoral success of the populists

---

<sup>21</sup> Sommeiller, P., Price, M. and Wazeter, E. (2016) ‘Income inequality in the U.S. by state, metropolitan area, and county’, Economic Policy Institute, Report, June 16, 2016.

<sup>22</sup> This has recently led to a plethora of articles and attempts to more adequate measures of growth, development and even happiness. See for example: Bok, D. (2010) *The Politics of Happiness: What Government Can Learn From the New Research on Well-Being*, Princeton, NJ: Princeton UP; Davies, W. (2015) ‘Spirits of Neoliberalism: ‘Competitiveness’ and ‘Wellbeing’ Indicators as Rival Orders of Worth.’ in R. Rottenburg et al. (eds.), *The World of Indicators: The Making of Governmental Knowledge through Quantification*, Cambridge: Cambridge UP, 283-306; Drechsler, W. (2016) ‘The Reality and Diversity of Buddhist Economics’, Keynote address III, ‘Buddhist Economics and World Crises’ conference, World Buddhist University, Bangkok, 22 May 2016.

<sup>23</sup> Picketty, T. and Saez, E. (2003; revised data 2016) ‘Income Inequality in the United States, 1913-1998’, *Quarterly Journal of Economics*, 118(1), 2003, 1-39 (for data see <https://eml.berkeley.edu/~saez/>).

and the threat of violent nationalism, combined with the pressing ecological threat to the planet, play the role that war played in inducing the change in the playing field in the 1940s?

In that case, the environmental problems can turn into the solution. A massive wave of innovation can be stimulated by providing urgent demand, together with funds for investment in a green, sustainable, direction, and with a tax system designed to discourage energy and materials use and to strongly favour their saving as well as enabling the production of intangible goods and services. In such a context, the mountains of money that are now playing for gains in the world of derivatives, asset inflation, stock buybacks, high frequency trading and other short-term casino games could be penalised, while strongly favouring profitability in longer-term investment in the real economy. That would unleash a wave of innovation and investment in a win-win game between business and society.

But this time boosting domestic demand may not be enough. In fact, it is very likely that many of the necessary jobs in the advanced countries would have to come from helping create demand for capital goods and engineering in the lagging countries. A positive sum game between advanced emerging and developing countries will also be required.

### **Why would full global development be in the interest of the advanced world?**

However much we have celebrated here the win-win nature of the post-war Golden Age, it is clear that the covenant did not include the then-called Third World. The counterpart of high wages in the North was cheap raw materials and energy from the South. Today, however, it could be that *expensive* natural resources may end up leading to the solution for both North and South.

Even if only the two most dynamic emerging countries – China and India – were to reach full development in the next couple of decades, they could not do so by adopting the resource-intensive ‘American Way of Life’, the consumerist model of the old ‘good life’. Scarcity, pollution and waste disposal would become a brake and would soon increase prices, making cost a further obstacle. China appears to now understand this potential hindrance, and is actively pursuing innovation and investment in a green direction.

For the advanced world, the problem is to find a new specialisation route. Mass production of consumer goods has essentially moved to Asia, and, despite increasing labour and material prices, that is unlikely to change anytime soon, despite the

promises of politicians: the systems of production and innovation in those sectors are already firmly in place. The advanced countries need to reorient their high engineering skills, together with the new ICT potential – robotics, artificial intelligence, 3D printing and so on – plus new materials, nanotech etc. in a new direction, which could be the capital goods industry. But demand would not be sufficient nor dynamic enough unless a significant number of new countries engage in an intense development route. The financial security brought about by the Welfare State created a previously unimaginable demand for what could be seen as ‘capital goods’ for the home. In a similar manner, a sort of Marshall Plan for the developing world – perhaps funded with a global financial transactions tax – could create, in Africa, the Middle East, Latin America and the rest of Asia, massive but differentiated demand for customised equipment, adequate to their specific environmental and social conditions.

The Millennium Development goals are not likely to be reached without a major effort of that kind. And such an effort, while helping fulfil those humanitarian goals, would make sure that development is viable through gearing it to smart green growth. R&D would aim at novel construction methods, new forms of transport, internet-aided ways of imparting education, technologies for obtaining drinking water from the sea, sustainable approaches to air conditioning, renewable energy transport systems and many other innovative ways of enabling development under environmental constraints.

Fostering the development of the lagging countries would also contribute to rebalancing global trade across continents, to drastically reducing economic migrations and to reviving employment in the engineering industries of the advanced countries.<sup>24</sup>

If the notion of fostering full global development sounds utopian, it is no more so than the prediction – or proposal – of independence for all colonies would have sounded in the 1930s. At that time, not only was empire the ‘natural’ order of the world, but the leaders of countries, such as Germany, which didn’t have enough colonies, were waging war with the intention of expanding the territory under their direct control. It is true that much decolonisation was achieved after long wars and bloodshed, but the time was ripe, even if it was not obvious.

---

<sup>24</sup> This is not to say that those rapidly developing countries would also not be competing in engineering. But the focus would shift from prioritising labour costs and volume production to the quality and effectiveness of innovations, with financial and geopolitical factors also at play.

## Creating the conditions for the best of possible futures

The context created by the turning point is one where the combination of threats and opportunities are at their maximum level. The socio-political turmoil and the decoupling of finance from production seem to leave leaders impotent to turn the tide. And yet, there is never a greater opportunity to unleash the best times that the system can provide. It is a question of tilting the playing field so that the interests of business coincide with those of the majority of society. Historical experiences can teach us how to do it; understanding the nature of the ICT revolution can give us the most appropriate directions in which to stimulate the underlying potential for innovation and investment.

In this chapter, we have argued that the most appropriate directions in which to guide the ICT potential are 'smart green growth', leading to a constant increase in the proportion of intangibles in GDP and in lifestyles, and 'full global development'. Global reach is in the very nature of ICT, but without sustainability shaping it, the result will not be development. Both directions would aim at moving finance out of the current casino behaviour and reconnecting it with real production investment. It has happened at previous turning points and it can happen again. A win-win game is there to be unleashed between business and society in every country and between the advanced, emerging and developing worlds.

Unleashing the power of ICT to bring a sustainable global boom could do for the world population what the post-war golden age did for that of the Western democracies. To turn this possibility into probability will require a difficult consensus-building process, moved by persuasion – or by a serious decline in the world economy. It is to be hoped that persuasion will succeed in time.

\* Carlota Perez is Visiting Professor at LSE; Professor at TUT, Estonia; Honorary Professor SPRU, University of Sussex and Academic in Residence at the Anthemis Institute. Thanks to Tamsin Murray Leach, my Research Officer for her invaluable help in the preparation of this chapter and to Anthemis UK for funding the work on it.

## Bibliography

- Backhouse, R. E., and Boianovsky, M. (2016), 'Secular stagnation: The history of a macroeconomic heresy', *The European Journal of Economic Thought*, Vol. 23, Issue 6.
- Bok, D. (2010) *The Politics of Happiness: What Government Can Learn From the New Research on Well-Being*. Princeton, NJ: Princeton UP.
- Davies, W. (2015) 'Spirits of Neoliberalism: 'Competitiveness' and 'Wellbeing' Indicators as Rival Orders of Worth.' in R. Rottenburg et al. (eds.), *The World of Indicators: The Making of Governmental Knowledge through Quantification*. Cambridge: Cambridge UP, 283-306.
- Drechsler, W. (2016) 'The Reality and Diversity of Buddhist Economics', Keynote address III, 'Buddhist Economics and World Crises' conference, World Buddhist University, Bangkok, 22 May 2016.
- Geels, F.W. (2002) 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and case study.' *Research Policy*, 31, 1257-1274.
- Gordon, R. (2012) 'Is U.S Economic Growth Over? Faltering Innovation Confronts The Six Headwinds', Working Paper 18315, National Bureau of Economic Research, August 2012. <http://www.nber.org/papers/w18315>
- Grubler, A., Riahi, K., 2010. 'Do governments have the right mix in their energy R&D portfolios?', *Carbon Management*, 1(1): 79–87.
- Hansen, A. (1938) *Full Recovery or Stagnation?* New York: W. W. Norton.
- Higgins, B. (1950) 'The Theory of Increasing Under-Employment', *The Economic Journal*, Vol. 60, No. 238, pp. 255-274.
- Keynes, J.M. (1938) 'Private letter to Franklin Delano Roosevelt,' February 1st 1938, in Moggridge, D.E. (1992) *Maynard Keynes: An economist's biography*. London: Routledge.
- Mazzucato, M. (2013a) *The Entrepreneurial State: debunking private vs. public sector myths*. London: Anthem Press.
- Perez, C. (2002) *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham: Edward Elgar, esp. Ch. 7.
- Perez, C. (2009) 'The Double Bubble at the Turn of the Century: Technological Roots and Structural Implications', *Cambridge Journal of Economics*, 33:4, 779–805.

- Perez, C. (2010) 'Technological dynamism and social inclusion in Latin America', CEPAL Review no. 100, pp. 121-141.
- Perez, C. (2015) 'From long waves to great surges: continuing in the direction of Chris Freeman's 1997 lecture on Schumpeter's business cycles', *European Journal of Economic and Social Systems*, Volume 27 – N° 1-2, pp. 69-79.
- Perez, C. with Marín, A. and Navas-Aleman, L. (2014) 'The possible dynamic role of natural resource-based networks in Latin American development strategies' in Dutrénit, G. and J. Sutz (eds), *Innovation Systems For Inclusive Development: The Latin American Experience*, Ch. 13. Cheltenham: Edward Elgar.
- Picketty, T. and Saez, E. (2003; revised data 2016) 'Income Inequality in the United States, 1913-1998', *Quarterly Journal of Economics*, 118(1), 2003, 1-39 (for data see <https://eml.berkeley.edu/~saez/> ).
- Rockström, J. et al. (2009) 'Planetary boundaries: exploring the safe operating space for humanity.' *Ecology and Society* 14:2, 32.
- Schumpeter, J.A. (1939:1982) *Business Cycles*. Philadelphia: Porcupine Press.
- Sommeiller, P., Price, M. and Wazeter, E. (2016) 'Income inequality in the U.S. by state, metropolitan area, and county', Economic Policy Institute, Report, June 16, 2016.
- Summers, L. (2013) 'Why stagnation might prove to be the new normal,' *Financial Times* December 15, 2013.
- UNDP (2011) 'Sustainability and Equity: A Better Future for All'. Summary. Human Development Report 2011, New York: UN  
[http://www.undp.org/content/dam/undp/library/corporate/HDR/2011%20Global%20HDR/English/HDR\\_2011\\_EN\\_Summary.pdf](http://www.undp.org/content/dam/undp/library/corporate/HDR/2011%20Global%20HDR/English/HDR_2011_EN_Summary.pdf)