Second Machine Age or Fifth Technological Revolution? Different interpretations lead to different recommendations –

Reflections on Erik Brynjolfsson and Andrew McAfee's book *The Second Machine Age* (2014).

Part 3

The current moment: the beginning of a new machine age and/or the turning point of the fifth great surge?

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***T**his is the third instalment in a series of posts (and Working Paper in progress) that reflect on aspects of Erik Brynjolfsson and Andrew McAfee's influential book, The Second Machine Age (2014), in order to examine how different historical understandings of technological revolutions can influence policy recommendations in the present. The previous post discussed various criteria used for identifying a technological revolution, why we undertake such an exercise in periodisations, and the key lessons to be gleaned from observing the regularities in the diffusion of technological change. This instalment introduces the different implications that stem from applying either the 'machine ages' or my 'great surges' point of view to the interpretation of the present moment. Once this is understood, we can then propose what we see as the virtues and limits of Brynjolfsson and McAfee's policy proposals, and why implementing policies appropriate to the stage of development of any technological revolution has been crucial to unleashing 'Golden Ages' in the past.*

The current moment: the beginning of a new machine age and/or the turning point of the fifth great surge?

Having argued in the previous post in favour of an interpretation of technological revolutions that would count the current ICT transformation as the fifth surge since the first industrial revolution, I can nevertheless recognize that there are grounds for seeing it as the beginning of a 'second machine age'. The essential break that Brynjolfsson and McAfee rightly register is that until now the leaps in productivity which accompanied each surge were related to the replacement of muscle power with machines; the impact of our current set of new technologies is from the replacement of brain power.

In that sense, these two theoretical frameworks are not incongruent; it is potentially fruitful to acknowledge that the first four technological revolutions and great surges of development that my work identifies occurred within what Brynjolfsson and McAfee have called the first 'machine age', and that the ICT revolution may prove to be the first of a second set. However, whether this break does indicate a second 'age' purely related to the replacement of *brain* power, remains to be seen; the next revolutionary technological shift may be driven by biotech, nanotech or some still unidentified combination which relates to the replacement or enhancement of some other previously immutable element of human existence. It is difficult to tell, from this relatively early vantage point, how significant this particular break will be in the long term.

The key questions that I wish to discuss here, however, are whether one can claim, as I do, that even if this particular technological revolution does signal the beginning of a new 'age', its process of assimilation to date has followed the same overall pattern as the four preceding ones; and, that being so, whether the notion of such long 'ages' —the first being over two centuries in length— is helpful in attempt to learn from history or risks valuable lessons from the past being overlooked.

New unique technologies and social pioneers or dinosaurs

My contention is that each of the five surges of development to date, being the process of assimilation and deployment of each technological revolution detailed in the previous post, has both common and unique features in relation to the others. The uniqueness comes mainly from the nature of the technologies and of the specific historical context; the commonality, from the more predictable nature of human behaviour and of social change processes in the context of capitalism. What my research has led me to understand is that the recurring sequence is caused by this commonality, not by anything intrinsic to the technologies. Indeed, this is why I argue that it is possible to predict and set a policy course for what is still unknowable – and why, in order to do so, we must avoid reliance on the recent past and instead search for lessons (good and bad) from the study of social processes occurring at the same point in the diffusion of the surge as the present one.

I will not repeat here my entire argument regarding the role of social processes in diffusion: the frenzy of creative destruction, the role of 'lifestyle' shifts, the patterns of protest and conciliation, although we shall return to the topic when discussing how to identify and design viable policy recommendations.

But in questioning whether the current moment is indeed 'an inflection point', as Brynjolfsson and McAfee suggest, marking the start of a second machine age, it is important to elaborate on what occurs during the overlap as one technological revolution reaches maturity and another begins to irrupt. A crucial aspect of human behaviour affecting the propagation of new technologies is the strength of habits formed after a period of success with existing practices. When the primary industries of a particular technological revolution face maturity and market saturation, even though they are no longer able to innovate incrementally to increase productivity or to introduce new products, the established management, successful until then, is not prepared for a major change in behaviour. Thus, in the 1970s, as the mass production paradigm began to level off in the West in terms of innovation possibilities and productivity increases and, consequentially, of profitability, industry leaders and policymakers acted as one would expect: they looked for shortcuts such as acquisitions, leads and lags in international payments, and moved production to developing countries with lower labour or other costs, rather than leap into the unknown with the radical new technologies of the ICT revolution. The gradual diffusion of computers required deep organizational and technical changes; but having successfully applied their accumulated experience with mass production and hierarchical pyramid structures, the incumbents were unwilling to profoundly change their leadership style, to embrace new technologies and build open networks.

These incumbents are embodied by the term 'dinosaurs', acting towards the microprocessor as railway magnates responded to the 'impracticality' of automobiles, and as canal engineers tended to respond to the railways; unlike the digital natives, they fail to see that 'this changes everything'. It is at this point, during the crossover, where the disruptors come in and where finance, which is not tied to any particular technology or product, can shift to the new without great effort, facilitating the *installation* period of each surge (see previous post). It is in the nature of capitalism to have a functional separation between financial and production capital which allows such major changes to occur. This marks a major dynamic difference between capitalism and a system such as the Soviet top-down planning, for instance, which despite having access to computers and microprocessors was completely unable to lead the corresponding transition – its institutional framework did not contemplate a mechanism for dealing with or enabling major disruptions. When the leaders of the Prague Spring in 1968 tried to set up such mechanism, they were violently crushed. The movement wanted the intelligentsia to replace the bureaucrats, precisely because they were acutely aware of the deep shift implied by the advent of computers.[1]

What type of a transition are we in?

Brynjolfsson and McAfee locate the start of the second machine age in the present moment, thus overlooking the recurring pattern. Rather than seeing an information age beginning in the 1970s with the widespread application of the microprocessor, the spread of computers,

[1] See Richta, Radovan (1967) *Civilization at the Crossroads*: *Social and Human Implications of the Scientific and Technological Revolution*. Prague: International Arts and Sciences Press. The book was originally published in Czech in 1966 as a sort of manifesto of the movement that followed; a collective work, supervised by Richta, attempting to analyse the social and human implications of technological change.

and the advent of the internet, as I would, they take the start of their new machine age from an advanced stage of these technologies: i.e. with robotics and artificial intelligence.

> *"We'll show why and how the full force of these technologies has recently been achieved and give examples of its power. 'Full,' though, doesn't mean 'mature.' Computers are going to continue to improve and to do new and unprecedented things. By 'full force,' we mean simply that the key building blocks are already in place for digital technologies to be as important and transformational to society and the economy as the steam engine. In short, we're at an inflection point—a point where the curve starts to bend a lot—because of computers. We are entering a second machine age."* Brynjolfsson and McAfee Ch.1 p.9 (our emphasis)

Their argument is quantitative, and grounded in the exponential characteristics of ICT advances. In claiming that the inflection point of the second machine age is now, they refer to the ancient Indian story of the 'doubling of the grains of rice on each square of the chessboard' and the amazing speed of growth once one reaches the second half of the board. This not only overlooks the nature and implications of the installation period since the 1970s to the present moment, but also seems to indicate that it is only due to the very nature of ICT that this phenomenon of exponential growth occurs.

They are indeed right when saying that the technologies are not 'mature' but rather ready to perform a great transformation. In fact, in noting 'that the key building blocks are already in place', I would argue that what they are recognizing as their inflection point is what my research has identified as the *turning point* (see previous post) of each techno-economic surge in the past: that period after the creative destruction process of the installation period and after the bubble crash, in which the full potential of the technological revolution is ready to be deployed across the whole economy, requiring only that production, investment and innovation have a direction to follow and that the financial world is drawn away from casino behaviour and back to supporting innovation and production. It is not by chance that such deployment periods have been called the 'Golden Ages'.

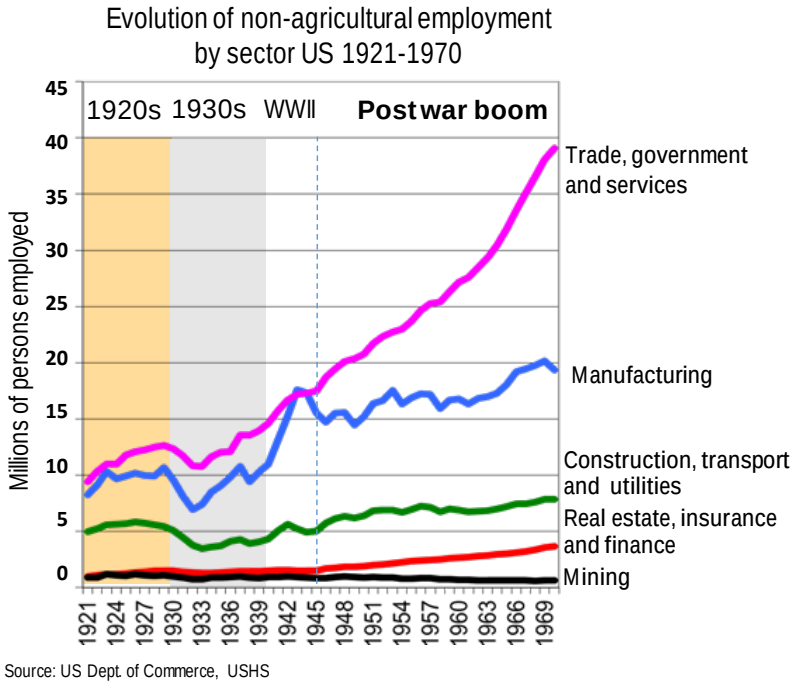
The generations that live through the explosion of new possibilities that follows the turning point (in *deployment*) feel a combination of awe and empowerment. The Great Exhibition in London in 1851 astonished the world with the marvels of manufacturing; it opened the door to a universe of new possibilities, in which fast and powerful machines replaced the handmade work of patient artisans. The key building blocks for that Victorian boom had been put in place in the previous two decades by the railway mania and refinements to the steam engine. When the Belle Époque society emerged triumphant in Europe in the late 1890s and 1900s (paralleled by the Progressive Era in the USA), it marked a new age of power over distance and nature, of science as a tool of man. It was the first real period of globalisation: the planet was shrinking and empires were flourishing. The conditions for such a world had been put in place by the development, from the 1870s, of Bessemer and basic steel: a 'magical' engineering material, infinitely superior to iron in strength and flexibility and astonishingly cheap. With it, the planet was interwoven by powerful transcontinental railways and transoceanic telegraph cables, while rapid steamships replaced the old sails, traversing the globe via the newly built Suez Canal (with the Panama in the offing). Engineering feats during installation had created bridges and tunnels to cross previously unpassable rivers and mountains, harnessing the power of chemistry, metallurgy

and electricity. All the pieces were indeed in place. Equally, after World War II (WWII) and the detonation of the atom bomb, amidst the post-war destruction, there was yet a sense of triumph over all obstacles and of reaching all goals, based on the 'techno-scientific society'. The key building blocks for that confidence had been put in place early in the century by Henry Ford with his assembly line and the development of petro-chemistry. This was followed in the 1920s by the marvels of radio, the spread of electricity, the amazing uses of plastics along with the early versions of multiple machines for the home, and the realisation of the age-old dream of flying. Each time, just as now, it looked like a new world was dawning – and so it was.

Yet as each of these new worlds unfolds, significant parts of the old economy are destroyed or made obsolete to the detriment of the particular workers or business people that are left behind, and this process becomes very apparent as the installation period progresses, suggesting a worrying future when the crisis of the crash hits. It is no coincidence that 'secular stagnation', a term expressing the fear that economic growth is a thing of the past and that jobs are in permanent decline, was first used in the midst of the Depression of the 1930s. The fears that are expounded today are not new; nor is the rise in populism or the return of fascist tendencies as the rising inequality and drop in employment brought about by the mid-surge bubble and crash are felt across society.

What is important to determine, then, is whether the final result of the present technological revolution can really be defined by the first tumultuous period of transformation. And that is the key difference in the two approaches. Brynjolfsson and McAfee see the advance of the main new technology as inexorable, through its own internal logic of transformation, which leaves society to find the best way to cope with the consequences. By contrast, the interpretation of historical precedent presented here sees the installed technologies of each technological revolution as merely providing an innovation potential to be shaped by socio-political choice. As described in the last post, the industries of the new technologies that emerge and proliferate in the period of creative destruction are merely the tip of the iceberg of the new potential for wealth creation. Each revolution not only brings the possibility of sectors that make a huge leap in productivity, but also new infrastructures that open new markets, a change in the methods of production across the whole economy, and a whole set of conditions for creating a new way of life – a new techno, economic and social paradigm. What is crucial to understand is that those new ultra-high productivity sectors are not the primary engine of job creation: rather, the greater wealth they create overflows into other lower-productivity activities that cater to the new model of everyday life and cover complementary services for the new production practices. That is the source of the replacement jobs. It is the combination of both that brings the so-called 'golden ages' of each surge.

An illustration of this is provided by the evolution of employment in post-war USA. While overall employment was multiplied by five, manufacturing employment grew by less than 30%. Mechanisation, mass production and continuous processing drastically reduced the relative number of jobs in manufacturing, but multiple sectors serving the 'American Way of Life' flourished and fulfilled the full-employment goal. See Figure 1.



However, such results can be achieved if – and only if – bold and effective policies are set up providing appropriate conditions for the best outcome, as indeed occurred after WWII. Neither golden nor gilded age is guaranteed in the future; technology only provides the stage for social decision-making. That is the meaning of the turning point.

Recognizing the wide range of the viable

According to this interpretation, we are yet to emerge from the turning point of the ICT revolution, and the space for shaping the future is much wider than it seems. To give a sense of the range of the viable, we can again look back at the 1930s, the turning point of the last surge. The shaping of the potential of mass production manifested in very different ways under Nazi-Fascism, Sino-Soviet socialism and Keynesian democracies, and with great variations in each – as between Mussolini and Hitler; Russia and China, Sweden and the USA. The present moment, according to the more segmented pattern of history that I have observed, is when institutional innovation is called upon to shape and direct the new technologies.

As in all cases in scientific analysis, the interpretation signals the direction of purposive action. If the current period were merely seen as the beginning of the second machine age, then the only truly equivalent period in which to examine how and why technological potential has diffused in the past would be the first few decades of the industrial revolution in England at the turn of the 19th century. Consequently, there would be very little to learn from the past in terms of regularities or lessons. But if we are in fact now at the turning point, in the equivalent of the 1930s, the 1890s and 1840s, as I hold, then there is a world of experience to draw from, while keeping the distance that the uniqueness of each revolution and of social advances require.

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In order to properly analyse their policy recommendations, it is important to first consider two key concepts used by Brynjolfsson and McAfee in their evaluation of future wealth creation and distribution: 'bounty' and 'spread'. Their concern is that current monopolistic tendencies and increasing inequality are characteristic of the 'second machine age'. In the next post, I will examine these concepts in the light of the historical pattern that has been laid out over the previous two posts. Income polarisation and technological unemployment are two of the greatest preoccupations regarding our economic future at present, and I argue that understanding recurrent patterns of 'bounty' and 'spread' is key not only to mitigating those fears, but also to setting policy directions for a future that benefits the many.