

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 7

The limits of the Brynjolfsson and McAfee policy recipes: Proposals on science, technology and infrastructures

Carlota Perez

November 2018

<http://beyondthetechrevolution.com/blog/second-machine-age-or-fifth-technological-revolution-part-7/>

Contents

Technology and production: research, innovation and infrastructures

SCIENCE: fund basic research only or act as an innovative 'entrepreneurial state'?	2
INNOVATION: Prizes for individual innovations or give a prize to all potential innovators by tilting the playing field?	2
INFRASTRUCTURE: Stick with revamping the old networks or also promote the new ones?	3

In this post I continue to discuss the policy recommendations in [Erik Brynjolfsson and Andrew McAfee's](#) influential book, [The Second Machine Age](#) (2014), examining their proposals in the light of the richer understanding of the social assimilation of technological revolutions discussed in this series. The [previous post](#) focused on human capital: education, employment and 'brain gain'. This one looks at their suggestions in the fields of science, technology, innovation, production and infrastructure, analysing the limitations of their framework and putting forward ideas for a more systemic approach to policy change.

Technology and production: research, innovation and infrastructures

SCIENCE: fund basic research only or act as an innovative ‘entrepreneurial state’?

As is customary among orthodox economists, Brynjolfsson and McAfee claim that the role of government is to fund ‘basic’ research, i.e. the scientific foundation for technologies, and let the private sector do the rest.

“After rising for a quarter-century, U.S. federal government support for basic academic research started to fall in 2005. This is cause for concern because economics teaches that basic research has large beneficial externalities. This fact creates a role for government, and the payoff can be enormous” (p.217).

Yet when making their argument for increased funding in the pure science direction, Brynjolfsson and McAfee actually include many government-funded technologies, which only received private investment when they were already at the market development stage, far down the line from basic research. This was the case with internet; with GPS and even SIRI. The same is happening in the pharmaceutical sector. As has been recently argued forcefully by [Fred Block](#) (2011)¹ and [Mazzucato](#) (2013)²; the truly risky research projects tend to be initially funded by government and taken to a point where they are ripe for use by the potential Steve Jobs’ of the private sector. Even far back, during the ‘Industrial Revolution’ at the end of the 18th century, the British government handed over production of most naval ships to the private sector but kept to itself the responsibility – and risk – of constructing the biggest and most complex ones.

This is currently also true of the successful policies of the Chinese government. In order to climb up from low-cost assembly industrialisation, they are investing heavily in ‘riskier’ green and artificial intelligence technologies, from the early scientific research to the finished ‘innovation’. Today’s orthodox economists have decided to be blind to this reality, in order that their image of the world fits their models – but experienced engineers like the authors of the *Second Machine Age* do not need to delude themselves. They know perfectly well that it was government procurement that fuelled the exponential development of microelectronics – the cheap input behind the entire ICT revolution – as well as the internet itself.

INNOVATION: Prizes for individual innovations or give a prize to all potential innovators by tilting the playing field?

Brynjolfsson and McAfee do give a role to government in promoting innovation through competitions that result in big prizes for the winner, as the US Defence Department (DARPA) has done [with self-driving cars](#) - a gambit that harkens back to the years leading up to the big bang of Industrial Revolution, when the British Parliament set up an award to encourage the development of the [marine chronometer](#) – an invention that would revolutionise shipping and therefore trade. Although this is another prescription at the fringes of the problem, such encouragement is a good

¹ Block, Fred L. and Keller, Matthew R. eds., (2011) *State of Innovation*. Boulder: Paradigm Publishers

² Mazzucato, Mariana (2013) *The Entrepreneurial State*. Bath: Anthem

idea and there should be more of it. However, wouldn't a bigger prize be the enablement of massive profit-making opportunities to all potential entrepreneurs and innovators?

Their list of conditions for successful innovative competitions does include “inspire risk-taking by offering a level playing field” (218-19). In this they pick up another one of the favourite recipes of orthodox economists. However, there is a huge difference between a ‘level’ playing field, meaning that all have equal opportunities to compete, and a ‘directionless’ playing field meaning that there is no convergence and no shared synergies when investing or innovating along common routes. That is what the Victorians enabled with urbanisation and the opening of world markets; what the US and German governments provided from the 1870s by protecting agriculture and their infant industries; and what Western government provided for the post war boom with suburbanisation and the Cold War as directions for innovation in mass production and frontier technologies. The playing field was level for competition, but it was both defined and tilted! We now have a global opportunity to provide a context that both in taxation and regulation is strongly favourable to innovation in the productivity of resources and energy, in revamping the built environment, in intangible products, in bio-materials, in healthcare, in local production, in the creative economy, the sharing economy and other elements of what can be called ‘smart green growth’ (see also the section on infrastructure, below).

Indeed, the emerging and developing countries will soon confront resource and environmental limits if they are to copy the ‘American Way of Life’. They will need to innovate in more sustainable directions and, as they do, they will also be creating opportunities for the advanced countries to provide engineering, education, equipment and infrastructures redesigned to adapt to climates and cultures in a new digital-plus-green world. Promoting full global development is another way of creating profitable opportunities for innovation and investment for the advanced countries. It can be another direction for systemic policies. I will return to the potential of ‘smart green growth’ in the context of full global development in the concluding post.

INFRASTRUCTURE: Stick with revamping the old networks or also promote the new ones?

It is rather astonishing that at the end of a book that is all about the new digital world, Brynjolfsson and McAfee list only the traditional infrastructures when arguing for infrastructural investment.

“It's almost universally agreed among economists that the government should be involved in building and maintaining infrastructure— streets and highways, bridges, ports, dams, airports and air traffic control systems, and so on. This is because, like education and research, infrastructure is subject to positive externalities” (p. 219).

Why refer only to the infrastructures of what they consider the first machine age? Is this because they assume that the main networks of the new age should be in the hands of the private sector, whereas roads, railways, shipping lines and the rest are perceived as old fashioned public goods? Yet the turnpikes and canals that enabled the spread of the first Industrial Revolution in Britain were mainly privately funded, as were the railways. But in many of the catching up countries, including the US, government support was crucial in providing the land and favourable regulation and even undertaking the construction itself as in Prussia and other German states and in several European countries. In many of the privately funded cases – as with the internet – the initial surge of interest and innovation in those infrastructures led to manias and then to busts, at which point the state had

to step in to regulate for ‘the public good’ – meaning in favour of stable businesses, with civil society benefitting as a side effect. From health and safety (including policing) through gauge sizes to ticket prices, the innovations of the early days of these technologies needed to be ‘tilted’ in order for the overall infrastructural network to flourish. The US highway system is probably the biggest state-funded programme ever undertaken – but, without it, there would have been no generalisation of the automobile.

Why not mention FTTH (fibre optics to the home) or smart grids? What about universal high-speed internet at low cost? Why not think of power grids for electric cars? Or bicycle lanes? Or superhigh speed trains or even newer transport solutions? Where are the infrastructures of *The Second Machine Age*? Even telecommunications is not in their list. By contrast, the Report of the US President’s Council of Advisors on Science and Technology (PCAST) in 2016 on ‘[Technology and the Future of Cities](#)’ (2016)³ lists dozens of digital age infrastructure projects that could be supported by governments.

It is the section on infrastructure, especially, that highlights how wary Brynjolfsson and McAfee appear to be about violating the sacrosanct space of neo-classical economists. They specifically avoid any risk of being associated with Keynesian economics by clarifying that: “We’re making our argument for infrastructure investment because of these externalities, independent of any Keynesian stimulus it might provide, and we’re squarely in the economic mainstream when we do so” (p.221).

It is in the section on infrastructure, also, where one really notices the absence of any attention paid to the environmental issues, that are key to both future growth and survival, and which, as I have argued [elsewhere](#), should be seen as great opportunities and not as threats. There is no mention of the change in energy infrastructure needed for an effective and efficient change to renewables – despite the massive innovative transitions going on outside the United States in that direction. Germany’s *Energiewende* has already been mentioned; the Scandinavian countries are well on their way to carbon-free futures, even though Norway continues to export oil to others. China, as noted, is investing heavily in renewables; even the petro-state of Saudi Arabia, in their 2030 Vision Plan, includes a shift towards renewables. In fact, the only mention of the environment Brynjolfsson and McAfee make relates to reducing pollution, not to innovating towards a safer future. The authors even ignore the infrastructure requirements of the shift to electric vehicles or to the self-driving cars, which they discuss so profusely in the central part of the book.

– – – – –

In the next and penultimate post, I will move to the policy proposals of The Second Machine Age on fiscal stability and welfare. From taxation to the negative income tax, Brynjolfsson and McAfee again remain conservative in their approach. It is only in a short list of suggestions dubbed ‘wild ideas’ that they begin to explore the imaginative solutions necessary to meet the challenges of the new technological paradigm which they describe – ideas that I will contend are not really that wild and are, in fact, already being piloted in niches, contributing to an understanding of the necessarily systemic approach to our current transition.

³ ‘Report to the President: Technology and the Future of Cities’, President’s Council of Advisors on Science and Technology, February 2016.