

**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 5

**Does technology determine the future? Socio-political shaping as a recurring
need within the unique space of the possible**

Carlota Perez

February 2018

Blog post: [http://beyondthetechrevolution.com/blog/second-machine-age-or-fifth-
technological-revolution-part-5/](http://beyondthetechrevolution.com/blog/second-machine-age-or-fifth-technological-revolution-part-5/)

From technological determinism to socio-political choice..... 3

Shaping technology to shape the future..... 4

State and/or markets to lead the transition 9

This is the fifth 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 guide policy recommendations in the present. The [previous post](#) examined the regularities in the historical patterns of wealth creation and distribution generated by technological change (what Brynjolfsson and McAfee call ‘bounty’ and ‘spread’), particularly in terms of (un)employment and income (in)equality. In this post I discuss the parts played by uniqueness and socio-political direction in the diffusion of each techno-economic paradigm. For while a grasp of the regularities inherent in the pattern can help to guide our understanding of how and when to respond, the specific context and conditions that accompany each shift demand that the institutional framework for providing that response needs to also shift appropriately. Furthermore, I will argue that markets cannot make this shift, and look at the two different modes of market operation at work in each surge of development.

Does technology determine the future? Social shaping, between uniqueness and regularity

In the 1950s and 60s it was widely believed that capitalism had found its true nature and that the world would gradually move towards the model developed in 'the West'. Johnson's ['Great Society'](#) idealized what could still be achieved along that path. This was reinforced in the early 1990s by Fukuyama's [The End of History](#), which held that Liberal democracy had triumphed and that its critics, especially the Marxist ones, had been defeated by the facts. With the bloodless dissolution of the Soviet Empire, not only was the Cold War over, but also any attempt to question the superiority of capitalism for bringing wellbeing to the majorities. Yet, even as that book was being written, quite a different socio-political ideology had taken hold in the Western democracies to that of the post-war years. The gradual – sometimes brutal – dismantling of the welfare state was hitting many people and many regions, and free market globalization was stripping the advanced countries of their advantage in multiple sectors. Something very different was going on.

Since then we have been through two bouts of deceptive prosperity that were revealed as bubbles when they collapsed; recession; feeble jobless growth; and a strange economy that does not lead to inflation despite the injection of trillions of dollars, pounds and euros, nor to increased investment despite zero or even negative interest rates. The 1930s idea of ['secular stagnation'](#) has been revived – accompanied, as in that pre-war decade, by populism at both extremes of the political spectrum. Surely, something different is going on.

With all this, a new conviction has been spreading: the post war boom was, in fact, a unique event in history. [Thomas Piketty](#) sees those decades as a deviation from trend; [Robert Gordon](#) as a period of unrepeatable prosperity, due to the specific technologies that made life better and easier – only once – and brought a leap in productivity. From the previous posts in this series my position on this should be clear: that both the golden age of the 1950s and 60s and the bubbles of the 1990s and 2000s are typical phenomena associated with the way capitalism evolves through successive technological revolutions. They are the form regularly taken by the difficult process of assimilation of the massive waves of Schumpeterian 'creative destruction' that emerge in market economies when the previous wave is exhausted.

So, is the post war golden age repeatable or unique? It is both. It is repeatable in the sense that we could today establish a new policy framework that is a good match for the nature of the current ICT revolution, in the same way as the Keynesian policies matched the requirements of the mass production revolution, and as policies in previous golden ages matched the previous ones. But, it is unique and unrepeatable, just like the others were

before it, because its particular characteristics depended on the nature of that technological revolution. It is because mass production was dependent on mass demand that society was able to set up a Welfare State, lifting semi-skilled workers to middle income consumption patterns, creating the massive demand needed by mass production, while providing a convergent direction for social progress and profitable innovation and investment.

Thus, a socially stable period of deployment of the current technological revolution can happen again – as has happened before – because democratic market economies function that way. As discussed in the previous posts and [detailed in my book](#), after the first decades of Schumpeterian ‘creative destruction’ with their inevitable consequences in unemployment, inequality, regional shifts and other social ills, the new technologies and infrastructures they install open the way to higher productivity, greater wealth and the potential for an increase in social wellbeing. It is by finding a way to shape that specific potential in a direction that is both socially beneficial and economically profitable that the ‘golden ages’ have come about and that, somehow, the history of capitalism can be seen as one of continuous progress, in spite of the bumpy road and of the suffering of the excluded.

So, the post-war boom in the US and the Western countries, is akin to the Great British leap in the early 1800s, to the Victorian boom in the UK in mid-19th Century, to the Belle Époque and the Progressive Era in the years before WWI. And yet all those ‘golden ages’ were as unique and different from each other as the technologies that made them possible.

From technological determinism to socio-political choice

Many scholars shy away from cyclical interpretations of history for fear of embracing any form of determinism; even more so if it’s technological. Indeed, to imagine that it is technology rather than human decisions in business, politics and culture that define the course of history is problematic, to say the least. Nevertheless, societies make their choices from the options available, and these depend strongly on the prevailing technologies at the time. It is also difficult to accept that the infinite variety of events that make up the historical record can be compressed into neat cycles of a regular nature, however flexible the interpretation. And yet, economists today make mathematical models of human behaviour and of markets that are more like physics than like any of the sciences that study society. So, the allergy seems somewhat incongruous.

On the other hand, the business world tends to accept that new technologies will inevitably do what they can do, especially in terms of eliminating labour. The Davos crowd is ready to see what they call the [Fourth Revolution](#) with AI and robotics as inexorable. Yet, there is little uproar among the scientific community against this form of technological determinism. Even Brynjolfsson and McAfee, in their sophisticated work studying the potential of artificial intelligence and robotics, assume that what *can* happen *will* happen. And, in their recommendations, they implicitly accept that society will have to find ways of adapting and mitigating the effects. They do not envisage shaping the course of technology, as was clearly

done in the post-war boom by Hitler, Stalin and the Keynesian democracies, with their differing results.

Even in the capitalist democracies, markets do not by themselves do this shaping. A cursory comparison of the [varieties of capitalism](#), from the 'liberal economies' such as the US, Australia and the UK, the 'coordinated economies' of Germany, Japan or Italy, and the so-called Nordic Model across Scandinavia shows how differing socio-political frameworks resulted in significant diversity in the way that business and society have been organised.¹ These were all market economies, using and shaping the power of the same mass production revolution, but each with a socio-political framework that developed in a specific historical context, reflecting specific cultural and political values. And they have all since begun to respond differently to the disruptions and opportunities brought by the ICT revolution and the globalisation it enabled.

Shaping technology to shape the future

What technological revolutions provide is a powerful set of tools which need to be shaped by society to allow for effective economic growth. The problem is that, in the early days, nobody really knows what these tools are capable of doing. They have to be let loose in the context of more or less unfettered markets, unencumbered as much as possible from pre-existing constraints. For reasons that have to do with the synergies and advantages created in the diffusion of each revolution, the next one is prevented from emerging until the previous one is spent [see [Ch.3 Section C](#) of my *Technological Revolutions and Financial Capital* (2002) for an explanation of this]. Consumer behaviour, regulations, policies and the whole cultural and institutional framework inherited from the previous paradigm are adapted – even over-adapted – to the declining revolution. Nothing is ready to cater to the next one, and the new technologies themselves are still a fuzzy promise of great things, yet unknown, to come.

This was the situation in the 1980s. Stagflation settled in because the prevailing technologies could no longer increase productivity, while the previous upward pressures on input costs and labour were still acting. The mass production era was in maturation and investment was not forthcoming; the policy tools that had worked so well before had become impotent. Finance, disenchanted with the low yields of the old activities, turned to funding the developing world – fuelling the later debt crisis – and to embracing the new technologies, helping to stage the huge experiment that will end in a bubble and its crash. Those free market experiments in ferocious competition, with high risks for high profit stakes, select the winners in products and services and the companies that will be the new giants. They are times of income polarisation and especially of technological unemployment – really 'disemployment' – deskilling, regional shifts and general upheaval. until the bubble collapse reveals the pain created under the superficial prosperity of the 'Gilded Age'.

¹ See, [Hall and Soskice](#) and [Esping-Andersen](#)

That is precisely the moment when social shaping can take place. And that is the moment we are living today. Two conditions are met: One is that the potential of the new technologies is fully known and available and, the other, that stability is threatened by social unrest and pressure for overcoming the current ills and avoiding further ones.

However, a huge obstacle is in the way: the belief in unfettered free markets as the way to bring prosperity. This belief was certainly there to hinder Roosevelt's New Deal in the 1930s. It is even stronger now, despite its meagre results since 2008. And in this case, possibly as a historical exception, finance – rather than weakened by the bubble collapses – has been over-protected by governments and is even more powerful than before; wielding enormous influence over politicians. Yet the legitimacy of capitalism is at stake – and urgent action is indispensable to avoid a populist take-over.

What exactly could such action involve? The first thing to recognise is that working conditions are changing rapidly and extensively. There is little in the current world of work that reminds us of the old jobs-for-life culture. From the proliferation of self-employment – voluntary or otherwise – and the spread of zero-hours contracts, to the introduction of robots and artificial intelligence there is massive change in the nature of jobs, including their outright elimination. Therefore, the post-war welfare system – which we had come to consider normal – has become obsolete. It is based on 'unemployment' as a clearly identifiable temporary condition and on 'pensions' as something accumulated in a permanent job until retirement. Equally obsolete are the regulations protecting workers, and the organisation of unions. Given the conglomerate nature of many giants – think of Amazon or Google – and the organisation in global value chains, boundaries between industries are not clear, workplaces are unstable and production moves from country to country. Hence, the standard liberal 'safety net' has lots of holes in it. The majorities in the already advanced economies are not likely to accept such insecurity for long; boldness, imagination and determination will be needed to replace the outdated system with one that is fit-for-purpose.

Ironically, one of the policies of the post-war golden age that has been abandoned in some countries is free higher level education, just when everybody's future may depend on it, as will the future of each country. Yet there is little change to be seen in the education system itself, which, although increasingly expensive for the recipients, remains practically intact in its fundamental structure, content and practices, despite the massive changes occurring in the nature of work and in the type of skills and knowledge required. Even simple things like teaching how to ask questions and make choices from a range of possible answers have not become standard in the Age of Google, Wikipedia and 'fake news'. Lifelong education is a frequently mentioned aspiration but little is done to make it a practical everyday reality. In the meantime, teachers' salaries and prestige have decreased, diminishing the capacity of the system to attract the best among the young.

The issue of the traditional forms of consumer demand as a driver of investment and growth should be seriously questioned too. Both economists and governments are waiting for and encouraging the wrong solution and creating problems for the near future. This leads

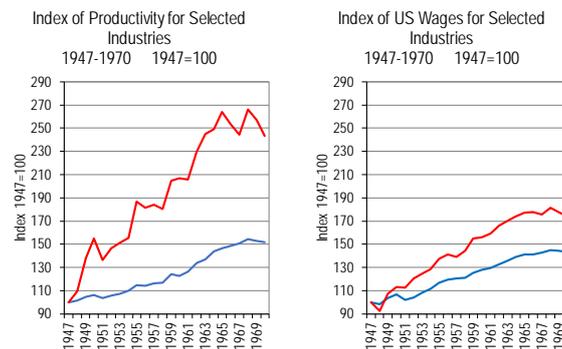
consumers themselves to increase their debt, believing they have no alternative with which to keep hold of their accustomed living standards, in a time of stagnant salaries and increasing cost of living. They thus risk personal and family bankruptcy, whilst the very economy that is engendering that behaviour is pushed even closer to collapse. The truth is that there is a disconnect between the interests of the global corporations, whose target markets are now those of the emerging countries, and the interests of the population of their countries of origin. Salaries in the advanced world can, as far as the globalised economy is concerned, remain stagnant or even decrease while large businesses prosper, because the most profitable demand is no longer in their home markets and it can be covered with low cost labour imports. Thus, the new homes set up by young couples, which used to be a main source of demand growth for electrical appliances, automobiles, TV sets and the other products typical of mass production, if they do manage to get on the housing ladder, are more likely to create demand in Asia than at home. It is true that some middle-class parents are able to help their adult children get access to a mortgage, thanks to the huge appreciation of their own homes over the past 30-40 years, but the majority of young people are facing the daunting prospect of an inflated housing market combined with huge student debt burdens.

Much of the erstwhile middle income working class is disappearing into low paying jobs or 'uberization', which again bars access to mortgages and home ownership. To support this section of the population the leap in imagination and policy design might need a rethink from first principles. In fact, the whole notion of home ownership as the essential form of security for people and of demand for business may require reconsideration. Do we move from possession to access? Are there forms of security in old age other than home ownership? These are very fundamental questions that need to be faced without the useless illusions of counting on a return to 'business as usual' or on the magic of markets.

Most importantly, there is the issue of creating enough jobs for the population. Societies that have known full employment and social mobility will not easily accept continuation of the current 'precarariat' – or the feeling that the next generation will be worse off than their parents. A cosmopolitan elite has done well out of the early stages of the paradigm shift, but – as has been the case in previous revolutionary shifts – a chasm has opened between it and everyone else, from the 'squeezed middle' to the semi-skilled, or even highly skilled but deskilled, working class. The solution is not to stop the adoption of robots and artificial intelligence, even if that were possible; together with internet, mobile phones and computers, those are and will be the source of the quantum leap in productivity and wealth creation that each revolution brings, and society needs. The question is how to promote innovation and investment in areas that can create new jobs, which have not, in the past, sprung primarily from the new technologies but from industries and services catering to the new lifestyle engendered by those technologies (See [my Ch.11](#) in [Mazzucato and Jacobs](#) 2016). In the previous revolution, as we've seen, demand came primarily from home and car ownership, with new jobs in construction, retail, banking, insurance, utilities, transport and government. And not only did the State use public money to build the roads that made suburbanisation possible, they also made it easy for banks to lend to salaried employees for

buying houses and cars, by providing unemployment and default insurance (through Fanny Mae equivalents), and often giving tax exemption for mortgage payments – though not for rent. Governments were active on both the supply and the demand side, shaping the growth that made full employment possible.

Essentially, the state gave a clear direction for innovation and investment through a systemic set of policies that encouraged the high productivity activities, while also creating opportunities for low productivity ones that took up the employment challenge. As average productivity grew in each society, the wages of the low productivity sectors also increased. Figure 1 shows that, in the US during the golden age, the difference in wages is much smaller than the difference in productivity between the automobile industry and retail trade, which allowed both groups to be part of the middle-income consumer class.



Source: US Dept. of Commerce, *US Historical Statistics Colonial Times to 1970* (our graphs)

Many will say that information technology eliminates both the manufacturing jobs and the service jobs; indeed, Brynjolfsson and McAfee suggest as much. Of course. What every technological revolution does is to transform the old economy, providing a quantum jump in productivity for virtually all activities (and we are as far from the possible transformation this one can bring as the world was in the early 1940s from seeing the full potential of mass production). The issue is that the new jobs must come in new areas. In the [first post](#) of this series I announced that I would be arguing for policies systemically favouring ‘smart green growth’ as a positive-sum direction for unleashing ICT’s transformative power, while creating new jobs associated with increasing quality of life in a different lifestyle. This would essentially mean turning the environmental problems into solutions for job creation and even for reducing inequality. [Elsewhere](#), I have explained how a new quality of life based on access rather than possession and geared to health, caring, creativity, education and other life enhancing activities, together with recycling, reusing, maintenance, biomaterials, alternative energy sources, and so on, could reduce the energy and material content of GDP and consumption while significantly increasing employment, thus solving both environmental and social problems. I will return to elements of this in the posts still to come.

What is important to emphasise here is that this possibility is, of course, another unique feature of the current context. The ignorance of – or short-sighted approach to – our environmental limits was a key contextual factor in the deployment of the mass production revolution, and a central element in its success. As our awareness grows of these limits, we

have begun to understand that changing that trajectory is not only essential for the environment – but that failure to do so will increase costs, restrict the economy and stranglehold future generations. Embracing the present context, rather than attempting to mitigate it using tools developed for a previous one, allows us to see the economic potential in taking a new path, rather than viewing environmental awareness as an undesirable cost burden.

The other major blind spot to the present context is the obsolete idea that each country can have a national policy, independent of the changes that globalisation has wrought. While mass production was very much a national economy model, in which Keynesian policies could have their expected effect, we are now in a world in which the internet leaps across frontiers and makes the rapid mobility of capital possible. It is a context in which tax havens and avoidance can thrive, and in which national policies to control or regulate business can result in companies and finance moving elsewhere; the money supply is no longer contained within national borders. The case of [quantitative easing \(QE\) escaping the major economies](#) to create problems in Brazil, India and elsewhere is a case in point. And the increase in world trade inevitably has a major role in defining the best specialisation choices for each region or country. Since Asia has become the assembled-consumer-goods factory of the world, perhaps [countries with a high endowment of natural resources could specialise in the processing industries](#). This is not to say that protection should be excluded in all forms; in many cases it could be indispensable. It would be simplistic and irresponsible, given the social consequences of totally unfettered trade, to accept it as the best solution for all countries and all cases. But, again, intelligent and sensitive institutional innovations will be needed.

Among the main differences between the new global context and the old ‘inter-national’ economy is the integration of the erstwhile communist countries into a single global economy and the much closer interlinkages between the advanced world and the emerging and lagging countries. The deep chasm between them, which had left the erstwhile ‘third world’ as producers of cheap energy, raw materials and food (often, and still, facing tariffs and barriers to entry), exists no longer. Globalisation has incorporated Asia into manufacturing production for the world; Latin America is struggling to find its new place in the global economy. China is aiming for a place at the top and India is following behind. The African nations, to varying degrees, are slowly beginning to emerge from decades of war and economic instability – but ongoing deprivations here and in the Middle East have created a wave of migratory pressure that is undermining the political stability of the European countries. This wave of migration is extending to the US, which is also a ‘promised land’ destination for those from Latin America looking to escape poverty and lack of prospects.

As with the reality of environmental pressures, it would be a positive step for policy makers in the West to face up to the complex reality of globalisation, rather than play up to the strain of populism that harkens back to bygone times. That is one of the reasons why the other possible direction I propose for government action, alongside ‘smart green growth’, is that of ‘full global development’. Recognising the globalising nature of the digital age, such a

process has the potential to combine lifting millions out of poverty with the creation of markets for engineering and for capital goods, which, designed and produced in the advanced countries, could create jobs for skilled workers. This could result in [a positive sum game between advanced and lagging countries](#) analogous to the one created within the advanced countries in the previous 'golden age', when millions of workers were lifted into mass consumption creating demand for mass production.

The policies that this could imply will be discussed in the next post, in relation to Brynjolfsson and McAfee's 'Economics 101' proposals. But first, there is something else that must be clarified: Why can markets not effect this shift? Why should the state get involved?

State and/or markets to lead the transition

If, after reading the above, there are still some who think that markets alone can do the job of straightening all those ills and handling all the changes that the new context has brought, it might be worth providing some simple arguments of why this is unlikely.

Individual capitalists and top managers do not normally have the wellbeing of the rest of society in mind when they engage in the intense tasks involved in the pursuit of profit (philanthropists either leave the company, as Bill Gates did, or hand over the job to others as the majority have usually done). Nevertheless, the legitimacy of capitalism rests upon the expectation that general wellbeing will result from their collective actions. The indignation of the 99% was based on this expectation not being fulfilled; today's populist leaders find support among those that feel their lives are worsening and they are disenfranchised. The statistics of inequality and lack of social mobility across the advanced world – with few exceptions – are staggering and unacceptable. And the discontent is all the greater, given the expectations created by the reality of the post-war boom.²

Let us take the example of mass consumerism as the source of the dynamic demand that brought profits and growth with mass production. An essential element for that positive sum game to succeed – as Henry Ford understood well from the beginning – was for workers to enjoy relatively high salaries. Yet this was not in the best interests of individual firms. The solution was for government to officialise labour unions, and preferably by industry rather than by trade. Workers in the dominant industries would fight for high salaries, to be raised along with productivity and inflation, which set the rhythm that other industries would follow. It was a common context for all, where competition would not be based on squeezing wages nor on price, but rather on other features such as brands, appearance, service, etc., strengthened by advertising (which itself became a huge employer).

² In the model of regularities in the behaviour of capitalist societies when assimilating successive revolutions, there are two different periods when social discontent tends to increase. One is, such as now, when the consequences of the 'creative destruction' period are being acutely felt; the other is, as in the late 1960s, when the exhaustion of a revolution makes it incapable of fulfilling its promises and continuing to maintain and deepen the expected golden age conditions. Both the reasons, the participants and the nature of the protests are different. But this is not the place to discuss that. See Freeman and Louçã (2001) *As Time Goes By: From the Industrial Revolutions to the Information Revolution*, OUP.

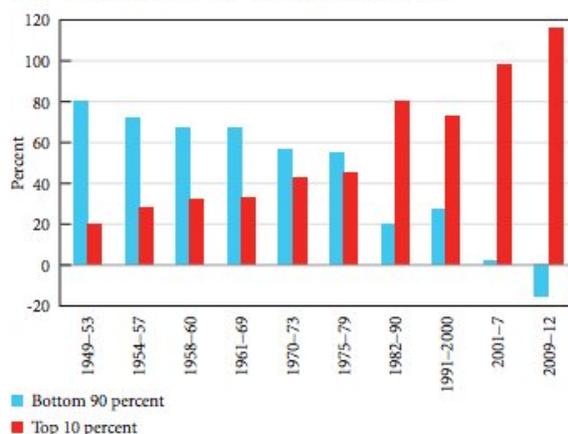
The notion of a level playing field – so revered by market fundamentalists – is not one where there are no rules, but one where the rules are intelligent and the same for all. A playing field that is tilted towards social wellbeing and environmental safety sets up the best possible win-win game. In the 1950s and 60s, consumer and worker protection, public infrastructures, taxes and social security, anti-monopoly regulation, safety standards, free public education, publicly funded science and innovation, the rule of law and other context shaping measures to avoid damaging behaviour, made the playing field equal for all at the same time as providing externalities that enhanced the competitiveness of each company. Suffice it to contrast the conditions for business in an advanced country with those in a lagging one. In essence, ‘free’ markets function well for the benefit of all when government shapes the playing field in a clear *direction* and provides adequate support measures.

As the bubbles have shown, laissez faire does ‘function’ for wealth creation, but not always for the best outcome. Although gilded age prosperities look good in the GDP figures – while they last – their double role of discovery of the new and modernisation or dismantling of the old has a very high social cost. Governments could and should take care of those who lose – jobs, ways of living, expected futures – in this process. They rarely do; possibly such losses are inevitable in capitalism, although I would argue that a deeper understanding of the process could at least lead to mitigation of these bads far earlier (see, for example, the tripartite negotiations and subsequent welfare distributions and reskilling that the Nordics have done well). What we do know, from history, is that governments have been able to step in, after the decoupling is revealed and when social protests have threatened stability, to modify the context and usher in times of better shared prosperity. As Mazzucato argues, [markets are outcomes](#) of a multitude of players, of which the public sector, as both context shaper and direct actor, is a crucial one.

It is important to note that finance becomes very risk-averse after bubble crashes. At that time the technology risk is very low – the paradigm is clear, and innovators know what can be done – but the market risks can be very high. It is precisely by shaping the context through systemic policies to set a clear direction for growth that demand can be pretty much assured. When that happens the financial actors gladly step out of the speculative casino to make money in the real economy. All the trappings of suburbanisation and the Cold War were safe bets for investment in the post-war boom; as I shall explain further, smart green growth and full global development can do the same for the sustainable global boom that the potential of ICT can deliver.

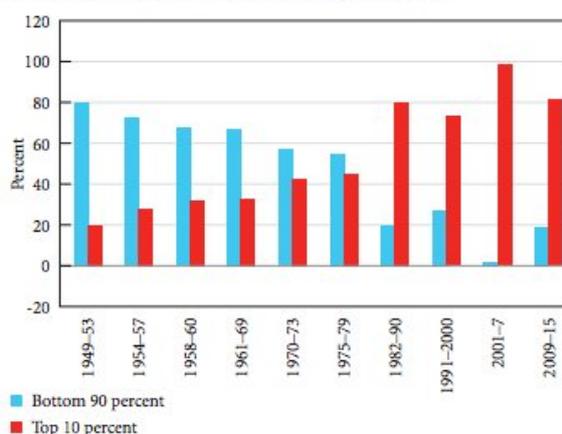
I hold then that markets can work well in two different modes: in a disruptive mode, to install a technological revolution and replace the old, ripping society apart between winners and losers; and in a constructive mode, once the State becomes a direction setter shaping the playing field so that business, technology and growth can truly benefit all. The impact of these two modes of market operation is illustrated in the following graphs, from [Pavlina Tcherneva](#), of the Levy Economics Institute, based on Piketty and Saez and NBER data. The difference couldn’t be clearer: from 1949 to 1979 half or more of income growth went to the majority; from then until now more than 75% – even 120%! – has gone to the top 10% of households:

Figure 1 Households' Share of Average Income Growth: 1949–2012 Expansions (including capital gains)



Sources: Author's calculations based on Piketty/Saez data and NBER

Figure 2 Households' Share of Average Income Growth: 1949–2015 Expansions (including capital gains)



Sources: Author's calculations based on Piketty/Saez data and NBER

The increasing levels of inequality are precisely what worry Brynjolfsson and McAfee as a result of the Second Machine Age. Yet those levels of inequality were there even in the 1980s, when computers were in their infancy, government had not opened up the internet to the private sector and artificial intelligence looked very limited. Hence, the increasing spread between the top and the bottom in the wealth distribution is not only due to the new technologies. In fact, it also happened in the 1920s when the technologies of the mass production revolution were in a similar phase, and it was only reversed once the Welfare State and the Bretton Woods measures changed the whole socio-economic landscape. I believe that the disruptive mode of markets has already done – and overdone – the creative destruction job; the time has now come for creating the context that can promote the constructive mode.

-. . . -

In the following post I will discuss Brynjolfsson and McAfee's policy proposals in The Second Machine Age. Perhaps due to their broad periodisation, as discussed in the previous posts, their recommendations sit in an uneasy place between technological determinism and Economics 101; between the uniqueness of the current technologies and the narrow view of economics as excluding history, society and institutions. Neither will work to make the best of the current technological potential for widespread prosperity. We are now at the point where a new direction is needed – one that is as bold and imaginative as the combination of the Welfare State and Bretton Woods was in the 1940s and as appropriate to the digital revolution as that framework was for mass production. In the next post, I will examine each of their policy recommendation areas and suggest why the perspective presented in these posts can change the outlook from pessimistic timidity to a more optimistic future.