Robots and AI: utopia or dystopia? part one

I did a recent post on Paul Mason's new book, Postcapitalism, which argued that the internet, automation, robots and artificial intelligence were creating a new economy which could not be controlled by capitalism. According to Mason, new forces are at work that were replacing the old class struggle between capital and the proletariat, as Marx saw it, with a network of communities. Technology and the network would lead to a post-capitalist (socialist?) world that could not be stopped

I disagreed that the new technology would replace the 'old forms' of class struggle or for that matter regular and recurrent economic crises under capitalism would dissipate towards a high productivity, low working day as capitalism 'withered away'.

But this debate has encouraged me to do something that I have been wanting to deal with in more detail for some time. Namely, what are the implications of these new technologies for capitalism? In particular, are robots and artificial intelligence set to take over the world of work and thus the economy in the next generation and what does this mean for jobs and living standards for people? Will it mean socialist utopia in our time (the end of human toil and a superabundant harmonious society) or capitalist dystopia (more intense crises and class conflict)?

It's a big subject. So let me first make a few definitions. By robots, I mean machines that can replace human labour through the use of computer programmes that direct the movement of machine parts to carry out tasks, both simple and increasingly complex.

The International Federation of Robotics (IFR) considers a machine as an industrial robot if it can be programmed to perform physical, production-related tasks without the need of a human controller. Industrial robots dramatically increase the scope for replacing human labour compared to older types of machines, since they reduce the need for human intervention in automated processes. Typical applications of industrial robots include assembling, dispensing, handling, processing (for instance, cutting), and welding – all of which are prevalent in manufacturing industries – as well as harvesting (in agriculture) and inspecting of equipment and structures (common in power plants).

Industrial robotics has the potential to change *manufacturing* by increasing precision and productivity without incurring higher costs. 3D printing could generate a new ecosystem of companies providing printable designs on the web, making everyday products endlessly customizable. The so-called 'Internet of Things' offers the possibility to connect machines and equipment to each other and to common networks, allowing for manufacturing facilities to be fully monitored and operated remotely. In *health care and life sciences*, data driven decision-making, which allows the collection and analysis of large datasets, is already changing R&D, clinical care, forecasting and marketing. The use of big data in health care has led to highly personalized treatments and medicines. The *infrastructure* sector, which had no gain in labour productivity in the last 20 years, could be greatly enhanced by, for example: the creation of Intelligent Transportation Systems, which could massively increase asset utilization; the introduction of smart grids, which could help save on power infrastructure costs and reduce the likelihood of costly outages; and efficient demand management, which could dramatically lower per-capita energy use.

Which of these emerging technologies have the greatest potential to drive improvements in productivity? McKinsey Global Institute (MGI) (2013) reckon that 'technologies that matter' are technologies that have the greatest potential to deliver substantial economic impact and disruption in the next decade. Those that make their list are rapidly advancing (e.g. gene-sequencing technology); have a broad reach (e.g. mobile internet); have the potential to create an economic impact (e.g. advanced robotics) and have the potential to change the status quo (e.g. energy storage technology). MGI estimates that the economic impact of these technologies – derived from falls in their prices and their diffusion and improved efficiency – to be between $14 and $33 trillion per year in 2025, led by mobile internet, the automation of knowledge work, the internet of things and cloud technology.

John Lanchester in a brilliant essay summed this up *(Lanchester): "Computers have got dramatically more powerful and become so cheap that they are effectively ubiquitous. So have the sensors they use to monitor the physical world. The software they run has improved dramatically too. We are, Brynjolfsson and McAfee argue, on the verge of a new industrial revolution, one which will have as much impact on the world as the first one. Whole categories of work will be transformed by the power of computing, and in particular by the impact of robots."*

By artificial intelligence (AI), is meant machines that do not just carry out pre-programmed instructions but learn more new programmes and instruction by experience and by new situations. AI means in effect robots who learn and increase their intelligence. This could happen to the point where robots can make more robots with increasing intelligence. Indeed, some argue that AI will soon surpass the intelligence of human beings. This is called the 'singularity' – the moment when human beings are no longer the most intelligent things on the planet. Moreover, robots could even develop the senses and form of human beings, thus being 'sentient'.

But before we get into science (or science fiction?), let us consider first things first. If robots and AI are fast on their way, will this mean a huge of loss of jobs or alternatively new sectors for employment and the need to work fewer hours?

In recent work, Graetz and Michaels looked at 14 industries (mainly manufacturing industries, but also agriculture and utilities) in 17 developed countries (including European countries, Australia, South Korea, and the US) They found that industrial robots increase labour productivity, total factor productivity, and wages. At the same time, while industrial robots had no significant effect on total hours worked, there is some evidence that they reduced the employment of low skilled workers, and, to a lesser extent, also middle skilled workers. Full paper here .

So in essence, robots did not reduce toil (hours of work) for those who had work, on the contrary. But they did lead to a loss of jobs for the unskilled and even those with some skills. So more toil, not less hours; and more unemployment.

Two Oxford economists, Carl Benedikt Frey and Michael Osborne, looked at the likely impact of technological change on a sweeping range of 702 occupations, from podiatrists to tour guides, animal trainers to personal finance advisers and floor sanders. Their conclusions were frightening: *"According to our estimates, about 47 percent of total US employment is at risk. We further provide evidence that wages and educational attainment exhibit a strong negative relationship with an occupation's probability of computerisation…. Rather than reducing the demand for middle-income occupations, which has been the pattern over the past decades, our model predicts that computerisation will mainly substitute for low-skill and low-wage jobs in the near future. By contrast, high-skill and high-wage occupations are the least susceptible to computer capital.'* Lanchester summed up their conclusions: *"So the poor will be hurt, the middle will do slightly better than it has been doing, and the rich – surprise! – will be fine."*

Lanchester makes the point in his essay that the robotic world could lead, not to a 'post-capitalist' utopia but instead to a 'Pikettyworld' *"in which capital is increasingly triumphant over labour."* And he quotes the huge profits that the large techno companies are making. *"In 1960, the most profitable company in the world's biggest economy was General Motors. In today's money, GM made $7.6 billion that year. It also employed 600,000 people. Today's most profitable company employs 92,600. So where 600,000 workers would once generate $7.6 billion in profit, now 92,600 generate $89.9 billion, an improvement in profitability per worker of 76.65 times. Remember, this is pure profit for the company's owners, after all workers have been paid. Capital isn't just winning against labour: there's no contest. If it were a boxing match, the referee would stop the fight."*

But looking at the profits of companies that have seized the value created by labour in the new sectors is not necessarily a guide to the health of capital as a whole. Is capitalism as a whole having a new lease of life as a result? After all, overall investment growth is very low in the current long depression and productivity growth as a result also. See my posts on productivity and investment.

Robots do not do away with the contradictions within capitalist accumulation. The essence of capitalist accumulation is that to increase profits and accumulate more capital, capitalists want to introduce machines that can boost the productivity of each employee and reduce costs compared to competitors. This is the great revolutionary role of capitalism in developing the productive forces available to society.

But there is a contradiction. In trying to raise the productivity of labour with the introduction of technology, there is process of labour shedding. New technology replaces labour. Yes, increased productivity might lead to increased production and open up new sectors for employment to compensate. But over time, a capital-bias or labour shedding means less new value is created (as labour is the only form of value) relative to the cost of invested capital. There is a tendency for profitability to fall as productivity rises. In turn, that leads eventually to a crisis in production that halts or even reverses the gain in production from the new technology. This is solely because investment and production depend on the profitability of capital in our modern mode of production.

So an economy increasingly dominated by the internet of things and robots under capitalism will mean more intense crises and greater inequality rather than super-abundance and prosperity. In my next post on this subject, I'll consider whether the world of robots making robots with ever-increasing intelligence – and perhaps eventually no human labour employed – would end the law of value and recurrent crises under capitalism.

Robots and AI: utopia or dystopia? – part two

In my first post on Robots and AI, I dealt with the impact of these new technologies on future employment and productivity. I raised the contradiction that develops within the capitalist mode of production between increased productivity achieved through new technology and falling profitability.

In this second part, I want to consider the impact of robots and AI seen through the prism of Marx's law of value under capitalism. There are two key assumptions that Marx makes in order to explain the laws of motion under capitalism: 1) that only human labour creates value and 2) over time, investment by capitalists in technology and means of production will outstrip investment in human labour power – to use Marx's terminology, there will be a rise in the organic composition of capital over time.

There is no space here to provide the empirical evidence for the latter. But you can find it here (crisis and the law for BOOK1-1). Marx explained in detail in Capital that a rising organic composition of capital is one of the key features in capitalist accumulation. Investment under capitalism takes place for profit only, not to raise output or productivity as such. If profit cannot be sufficiently raised through more labour hours (i.e. more workers and longer hours) or by intensifying efforts (speed and efficiency – time and motion), then the productivity of labour (more value per labour hour) can only be increased by better technology. So, in Marxist terms, the organic composition of capital (the amount of machinery and plant relative to the number of workers) will rise secularly. Workers can fight to keep as much of the new value that they have created as part of their 'compensation' but capitalism will only invest for growth if that wage share does not rise so much that it causes profitability to decline. So capitalist accumulation implies a falling share to labour over time, or what Marx would call a rising rate of exploitation (or surplus value).

The 'capital-bias' of technology is something continually ignored by mainstream economics. But as Branco Milanovic has pointed out, even mainstream economic theory could encompass this secular process under capitalist accumulation. As Milanovic puts it: *"In Marx, the assumption is that more capital intensive processes are always more productive. So capitalists just tend to pile more and more capital and replace labor….. This in Marxist framework means that there are fewer and fewer workers who obviously produce less (absolute) surplus value and this smaller surplus value over an increased mass of capital means that the rate of profit goes down. …..*

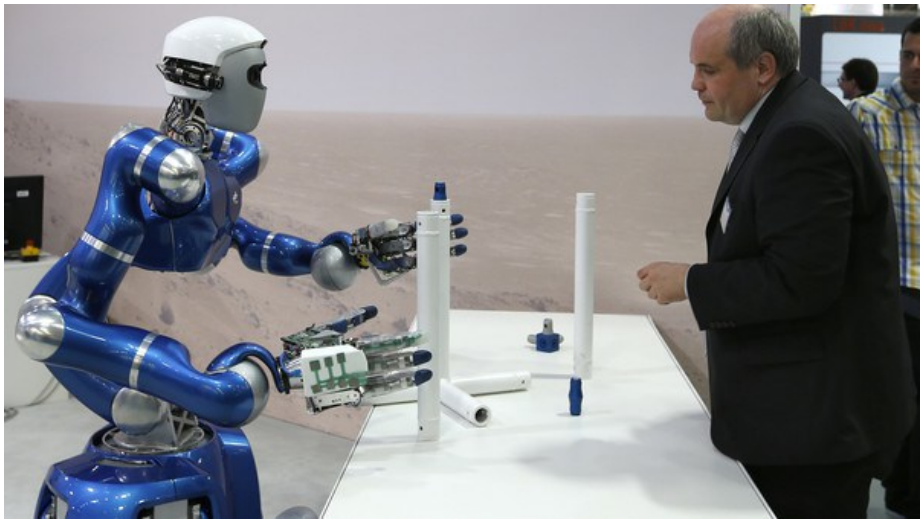
"The result is identical if we set this Marxist process in a neoclassical framework and assume that the elasticity of substitution is less than 1. Then, simply, r shoots down in every successive round of capital-intensive investments until it practically reaches zero. As Marx writes, every individual capitalist has an interest to invest in more capital-intensive processes in order to undersell other capitalists, but when they all do that, the rate of profits decreases for all. They thus work ultimately to drive themselves "out of business" (more exactly they drive themselves to a zero rate of profit).

Milanovic then considers the robot technology: *"Net income, in Marxist equilibrium, will be low because only labor produces "new value" and since very few workers will be employed, "new value" will be low (regardless of how high capitalists try to drive the rate of surplus value). To visualize Marxist equilibrium, imagine thousands of robots working in a big factory with only one worker checking them out, and with the useful life of robots being one year so that you keep on replacing robots continuously and thus run enormous depreciation and reinvestment costs every year. The composition of GDP would be very interesting. If total GDP is 100, we could have consumption=5, net investment=5 and depreciation=90. You would live in a country with GDP per capita of $500,000 but $450,000 of that would be depreciation."*

This poses the key contradiction of capitalist production: rising productivity leads to falling profitability, which periodically stops production and productivity growth. But what does this all mean if we enter the extreme (science fiction?) future where robotic technology and AI leads to robots making robots AND robots extracting raw

materials and making everything AND carrying out all personal and public services so that human labour is no longer required for ANY task of production at all?

Let's imagine a totally automated process where no human existed in the production. Surely, value has been added by the conversion of raw materials into goods without humans? Surely, that refutes Marx's claim that only human labour can create value?



But this confuses the dual nature of value under capitalism: use value and exchange value. There is use value (things and services that people need); and exchange value (the value measured in labour time and appropriated from human labour by the owners of capital and realised by sale on the market). In every commodity under the capitalist mode of production, there is both use value and exchange value. You can't have one without the other under capitalism. But the latter rules the capitalist investment and production process, not the former.

Value (as defined) is specific to capitalism. Sure, living labour can create things and do services (use values). But value is the substance of the capitalist mode of producing things. Capital (the owners) controls the means of production created by labour and will only put them to use in order to appropriate value created by labour. Capital does not create value itself.

But in our hypothetical all-encompassing robot/AI world, productivity (of use values) would tend to infinity while profitability (surplus value to capital value) would tend to zero. Human labour would no longer be employed and exploited by Capital (owners). Instead, robots would do all. This is no longer capitalism. I think the analogy is more with a slave economy as in ancient Rome.

In ancient Rome, over hundreds of years, the formerly predominantly small-holding peasant economy was replaced by slaves in mining, farming and all sorts of other tasks. This happened because the booty of the successful wars that the Roman republic and empire conducted included a mass supply of slave labour. The cost to the slave owners of these slaves was incredibly cheap (to begin with) compared with employing free labour. The slave owners drove the farmers off their land through of a combination of debt demands, requisition in wars and sheer violence. The former peasants and their families were forced into slavery themselves or into the cities, where they scraped a living with menial tasks and skills or begged. The class struggle did not end. The struggle was between the slave-owning aristocrats and the slaves and between the aristocrats and the atomised plebs in the cities.

A modern science fiction can be found the recent Elysium movie. In this movie, the owners of the robots and modern technology have built themselves a complete space planet separate from the earth. There they live a life of luxury off the things and services provided by robots and defend their separated lives with their robot armies. The rest of the human race lives on earth in a dire state of poverty, disease and misery – an immiseration of the working class who no longer work for a living.

In the Elysium world, the question would remain: who owns the means of production? In the completely automated planet, how would the goods and services produced by the robots be distributed

in order to be consumed? That would depend on who owns the robots, the means of production. Suppose there are 100 lucky guys on the robot-run planet. One of them may own the best robots and so appropriate the whole product. Why should he share it with the other 99? They will be sent back to the Earth. Or they might not like it and will fight for the appropriation of some of the robots. And so, as Marx put it once, the whole shit begins again, but with a difference.

All will depend on how humanity would get to a completely automated society. On the basis of a socialist revolution and common ownership, the distribution of the output produced by the robots can be controlled and distributed to each according to his/her needs. If society operates on the basis of a continuation of the private ownership of the robots, then the class struggle for the control of the surplus continues.

The question often posed at this point is: who are the owners of the robots and their products and services going to sell to make a profit? If workers are not working and receiving no income, then surely there is massive overproduction and underconsumption? So, in the last analysis, it is the underconsumption of the masses that brings capitalism down?

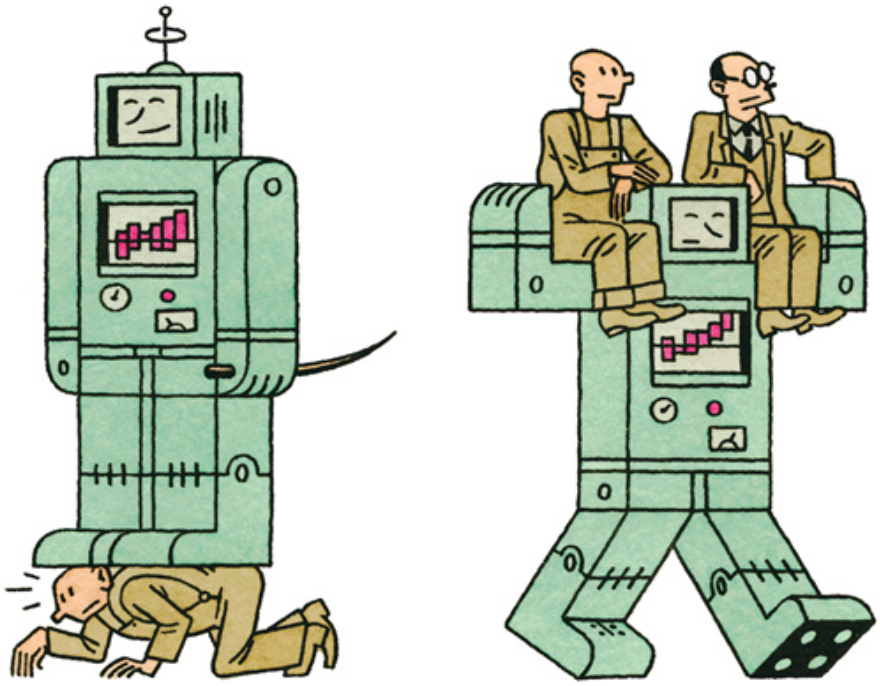
Again, I think this is a misunderstanding. Such a robot economy is not capitalist any more; it is more like a slave economy. The owners of the means of production (robots) now have a super-abundant economy of things and services at zero cost (robots making robots making robots). The owners can just consume. They don't need to make 'a profit', just as the aristocrat slave owners in Rome just consumed and did not run businesses to make a profit. This does not deliver an overproduction crisis in the capitalist sense (relative to profit) nor 'underconsumption' (lack of purchasing power or effective demand for goods on a market), except in the physical sense of poverty.

Mainstream economics continues to see the rise of the robots under capitalism as creating a crisis of underconsumption. As Jeffrey Sachs put it: *"Where I see the problem on a generalised level for society as a whole is if humans are made redundant on an industrial scale (47% quoted in US) then where's the market for the goods?"* Or as Martin Ford puts it: *"there is no way to envision how the private sector can solve this problem. There is simply no real alternative except for the government to provide some type of income mechanism for consumers"* .Ford does not propose socialism, of course, but merely a mechanism to redirect lost wages back to 'consumers', but such a scheme would threaten private property and profit.

A robotic economy could mean a super-abundant world for all (post-capitalism as Paul Mason suggests); or it could mean Elysium. FT columnist, Martin Wolf put it this way: *"The rise of intelligent machines is a moment in history. It will change many things, including our economy. But their potential is clear: they will make it possible for human beings to live far better lives. Whether they end up doing so depends on how the gains are produced and distributed. It is possible that the ultimate result will be a tiny minority of huge winners and a vast number of losers. But such an outcome would be a choice not a destiny. A form of techno-feudalism is unnecessary. Above all, technology itself does not dictate the outcomes. Economic and political institutions do. If the ones we have do not give the results we want, we must change them".* It's a social 'choice' or more accurately, it depends of the outcome of the class struggle under capitalism.

John Lanchester is much more to the point: *"It's also worth noting what isn't being said about this robotified future. The scenario we're given – the one being made to feel inevitable – is of a hyper-capitalist dystopia. There's capital, doing better than ever; the robots, doing all the work; and the great mass of humanity, doing not much, but having fun playing with its gadgets…There is a possible alternative, however, in which ownership and control of robots is disconnected from capital in its current form. The robots liberate most of humanity from work, and everybody benefits from the proceeds: we don't have to work in factories or go down mines or clean toilets or drive long-distance lorries, but we can choreograph and weave and garden and tell stories and invent things and set about creating a new universe of wants. This would be the world of unlimited wants described by economics, but with a distinction between the wants satisfied by humans and the work done by our machines. It seems to me that the only way that world would work is with alternative forms of ownership. The reason, the only reason, for thinking this better world is possible is that the dystopian future of capitalism-plus-robots may prove just too grim to be politically viable. This alternative future would be the kind of world dreamed of by William Morris, full of humans engaged in meaningful and sanely remunerated labour. Except with added robots. It says a lot about the current moment that as we stand facing a future which might resemble either a hyper-capitalist dystopia or a socialist paradise, the second option doesn't get a mention."*

But let's come back to the here and now. If the whole world of technology, consumer products and services could reproduce itself without living labour going to work and could do so through robots, then things and services would be produced, but the creation of value (in particular, profit or surplus value) would not. As Martin Ford puts it: *the more machines begin to run themselves, the value that the average worker adds begins to decline."* So accumulation under capitalism would cease well before robots took over fully, because profitability would disappear under the weight of 'capital-bias'.



The most important law of motion under capitalism, as Marx called it, would be in operation, namely the tendency for the rate of profit to fall. As 'capital-biased' technology increases, the organic composition of capital would also rise and thus labour would eventually create insufficient value to sustain profitability (i.e. surplus value relative to all costs of capital). We would never get to a robotic society; we would never get to a workless society – not under capitalism. Crises and social explosions would intervene well before that.

And that is the key point. Not so fast on the robot economy. In the next and final post on the issue, I shall consider the reality of the robot/AI future under capitalism.

Robots and AI: utopia or dystopia? – part three

This is the third and final post on the issue of robots and artificial intelligence (AI). In the first post, I argued that while robots and AI are a leap forward in mechanisation and automation, they will not do away with the basic contradiction within the capitalist mode of production between the drive to raise the productivity of labour and the profitability of capital over time. As I said *"over time, a capital-bias or labour shedding means less new value is created (as labour is the only form of value) relative to the cost of invested capital. There is a tendency for profitability to fall as productivity rises. In turn, that leads eventually to a crisis in production that halts or even reverses the gain in production from the new technology. This is solely because investment and production depend on the profitability of capital in our modern mode of production."*

In the second post, I considered in more detail how the law of value that dominates the profit-making capitalist mode of production would be affected by the hypothetical (or real?) possibility of a fully automated economy where no human labour is expended at all. *"In our hypothetical all-encompassing robot/AI world, productivity (of use values) would tend to infinity while profitability (surplus value to capital value) would tend to zero. Human labour would no longer be employed and exploited by Capital (owners). Instead, robots would do all. This is no longer capitalism."*

But I argued that before this state of 'singularity' (as it is called) was reached, capitalism as system would have broken down. *"We would never get to a robotic society; we would never get to a workless society – not under capitalism. Crises and social explosions would intervene well before that… accumulation under capitalism would cease well before robots took over fully, because profitability would disappear under the weight of 'capital-bias'*."

In this third post, I want to consider just how likely it is that highly intelligent robots will take over the world of work (and maybe the world) in the near future. It's my contention that, despite the optimism of the AI and robot drivers, it's not going to happen soon.

What is true is that the use of robots is rising fast. The level of robotics use has almost always doubled in the top capitalist economies in the last decade. Japan and Korea have the most robots per manufacturing employee, over 300 per 10,000 employees, with Germany following at over 250 per 10,000 employees. The United States has less than half the robots per 10,000 employees compared to Japan and The Republic of Korea. The adoption rate of robots increased in this period by 40% in Brazil, by 210% in China, by 11% in Germany, by 57% in The Republic of Korea, and by 41% in the United States.

This development has been called a 'second wave of automation', one that is centered on artificial cognition, cheap sensors, machine learning and distributed smarts. This deep automation will touch all jobs, from manual labor to knowledge work. And it is reducing employment, just as mechanisation under previous industrial revolutions did.

Andrew McAfee, the coauthor with his MIT colleague Erik Brynjolfsson of *The Second Machine Age*, has been one of the most prominent figures describing the possibility of a *"sci-fi economy"* in which the proliferation of smart machines eliminates the need for many jobs. (see "Open Letter on the Digital Economy," in which McAfee, Brynjolfsson, and others propose a new approach to adapting to technological changes.) Such a transformation would bring immense social and economic benefits, he says, but it could also mean a *"labor-light*" economy.

Hod Lipson says *"More and more computer-guided automation is creeping into everything from manufacturing to decision making*". Prominent Columbia University economist Jeffrey Sachs recently predicted that robots and automation would soon take over at Starbucks. But there are good reasons to believe that Sachs and others could be wrong. The success of Starbucks has never been about getting coffee more cheaply or efficiently. Consumers often prefer people and the services humans provide. Take the hugely popular Apple stores, says Tim O'Reilly, the founder of O'Reilly Media. Staffed by countless swarming employees armed with iPads and

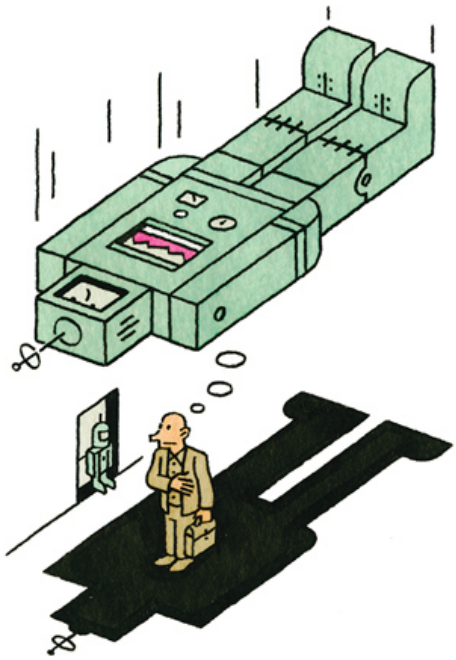
iPhones, the stores provide a compelling alternative to a future of robo-retail; they suggest that automating services is not necessarily the endgame of today's technology. *"It's really true that technology will take away a class of jobs,"* says O'Reilly. *"But there is a choice in how we use technology."*

And just how close are AI robots to doing all human work? AI researchers have noted that the simplest tasks for humans, such as reaching into a pocket to retrieve a quarter, are the most challenging for machines. For example, iRobot's Roomba robot is autonomous, but the vacuuming task it performs by wandering around rooms is extremely simple. By contrast, the company's Packbot is more expensive, designed for defusing bombs, but must be teleoperated or controlled wirelessly by people.

The Defense Advanced Research Projects Agency , a Pentagon research arm, held a Robotics Challenge competition in Pomona, Calif. Theer was $2 million in prize money for the robot that performs best in a series of rescue-oriented tasks in under an hour. In the previous contest in Florida in December 2013, the robots, which were protected from falling by tethers, were glacially slow in accomplishing tasks such as opening doors and entering rooms, clearing debris, climbing ladders and driving through an obstacle course. (The robots had to be placed in the vehicles by human minders.) Reporters who covered the event resorted to such analogies as "watching paint dry" and "watching grass grow."

This time, the robots had an hour to complete a set of eight tasks that would probably take a human less than 10 minutes. And the robots failed at many. Most of their robots were two-legged, but many had four legs, or wheels, or both. But none were autonomous. Human operators guided the machines via wireless networks and were largely helpless without human supervisors. Little headway has been made in "cognition," the higher-level humanlike processes required for robot planning and true autonomy. As a result, any researchers have begun to think instead of creating ensembles of humans and robots, an approach they describe as co-robots or "cloud robotics."

So there's still a long way to go. David Graeber has also raised other obstacles to the fast adoption of autonomous AI fully automated robots, namely the capitalist system itself. Funding for new technology does no go into solving the needs of people and reducing human toil as such, but into what will raise profitability. *"Once upon a time,* he said, *"when people imagined the future, they imagined flying cars, teleportation devices and robots who would free them from the need to work. But strangely, none of these things came to pass."*



What happened, instead, was that industrialists poured research funds not into the invention of the robot factories that everyone was anticipating in the sixties, but into relocating their factories to labor-intensive, low-tech facilities in China or the Global. And governments shifted funds into military research, to weapons projects, research in communications and surveillance technologies and similar security-related concerns. *"One reason we don't have robot factories yet is because roughly 95 percent of robotics research funding has been channeled through the Pentagon, which is more interested in developing unmanned drones than in automating paper mills."*

William Nordhaus from Yale University's department of economics, has tried to estimate the future economic impact of AI and robots (SSRN-id2658259). Nordhaus reckons 'singularity'and its impact is still a long way away. Consumers may love their iPhones, but they cannot eat the electronic output. Similarly, at least with today's technologies, production requires scarce inputs ("stuff") in the form of labour, energy, and natural resources, as well as information for most goods and services. Nordhaus says projecting the trends of the last decade or more, it would be in the order of a century before growth variables would reach the level associated with a growth-focused singularity.

Nordhaus also raises the issue of robots out of control – robots rule the world including us. *"The development of*

superintelligence raises a new concern not contemplated before in the development of political and military spying and weapons. We must be concerned that to the list of adversaries will be added the superintelligent machines themselves…. Will the superintelligent treat us as flies to wonton boys?" So there's one job category for humans that won't be easily eliminated: defending our interests from the all-encompassing power of the AI: *"We routinely spend 5% of output on defense, and this might rise to a much larger number when faced with a more powerful enemies like superintelligent machines. So one occupation at least would survive into the Era of Singularity."*

But let's not throw the baby out with the bathwater. Technical advances to meet the needs of people, to help end poverty and create a society if superabundance without damaging the environment and the ecology of the planet is what we want. If AI/robotic technology can bring us closer to that, all the better.

But the obstacle to a harmonious superabundant society based on robots reducing human toil to a minimum is Capital. In its Future of Work report last year, UKCES came up with a number of scenarios which included both the possibility of a long period of stagnation and of a technology-driven productivity leap. One thing all the scenarios had in common, though, was that, for those without good skills, powerful connections or inherited wealth, the future looks extremely bleak. The Economist concluded, at the end of a long piece on technology and work last year: "*S]ociety may find itself sorely tested if, as seems possible, growth and innovation deliver handsome gains to the skilled, while the rest cling to dwindling employment opportunities at stagnant wages."* Or, as John Naughton put it, *"a concierge economy [with] legions of network co-ordinated serfs."*

While the means of production (and that will include robots) are owned by a few, the benefits of a robot society wil accrue to the few. Whoever owns the capital will benefit as robots and AI inevitably replace many jobs. If the rewards of new technologies go largely to the very richest, as has been the trend in recent decades, then dystopian visions could become reality. I quote again from John Lanchester: "*It seems to me that the only way that world would work is with alternative forms of ownership. The reason, the only reason, for thinking this better world is possible is that the dystopian future of capitalism-plus-robots may prove just too grim to be politically viable. This alternative future would be the kind of world dreamed of by William Morris, full of humans engaged in meaningful and sanely remunerated labour. Except with added robots. It says a lot about the current moment that as we stand facing a future which might resemble either a hyper-capitalist dystopia or a socialist paradise, the second option doesn't get a mention."*

Let me sum up the conclusions of my posts on robots and AI.

- The new technology of robots and AI is coming fast. As in all technology under capitalism, it has a 'capital-bias'; it will replace human labour. But under capitalism, that capital bias is applied to reduce costs and boost profitability not meet people's needs.
- Robots and AI will intensify the contradiction under capitalism between the drive by capitalists to raise the productivity of labour through 'mechanisation' (robots) and the resulting tendency for the profitability in this investment for the owners of capital to fall. This is Marx's most important law in political economy – and it becomes even more relevant in the world of robots. Indeed, the biggest obstacle to a world of super-abundance is capital itself. Well before we get to 'singularity' (if we ever do) and human labour is totally replaced, capitalism will experience an increasingly deeper series of man-made economic crises.
- Robot technology will reduce many existing jobs (and create some new jobs) and is doing so already. But singularity and a robot world is still a long way away. That is because the AI technology is not being directed by capital into the most productive areas but into the most profitable (not the same thing). And the costs of 'controlling' AI robots will increase.
- A super-abundant society where human toil is reduced to a minimum and poverty is eliminated won't happen unless the ownership of the means of production changes from private control (capitalist oligarchy) to ownership in common (democratic socialism). That's the choice between utopia and dystopia.