REVIEW ESSAY

The Robot Revolution: Understanding the Social and Economic Impact, John Hudson (2019), Edward Elgar Publishing, Cheltenham, 192pp., hardback £63, ISBN: 978 1 78897 447 9

The ancient Greeks believed that the swan reserves some of its most beautiful songs for its final days; hence the term 'swan-song'. *The Robot Revolution* is John Hudson's 'swan-song' – completed just before he died in July 2018. It is certainly a beautiful work in empirical economics, though there is an element of Greek tragedy in the story. For all the many clever and useful things that robots will be able to do for us, Hudson argues that their introduction will carry considerable risks for our economy and society.

For those who did not know John Hudson, it is essential to learn a little about his career. As Hudson's long-term co-author and research partner, Paul Mosley (2018), notes in his obituary:

> [Hudson] left school at 16 and followed his father into a job in the West Midlands engineering industry . . . He went to (university) in his mid-20s as a mature student, to study economics, and always took pride in having entered academia the hard way.

Indeed, the portrait that Hudson chose to place at the front of this book depicts him and his colleagues in the small engineering firm for which he worked as a young man. Hudson was eventually to become professor of economics at the University of Bath.

When I first met Hudson, in 1984, we spent some time discussing the economics of innovation. He said that economists who had experience of working in a particular industry were exceptionally well placed to understand the role of innovation in that industry. He felt that the tacit knowledge and skills he had acquired in his ten years as a mechanical engineer were an important part of his human capital as an economist. I entirely agreed with these observations. Indeed, at several points in the book, he gives illustrations of such lessons:

> In the 1960s the author of this book worked at a small factory in the UK's West Midlands, setting up and programming automatic capstan lathes. One worker could easily look after four of these capstans, which would previously have required four semi-skilled workers. Automation effectively means, and implies, the replacement of human workers by automatic machines. The use of the term has now stepped out of the factory and we have, for example, office automation. Comparing those automated capstan lathes with industrial robots, one difference lies in the latter having an arm and a gripper that can be used on, for example, different cars as they pass through an assembly line. With capstan lathes there is no assembly line. But both, to differing degrees, replace humans. (p.21)

The central argument of Hudson's book is this. In the future, robots and artificial intelligence will fundamentally change our world. In some ways, they offer a golden future, where robots provide welcome help to the elderly, help the disabled to walk, protect our security, bring the best urban facilities to remote communities, and greatly enhance productivity. But throughout the book, he discusses several dangers. Robots will replace jobs, creating unemployment, and increasing inequality. People may come to rely too much on robots, reducing human contact and our cognitive abilities. Robots will change the world in dramatic ways, and some people will find this alarming.

The book's nine chapters can naturally be gathered together into four groups – though not necessarily in chapter order. The first group (Chapters 1 and 9) is concerned with basic principles of the economics of innovation. Much of this discussion will be familiar to researchers in that field, and is not remarkable in itself. But Hudson makes three essential points that do stand apart.

First, all economists working in the Schumpeterian tradition recognize that innovation involves creative destruction, but many seem to accept that the destructive side of innovation is inevitable and, while unfortunate, is not usually serious enough to cast doubt on the social value of innovation. From the start, however, Hudson takes a different line, and considers that the destructive side deserves more serious attention.

Second, in that same vein, he reappraises the Luddite movement of the early nineteenth century, where weavers were strongly opposed to some innovations in textile machinery which they (correctly) feared would take away their jobs. The term 'Luddite' has come to mean an obstinate and unthinking opposition to technical progress, but Hudson from the start sees it as a natural and rational fear.

And third, Hudson adds a third point in Chapter 9 which has not been fully grasped by researchers in the field of innovation. We all recognize that the robot revolution is the product of many innovations in many different areas, but fewer people have taken on board that the very process of innovation itself will, in future, be modified in important ways by the robot revolution. The robot is both the product of earlier innovation and a powerful force for even wider future innovation.

The second group (Chapters 2–4) considers the history of robots, the science of robotics, and the many different contexts in which robots may be used in future. All of them reflect Hudson's background in mechanical engineering, and his deep interest in robotics.

The idea of something like a robot has been found in works of fiction for a very long time. Hudson cites some examples from ancient Greek mythology, though he doubts that any of these were close to the robots of today. However, by the end of the Middle Ages, machines equivalent to robots were starting to appear in fiction, and by the 1800s, such references were becoming quite common. This history is important as it suggests that a 'need' has long been perceived: the challenge has been to develop the necessary technology. This could be interpreted to mean that the intent of creating robots was benign as it sought to meet a need. Indeed, the term 'robot' derives from the Slavic word *robota*, which refers to those peasants who were obliged to do forced labour in the feudal system. Indeed, the very idea of a mechanical robot was that humans should no longer have to do the soulless work of the forced labourer, which would instead be done by a soulless machine.

Hudson observes that many of the developments in robotics have, to some degree at least, been discussed in modern science fiction literature. This literature also considers whether a world with widespread use of robots is more likely to be utopian or dystopian. Some readers may think that this discussion of science fiction is ephemeral, but not so: such discussion is one of the ways in which the potentially dystopian side-effects of a new technology can be analysed and anticipated.

Why include a chapter about the science of robots? Hudson's answer is simple: 'One cannot really understand what robots are capable of now or in the future, unless one has some understanding of the underlying science' (p.52). There are three essential capabilities required of any robot: (a) the ability to manoeuvre in the context of application; (b) the ability to sense space and location; and (c) the intelligence required to guide the robot's actions. To deliver these three capabilities requires a hybrid science that builds on a wide variety of disciplines:

> robots build upon the fields of mechanics, automation, electronics, solid-state physics, fibre optics, computer science, cybernetics and artificial intelligence (AI). In addition, robots used in specialised activities, particularly service robots, need contributions from the relevant disciplines, for example mathematics, logic, psychology, the law, biology and industrial design. The wide range of expertise that is being brought into play in the development of robots in part differentiates it from previous technological revolutions. (p.52)

One discipline is conspicuous by its absence from Hudson's list – economics! Why did he omit economics? Having written this book, he obviously did not think that economics had nothing to contribute to the hybrid science of robotics. No, I suspect the reason for the omission is that his list

describes the disciplines most heavily involved at the time of his writing. This is not to deny that economics must get involved too.

Turning to the chapter 'Robots now and in the future', the sheer variety and pervasiveness of potential robot use becomes clear. There will be industrial robots, warehouse robots, agricultural robots, autonomous vehicles, robots caring for old people, medical robots used in surgery, robots in education, security robots, military robots, robots for dangerous situations, and robots with high capability in artificial intelligence (AI). Naturally, the scope for useful applications and, more importantly perhaps, the possible risks and unwanted side effects vary markedly from one context to another.

The third group (Chapters 5 and 7) presents original econometric research. In Chapter 5, Hudson considers the impact of robots on unemployment, employment and wages. He uses data from Eurobarometer surveys which record whether respondents think robots will take some people's jobs, and in particular, whether respondents think their own job is at risk. Across the sample as a whole, 38% think that robots will certainly take jobs from workers, but 52% think that robots could not possibly do *their* job. He estimates ordered probit models to see how the response to these two questions depends on socio-economic and geographical factors. Respondents are more likely to be concerned about losing their own job if they are 'hard up', young, male, and live in regions where a high proportion of the labour force works with robots. Respondents are more likely to believe that robots could take jobs (in general) if they are poor, old, had left full-time education at a young age, and live in regions with high unemployment. Attitudes also vary according to the occupation of the respondent. Manual workers (especially unskilled) are most concerned about losing their job to a robot, while professionals, managers and business proprietors are least concerned.

In Chapter 7, Hudson examines the hopes and fears of citizens about the use of robots. How do different groups of citizens see the prospects for the benign application of robots? And which groups appear to have most to fear from risks and unwelcome side-effects? Once again, he uses data from Eurobarometer surveys. Across the sample as a whole, respondents are more in favour of robots than against, but there are some important differences by area of application. Unsurprisingly, they are strongly in favour of the use of robots in dangerous situations, but much less keen on the use of robots in surgery and autonomous vehicles (specifically, driverless cars). Again, there are interesting differences in opinions across socioeconomic groups. Young people (especially students), highly educated respondents, professionals and managers tend to be more in favour of the various applications of robots than older people (especially retired people), poorly educated respondents, and unskilled manual workers. Once again, Hudson estimates ordered probit models to see how approval ratings for the use of robots vary with a wider variety of socioeconomic factors. Respondents tend to give higher approval ratings if they are male, young, live in cities, are highly educated, professionals or managers. Respondents tend to give lower approval ratings if they are female, old, live in the country, are less educated, unemployed, manual workers (especially unskilled), farmers, and live in areas of high unemployment.

The fourth group comprises Chapters 6 and 8, which might be described as 'crystal ball' chapters. In using that term, I intend no criticism of these chapters. On the contrary, I believe that one of the greatest obligations of applied economists, especially when studying innovation, is to look forward, even if it is hard to predict the future. In Chapter 6, Hudson stresses that while he does not want to play down the positive impacts of robots, he believes there will be some subtle and indirect effects of robotization on society and economy, which may be a cause for concern. He argues that robotization will reduce the number of occupations in which people are employed, which will increase the number of high-paid jobs, and reduce the number of middle-skilled and low-skilled jobs. It will therefore increase income inequality. He argues that low incomes and the potential for unemployment will mean that extremist and populist politicians may become more popular, pushing political systems to the left or the right. He also argues that the growth of robotization may lead to a reduction in the extent of social interaction, and therefore to a reduction in social

capital. Indeed, he goes further in discussing the 'singularity hypothesis', according to which accelerated technological change can pose a challenge to humanity in its current form.

In Chapter 8, Hudson considers what government policy might do to promote the beneficial applications of robots, and equally, to avert some of the undesirable side-effects of robotization. With regard to the first, one proposal involves steering university research funding towards projects designed to maximize the benefits from robots. Another is to direct resources towards the entrepreneurs who can turn these research outputs into viable robot applications. With regard to the second, Hudson discusses the introduction of policies such as universal basic income – or, indeed, a (non-universal) basic income – targeted at those who lose from the advent of robotization. He also makes proposals to solve the social and political problems discussed in Chapter 6. He argues that competitive pressure means that governments have little option but to pursue the development of robotization. If they do not, other countries will and this will damage their domestic economy. But what can governments do to avoid some of the undesirable effects? Hudson considers suggestions for an ethical framework for the design production and use of robots, and a code of conduct for robotics engineers and research ethics committees. And he considers the role that might be played by international standards organizations to set standards for responsible robotization. Like Hudson, I believe that standards organization can play a quiet, but very effective role in dealing with such issues, but the challenge of ensuring responsible robotization would rank as one of the hardest ever faced by these standards organizations.

Five comments

I have five comments to make about the issues raised in *The Robot Revolution*, and the way in which Hudson tackles this difficult subject. It is perhaps inevitable that these comments should also relate to my own intellectual journeys, but I hope the reader will forgive me for this. The first comment refers to the question of how we should do empirical economics. I believe that one of the greatest obligations of applied economists is to pursue an absolutely essential principle set out by Ragnar Frisch (1956, p.302):[1]

> If we economists and econometricians only stick to perfecting the type of theories and type of data that can explain the economic happenings of the past, we will never get out of the interesting and spectacu1ar, but hopelessly inadequate, type of analysis which may be characterized as *belated economics*. To be really useful we must show imagination . . . I advocate most emphatically that in theoretical thinking and data collection we must try to look forward, to think out what will be the analytical tools that can be useful in the concrete situations that will prevail tomorrow or 10 to 20 years from now.

I would say that this obligation applies to all economists, and above all, perhaps, to those who research the economics of innovation. In this field, almost by definition, the past will be an incomplete and inadequate guide to the future. Hudson's book is a very good example of the forward-looking research we must do on all innovations.

There is another characteristic of Hudson's book of which I thoroughly approve. In my view, true empirical economics must involve a wide variety of fact-finding research, and that is exactly what we find here. Some of it – for example, the econometric work described above – would fit into the format required for leading journals. But much of it will be descriptive, historical, case-study based, and – in the economics of innovation – will involve a discussion of technological considerations. Work of this sort is much less likely to be accepted for publication in leading economics journals. Indeed, I suspect that only two chapters of this book would make it into leading journals, and most (if not all) of the other chapters would be considered unsuitable for that format.

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[1] Frisch was one of the founders of the Econometric Society, and shared (with Jan Tinbergen) the first Nobel Prize for economics in 1969.

But, in my view, all of the chapters here are equally important and equally valuable. Indeed, an empirical analysis that omitted the second group of chapters (on history, the present, and the science of robotics) and the fourth group of 'crystal ball' chapters would be quite inadequate.

This makes clear the role of the monograph in empirical economics. The monograph finds room for all the essential parts of an empirical analysis. Mark Casson makes a very succinct statement of what is wrong with the publication culture in economics: 'It distorts incentives by prioritising some research outputs, such as 'four-star' papers, over others, such as monographs.'[2] For true empirical economists, this is a very unwelcome distortion, because it fails to grasp the fact that true empirical economics often requires a wide range of activities that simply will not be published in leading journals.

The second comment returns to the issue of creative destruction. All innovation is about creative destruction. With luck the creative offsets the destructive, but this cannot be guaranteed. In the tradition of Schumpeter (1954), the destructive effects of innovation are often accepted as the unavoidable collateral damage of technological progress. Hudson considers that the destructive side of innovation deserves more serious attention than this, and I quite agree. In Swann (2014, chapters 7–13), I consider seven case studies of the destructive side of innovation, and show that these negative effects are not restricted to other businesses that are less competitive than the innovator. They extend to education, art, the quality of the marketplace, the socio-economic environment, the natural environment, consumption and health.

Take the example of the Luddites, as discussed by Hudson. They were the early nineteenth-century weavers who used small domestic hand-looms, who were very concerned at the implications of the new, large-scale 'wide looms' for their survival. The term 'Luddite' has come to mean something very pejorative: people who have an uncritical and 'knee-jerk' opposition to new technologies that could have a great impact on productivity and wealth creation. And the related 'Luddite fallacy' is the idea that (apart from some short-term dislocation) new technology does not lead to higher overall unemployment in the economy, but simply changes the composition of jobs in the economy.

Actually, the objections of the Luddites were more subtle and discriminating, even if their occasional use of machine-breaking was extreme. They were concerned that the use of wide looms by unskilled workers would lead to lower quality produce, and that these low-quality goods would undermine the market for superior work produced on traditional frames by skilled workers. These fears we quite justified, as Babbage (1832, pp.104–5) describes. Moreover, while the Luddite fallacy may indeed be a fallacy in the long term, it is a gross underestimate to refer to the effects on displaced workers as a short-term dislocation. Consider this passage from Marx (1867/1974, p.406):

> When machinery seizes on an industry by degrees, it produces chronic misery among the operatives who compete with it. Where the transition is rapid, the effect is acute and felt by great masses. History discloses no tragedy more horrible than the gradual extinction of the English hand-loom weavers, an extinction that was spread over several decades, and finally sealed in 1838. Many of them died of starvation, many with families vegetated for a long time on 2½ pence a day.

If innovation has destructive side-effects on this scale, then I think it is fair to describe it as 'pathological innovation' (Swann, 2019) – unless, and until, we can create commensurate innovations in the socio-economic environment which insure the displaced against such extreme losses.

The third follows on in an obvious way. Should we really go on allowing these destructive side effects to accumulate? Is it really acceptable to treat these as unavoidable collateral? And how far can we go to police and compensate for the destructive effects of innovations? We can find two entirely different perspectives on these questions. As I write this review, the UK is mired in the apparently intractable problem of Brexit. Among those who favour Brexit, we find several tribes, but one of the most powerful is found on the right wing of the Conservative Party. This tribe

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[2] Quoted from his endorsement on the cover of Moosa (2018).

believes that the level of business regulation in the EU is excessive, and that Brexit is an essential part of a larger political project to deregulate the British economy. For such politicians, the idea of policing innovations to avoid destructive side effects is complete anathema.

At the other end of the spectrum, consider the widespread policy of regulating the introduction of new drugs (e.g. the FDA in the US, the EMA in the EU, and the MHRA in the UK).[3] These agencies enforce strict approval processes before pharmaceutical companies are permitted to introduce their innovations to the market. Some companies consider the processes unduly strict, but equally, some parts of the medical profession and consumer groups consider that it is too easy for companies to influence the process towards acceptance. On the whole, however, there is no serious suggestion that FDA approval of pharmaceutical innovations is unnecessary and should be replaced.

Could we envisage similar agencies for the approval of innovations in all (or most) other sectors? The Conservative politicians I described above would object strongly. Others might argue that the risk from toxic medicines is of a greater order of magnitude than the risk from other toxic innovations. I am not convinced: consider, for example, the toxicity of some social media platforms! Two more significant objections to extending the FDA concept to other innovations are these. It is not always possible to design or carry out relevant and comparable field trials. Moreover, unlike the medical profession, social scientists are at a disadvantage in predicting where destructive effects may be expected. Consider, for instance, the contribution made by frequent upgrades in personal computer software to the rapid growth of e-waste. How many people saw that connection in advance? Despite these difficulties, my instinct is that, sooner or later, we will have no choice but to increase regulation of the destructive side of innovation.

The fourth point has bothered me since I first opened Hudson's book. Ernst Schumacher (1974, p.26) famously observed that 'man is far too clever to be able to survive without wisdom'. This brilliant maxim captures the essential problem as Hudson sees it: robots can offer many clever applications, but widespread robotization is potentially dangerous, unless we are wise enough to anticipate the risks. What does wisdom provide that cleverness does not? My short answer is 'systems thinking', as described by Churchman (1979). His argument is that disciplinary scholars may be very clever, but wisdom requires systems thinkers, people who are capable of envisaging how an apparently benign intervention in one part of a system may have complex and undesirable effects in another part of the system. Churchman's concern is that mono-disciplinary thinking is the enemy of systems thinking: to cultivate the systems thinking necessary for wisdom, there must be an active forum for wide-ranging inter-disciplinary dialogue in large and complex hybrid disciplines. And here, again, I refer back to the conspicuous absence of economics from Hudson's list of disciplines that underpin robot science. How can we hope to understand the wider, and indirect, economic effects of robotization, until economists play an active and prominent role in the robot science community?[4]

Schumacher's maxim is surely relevant to any debate about the value and risks of robotization. Moreover, it helps us understand why a lack of systems thinking has massively increased the risk of environmental breakdown (Laybourn-Langton, Rankin and Baxter, 2019). The fifth and final point concerns my hopes for *The Robot Revolution*. My own PhD research (on the economic effects of innovation in microelectronics) was inspired by Braun and Macdonald's (1978) book, *Revolution in Miniature*. Many of my contemporaries who worked on innovation would say the same. I would like to think that within (say) ten years, Hudson's book is inspiring PhD students to research some of the many questions about the economic and social effects of robotization.

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[3] Food and Drug Administration (FDA), European Medicines Agency (EMA), and the Medicines and Healthcare Products Regulatory Agency (MHRA).

[4] Swann (2019, chapter 17) discusses the role of hybrid disciplines in the development of economics.

References

Babbage, C. (1832) *On the Economy of Machinery and Manufactures*, Charles Knight, London.

Braun, E. and Macdonald, S. (1978) *Revolution in Miniature: The History and Impact of Semiconductor Electronics*, Cambridge University Press, Cambridge.

Churchman, C. (1979) *The Systems Approach and its Enemies*, Basic Books, New York.

Frisch, R. (1956) 'Opening address to the Kiel meeting of the Econometric Society', *Econometrica*, 24, 3, pp.300–2.

Hudson, J. (2019) *The Robot Revolution: Understanding the Social and Economic Impact*, Edward Elgar, Cheltenham.

Laybourn-Langton, L., Rankin, L. and Baxter, D. (2019) *This is a Crisis: Facing up to the Age of Environmental Breakdown*, Institute for Public Policy Research, available at www.ippr.org/research/publications/age-of-environmental-breakdown, accessed October 2019.

Marx, K. (1867/1974) *Capital: A Critical Analysis of Capitalist Production*, Volume 1, Lawrence and Wishart, London.

Moosa, I. (2018) *Publish or Perish: Perceived Benefits versus Unintended Consequences*, Edward Elgar, Cheltenham.

Mosley, P. (2018) 'John Hudson Obituary', *Guardian*, 12 August, available at www.theguardian.com/education/2018/aug/12/john-hudson-obituary.

Schumacher, E. (1974) *Small is Beautiful*, Abacus/Sphere Books, London.

Schumpeter, J. (1954) *Capitalism, Socialism and Democracy*, Unwin University Books, London.

Swann, P. (2014) *Common Innovation: How We Create the Wealth of Nations*, Edward Elgar, Cheltenham.

Swann, P. (2019) *Economics as Anatomy: Radical Innovation in Empirical Economics*, Edward Elgar, Cheltenham.

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