

**Boris Begović**

University of Belgrade,  
School of Law,  
Serbia  
✉ begovic@ius.bg.ac.rs

# The Technology Trap: Capital, Labor, and Power in the Age of Automation

by **Carl Benedikt Frey**

Princeton University Press, 2019.

Before even beginning to read the preface, from the very title of the book, the reader infers that the book is about artificial intelligence (AI), robotics, machine vision, sensor technologies, and computers as learning machines. Hence, it is about future. Nonetheless, most of the book is actually about history of technological progress – either about its preconditions or about its consequences. As Frey points out: “The idea underpinning this book is straightforward: attitudes toward technological progress are shaped by how people’s incomes are affected by it” (p. x). The idea is certainly straightforward, but to what extent it is accurate – that is an empirical question. And answering that question, actually many specific questions within that framework, inevitably means going back to history. The problem is that the author specifies that: “the purpose of this book is to shed light on present times and challenges facing the workforce today” (p. 22). Obviously, Frey believes that history will provide, if not an insightful answers about the future, then proper ground for these answers, as “so far our age of automation largely mirrors the early days of industrialization in economic terms” (p. x). Nonetheless, the author is aware that the main challenge of the book “is probably to convince the reader that we can learn from the past” (p. 23), assuming that the reader could subscribe to Hegel’s caveat: “*The only thing we learn from history is that we learn nothing from history*”.

Whatever the outcome of the challenge may be, the question is whether this book is about economics or about economic history, as there are methodological differences and communication difficulties between the two disciplines. Effectively, it is about economic history, as the author provides rich insights about the history of technological progress, going back the dawn of humankind. Four out of the five parts of the book that are devoted to economic history. When Frey moves to economics in the last part of the book (only two chapters as opposed to three in almost all other parts), the insights are not as rich, the findings are not as convincing, and recommendations (for the future) are not as plausible.

The past is analysed within a consistent methodological framework. Two types of labour-saving technological progress are identified: (1) replacing technologies,

which render jobs and skills redundant; and (2) enabling technologies, which make people more productive at existing tasks or create entirely new jobs for them<sup>1</sup>. The first type is described in the book using the example of lamplighters that lost their jobs with the advent of electricity and electrical public lighting. The second type (increased productivity in existing task version) is described by increased productivity in steel industry in its heyday, which made steel cheaper, increased demand for it and increased output, generating new jobs even with the productivity increase. The other version of the second type of technological progress (creating new jobs) is described using the example of computer-aided design software, which made skilled professionals (architects, engineers, etc.) more productive, while creating new jobs in the IT industry, both in terms of production (of both hardware and software) and maintenance. Hence, the second type of technologies, sometimes labelled as augmenting, will help some workers more than others, but in due course all will end up with jobs with higher wages – a Pareto improvement.

The author has no second thoughts about the driving force of economic progress, referring to Paul R. Krugman's (1995) quip "depressions, runaway inflation, or civil war can make a country poor, but only productivity can make it rich". But economic progress can be stopped because of someone's private interest, being it pecuniary or not. Hence, it is a political economy that provides a technology trap in which labour-replacing technology is not introduced due to some private interest, however it is disguised as a public one. This approach starts with the period before Industrial Revolution (Part I of the book: *The Great Stagnation*) in which "resistance to worker-replacing technologies has been the norm rather than the exception" (pp. 30-31). With this approach, the author concludes that in this period the lack of technological creativity was not the key obstacle to economic growth.

Anecdotal evidence on the political economy constraints on the technological progress starts with the story of Suetonius who describes how Roman Emperor Vespasian refused the use of an invented device for transporting columns to Capitoline Hill, asking: "How will it be possible for me to feed the populace?" (p. 40). The list of the sovereigns who, for political reasons, specified as stability of their reign, have held up technological progress is long and it includes King Charles I and Queen Elizabeth I of England and, moving forward to the 19<sup>th</sup> century, also includes Francis I, the last Emperor of the Holy Roman Empire, and Russian Tsar Nicholas I. The other source of political economy barriers for technology were actions of guilds who feared that the jobs of their members would be replaced by new technology, for example, as described in the book, new technology being smashed by Cologne guild at the end of 15<sup>th</sup> century and Fulda boatmen's guild at the beginning of 18<sup>th</sup> century.

But even within that environment some technological progress occurred. Perhaps the best example, described in detail in the book, is Gutenberg's metal moving type printing press, invented in 1453. The introduction of the new technologies went

---

<sup>1</sup> This is exactly the division of labour replacing technologies used by Daron Acemoglu and Pascual Restrepo (2018) in their formal model of explanation of falling wages (labour income), as a share of the US national income and falling/stagnant equilibrium wages, in segments of the labour market in the US. Frey refers to this article specifies that the book "looks at the historical record through the lens of their (i.e. D. A. & P. R.) theoretical framework" (p. 15).

smoothly, and although that printing press replaced professional scribes, they did not provide any resistance because of the increased demand for their services, although some of them slightly modified. The demand for books was created and it has been ever-growing, so new jobs were created, benefitting many scribes. Although the invention of the moving type printing produced immediate effect of economic growth that were unmeasurably small, as pointed out by Gregory Clark (2008), it blaze the trail to the Renaissance, the European scientific revolution that was an indispensable building block for the Industrial Revolution<sup>2</sup>.

It was the Renaissance that produced the age of instruments, promptly used by rulers for navigation, and military technologies for fighting each other, as substantial consolidation of the European realms, and the emergence of modern states that occurred after the Thirty Years War (1618-1648) with the Peace of Westphalia. Stiff competition emerged between the realms and the external dangers became more profound than the fear of domestic rebellion. As Philippe T. Hoffman (2015) demonstrated, this competition made European military technology the leading in the world. Frey, on the other hand, points out that position of aligning against technological progress started to fade from the minds of European political elite. Still, according to the author, the political elite was not in favour of Schumpeterian, but rather Smithian growth with international division of labour, boosted by improved navigation.

The expansion of international trade created additional demand for various merchandise, especially for the economies of maritime nations such as Britain, leading to the production in rural industries, i.e. rural non-agricultural activities, basically artisan manufacturing of goods, which Franklin F. Mendel (1992) labelled as proto-industrialization. In short, this was industrialization without mechanization or factories, creating non-agricultural rural employment. The sustainability of proto-industrialization was dependant on the advent of the Industrial Revolution, so the author makes great effort to explain its timing and consequently its enabling factors. Wedged between the Industrial Revolution demand side explanation (Robert C. Allan 2009) and its supply side explanation (Joel Mokyr 2009), Frey comes back to the political economy explanation – that it was in the interest of the political elite, in the time of growth of both international trade and threats, to have a productive economy, whatever the domestic cost in instability may be. As the author specifies: “The external threat ... became greater than the threat from below” (p. 92).

So, it is the political economy explanation that dominates Part II of the book: The Great Divergence. The bottom line is that the British Government sided with entrepreneurs and the labour-replacing technologies that they introduced, rather than with the workers whose jobs were being replaced. The author provides numerous examples of riots and mutinies, including destruction of machines and brute intervention by the Government in such cases. The failure of the Luddites to stop the technological change is explained only by the decisive coercion imposed by the Government. The reader is not quite convinced that this is the central, let alone the only explanation of the success

---

<sup>2</sup> Political elite across Europe was rather indifferent regarding the Gutenberg’s invention. It was Sultan Bayezid II who banned printing in Arabic in the Ottoman Empire, obviously due to the concern for his reign. His decision produced dismal long-term consequences for literacy and economic growth of the Empire.

of the Industrial Revolution, but the author set the stage in such a way that focuses attention only on the Government coercion as the explanation. One of the elements of the stage is the claim that there was a decline in the wages, in real terms, of the labour that moved from rural to urban settlements and was employed in manufacturing industries in the early 19<sup>th</sup> century Britain. So, they had it better before the Industrial Revolution. But this goes against logic, not only of economists, as the people had no incentive to move to cities and to decrease their purchasing power. Frey is ready for this conundrum, explaining that they were pushed, not pulled: it was productive mechanized industry that made artisan, non-mechanized, home based production uncompetitive, and those artisans had no alternative other than to go to the cities and find employment whatever terms were offered. Well, the explanation is not convincing. The author himself points out that most of the employees in early factories were children, not artisans. The author provides no data on which share of labour employed in the factories came from agriculture and without this information, his push-rather-than-pull hypothesis cannot be verified. Furthermore, it is reasonable to assume that children now employed in the factories were previously employed in agriculture. This pastoral child labour conditions may be more grateful, but it is still child labour.

The other feature of the early decades of the Industrial Revolution is much better elaborated in the book. It is the discrepancy between the increase in productivity and more or less stagnant real wages – Allan's (2009) "The Engels pause". Frey explains that it was the labour-replacing technology, introduced during this period, that was to blame, as he points out that: "artisan workers in the domestic system were replaced by machines, often tended by children" (p. 131). In short, demand for labour decreased and equilibrium wages went down, irrespective of the increase in productivity, producing the increase in share of capital in the national income. In Fredrich Engels words: "industrialists grow rich on the misery of the mass of wage earners". The reader could find a more subtle explanation in the book when the author starts to explain the increase in wages from 1840 onward. The early mechanising technology introduced in the advent of the Industrial Revolution, mechanising weaving and spinning in the textile industry, was a specific purpose technology and virtually no human capital is needed for its operation. General purpose technology, steam power, came later, enabling more sophisticated machines to operate, including railways and steamships, that needed skilled operators. As Frey points out: "the complementarity between factory equipment and the human capital necessary to operate it grew stronger as machines became more complex" (p. 135). Demand for labour force, especially for skilled labour increased – human capital had started to be appreciated and because it was in limited supply, wages started to increase. Hence during the rest of the 19<sup>th</sup> century, the increase in real wages followed the increase in productivity in Britain. The capital and labour shares in the national income started to converge. Frey has no second thought: it did not happen because of the political activities of the working class, though unionisation contributed to some extent – it was because of the change in the labour market conditions due to the different type of technological progress.

That is basically the title of Part III of the book (The Great Levelling), as the convergence continued with the Second Industrial Revolution, which was based on the introduction of electricity and internal combustion engines. The analysis in the book

moves to America, since that was the country that took over the leading position on the technological frontier from Britain. What follows is a US economic history through to the 1980s, which has already been analysed in detail by Robert J. Gordon (2016). What is new in this book is the emphasis that the labour-saving technological progress during that period was based on enabling (augmenting) technologies that created more jobs than they replace, with demand for more human capital and with higher equilibrium wages. As productivity rose, so did the wages in real terms, transforming American blue-collar workers into the middle class. Hence Engels' proletariat became the middle class. It is no surprise, emphasises the author, that the "machinery question" was not on the top of the economic or political agenda. It was obvious that "some workers struggled to adjust" and that in the aftermath of the Great Depression some of the National Recovery Administration regulations (36 out of 280) "included restrictions on the installation of new machines" (p. 179), but in general that was a good time for the introduction of labour-replacing technology. Frey gives anecdotal evidence: a story about the introduction of automatic elevators in the US, where elevator operators were not able to muster any resistance to the technological change, even though their jobs were replaced. Summing up the fears that floated at the media at the time about elevators without operators, one could compare it to the contemporary fears regarding self-driving vehicles.

Part IV of the book (The Great Reversal) gives an account of the developments on the technological and economic front since 1980s, predominantly in America. This is not surprisingly, considering that this is a country on the technological frontier and other countries will follow its path in due course. The main development in this period is the advent of the computer in business operations. The point is that for some jobs, predominantly repetitive, routine jobs, computers are a job-replacing technology and for some they are enabling, as some human skills are complemented by computers. The point is that more human capital is needed for enabling technology to create jobs and repetitive jobs are lost anyway. So, these are blue-collar, manufacturing, middle class jobs suitable for people with only high school, i.e. secondary education that are lost. The divide is now between highly skilled professionals whose productivity and wages increase, and low skilled workers who are relegated to low quality, low wages jobs in the service industry, as demand for manufacturing, blue-collar labour has diminished.

Frey considers the rise of wages of highly skilled professional within a framework of Tinbergen's concept of the race between technology and education. The new technology increases demand for skilled labour, for more human capital, and the education response increases supply. To the extent that education/supply of human capital is insufficient, the equilibrium wages of the highly skilled labour increases. In theory, if the supply of human capital is wage elastic enough, the wages of highly skilled labour will stagnate. This is implicit reasoning behind the "more education" concept of dealing with technological changes that the author subscribes to. The problem with this approach (which, by the way, can only resolve the rising inequality issue) is that there are limits to the human capital elasticity of the supply. People have different levels of IQ, cognitive capacity, discipline needed for schooling, gift for value producing activities – the number of talented people is limited, which is precisely the reason

why they are exceptional. College, i.e. university education is not for everyone, even if all the expenses are paid. In the era of political correctness, it is undesirable to point out some truths. People are born equal in terms of their rights, but they are different in everything else. Treating them as equal produces analytical mistakes.

Frey points out that Tinbergen's concept is appropriate only for enabling labour-saving technologies, those that create new jobs. In the case of labour-replacing technologies, jobs are just lost and demand for labour decreases, so even if unemployment is temporary, the equilibrium wages for those jobs decrease. Basically, that is the finding of Acemoglu and David Autor (2011), explaining the steady decline of real wages of US workers without college education since the 1980s – for three consecutive decades.

Hence the American labour market is now divided into two segments. One is for highly creative, the new class of “symbolic analysts”, according to Robert Reich (1991), whose productivity is enhanced by computer technology, and the other are repetitive jobs in personal services. Most of the manufacturing repetitive jobs, those who once created the biggest segment of the US employment vanished, due to computer technology but also due to globalisation and reallocation of manufacturing industry to developing countries. Hence, part of the blue-collar jobs is replaced by new technologies and part emigrated from the US and other developed nations. As to the technology, Frey compares the introduction of computers into business operations to the: “technological change during the Industrial Revolution (that) pushed people out of middle-income jobs in the domestic industry, to the detriment of many craftsmen, while creating low-income production jobs in the factories and high-paying skilled jobs for white-collar workers to manage and administer production” (p. 245). Hence, according to Frey, history repeats itself. The reader wonders, within that framework, whether the advent of AI and robotization will produce scorched labour markets for anyone but those with a college education.

Nonetheless, it was quite expected that, in putting the Industrial Revolution, at least how he understands it, and the Computer Revolution on the equal footing, Frey would end up with the unavoidable conclusion that the time has come for The New Luddites, remarking that: “If the Luddites had been successful, the mechanized factory would have failed to replace domestic industry, and it is quite likely that the Industrial Revolution would not have begun in Britain” (p. 289). Irrespective to what extent this counterfactual is convincing, especially taking into account the 1 or 0 framework, Frey plays down the Ludditian threat, reducing it to the possibility that: “It is perfectly possible for automation to become a political target. The twentieth century was an extraordinary period in human history in that it saw very little resistance to machines” (p. 291).

So, the stage is set for the long-expected part of the book: The Future (Part V). The main finding basically replicates the results of Carl Benedikt Frey and Michael A. Osborne (2017) that: “47 percent of American jobs are susceptible to automation, meaning that they are potentially automatable from a technological point of view. What most of these jobs have in common is that they are low-income jobs that do not require high levels of education” (p. 320). Although Frey downplays the political threats, pointing out that automatization will not be fast (the historical experience of

the introduction of tractors to American farms is used as evidence), he sticks to his main thesis. “As we have seen, historically when machines threaten to take people’s jobs and governments fear instability as a consequence, implementation can often be blocked for entirely political reasons” (p. 331).

Well knowing now that the implementation of new technologies can be blocked – rather a trivial finding – the reader wonders whether it will be blocked. On political grounds, the resistance to new technology is exceedingly difficult to arrange. As the author himself points out, the losers to the new technology are low skill workers. It is unlikely that they would be able to organize themselves into an effective interest group: they are dispersed and that aggravates the free rider problem; they cannot muster sufficient resources needed for interest group activities; and they are opposing the American political and business elites, who have every reason to support the introduction of the new technologies as they are bound to benefit from them. Hence, there is no room on the interest group politics stage for their technological progress discontent.

Nonetheless, their discontent can be channelled into the elections process, but this is no longer a single-issue policy arena, and their interest is diluted. Furthermore, they, among others, have elected Donald Trump once (and could possibly twice), a tweeting President, though this was mainly due to their discontent with globalization (a vindication for Joseph Stiglitz), but the executive government made no effort to block the technological progress due to the fear of instability. Actually, it is President Trump who repeatedly creates political instability rather than having any fear of it. Instability is the swamp that he likes.

Finally, the question is whether their discontent over the introduction of new technology can transform into a proper Ludditian movement, with widespread riots and violence; smashing machines is optional. America is not a stranger to riots and widespread street violence, but these riots have been against the Vietnam War, racism, police brutality – hardly against new technologies. The probability of effective political action in foreseeable future is rather low, it seems.

Another important question that the author does not address and leaves entirely to the reader is what will be the outcome – what will be the equilibrium wages of the labour force whose jobs will be replaced by incoming IT technologies, AI and robots, such as driverless vehicles. Several issues should be addressed. The first one is the supply of new jobs to which workers being replaced by the AI and robots can be reallocated. This depends on the future human needs and demand for new products and predominantly new services. The increased productivity due to the new technology creates additional income, and that income creates demand for entirely new services. In the time of increased commodification of services, emphasised by Branko Milanovic (2019), new markets for various personal services can be created. One should not dismiss all of them as being low-wage, low quality jobs. Nobody knows what kind of personal services markets will surface in the future. As pointed out by Richard Baldwin (2016), AI technology is not endowed with emotional intelligence and human touch, which is essential for many personal services. With a growing population and care about the elderly, empathy is indispensable for the success of these activities. Empathy and compassion are missing from machines, even those in science fiction novels, such as HAL 9000 computer in Arthur C. Clarks’ “A Space Odyssey” (2001).

Humans, even those with very modest skills, still have a comparative advantage in many areas of services. The author did not even attempt to consider them. Perhaps then he would have thought twice before drawing the parallel between the Industrial Revolution and the coming AI revolution.

The reallocation of the replaced low skilled labour to new jobs also depends on their ability to readjust, to increase their human capital, to sustain some training for the new jobs. This does not mean that those people will need to receive a college education, as in many cases very modest requirements would suffice. Precisely emotional intelligence should be cultivated and enhanced by the training, because this kind of intelligence is not available for robots, at least in the foreseeable future. It is very unlikely that lorry drivers who will be replaced will become CEOs of some of the new high-tech firms, but they can still readjust their lives in a meaningful way and be useful to society, so the wages that they receive will be decent.

It is a pity that Frey does not compare the capacity for the adjustment and acquisition of additional and entirely new human capital for those who lost their jobs during the Industrial Revolution and the modern world that the US represent today. The general level of human capital is today much higher, starting with the spread of literacy. Human capital is general purpose capital, provided by general education, and that means that it can be improved rather easily, building on the existing foundation. Methods of communication and learning are today much more developed, and they are quite effective. Social infrastructure is also developed with substantial public expenditure and generous government budgets compared to the budgets at the time of the Industrial Revolution. So, after all, the incentive for people who lost their jobs to labour-replacing technology to enter the political arena in one way or another and to stop technological progress is rather slim.

The author refers to the joke by Wassily Leontief: “If horses could have joined the Democratic party and voted, what happened on farms might have been different”<sup>3</sup> (Charlotte Curtis 1983). It is Acemoglu and Restrepo (2018) that provided a response: “the difference between human labor and horses is that humans have a comparative advantage in new and more complex tasks. Horses did not. If this comparative advantage is significant and the creation of new tasks continues, employment and the labor share can remain stable in the long run even in the face of rapid automation”. Such a clear and focused thinking is missing from the book.

It is not surprising that policies that are recommended for the future, which are spelled out at the end of the book, are not well elaborated and are not convincing. Some of them are reasonable, like decreasing regulation that provides barriers to entry in professions by imposing occupational licences, but they are hardly specific to technology-induced unemployment. However silly these regulations may be (such as occupational licensing hair shampooers in Tennessee), they are the product of specific political economy constellations and sweeping reform in this area should not be expected. Some of the recommendations are reasonable, but too general, such as education – “governments are advised to invest more heavily in early childhood education”

---

<sup>3</sup> Actually, to use this framework, some horses would not have joined any political party, Democrat or Republican, since their equine capital was substantial and they got jobs in equestrianism, a rising leisure industry due to the increased productivity.



(p. 351) – or retraining. Some of them are rather far from the point, such as relocation of labour through “mobility vouchers” that would overcome high costs of migration from one city to another, while some are rather bizarre, such as the Hyperloop train that would make commuting less time-consuming.

Frey did a great job as an economic historian. He reviews the Industrial Revolution from a specific point of view, and it is a pleasure to read these sections as he finds a niche for observations between economic history giants such as Allan (2009) and Mokyr (2009) who considered, without agreeing with each other, the origins of the Industrial Revolution. Whether Frey’s conclusions are convincing, whether the reader agrees with him, is another issue, but the job was well done. The same accolades go to the economic history of the Second Industrial Revolution, basically the history of economic change in America in the 20<sup>th</sup> century. Frey’s insights are a valuable addition to Gordon (2016) seminal contribution.

His accomplishments in this book as an economist are a few notches lower. He does not formulate all the relevant questions, he does not provide a consistent methodological framework for answering them, and he does not see the big picture, being obsessed with the history of the Luddites and other anti-machinery movements. Actually, it is the very tree of politically induced technological trap that prevents him to see the woods of the prospects of technological progress. This is pity because this book is or at least should be predominantly about economics and about the future. Not only that the bulk of the pages are dedicated to economic history, but these pages are superior to the rest, which focus on the future.

At the very begging of the book Frey points out that he feels that the main challenge of his contribution “is probably to convince the reader that we can learn from the past”. It is uncertain that the reader is convinced that we can actually learn from the past, but is rather convinced that the way that the author tried to achieve this in the specific case of the technological trap is not a promising one. The quest for the answers about the next technology trap continues, hopefully based on the knowledge of the shortcomings of Frey’s approach.

## References

- Acemoglu, Daron, and David Autor.** 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labour Economics*, ed. David Card and Orley Ashenfelter, 1043-1171. Amsterdam: Elsevier.
- Acemoglu, Daron, and Pascual Restrepo.** 2018. "The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment." *American Economic Review*, 108(6): 1488-1542. <http://dx.doi.org/10.1257/aer.20160696>
- Allan, Robert C.** 2009. *The British Industrial Revolution on Global Perspective*. Cambridge, M. A.: Cambridge University Press.
- Baldwin, Richard.** 2016. *The Great Convergence: Information Technology and the New Globalization*. Cambridge, M. A.: The Belknap Press of Harvard University Press.
- Clark, Gregory.** 2008. *A Farewell to Alms: A Brief Economic History of the World*. Princeton: Princeton University Press.
- Curtis, Charlotte.** 1983. "Machines vs. Workers." *The New York Times*, February 08. <https://www.nytimes.com/1983/02/08/arts/machines-vs-workers.html>.
- Frey, Carl Benedikt, and Michael A. Osborne.** 2017. "The Future of Employment: How Susceptible Are Jobs to Computerisation?" *Technological Forecasting and Social Change*, 114(1): 254-280. <http://dx.doi.org/10.1016/j.techfore.2016.08.019>
- Gordon, Robert J.** 2016. *The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War*. Princeton: Princeton University Press.
- Hoffman, Philippe T.** 2015. *Why Did Europe Conquer the World?* Princeton: Princeton University Press.
- Krugman, Paul R.** 1995. *Peddling Prosperity: Economic Sense and Nonsense in the Age of Diminished Expectations*. New York: W. W. Norton & Company.
- Mendel, Franklin F.** 1992. "Proto-Industrialization: The First Phase of the Industrialization Process." *Journal of Economic History*, 32(1): 241-261. <http://dx.doi.org/10.1017/S0022050700075495>
- Milanovic, Branko.** 2019. *Capitalism, Alone: The Future of the System That Rules the World*. Cambridge, M. A.: The Belknap Press of Harvard University Press.
- Mokyr, Joel.** 2009. *The Enlightened Economy: Britain and the Industrial Revolution 1700-1860*. London: Penguin Books.
- Reich, Robert.** 1991. *The Work of Nations: Preparing Ourselves for Twenty-First Century Capitalism*. New York: Alfred A. Knopf, Inc.