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Should We Be Reassured If Automation in the Future Looks Like Automation in the Past?

Jason Furman

Much of the debate about the economic impact of artificial intelligence (AI) centers on the question of whether this time will be different. Some optimists argue that AI is no different than technologies that came before it and that centuries of fears that machines will replace human labor have proven unfounded, with machines instead creating previously unimagined jobs and raising incomes. Others argue that AI is different—by replacing cognitive tasks, it could render much of human employment redundant, leading to mass unemployment in the eyes of the pessimists or historically unparalleled freedom for leisure in the eyes of the optimists.

The history of automation—and how the US economy has handled it over the last several decades—suggests that even if AI is similar to previous waves of automation, that should not be entirely comforting since technological advances in recent decades have brought tremendous benefits but have also contributed to increasing inequality and falling labor force participation. This outcome, however, is not inevitable because the effects of technological change on the workforce are mediated by a wide set of institutions, and as such, policy choices will have a major impact on actual outcomes. Artificial intelligence does not call for a completely new paradigm for economic policy—for example, as advocated by proponents of replacing the existing social safety net with a universal basic income (UBI)—but instead reinforces many of the steps that could already be justified by the goal of making sure that growth is shared more broadly.

To date, in fact, the problem we have faced is not *too much* automation

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but *too little* automation—the issue I will address before considering some of the potentially harmful side effects that a faster pace of innovation can have for inequality and labor force participation. In the course of this discussion I will address the extent to which policy can advance AI while ensuring that more people share in the benefits of it, two goals that are ultimately complementary.

12.1 The Benefit of More Artificial Intelligence

Technologists see transformative change all around us but economists are a more sour bunch, focusing on productivity statistics that show that we are adding very little to output per hour. Measured productivity growth has slowed in thirty-five of thirty-six advanced economies, slowing from a 2.7 percent average annual growth rate from 1996 to 2006 to a 1.0 percent average annual growth rate from 2006 to 2016—with the slowdown in the G7 economies shown in figure 12.1.

There are many reasons to believe that the official statistics fail to capture the full range of productivity improvements, so the 1.0 percent estimate likely understates productivity growth from 2006 to 2016. But so, too, does the 2.7 percent figure understate productivity growth from 1996 to 2006, a period that witnessed the de facto invention of the World Wide Web and its associated uses for search, ecommerce, email, and much more—not to mention the widespread adoption of cellphones and invention of mobile

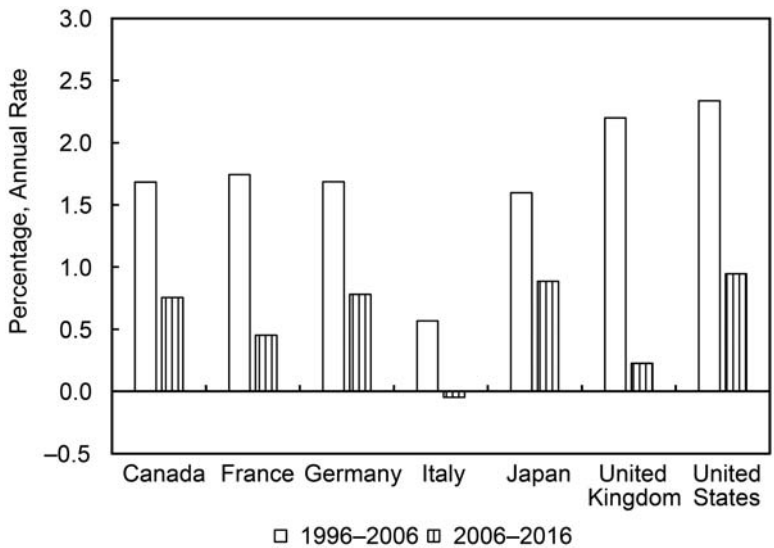

Fig. 12.1 Labor productivity growth, G-7 countries
Source: The Conference Board, Total Economy Database; author's calculations.

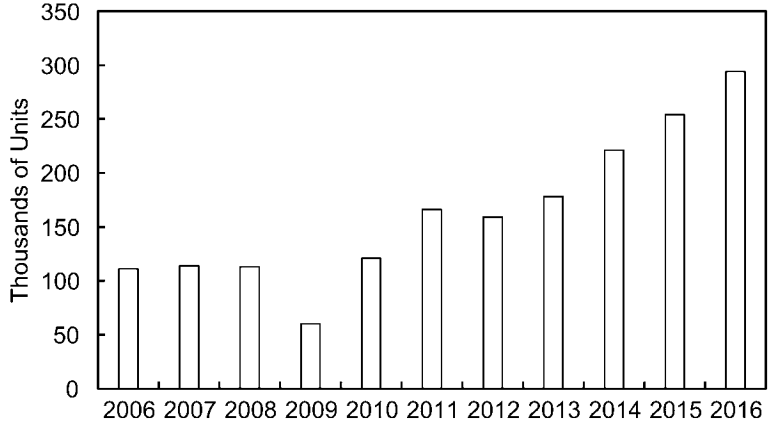

Fig. 12.2 Estimated worldwide annual supply of industrial robots, 2006–2016
Source: International Federation of Robotics, World Robotics (2016, 2017).

email. Recent research has confirmed that there is little reason to doubt the magnitude of the reduction in productivity growth, including pointing out that the slowdown has also occurred in well-measured industries (Byrne, Fernald, and Reinsdorf 2016; Syverson 2016).

This may seem counterintuitive given all the excitement around new innovations—including in robotics, AI, and automation more generally—but as exciting as these innovations may be, they still represent only a tiny fraction of our lives when compared to other sectors of the economy like housing, retail, education, and health—and, at least to date, the improvements they are making in these sectors are not dramatically different than the improvements we saw in previous eras of the economy.

That said, the technology sector of our economy is making important contributions to productivity growth. A 2015 study of robots in seventeen countries found that they added an estimated 0.4 percentage point on average to those countries' annual gross domestic product (GDP) growth between 1993 and 2007, accounting for a bit more than one-tenth of those countries' overall GDP growth during that time (Graetz and Michaels 2015). Moreover, since 2010, worldwide shipments of industrial robots have increased dramatically, as shown in figure 12.2, potentially signaling even more productivity growth in the future.

Relatedly, there has been dramatic progress in recent years in AI and its application in a diverse set of areas. For example, companies are using AI to analyze online customer transactions in order to detect and stop fraud, and, similarly, social networking sites are using it to detect when an account may have been hijacked. Thanks to AI, web search applications are now more accurate—for example, by correcting for manual entry error—thereby reducing costs associated with search. In radiology, where doctors must be

able to examine radiological images for irregularities, AI's superior image processing techniques may soon be able to provide more accurate image analysis, expanding the potential for earlier detection of harmful abnormalities and reducing false positives, ultimately leading to better care. Artificial intelligence is also making inroads in the public sector as well. For example, predictive analytics has great potential to improve criminal justice procedures, although it must be used responsibly to avoid bias.

However, while AI research has been underway for decades, recent advances are still very new, and, as a result, AI has not had a large macroeconomic impact, at least not yet. The most recent major progress in AI has been in deep learning, a powerful method but one that must be applied in a customized way for each application. Even though we have not made as much progress recently on other areas of AI, such as logical reasoning, the advancements in deep-learning techniques may ultimately act as at least a partial substitute for these other areas.

While AI has an advantage over humans in many respects, humans still maintain a substantial advantage over AI for tasks that involve social intelligence, creativity, and general intelligence. For example, AI today can do decent translations but cannot come close to what a human can do with his or her knowledge of both languages, social and cultural context, and sense of the author's argument, emotional states, and intentions. As it stands, even the most popular machine translator still fails to reach the accuracy of a human translator.

It is possible that major new inventions like electricity have manifested themselves in the past in successive waves of added productivity growth, a pattern that could repeat itself in the future (Syverson 2013).

12.2 Past Innovations Have Sometimes Increased Inequality—and the Indications Suggest AI Could Be More of the Same

Advanced economies have seen vast amounts of innovation in the last three centuries. Most of the kinds of jobs that existed in the 1700s do not exist today, but jobs no one could have imagined then have taken their place. As a result, over long periods of time it has generally been the case that about 95 percent of the people in the United States who want a job at a given point in time can find one—despite massive changes in technology.

Although labor markets do not function like the stylized models for a commodity like wheat that populate economics textbooks, within broad parameters the basic operation of supply and demand is the mechanism that makes sure that just about everyone who wants a job can find one. For this to happen, however, wages need to adjust to make supply equal to demand. In recent decades, much of that adjustment in wages has been in the form of a large decline in wages for low-skill workers relative to high-skill workers.

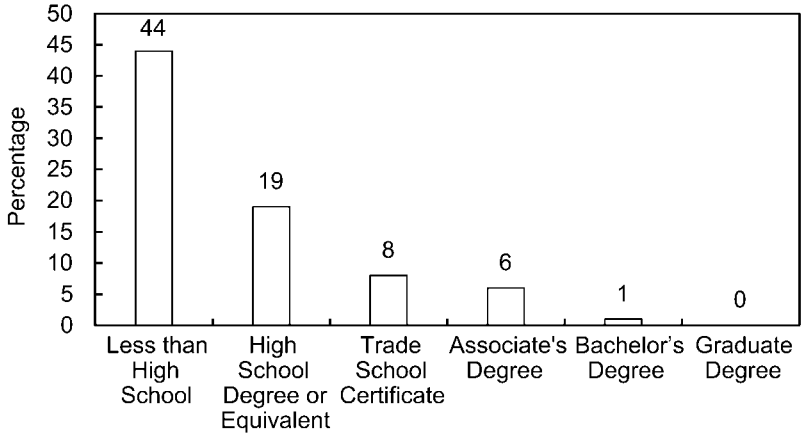

Fig. 12.3 Share of jobs with highly automatable skills by education
Source: Arntz, Gregory, and Zierahn (2016) calculations based on the Survey of Adult Skills (PIAAC 2012).

From 1975 until 2016, those with a high school degree watched their relative wages fall from over 70 percent of the amount earned by full-time, full-year workers with at least a college degree to just over 50 percent.

The worry is not that this time could be different when it comes to AI, but that this time could be the same as what we have experienced over the past several decades. The traditional argument that we do not need to worry about the robots taking our jobs still leaves us with the worry that the only reason we will still have our jobs is because we are willing to do them for lower wages.

The share of jobs that are threatened by future automation is fiercely debated, with estimates ranging from 9 percent by the Organisation for Economic Co-operation and Development ([OECD]; Arntz, Gregory, and Zierahn 2016, to 50 percent by Carl Frey and Michael Osborne 2013). While this question is important, there is less ambiguity on the wages/skills gradient of the jobs or tasks that are most likely to be substituted for by automation. The OECD researchers, for example, found that 44 percent of jobs with less than a high school degree had highly automatable skills, as compared to only 1 percent of jobs with a college degree, as shown in figure 12.3.

This is very similar to the gradient found in Frey and Osborne's work. The Council of Economic Advisers (Executive Office of the President 2016) sorted the Frey and Osborne occupations at risk of automation by wages and found that it ranged from 83 percent of occupations making less than $20 an hour to only 4 percent of occupations making more than $40 per hour, as shown in figure 12.4.

Since wages and skills are correlated, this means a large decline in the

demand for lower-skill jobs and little decline in the demand for higher-skill jobs. This result points to a shift in the impact of automation on the labor market. At points in the past, automation led to a so-called polarization of the labor market because jobs requiring a moderate skill level—which historically included bookkeepers, clerks, and certain assembly-line workers—were easier to routinize, although more recently that process of polarization appears to have stopped (Autor 2014; Schmitt, Schierholz, and Mishel 2013). Conversely, higher-skill jobs that use problem-solving capabilities, intuition, and creativity, as well as lower-skill jobs that require situational adaptability and in-person interactions, were less easy to routinize. If anything, the new trends could put more pressure on earnings inequality. We are already seeing some of this play out—for example, when we go shopping and take our groceries to a kiosk instead of a cashier, or when we call a customer service help line and interact with an automated customer service representative.

It would be wrong, however, to believe that inequality is purely a function of technology. Relative wages do depend in part on the demand for labor, which is partially a function of technology. However, they also depend on the supply of different levels of skill—in other words, the distribution of educational attainment (Goldin and Katz 2008)—and also on institutional arrangements that affect wage setting, such as collective bargaining (Western and Rosenfeld 2011).

Technology, in other words, is *not* destiny. Many countries have experienced similar technological change as the United States, yet over the last four decades the United States has seen both a greater increase in income

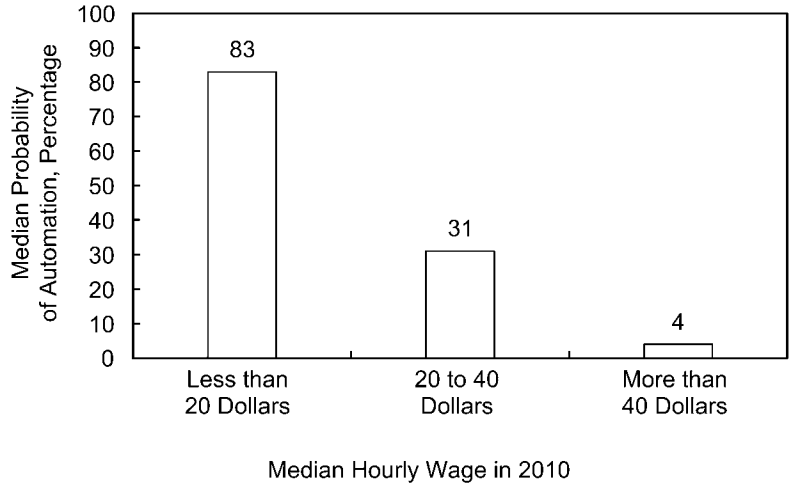

Fig. 12.4 Probability of automation by an occupation's median hourly wage
Source: Executive Office of the President (2016).

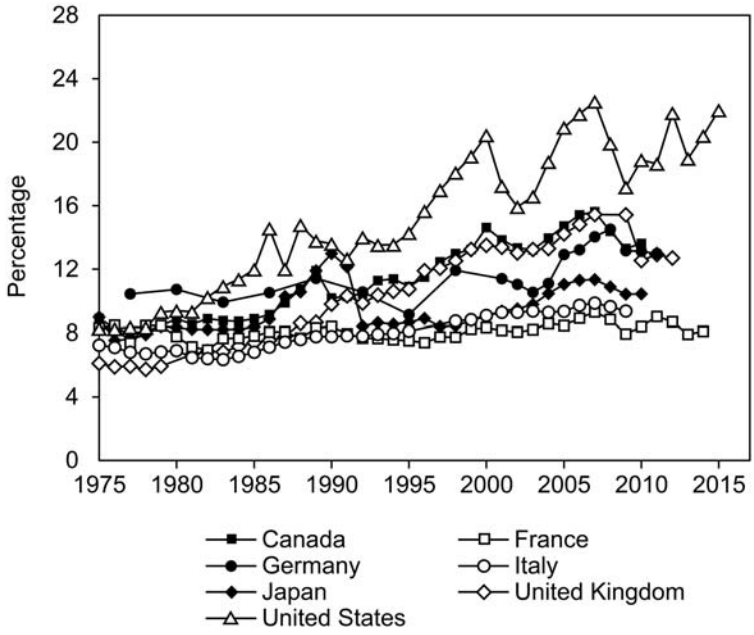

Fig. 12.5 Share of income earned by top 1 percent, 1975–2015
Source: World Wealth and Income Database.

inequality and higher overall levels of inequality than other major advanced economies, as shown in figure 12.5. When it comes to inequality—and, as I will note in a moment, to the labor market more broadly—institutions and policies can help determine whether and to what extent changes in technology shape economic outcomes.

12.3 The Long-Term Decline in the Labor Force Participation Rate Raises Other Concerns about the Potential Impact of AI

Moreover, the experience of the US labor market over the last half century raises questions around even this (relatively) optimistic view that we can avoid large-scale job losses at the expense of greater inequality. The fact that the labor force participation rate for men between the ages of twenty-five and fifty-four has declined steadily from a high of 98 percent in the 1950s to 89 percent in 2016 raises important doubts about the complacency about full employment as a general state of the economy. As discussed in detail in a report by the Council of Economic Advisers (2016), the decline in the labor force participation rate has been concentrated among men with a high school degree or less and has coincided with a decline in their relative wages. This decline suggests that decreasing labor force participation among this

group is a manifestation of reduced labor demand, resulting in both fewer employment opportunities and lower wages for less-skilled men. Technological advances, including the increasing use of automation, may partly account for this decline in demand for less-skilled labor, with globalization likely contributing as well.

(I focus on prime-age men because I believe their experience over the past six decades to be the best historical parallel for future effects of technological change on participation in the workforce for both men and women. In the second half of the twentieth century, prime-age women's participation rose sharply, as social and cultural changes in the decades following World War II swamped any negative effects on participation due to technological change. It is important to note, however, that prime-age women's participation has fallen in the last decade and a half—primarily for women with a high school degree or less—paralleling the earlier experience of prime-age men.)

The concern is not that robots will take human jobs and render humans unemployable. The traditional economic arguments against that are borne out by centuries of experience. Instead, the concern is that the process of turnover, in which workers displaced by technology find new employment as technology gives rise to new consumer demands and thus new jobs, could lead to sustained periods of time with a large fraction of people not working. The traditional economic view is largely a statement about long-run equilibrium, not about what happens in the short-to-medium term. The fall in the labor force participation rate suggests that we must also think carefully about short-run dynamics as the economy moves toward this long-run equilibrium. In the short run, not all workers will have the training or ability to find the new jobs created by AI. Moreover, this "short run" (which is a description of where the economy is in relation to equilibrium, not a description of a definite length of time) could last for decades and, in fact, the economy could be in a series of "short runs" for even longer.

As a result, AI has the potential—just like other innovations we have seen in past decades—to contribute to further erosion in both the labor force participation rate and the employment rate. This does not mean that we will necessarily see a dramatically large share of jobs replaced by robots, but even continuing on the past trend of a nearly 0.2 percentage-point annual decline in the labor force participation rate for prime-age men would pose substantial problems for millions of people and for the economy as a whole.

As in the case of inequality, however, we should not interpret this as technological determinism. While most other advanced economies have seen declines in prime-age male labor force participation, the decline in the United States has been steeper than in almost every other advanced economy, as shown in figure 12.6. Part of the reason may be that US labor market institutions are less supportive of participation in the workforce than other countries' (CEA 2016).

There is no reason the economy cannot generate substantial levels of

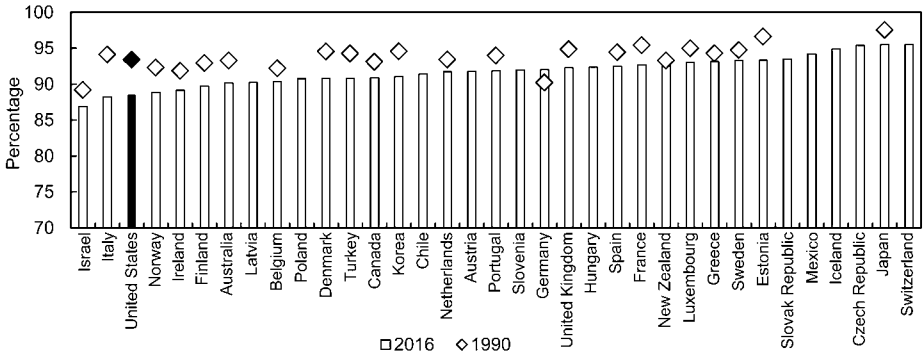

Fig. 12.6 Prime-age male labor force participation rates across the OECD
Source: Organisation for Economic Co-operation and Development.

employment at much higher levels of technology and productivity than we have today. What matters, however, is how our labor market institutions cope with these changes, help support the creation of new jobs, and successfully match workers to them. Some of the potential policies along these lines include expanding aggregate demand, increasing connective tissue in labor markets, reforming taxes to encourage work, and creating more flexibility for workers. Other possible policy responses include expanding education and training so more people have skills that complement and benefit from innovations, increasing the progressivity of the tax system to make sure that everyone shares in the overall benefits of the economy, and expanding institutional support for higher wages, including a higher minimum wage and stronger collective bargaining and other forms of worker voice.

12.4 The Costs of Replacing the Current Safety Net with a Universal Basic Income

Fears of mass job displacement as a result of automation and AI, among other motivations, have led some to propose deep changes to the structure of government assistance. One of the more common proposals has been to replace some or all of the current social safety net with a universal basic income (UBI): providing a regular, unconditional cash grant to every man, woman, and child in the United States, instead of, say, Temporary Assistance to Needy Families (TANF), the Supplemental Nutrition Assistance Program (SNAP), or Medicaid.

While the exact contours of various UBI proposals differ, the idea has been put forward from the right by Charles Murray (2006), the left by Andy Stern and Lee Kravitz (2016), and has been a staple of some technologists' policy vision for the future (Rhodes, Krisiloff, and Altman 2016). The different proposals have different motivations, including real and perceived

deficiencies in the current social safety net, the belief in a simpler and more efficient system, and also the premise that we need to change our policies to deal with the changes that will be unleashed by AI and automation more broadly.

The issue is not that automation will render the vast majority of the population unemployable. Instead, it is that workers will either lack the skills or the ability to successfully match with the good, high-paying jobs created by automation. While a market economy will do much of the work to match workers with new job opportunities, it does not always do so successfully, as we have seen in the past half century. Fostering skills, training, job-search assistance, and other labor market institutions is a more direct approach to addressing the employment issues raised by AI than UBI.

Even with these changes, however, new technologies can increase inequality and potentially even poverty through changes in the distribution of wages. Nevertheless, replacing our current antipoverty programs with UBI would in any realistic design make the distribution of income worse, not better. Our tax and transfer system is largely targeted toward those in the lower half of the income distribution, which means that it works to reduce both poverty and income inequality. Replacing part or all of that system with a universal cash grant, which would go to all Americans *regardless of income*, would mean that relatively less of the system was targeted toward those at the bottom—increasing, not decreasing, income inequality. Unless one was willing to take in a much larger share of the economy in tax revenues than at present, it would be difficult both to provide a common amount to all individuals and to make sure that amount was sufficient to cover the needs of the poorest households. And for any additional investments in the safety net that one would want to make, one must confront the same targeting question.

Finally, some of the motivation for UBI has nothing to do with future technological developments. Instead, some UBI proponents have put forward the argument that it would be simpler, fairer, and less distortionary than the social assistance system we have today. This is not the space to go into great detail on this, but suffice it to say that today's system is imperfect. But at the same time, a wave of recent research has found that many of the common criticisms of these programs—for example, that they discourage work, or that they do little to reduce poverty—have been greatly overstated, and a number of programs—including nutritional assistance, Medicaid, and the Earned Income Tax Credit (EITC)—have important benefits for the long-run earnings, health, and educational attainment of children who grow up in recipient households.

This is not to say that we should not make the tax-and-transfer system more progressive—just that we need to match our ambitions to the revenue available and understand what is already successful in our social safety net.

12.5 Conclusion

Artificial intelligence is a critical area of innovation in the US economy right now. At least to date, AI has not had a large impact on the aggregate performance of the macroeconomy or the labor market. But it will likely become more important in the years to come—bringing substantial opportunities—and our first impulse should be to embrace it fully.

We need more productivity growth, including through more AI. Most of the innovation will be driven by the private sector, but government policies also have an impact through basic research and establishing a regulatory environment around privacy, cybersecurity, and competition.

At the same time, with or without AI we would have a lot to do if we want to address high levels of inequality and the falling labor force participation rate. To the degree that we are optimistic about AI, that should increase our motivation to undertake these changes. But there is little basis for believing that AI should dramatically change the overall direction or goals of our current policies.

Exogenous technological developments do not uniquely determine the future of growth, inequality, or employment. Public policy—including public policies to help workers displaced by technology find new and better jobs and a safety net that is responsive to need and ensures opportunity—will affect whether we are able to fully reap the benefits of AI while also minimizing its potentially disruptive effects on the economy and society. And in the process, such policies could also affect productivity growth—including advances in AI itself.

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