

## DISRUPTIVE TECHNOLOGY, WORK, AND INNOVATION

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### I. TAKING AUTOMATION ANXIETY SERIOUSLY

Despite the fact that the United States has had its lowest rate of unemployment in fifty years<sup>1</sup> and an extended period of modest economic growth in the Gross Domestic Product (GDP),<sup>2</sup> there is a palpable sense of unease among many in the labor force and many commentators on the economy that there is trouble ahead.<sup>3</sup> That unease centers on what has come to be called “automation anxiety”—the fear that technological change is providing innovations that substitute for an increasing number of jobs previously performed almost exclusively by humans and, importantly, not creating new industries and new jobs for those displaced by the new technology. Indeed, there are credible estimates that more than half of today’s jobs are susceptible to replacement by machines and processes powered by artificial intelligence (AI) in the near future.<sup>4</sup> The issue is of such significance

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<sup>1</sup> See U.S. BUREAU OF LABOR STATISTICS, HOUSEHOLD DATA ANNUAL AVERAGE 1 (2019). The unemployment rate in December 2019 was 3.5 percent for those looking for a job. *See id.*

<sup>2</sup> The annual rate of economic growth for the last three quarters of 2019 was around two percent, a relatively modest growth rate. *Gross Domestic Product, Fourth Quarter and Year 2019*, BUREAU ECON. ANALYSIS (Jan. 30, 2020, 8:30 AM), <https://www.bea.gov/news/2020/gross-domestic-product-fourth-quarter-and-year-2019-advance-estimate> [<https://perma.cc/W2RR-BFE5>]. In the first quarter of 2019, the annualized growth rate was 3.1 percent, a much more impressive figure. *See id.*

<sup>3</sup> A notable exception is the Nobel-Prize winner, Paul Krugman. *See* Paul Krugman, *Democrats, Avoid the Robot Rabbit Hole*, N.Y. TIMES (Oct. 17, 2019), <https://www.nytimes.com/2019/10/17/opinion/democrats-automation.html> [<https://perma.cc/SUD4-U3F6>].

<sup>4</sup> CARL BENEDIKT FREY & MICHAEL A. OSBORNE, *THE FUTURE OF EMPLOYMENT: HOW*

that one contender for the Democratic nomination for president, Andrew Yang, has made preparing for a “world without work” one of his signature issues.<sup>5</sup> Another, New York Mayor Bill de Blasio, promised to “create a permitting process for any company seeking to increase automation that would displace workers.”<sup>6</sup>

I do not want to take issue with these anxieties, nor with the estimates of the future of technological change.<sup>7</sup> Although I will raise some cautionary notes about the process by which jobs are displaced, I shall, by and large, accept the prediction that AI and other technological changes are going to reduce the quantity and quality of jobs at which humans can make a comfortable living.

My focus will be on what we ought to do about this. First, I want to suggest that these concerns have been with us almost constantly for more than 200 years, since modern economic growth began in Western Europe in the mid-eighteenth and early nineteenth centuries.<sup>8</sup> In fact, we shall see that job-destroying innovation concerned a Roman emperor almost 2,000 years ago<sup>9</sup> and Queen Elizabeth I in the late fifteenth century.<sup>10</sup> I shall suggest that we might learn something from these historical episodes. For instance, we might be tempted to learn that every prior episode of concern about job-destroying technological change was misconceived. To put the matter colloquially, “it all worked out.” The Luddites who lost their jobs to power looms in the early nineteenth century found other employment.<sup>11</sup> The horse-cab drivers, stable

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SUSCEPTIBLE ARE JOBS TO COMPUTERISATION? 44 (2013), [https://www.oxfordmartin.ox.ac.uk/downloads/academic/The\\_Future\\_of\\_Employment.pdf](https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf) [<https://perma.cc/6UMK-D2P5>]

(“According to our estimates around 47 percent of total U.S. employment is in the high-risk category—i.e., jobs we expect could be automated relatively soon, perhaps over the next decade or two.”).

<sup>5</sup> See generally ANDREW YANG, *THE WAR ON NORMAL PEOPLE: THE TRUTH ABOUT AMERICA’S DISAPPEARING JOBS AND WHY UNIVERSAL BASIC INCOME IS OUR FUTURE* (2018).

<sup>6</sup> Bill de Blasio, *Why American Workers Need to be Protected from Automation*, WIRED (Sept. 5, 2019, 3:16 PM), <https://www.wired.com/story/why-american-workers-need-to-be-protected-from-automation/> [<https://perma.cc/8D5D-5PAX>].

<sup>7</sup> See generally ERIK BRYNJOLFSSON & ANDREW MCAFEE, *THE SECOND MACHINE AGE: WORK, PROGRESS, AND PROSPERITY IN A TIME OF BRILLIANT TECHNOLOGIES* (2014); CARL BENEDIKT FREY, *THE TECHNOLOGY TRAP: CAPITAL, LABOR, AND POWER IN THE AGE OF AUTOMATION* (2019) [hereinafter FREY, *THE TECHNOLOGY TRAP*]; DAVID SUSSKIND, *A WORLD WITHOUT WORK: TECHNOLOGY, AUTOMATION, AND HOW WE SHOULD RESPOND* (2020). For a more nuanced view of what has recently happened and is likely to happen to skills and the tasks that make up various jobs and a more hopeful view about jobs in the future, see David H. Autor, *Why Are There Still So Many Jobs?: The History and Future of Workplace Automations*, J. ECON. PERSP., Summer 2015, at 3; David H. Autor, *Work of the Past, Work of the Future*, 109 AEA PAPERS & PROCEEDINGS 1 (2019).

<sup>8</sup> See *infra* Section II.D.

<sup>9</sup> See *infra* text accompanying note 44.

<sup>10</sup> See *infra* text accompanying note 46.

<sup>11</sup> To be more accurate, I *think* that many did. Even the great English historian E.P. Thompson in

owners, and makers of horse-drawn wagons all found alternative employment when the internal combustion engine appeared.<sup>12</sup> Farm laborers, who planted, tended, and reaped crops and tended the draft animals who pulled farm machinery before the diffusion of tractors, transitioned to other jobs when the tractor and other mechanized farm equipment appeared.<sup>13</sup>

Another point worth making is that it is not always the case that disruptive technology destroys jobs. In some important ways, this technological change might actually *increase* the number of jobs. Consider the case of the introduction of automated teller machines (ATMs) in the United States. Between the 1980s and 2010, “the number of ATMs more than quadrupled[.] . . . [By 2010,] there were more than four-hundred thousand of them[.] . . .”<sup>14</sup> If one thinks, as seems reasonable, that ATMs substitute for human tellers, then one might have predicted that the large number of the machines would have significantly reduced the number of human tellers. In fact, the opposite happened. ATMs and human tellers turned out to be complements, not substitutes. ATMs were superior in the task of handing out money from customer accounts, but this freed up human tellers to perform other bank tasks, such as providing financial advice.<sup>15</sup> As a result, the “number of tellers also rose during [the 1980–2010] period, by as much as 20 percent.”<sup>16</sup> Interestingly, the average number of tellers at any given bank branch office fell from twenty in 1988 to thirteen in 2004, but “the number of branches rose during that time—in urban areas by as much as 43 percent—to meet the growing demand for banking services. This meant more work for bank tellers overall, and that is

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*The Making of the English Working Class*—in which he wrote eloquently about workers between the early 1790s and the early 1830s—was not certain, beyond anecdote, what happened to displaced weavers in that period. See generally E.P. THOMPSON, *THE MAKING OF THE ENGLISH WORKING CLASS* (1963).

<sup>12</sup> Alan L. Olmstead & Paul W. Rhode, *Reshaping the Landscape: The Impact and Diffusion of the Tractor in American Agriculture, 1910–1960*, 61 J. ECON. HIST. 663 (2001). This is a remarkably informative study of the impact of one significant technological change. Olmstead and Rhode cite a U.S. Department of Agriculture estimate that, comparing the man-hours in field operations and in caring for draft animals between the 1917–1921 period and 1944, shows the tractor saved “1.7 billion man-hours per year[, which] represented about 8 percent of the total agricultural labor requirements in 1944, and translates into about 850 thousand workers.” *Id.* at 665. In summary, they say, “[b]y 1960 the tractor had reduced labor requirements by an estimated 1.7 million workers relative to the horse technology that it replaced.” *Id.* at 692.

<sup>13</sup> The great economist, “Wassily Leontief[,] once joked that ‘If horses could have joined the Democratic Party and voted, what happened on farms might have been different.’” Carl Benedikt Frey, *The High Cost of Impeding Automation*, WALL ST. J. (Oct. 25, 2019, 7:04 PM), <https://www.wsj.com/articles/the-high-cost-of-impeding-automation-11571958240> [<https://perma.cc/BM4M-JUQT>] [hereinafter Frey, *The High Cost of Impeding Automation*]. I am very grateful to my colleague Amitai Aviram for bringing this article to my attention.

<sup>14</sup> SUSSKIND, *supra* note 7, at 27.

<sup>15</sup> *Id.*

<sup>16</sup> *Id.*

why the number of tellers rose rather than fell.”<sup>17</sup>

These examples might encourage one to hope that our modern concern with the disruptive effects of autonomous vehicles (AVs), fully automated retail stores like Amazon Go, automated hiring programs,<sup>18</sup> and the like are misplaced. We have been through these disruptions before, and we have not only survived but prospered. There is, of course, at least a sprig of truth in this account, but we should be cautious about adopting this optimistic view as a rebuttal to automation anxiety.

There are always lessons to be learned from past events, but, in the case of automation anxiety, we would be wise to take this worry seriously. The first and most important reason for doing so is that “this time [might be] different.”<sup>19</sup> The nature of the disruption that AI is making is fundamentally different from what has happened before. The labor market’s past technological disruptions tended to replace human muscle power with animal or natural power, such as water or steam.<sup>20</sup> Somewhat later, innovations tended to replace animal or natural power with other forms of power, such as electricity, internal combustion, and nuclear power.<sup>21</sup> The thrust of the more recent technological disruptions seems to be striking at the human ability to reason and to exercise control and judgment. Consider algorithm-based stock trading schemes,<sup>22</sup> AVs,<sup>23</sup> and AI-inspired decisions on granting bail.<sup>24</sup> The moment is not distant when AI-informed avatars will replace classroom instructors, write law review articles, or grade exams.

Very significantly, these AI-powered innovations do a better job at these

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<sup>17</sup> *Id.* at 28.

<sup>18</sup> See Ifeoma Ajunwa, *Beware of Automated Hiring*, N.Y. TIMES (Oct. 9, 2019), <https://www.nytimes.com/2019/10/08/opinion/ai-hiring-discrimination.html> [<https://perma.cc/4W8A-X7YZ>].

<sup>19</sup> CARMEN M. REINHART & KENNETH S. ROGOFF, *THIS TIME IS DIFFERENT: EIGHT CENTURIES OF FINANCIAL FOLLY* (2009).

<sup>20</sup> See generally JOCHEM VAN DER ZANDE ET AL., *THE SUBSTITUTION OF LABOR: FROM TECHNOLOGICAL FEASIBILITY TO OTHER FACTORS INFLUENCING JOB AUTOMATION* (2018), <https://www.hhs.se/contentassets/2a91f64953ca43b4a7f4352273d94c58/substitution-of-labor-final-4.pdf> [<https://perma.cc/R97Z-QMAA>].

<sup>21</sup> See generally *id.*

<sup>22</sup> Nitesh Khandelwal, *3 Myths About Algorithmic Trading*, BW BUSINESSWORLD (Oct. 13, 2018), <http://www.businessworld.in/article/3-Myths-about-Algorithmic-Trading/13-10-2018-162113/> [<https://perma.cc/RU9P-HPM4>].

<sup>23</sup> See generally HOD LIPSON & MELBA KURMAN, *DRIVERLESS: INTELLIGENT CARS AND THE ROAD AHEAD* (2017); LAWRENCE D. BURNS & CHRISTOPHER SHULGAN, *AUTONOMY: THE QUEST TO BUILD THE DRIVERLESS CAR AND HOW IT WILL RESHAPE OUR WORLD* (2018). These are good introductions to the topic, although—to illustrate how fast this area is moving—they should be supplemented with more recent material.

<sup>24</sup> Jon Kleinberg et al., *Human Decisions and Machine Predictions*, 133 Q.J. ECON. 237, 239 (2018). The truly frightening (or heartening) conclusion that Kleinberg et al. reach is that computer algorithms make *better* bail decisions than do experienced judges. *Id.* at 241. Similar things are happening in, for example, computer-aided diagnoses of disease. *Id.* at 245 n.13.

ratiocinative and judgment-based tasks than humans do. Recall that in 1997 IBM's Deep Blue computer beat Garry Kasparov, the reigning world chess champion, in two six-game matches.<sup>25</sup> And more recently, in 2016 the program AlphaGo, developed on Google's DeepMind computer, defeated Lee Sedol, the eighteen-time world Go champion in four games of a five-game match.<sup>26</sup>

But there is more. "On December 7, 2017, . . . Google's AlphaZero program defeated the Stockfish 8 program[, which] was the world's computer chess champion for 2016."<sup>27</sup> Stockfish 8 could "calculate seventy million chess positions per second."<sup>28</sup> AlphaZero could perform "only eighty thousand such calculations per second[.] . . ."<sup>29</sup> Moreover, its programmers had not taught the program any chess strategies. That is, AlphaZero came to the contest knowing nothing about chess. But the programmers gave AlphaZero machine-learning techniques so that it could teach itself chess by playing matches against itself. As Professor Harari writes, "Can you guess how long it took AlphaZero to learn chess from scratch, prepare for the match against Stockfish, and develop its genius instincts? Four hours."<sup>30</sup> And with only that practice, AlphaZero played Stockfish 8 in 100 games. "AlphaZero won twenty-eight and tied seventy-two," not losing a single game.<sup>31</sup>

This remarkable story captures dramatically why automation anxiety is real. Perhaps, it even suggests that we are not as worried as we should be.

In the earlier technological disruptions, there were other things that humans could do if the technology replaced them in their old jobs. For instance, if they were in a primary sector, such as agriculture or mining, they could transfer to manufacturing or services. And when the technology replaced them in manufacturing, they could retreat to services.

But when AI-inspired technological change comes to the services sector and reasons and exercises judgment better than we do, where will workers go?

There is a larger history to this point that is worth contemplating. The history of the United States illustrates a remarkable record of relatively smooth economic transitions—at least up to this point. The U.S. labor force around 1800 was around seventy-five percent engaged in primary extraction—

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<sup>25</sup> Mark Robert Anderson, *Twenty Years on from Deep Blue vs Kasparov: How a Chess Match Started the Big Data Revolution*, CONVERSATION (May 11, 2017, 10:12 AM), <http://theconversation.com/twenty-years-on-from-deep-blue-vs-kasparov-how-a-chess-match-started-the-big-data-revolution-76882> [<https://perma.cc/CM96-C3V4>].

<sup>26</sup> *Artificial Intelligence: Go Master Lee Se-dol Wins Against AlphaGo Program*, BBC NEWS: TECH. (Mar. 13, 2016), <https://www.bbc.com/news/technology-35797102> [<https://perma.cc/WL34-JRB7>].

<sup>27</sup> YUVAL NOAH HARARI, 21 LESSONS FOR THE 21ST CENTURY 32 (2018).

<sup>28</sup> *Id.*

<sup>29</sup> *Id.*

<sup>30</sup> *Id.*

<sup>31</sup> *Id.*

agriculture, fishing, lumbering, and mining.<sup>32</sup> By 1890 (the conventional date for the closing of the frontier), employment was just about evenly divided between extractive industries and manufacturing.<sup>33</sup> Clearly, this represented a dramatic increase in the amount of employment in manufacturing and a dramatic decrease in the extractive sectors. And, by the early twenty-first-century, services accounted for eighty percent of the economic activity in the United States.<sup>34</sup> Manufacturing employment is now well below ten percent of the labor force and expected to fall to about seven percent by 2028—and agricultural work accounts for just two percent of total U.S. employment.<sup>35</sup>

This transformation, from a largely agricultural economy to a largely service economy, happened over two centuries mostly through private calculation of profit and loss and not through government regulation and prodding. There were, of course, individual, regional, and even national problems,<sup>36</sup> but, by and large, this remarkable transition happened relatively peacefully, without much social disruption.<sup>37</sup>

The point is, however, that the current transition—from a service-oriented economy to one in which much production and service provision is automated—might not follow the previous historic path of a smooth transition. There may well be unsettling consequences of this transition, both individually and societally. And it might happen much quicker than past transitions. I doubt very seriously that in 2005—or even 2010—anyone foresaw how quickly the reality of AVs would be upon us. The AI disruption that has recently begun may or may not be like the other labor market transitions that we have experienced before. We simply do not know. But, as the story above about

<sup>32</sup> See Stanley Lebergott, *Labor Force and Employment, 1800–1960*, in *OUTPUT, EMPLOYMENT, AND PRODUCTIVITY IN THE UNITED STATES AFTER 1800* 119, 121 (1966).

<sup>33</sup> *Id.* Farm employment was 42.7 percent of the labor force; nonfarm employment was 57.3 percent. All primary employment (farm, fishing, mining) was almost forty-five percent of the workforce. Manufacturing employment was increasing but in 1890 was only 18.8 percent of the labor force. Construction and trade together accounted for 19.2 percent of the workforce.

<sup>34</sup> H. Pletcher, *Distribution of the Workforce Across Economic Sectors of the United States from 2009 to 2019*, STATISTA (Feb. 11, 2020), <https://www.statista.com/statistics/270072/distribution-of-the-workforce-across-economic-sectors-in-the-united-states/> [<https://perma.cc/LH7F-WUEN>].

<sup>35</sup> *Employment Projections: Employment by Major Industry Sector*, U.S. BUREAU LAB. STAT. (Sept. 4, 2019), <https://www.bls.gov/emp/tables/employment-by-major-industry-sector.htm> [<https://perma.cc/XF98-VC7W>].

<sup>36</sup> I do not mean to slight the trauma of the Civil War as part of this overall story. Some scholars see that horrific war (in which more Americans died than in all other U.S. wars combined) as having been about slavery, states' rights, and manufacturing v. agriculture.

<sup>37</sup> For example, the first U.S. industrial workers in the early nineteenth century were young women from New England farms. See *Lowell mill girls*, WIKIPEDIA, [https://en.wikipedia.org/wiki/Lowell\\_mill\\_girls](https://en.wikipedia.org/wiki/Lowell_mill_girls) [<https://perma.cc/E24V-9AZH>]. Several of the significant concerns that had to be addressed in moving those women to towns and factories were where they would live and who would stand *in loco parentis*. *Id.* Only when factory owners addressed those matters did manufacturing take off. *Id.*

AlphaZero tries to tell us, we would be prudent to think that it is *not* going to be like past disruptions. Not only is it happening quickly, but it also threatens to take over *all* our productive talents, including writing music, fiction, poetry, dance, and more. And the disruptions may not have the happy result that people simply transition to alternative employment—the displacements might last longer than in past instances; indeed, the displacements might become permanent in that there simply might not be enough jobs to go around. We might even move to “*A World Without Work*,” as Daniel Susskind suggests.<sup>38</sup>

So, we need to think through what to do. We cannot really know what we are facing until it has developed more, but that is not an argument for delaying until the problem has become much larger, more imminent, and, perhaps, more intractable. Rather, we have tools and policies that we can bring to bear on the issues that automation anxiety raises. That is, we can start to deal with this issue now and put ourselves in a position to do more and to do better if the full dimensions of the automation problems turn out to be worse than we feared.<sup>39</sup> Of course, if we discover that we have exaggerated those problems, we can pause and wait for the next challenge.

One course of action that I strenuously argue against is to address automation anxiety by trying to stop innovation that disrupts labor markets. That is the wrong criterion to use. Ideally, we would like to set off any innovation’s social benefits against its social costs, including its effects on labor. If we could do that, then we could take some portion of the social benefits and transfer them to those who are injured by the innovation. Society would then have a net benefit from the innovation, and those injured would have been compensated. Performing these calculations will be challenging but not impossible. In fact, we often do precisely this calculation—most notably in our policy of Trade Adjustment Assistance (TAA).<sup>40</sup>

I want to stress a point to which I may not have paid sufficient attention—the point that technological innovation is vital to the modern economy and to our society. Even the innovations that displace workers and displace them permanently are likely to have tremendous social benefits. Technological progress is the leading contributor to economic growth in modern societies and has been for 100 years.<sup>41</sup> The social benefits that have flowed from technology

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<sup>38</sup> SUSSKIND, *supra* note 7.

<sup>39</sup> I am very mindful of how much these choices between doing something now and waiting until we know more sound like our currently pathetic national attitudes toward climate change. I try strongly to resist the belief that in both instances—automation and climate change—we need disasters to get our full attention to do something.

<sup>40</sup> See *infra* Section III.F. (giving further consideration of these details).

<sup>41</sup> For general theories of growth, see CHARLES I. JONES & DIETRICH VOLLRATH, INTRODUCTION TO ECONOMIC GROWTH (3d ed. 2013); for the United States specifically, see BHU SRINIVASAN, AMERICANA: A 400-YEAR HISTORY OF AMERICAN CAPITALISM (2017); ROBERT GORDON, THE RISE AND FALL OF AMERICAN GROWTH: THE U.S. STANDARD OF LIVING SINCE THE CIVIL WAR (2016). Some serious economists are discussing the possibility of a steady-state economy with

are remarkable. Consider what has been accomplished medically and the remarkable benefits that have flowed therefrom.<sup>42</sup> In 1900, the average life span at birth for both sexes and all races was slightly more than forty-seven years.<sup>43</sup> Today, it is nearly eighty.<sup>44</sup> And it is generally expected that the average female born today will live to be 100 years old.<sup>45</sup> There are many more medical advances to come, and almost all of them will make human life richer, happier, and more rewarding.

Also, consider the social benefits of an AI-mediated innovation to which I have already referred, AVs. The National Highway Transportation Safety Administration estimates that ninety-four percent of all highway accidents are due to human error.<sup>46</sup> The National Safety Council reports that for each of the past three years highway accidents have killed about 40,000 people.<sup>47</sup> Those who study AVs estimate that as many as 36,000 of these deaths (and many other losses from automobile accidents) can be avoided if all vehicles on the

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little or no growth but a comfortable standard of living. *See, e.g.*, John Cassidy, *Steady State: Can We Have Prosperity Without Economic Growth?*, NEW YORKER, Feb. 10, 2020, at 24–27.

<sup>42</sup> I can testify to this fact. In 2012, as a result of an episode of ventricular tachycardia (VT) following a long bike ride, I discovered that I had an inherited heart condition that killed my maternal grandfather at the age of fifty-four. In brief, the electrical system of my heart is on permanent vacation. But, because of a remarkable machine (smaller than a pack of cards and with a seven-year battery life) in my chest that paces my heart and shocks me if VT recurs, I am alive and well. And, even more importantly, my children and grandchildren are on alert to look for this genetic mutation. Incidentally, in 2015, geneticists could only explain thirty-three percent of the incidence of my heart condition as a result of genetic testing. Now they can explain sixty-six percent, and, in five more years, they expect to be able to explain 100 percent of this cardiomyopathy's incidence. My cardiologist urges me not to worry about my children and grandchildren because by the time this genetic condition might manifest in them, medicine will have found a way to reverse or eliminate the condition.

<sup>43</sup> *See* ROBERT D. GROVE & ALICE M. HETZEL, U.S. DEP'T OF HEALTH, ED., & WELFARE, VITAL STATISTICS RATES IN THE UNITED STATES, 1940–1960 122 (1968).

<sup>44</sup> *See World Development Indicators: Mortality*, WORLD BANK, <http://wdi.worldbank.org/table/2.18> [<https://perma.cc/H84B-U9KR>]. Please note, however, that life expectancy in the U.S. has fallen for the three years from 2016–2019, largely due to “deaths of despair.” *See infra* text accompanying note 173.

<sup>45</sup> *See, e.g.*, STEVEN PINKER, ENLIGHTENMENT NOW: THE CASE FOR REASON, SCIENCE, HUMANISM, AND PROGRESS (2018); GREGG EASTERBROOK, IT'S BETTER THAN IT LOOKS: REASONS FOR OPTIMISM IN AN AGE OF FEAR (2018); ANNA ROSLING RONNLUND ET AL., FACTFULNESS: TEN REASONS WE'RE WRONG ABOUT THE WORLD—AND WHY THINGS ARE BETTER THAN YOU THINK (2018); Hans Rosling, *The Best Stats You've Ever Seen*, TED (Feb. 2006), [https://www.ted.com/talks/hans\\_rosling\\_the\\_best\\_stats\\_you\\_ve\\_ever\\_seen?language=en](https://www.ted.com/talks/hans_rosling_the_best_stats_you_ve_ever_seen?language=en) [<https://perma.cc/C8KE-RKJH>].

<sup>46</sup> U.S. DEPARTMENT OF TRANSPORTATION, TRAFFIC SAFETY FACTS: CRASH STATS 1 (2015), <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812115> [<https://perma.cc/HG4B-YTMD>].

<sup>47</sup> *Motor Vehicle Deaths Estimated to Have Dropped 2% in 2019*, NAT'L SAFETY COUNCIL, <https://www.nsc.org/road-safety/safety-topics/fatality-estimates> [<https://perma.cc/3RCF-LJSA>].

road are autonomous.<sup>48</sup>

But I do not want to suggest that the social problems of dealing with workers displaced by technological change are trivial. They are not, as I shall indicate in Section III. Difficult they may be, but they are tractable.

I think the novel view that I bring to the discussion is to recognize we can “have our cake and eat it, too.” That is, we can preserve the incentive to innovate (and thereby enjoy the many social benefits of technological change) while caring for the needs of those who are harmed by innovation. To do so, we must drive down a “narrow [policy] corridor”<sup>49</sup> without going over the lines that demark the edges of the corridor. The thinking behind this observation is that both helping the victims of technological disruption and preserving the incentive to innovate are desirable goals. They are, however, potentially at odds. Going too far to help those at risk of losing their jobs might dampen the incentive to invent and to adopt net-benefit-generating innovations.

To put the matter bluntly, technological change typically confers greater (private) benefits than (private) costs. That is why it is attractive to private profit-maximizing parties to adopt the change. If there are social benefits or social costs to which private decisionmakers might not pay attention, then there is a case to be made for public intervention into the decision to adopt (or not) any particular technological change. There is more to the calculus than that, and I shall elaborate on it in Section III.

I think that a further important consideration in deciding what to do about disruptive technological change is to do as little harm as possible. In particular, I am struck by how ill-equipped we are to predict the consequences of disruptive technological change. Consider that the appearance of AVs is going to have some obvious consequences, such as making long automobile trips far more comfortable than they are today. An AV can drive through the night while the passengers sleep. Or the passengers can watch TV or movies, read books, play cards, nap, or snuggle, instead of paying close attention to the road

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<sup>48</sup> MICHELE BERTONCELLO & DOMINIK WEE, TEN WAYS AUTONOMOUS DRIVING COULD REDEFINE THE AUTOMOTIVE WORLD 4–5 (2015) (“By midcentury, the penetration of AVs and other ADAS [Advanced Driver-Assistance Systems] could ultimately cause vehicle crashes in the United States to fall from second to ninth place in terms of their lethality ranking among accident types. Today, car crashes have an enormous impact on the US economy. For every person killed in a motor-vehicle accident, 8 are hospitalized, and 100 are treated and released from emergency rooms. The overall annual cost of roadway crashes to the US economy was \$212 billion in 2012. Taking that year as an example, advanced ADAS and AVs reducing accidents by up to 90 percent would have potentially saved about \$190 billion.”).

<sup>49</sup> See generally DARON ACEMOGLU & JAMES A. ROBINSON, THE NARROW CORRIDOR: STATES, SOCIETIES, AND THE FATE OF LIBERTY (2019). One of the most significant contentions in this important work is that tradeoffs between policies that are individually desirable but jointly destructive is a common problem of economic policymaking, including that of fostering societal growth and well-being. *Id.*

and those around them or worrying about taking the correct off-ramp to their destination. Those consequences are fairly clear. But what about the fact that the layout of our cities may change dramatically? We will not necessarily need car-parking structures near our places of work or shopping. AVs may pick us up at home, transport us to our workplace, and then go to the edge of town to wait to be summoned. Will this free up space in urban areas for greenspaces, more offices, or who knows what?

Another way to think about the far-reaching and difficult-to-foresee consequences of disruptive technological change is to realize the new jobs that such change frequently creates. Consider that gaming software has given rise not merely to many hours of fun but to a thriving industry of competitive gaming, frequently called “esports.”<sup>50</sup> Investors are assembling teams of “pro-gamers,” who make very large sums of money from their participation in tournaments attended by thousands of spectators, in person and online, almost all of whom have paid to attend.<sup>51</sup>

To foreshadow my conclusion, the narrow policy corridor down which I suggest that we attempt to steer between helping those displaced by technological change and maintaining the incentive to innovate is to provide transitional aid for those displaced. That aid can be temporary or, in the extreme, a universal basic income. This aid will help those displaced survive their displacement without disrupting the innovative process. And, happily, we already have a model of how to deal with a similar problem—TAA, the program for helping those whose jobs have been displaced by foreign competition.<sup>52</sup> In Section III.F., I shall explain that program, how it would work with respect to jobs lost to technological disruption, and what the anticipatable problems will be with the program.

The rest of the paper will contain, in Section II, a brief history of automation anxiety and, in Section III, a consideration of programs to deal with disruptive-technology job losses. A concluding section summarizes and points to further research that might help to throw light on this issue.

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<sup>50</sup> Mariel Soto Reyes, *Esports Ecosystem Report 2020: The Key Industry Players and Trends Growing the Esports Market Which Is on Track to Surpass \$1.5B by 2023*, BUS. INSIDER (Dec. 18, 2019, 10:14 AM), <https://www.businessinsider.com/esports-ecosystem-market-report> [<https://perma.cc/8HSZ-KLVD>].

<sup>51</sup> See John Divine, *7 Top Esports Stocks to Buy Now*, U.S. NEWS & WORLD REP. (July 10, 2019, 1:16 PM), <https://money.usnews.com/investing/slideshows/how-to-invest-in-esports-7-winning-stocks> [<https://perma.cc/LT9H-KUUI>]. I recently asked a dear friend of mine who is the president of a local bank if he would entertain an application for a commercial loan of hundreds of thousands of dollars to organize a group of pro-gamers to train, travel to, and participate in international tournaments in on-line computer games. He replied, “absolutely not, not even with an extensive business plan.”

<sup>52</sup> See *supra* text accompanying note 39.

## II. A BRIEF HISTORY OF AUTOMATION ANXIETY

As I mentioned above, concerns regarding the loss of jobs because of technological change have been around for a long time and particularly since the onset of the Industrial Revolution. This anxiety in the face of technological change has been experienced by thousands of workers and their families, noticed by authors, moviemakers, rulers, and commentators, and acted upon, sometimes violently, by those whose livelihoods were threatened by technological change. These actions to slow or reverse job-disruptive technological change were almost invariably ineffectual. Change occurred; society and the displaced workers moved on. I have sought to distinguish our current anxieties and technology and jobs from the historical record. Here, I want to give a brief account of the historical record of these controversies.

### A. *Ancient Concerns*

The fascination with and concern about the relationship between men and machines dates, at least from the eighth-century BCE. Homer's *Iliad*, which is dated from that time, "describes a driverless vehicle, the tripod of Hephaestus, that navigates on its own. Homer refers to the vehicle as 'automatic.'"<sup>53</sup>

About four centuries later, "Aristotle, around 350 BCE, raised the possibility of machines replacing humans: 'For if every instrument could accomplish its own work, obeying or anticipating the will of others . . . ; if, in like manner, the shuttle would weave and plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.'"<sup>54</sup>

In the first century BCE, the Roman Emperor Vespasian (ruled 69–79 BCE) "refused to adopt machinery for transporting columns to the Capitoline Hill due to employment concerns."<sup>55</sup>

There may have been many other such episodes of blocking or fretting about technology over the next thirteen centuries, but we have not learned of them. And in part that may be because these centuries included the Dark Ages, during which technological change and improvements in the quality of human life were meager.

Then from the fourteenth century until the beginning of the Industrial Revolution in the mid-eighteenth century there were a few episodes in which technical improvements were not well received. We know, for example, that Gutenberg's printing press

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<sup>53</sup> ROBERT J. SHILLER, *NARRATIVE ECONOMICS: HOW STORIES GO VIRAL AND DRIVE MAJOR ECONOMIC EVENTS* 174–75 (2019).

<sup>54</sup> *Id.*

<sup>55</sup> Frey, *The High Cost of Impeding Automation*, *supra* note 13.

drew protests—from Italian professional [scriveners] in Genoa in 1472, German card makers in Augsburg in 1473, and French stationers in Lyons in 1477. . . . The gig mill, which is estimated to have allowed one man and two boys to do the work of 18 men and six boys, was prohibited in Britain. In 1589, England's Queen Elizabeth I refused to grant William Lee a patent for the landmark labor-replacing invention of the time, the stocking frame knitting machine, saying, 'Thou aimest high, Master Lee. Consider thou what the invention could do to my poor subjects. It would assuredly bring them to ruin by depriving them of employment, thus making them beggars.' The machine was opposed by the hosiers' guild. . . . In 1632, King Charles I of England banned the casting of [metal] buckets, suggesting it might ruin the livelihoods of the craftsmen who were still making buckets the traditional way. . . . In 1768, the first steam-powered sawmill in Limehouse, for which its founder Charles Dingley had been awarded the gold medal of the British Society of Arts, was burned to the ground by some 500 sawyers who claimed that it had deprived them of employment. Parliament passed an act in 1769 that made the destruction of machines a felony punishable by death.<sup>56</sup>

Consider the life of Anton Möller, a resident of Danzig, who invented the ribbon loom, which allowed the weaving of two or more webs on one loom.<sup>57</sup> The City Council of Danzig might have awarded him a patent.<sup>58</sup> However, the Council ordered him to be strangled for threatening the well-being of the town's weavers.<sup>59</sup>

James Hargreaves invented the spinning jenny, by which a worker could spin cotton thread on several spindles at once, greatly increasing the speed of creating thread. He patented the invention in 1770.<sup>60</sup> His neighbors broke into his house, destroyed his machine and, apparently to drive their message home, his domestic furniture.<sup>61</sup> Hargreaves and his business partner sought safety by attempting to set up a factory for producing the jennies in a different place, but they were attacked by a mob there.<sup>62</sup>

Another English inventor—John Kay—invented the flying shuttle in the

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<sup>56</sup> *Id.* These examples could be multiplied. Indeed, Frey's article has eight more examples, the most recent of which was in 2018 and involved culinary workers in Las Vegas walking off their jobs until casino operators agreed to set goals for technology and automation that protected workers' jobs, provided for alternate job training, advance notice of implementation, and severance packages.

<sup>57</sup> SUSSKIND, *supra* note 7, at 22.

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> *Id.* at 21.

<sup>61</sup> *Id.*

<sup>62</sup> *Id.*

1730s, which allowed for wider fabrics to be produced on automatic looms.<sup>63</sup> He, too, was attacked in his home by those whose livelihood was threatened by the innovation.<sup>64</sup> It is said that Kay would have been killed “had he not been conveyed to a place of safety by two friends in a wool-sheet.”<sup>65</sup>

By the end of the period covered here, technological change had picked up, and, as a result, protests against labor-saving machines increased and grew even more violent.

### **B. *The Industrial Revolution to the Present***

Concerns about the relationship between technology and human employment have been almost constant since the onset of the Industrial Revolution in the mid-eighteenth century.

There were the famous Luddites of 1811, led by the fictional Ned Ludd (or Ludham); the Swing Riots of the 1830s, which, led by the fictional Captain Swing, led to the destruction of mechanical threshers, which were said to have taken the jobs of many farm laborers; the severe depression of 1873–1879, which was widely blamed on the technological unemployment that was occurring in both the United States and Europe; and the focus in the 1876 Centennial Exhibition of Philadelphia on labor-saving inventions, which those who sponsored the exhibit thought would excite pride but turned out to foment anger.<sup>66</sup> Professor Shiller notes that in the wake of the criticism of the 1876 Centennial Exhibition an alternative narrative was gaining some currency: “that technological change *increases* the total number of jobs.”<sup>67</sup>

But the prevailing view, which continues today, was that technology was destroying jobs. And other bad events were also laid at the feet of labor-saving innovation. For example, Professor Shiller says that “the popular explanation of the Great Depression was *underconsumption*. That was tied to the belief that many workers had been displaced by machines and that the displaced workers were hoarding the money they had rather than spending it.”<sup>68</sup>

Let me give one final example of resistance to a job-destroying innovation that encapsulates all the problems with acting on automation anxiety.

In the early part of the twentieth century most telephones were on what was called a “party line.” That meant several people were on the same “line,”

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<sup>63</sup> SUSSKIND, *supra* note 7, at 15–16.

<sup>64</sup> *Id.*

<sup>65</sup> *Id.*

<sup>66</sup> See SHILLER, *supra* note 53, at 176–78.

<sup>67</sup> *Id.* at 178.

<sup>68</sup> *Id.* at 186–89. This is *not* the mainstream macroeconomic account of the cause of the Great Depression. An interesting aspect of Professor Shiller’s account of the Great Depression is that “in the United States [the Great Depression] caused the forced deportation (then called *repatriation*) of a million workers of Mexican origin. The goal was to free up jobs for ‘real’ Americans. No one contested this story.” *Id.* at 189.

so before one made a call, one had to pick up one's handset to see if anyone else on the "line" was using the phone, as I often did when staying with one of my grandmothers. One had to wait for others to get off the "line" before one could use it. Moreover, one did not dial another person's phone number. If the line was clear, one pressed the buttons on the phone several times to get the operator. You then told her who you wanted to call, and she (the job was almost always held by women) made the call and then told you when the connection had been made.

This method of using the telephone was not confined to small rural towns. It was the prevailing practice everywhere, including the U.S. Senate.<sup>69</sup> The dial telephone had been invented in 1892 although it did not come into common use, especially in big cities, until the late 1920s.<sup>70</sup>

But as we might now realize, there were concerns that adopting the dial telephone might lead to job destruction, precisely, the loss of employment for the party-line operators. The transition from the non-dial telephone to the dial telephone took many decades because of this concern.<sup>71</sup>

The transition from party-line to dial telephone did not go smoothly in the halls of Congress. In 1930, the first full year of the Great Depression, the U.S. Senate installed dial telephones.

Three weeks after their installation, Senator Carter Glass introduced a resolution to have them torn out and replaced with the older phones. Noting that operators' jobs would be lost, he expressed true moral indignation against the new phones: 'I ask unanimous consent to take from the table Senate resolution 74 directing the sergeant at arms to have these abominable dial telephones taken out on the Senate side. . . . I object to being transformed into one of the employees of the telephone company without compensation.'<sup>72</sup>

The resolution passed, but in a compromise, senators who wanted to have a dial telephone were allowed to keep theirs, while those who wanted the older

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<sup>69</sup> *Rotary Dial*, WIKIPEDIA, [https://en.wikipedia.org/wiki/Rotary\\_dial](https://en.wikipedia.org/wiki/Rotary_dial) [https://perma.cc/L4D4-MG SF].

<sup>70</sup> *Id.*

<sup>71</sup> My grandmother's phone was still a party line phone in the 1950s.

<sup>72</sup> SHILLER, *supra* note 53, at 191. U.S. Senator Glass's insight about his employment status is priceless. Here is the formal resolution: "Whereas dial telephones are more difficult to operate than are manual telephones; and Whereas Senators are required, since the installation of dial phones in the Capitol, to perform the duties of telephone operators in order to enjoy the benefits of telephone service; and Whereas dial telephones have failed to expedite telephone service; Therefore be it resolved that the Sergeant at Arms of the Senate is authorized and directed to order the Chesapeake and Potomac Telephone Co. to replace with manual phones within 30 days after the adoption of this resolution, all dial telephones in the Senate wing of the United States Capitol and in the Senate office building." *Senate Considers Banning Dial Phones*, U.S. SENATE, [https://www.senate.gov/artandhistory/history/minute/Senate\\_Considers\\_Banning\\_Dial\\_Phones.htm](https://www.senate.gov/artandhistory/history/minute/Senate_Considers_Banning_Dial_Phones.htm) [https://perma.cc/6JBJ-ACCE].

“manual” phones were allowed to return to those.

### C. Art and Technological Disruption

It is fascinating to note that artists and some scholars in various media took note of the tension between technological improvement and the social costs in the loss of jobs. Henry George’s *Progress and Poverty* (1879) is perhaps best known for its advocacy for a land tax. But it should equally be famous for its central contention that technological change was responsible for increased inequality and the poverty rate. George claimed that labor-saving innovation would inevitably lead to the disappearance of jobs in favor of machines.<sup>73</sup> One result would be that the owners of land would work the land without labor or capital and at enormous profit.<sup>74</sup> George believed that taxing land would slow down and perhaps halt the adoption of labor-saving machines.<sup>75</sup>

Edward Bellamy’s *Looking Backward, 2000–1887* (1888), a socialist utopian science fiction novel, was the third-largest bestseller of the late nineteenth century, after *Uncle Tom’s Cabin* (1852) and *Ben Hur: A Tale of the Christ* (1880).<sup>76</sup> Apparently prompted by the 1886 Haymarket Riots, Bellamy was concerned that the battle between laborers and their employers, exacerbated by technological change, had to be resolved in order to forestall social disintegration.<sup>77</sup> His protagonist fell asleep in the fraught 1880s and awoke to a utopian 2000 in which the problems of his own time had been resolved through the adoption of socialism.<sup>78</sup>

The English novelist E.M. Forster wrote a short story in 1909 entitled “The Machine Stops.” It is the future, and one machine controls and does everything, including caring for humans.<sup>79</sup> When a glitch causes the machine to break down, the consequences for humanity are dire.<sup>80</sup>

Karel Capek’s play *R.U.R.: Rossum’s Universal Robots* (1921) brought the word “robot” into widespread use (from the Czech word for “worker”).<sup>81</sup> Rossum is a scientist who invents an automated worker.<sup>82</sup> He persuades a

<sup>73</sup> *Id.* at 178.

<sup>74</sup> *Id.*

<sup>75</sup> *Id.*

<sup>76</sup> Matt Reimann, *This Best-Selling Book Turned Socialism into a Middle-Class Trend in the 1880s*, TIMELINE (May 5, 2017), <https://timeline.com/edward-bellamy-socialism-book-a3d3f78ed764> [<https://perma.cc/PV3U-SV8F>].

<sup>77</sup> I am grateful to my friend and former colleague Jeremy Atack of Vanderbilt University for pointing out the relevance of Bellamy’s famous novel.

<sup>78</sup> See generally EDWARD BELLAMY, *LOOKING BACKWARD: FROM 2000–1887* (2000).

<sup>79</sup> See generally E.M. FORSTER, *THE MACHINE STOPS* (Oxford & Cambridge Review 1909); SHILLER, *supra* note 53, at 181.

<sup>80</sup> SHILLER, *supra* note 53, at 181.

<sup>81</sup> *Id.* at 182; see generally KAREL CAPEK, *R.U.R.: ROSSUM’S UNIVERSAL ROBOTS* (1921).

<sup>82</sup> SHILLER, *supra* note 53, at 182.

businessman, Domin, to manufacture and sell the robots, but their plan is upended by the robots, who have become sentient and have their own ideas about what they want to do.<sup>83</sup>

Charlie Chaplin's classic comedy *Modern Times* (1936) tells the story of the Little Tramp, who works in a highly automated factory.<sup>84</sup> He is maltreated by the machines, rebels against them, is sent to a mental hospital to recover, is arrested for participating in a Communist rally, and more.<sup>85</sup> It is a masterpiece.<sup>86</sup>

Kurt Vonnegut's first novel, *Player Piano* (1952), is set in a world that is nearly completely automated.<sup>87</sup> There is constant tension between the engineers and scientists who have created this world, and the lower classes, whose modest skills have been replaced by machines.<sup>88</sup>

Finally, in *Machines Like Me* (2019), the great English author Ian McEwan has examined the possible impact of human-like, programmable androids—specifically, one named Adam and his impact on human relationships, particularly those between a man, his “owner,” and a woman, whom both the owner and Adam covet.<sup>89</sup>

#### **D. Who Solved the Problem of Technology and Innovation?**

The tension between innovation and jobs that has characterized Western history since the mid-eighteenth century has obviously been ameliorated, if not solved. Certainly there are still tensions (as the term “automation anxiety” indicates), but an accommodation of some sort has been reached because we are all much wealthier than we would be if these innovations had never been accepted; and there is not (yet) violence about the introduction of new and disruptive technology.

One observation that several students of automation anxiety—notably Carl Benedikt Frey and David Susskind—have made is that Western European societies made the accommodation between technology and innovation differently and at different times. For example, they both note that Great

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<sup>83</sup> *Id.*

<sup>84</sup> CHARLIE CHAPLIN, *MODERN TIMES* (1936).

<sup>85</sup> SHILLER, *supra* note 53, at 182.

<sup>86</sup> Professor Shiller also recommends Katherine Hepburn and Spencer Tracy. *DESK SET* (Henry Ephron 1957). The movie centers around a company about to acquire a mainframe computer called “Emerac.” SHILLER, *supra* note 53, at 202. I might add Stanley Kubrick's 2001: A SPACE ODYSSEY (Stanley Kubrick Productions 1968).

<sup>87</sup> *See generally* KURT VONNEGUT, *PLAYER PIANO* (1952).

<sup>88</sup> *Id.*

<sup>89</sup> *See generally* IAN MCEWAN, *MACHINES LIKE ME* (2019); *see* Jeff Giles, *Love, Sex and Robots Collide in a New Ian McEwan Novel*, N.Y. TIMES (May 1, 2019), <https://www.nytimes.com/2019/05/01/books/review/ian-mcewan-machines-like-me.html> [<https://perma.cc/EY7H-SLUH>].

Britain was the first to take the side of the innovators over that of the rioting workers.<sup>90</sup> Recall that in 1769 the British Parliament made the destruction of machines punishable by death.<sup>91</sup>

Apparently, that severe punishment was not honored sufficiently. Parliament felt that it had to reinforce the 1769 Act; so, it passed the “Destruction of Stocking Frames, etc. Act” in 1812, which either restated or reenacted the death penalty for destroying machines.<sup>92</sup> Several people were charged, convicted, and executed under the 1812 Act.<sup>93</sup> In 1813, Parliament converted the punishment for machine destruction to transportation to Australia.<sup>94</sup> But that was apparently under-detering because the death penalty was revived as a penalty in 1817.<sup>95</sup>

By contrast, the French took the side of the rioters over that of the inventors. The unrest of 1789 included attacks on factories and machines. Apparently, the revolutionary government feared the continued rioting more than the disincentive to introduce new machines and, as a result, did not take the same harsh stance toward disorder that the British did.<sup>96</sup>

Professor Joel Mokyr has long argued that Britain was the first country to industrialize precisely because it had a population that contained practical tinkers, who were, by and large, highly valued, and because Parliament forcefully protected the intellectual property of those tinkers.<sup>97</sup> Looking at how societies dealt with the social tension around disruptive technology at the beginning of the Industrial Revolution provides strong support for Mokyr’s view of Western economic development.

### **E. What More Do We Need to Know?**

I have suggested that the history of automation anxiety is instructive. We humans have been fascinated by and simultaneously repelled by machines for thousands of years. The current concerns about AI and automation have,

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<sup>90</sup> Frey, *The High Cost of Impeding Automation*, *supra* note 13.

<sup>91</sup> See *supra* text accompanying note 55; ROGER OSBORNE, IRON, STEAM & MONEY: THE MAKING OF THE INDUSTRIAL REVOLUTION 40 (2013).

<sup>92</sup> Destruction of Stocking Frames, etc. Act 1812, 52 Geo 3 c. 16 (Eng.).

<sup>93</sup> SUSSKIND, *supra* note 7, at 15.

<sup>94</sup> *Id.*

<sup>95</sup> *Id.* at 16. I would very much like to know what happened between 1813 and 1816 that caused Parliament to reinstate the death penalty for machine destruction.

<sup>96</sup> Frey, *The High Cost of Impeding Automation*, *supra* note 13.

<sup>97</sup> See generally Joel Mokyr, *Why Was the Industrial Revolution a European Phenomenon?*, 10 SUP. CT. ECON. REV. 27 (2003); Joel Mokyr, *Long-term Economic Growth and the History of Technology*, in HANDBOOK OF ECONOMIC GROWTH 1113, 1113 (Phillipe Aghion & Steven Durlauf eds., 2005); JOEL MOKYR, THE GIFTS OF ATHENA: HISTORICAL ORIGINS OF THE KNOWLEDGE ECONOMY (2002); Joel Mokyr, *Intellectual Property Rights, the Industrial Revolution, and the Beginnings of Modern Economic Growth*, 99 AM. ECON. REV. 349 (2009); JOEL MOKYR, A CULTURE OF GROWTH: THE ORIGINS OF MODERN ECONOMY (2018).

therefore, a strong pedigree. And, as I have indicated, we can learn things of value to our current problems from this history. I would suggest that there are two important lessons. First, the socially beneficial aspects of innovation are much more often than not greater than the social costs, but those social costs are real, deeply felt, and cannot be dealt with by telling those who incur those costs to calm down, that the benefits to all the rest of us exceed your pain, and that it will all work out. As I elaborate in the next section, it is not merely that disruptive technology imposes costs in the form of loss of income. There is more to employment than mere income and, therefore, more that is lost than the wherewithal to buy the necessities of life. A sensible society in which all of us look out for one another should have at its disposal some powerful policies to address the disruptions of technical innovation.

Second, technological innovation in the workplace is disruptive, sometimes violently so. And yet, almost every such innovation that provides greater social benefits than costs survives those disruptions, sometimes simply by enduring the “silent artillery of time”<sup>98</sup>; sometimes because society provides policies that ease the transition for those who suffer disruptions.

That being said, there is much more we need to know about the actual process of technological disruption. For example, I have searched the academic literature in vain for micro-studies of the process by which any of the various innovations dislodged workers and what those individuals did after losing their jobs. Did they find new ways of living? English historian E.P. Thompson’s great study has tantalizing glimpses of what happened to the weavers when the power loom and other innovations appeared.<sup>99</sup> But he has no systematic account of how many displaced workers got alternative jobs. Nor does he or anyone else address the many other questions: Did those who lost their jobs have to move to find new jobs? How far, on average? Did they leave the textile industry? Was there retraining involved? Were their wages less at the new job? Did their former employer provide any transitional aid? Did charitable groups help with living expenses or the costs of relocating or retraining?

The only beginning at producing that information, of which I am aware, is a marvelous new study (from which there is much more to come) by Jeremy Atack, Robert A. Margo, and Paul W. Rhode.<sup>100</sup> The authors discovered that in 1894, worried about technological unemployment, Congress “directed the

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<sup>98</sup> Abraham Lincoln, *The Perpetuation of Our Political Institutions: Address Before the Young Men’s Lyceum of Springfield, Illinois*, ABRAHAM LINCOLN ONLINE (Jan. 27, 1838), <http://www.abrahamlincolnonline.org/lincoln/speeches/lyceum.htm> [https://perma.cc/8H4H-23BG].

<sup>99</sup> See generally THOMPSON, *supra* note 11.

<sup>100</sup> See generally Jeremy Atack et al., “Automation” of Manufacturing in the Late Nineteenth Century: *The Hand and Machine Labor Study*, J. ECON. PERSP., Spring 2019, at 51, 51. I very highly commend this marvelous study and urge those interested to make a point of following the subsequent studies that come from these authors’ further studies of the HML report data.

Commissioner of Labor to ‘investigate and report upon the effect of the use of machinery upon labor and the cost of production, the relative productive power of hand and machine labor . . . and whether changes in the creative cost of products are due to a lack or surplus of labor or to the introduction of power machinery.’”<sup>101</sup> The report that appeared in 1899 is called the “Hand and Machine Labor” study.<sup>102</sup> It looks at production methods in great detail for a wide number of specific goods “at the task level for a matched pair of establishments, one of which produced the product by ‘hand’ (or traditional artisanal) methods and the other using ‘machine’ methods.”<sup>103</sup> This allows Atack et al. to compare the amount of time each task took in the two methods, the sequence in which the tasks were performed in the two methods, the characteristics of the workers employed, and more.<sup>104</sup>

The results of applying modern analysis and empirical techniques to this remarkable dataset are preliminary, but they are a model of precisely the sort of detailed study that will help us to understand exactly what happens when technology affects particular industries.

### III. POLICIES FOR DEALING WITH JOB LOSSES FROM DISRUPTIVE TECHNOLOGY

A 2017 Pew Research survey found that “85 percent of Americans are in favor of policies to restrict the rise of robots beyond hazardous work.”<sup>105</sup> And there is evidence that concern about “factory automation swung three key Rust Belt states—Michigan, Wisconsin, and Pennsylvania—in favor of Donald Trump in the 2016 election.”<sup>106</sup> So, this subject is troubling to the nation and impactful on significant public issues. The question is what to do about it.

In this section, I discuss some proposals that have been made to address the issues of disruptive technology and offer arguments for what I think are the best ways to approach these issues.

#### A. Disruptions—Generally

The disruptions that technological change can bring to workers are only one example of what Joseph Schumpeter called the “gale of creative

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<sup>101</sup> *Id.* at 52.

<sup>102</sup> *Id.*

<sup>103</sup> *Id.*

<sup>104</sup> *Id.*

<sup>105</sup> Frey, *The High Cost of Impeding Automation*, *supra* note 13; Monica Anderson, *6 Key Findings on How Americans See the Rise of Automation*, PEW RES. CTR. (Oct. 4, 2017), <https://www.pewresearch.org/fact-tank/2017/10/04/6-key-findings-on-how-americans-see-the-rise-of-automation/> [<https://perma.cc/Q5WB-A95P>].

<sup>106</sup> Frey, *The High Cost of Impeding Automation*, *supra* note 13.

destruction” that characterizes capitalism.<sup>107</sup> These disruptions happen to businesses, to individuals, to organizations, to institutions, to political understandings, and more. They are simply a part of life, and often the more dynamic a society, the more numerous and pervasive are the disruptions that it faces. Changes in demography occur and disrupt labor and product markets. For example, the baby boomer generation of, roughly, those born between 1946 and 1960 was much larger than the generation before it and the generation after it. The boomers moved through U.S. society like a “pig in a python.” Because they were relatively more numerous than the generation before them, they had a harder time getting into college because colleges were not large enough to accommodate the large numbers.<sup>108</sup> And when they graduated from college and entered the work force, the boomer generation was so much bigger than the generation above them that there were not enough jobs to accommodate them all.<sup>109</sup> Of course, the boomers had different life experiences for these and other reasons. In brief, their lives were disrupted, and they disrupted society.

Other disruptions arise from changing tastes—for example, a deeper concern for environmental issues, including a growing concern about the advisability of burning fossil fuels. If that concern results in a carbon tax or subsidies to alternative energy sources, there will be disruptions. Auto makers, gas station owners, petroleum extractors and transporters will be disadvantaged. Coal miners (whose number has dwindled from 176,000 in 1985 to 51,100 in January 2020)<sup>110</sup> will be displaced.

For individuals, accidents, deaths, divorce, adverse health results, and other traumas can disrupt lives.

Foreign trade can disrupt society, causing jobs to be lost. The furniture industry in the Carolinas has been decimated by inexpensive imports from the Orient.<sup>111</sup> Automobile parts manufacture has relocated to northern Mexico and now elsewhere.

Some of these disruptions are among the curve balls that life throws at us. They are not our fault; nor are they, in most cases, anyone else’s fault. We can avoid some of these disruptions by prudent living (exercise, avoiding risks,

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<sup>107</sup> JOSEPH A. SCHUMPETER, *CAPITALISM, SOCIALISM, AND DEMOCRACY* 82–83 (3d ed. 2008).

<sup>108</sup> U.S. COMMISSION ON POPULATION GROWTH AND THE AMERICAN FUTURE, *POPULATION AND THE AMERICAN FUTURE: THE REPORT 19* (1972); see also Karen L. Fingerman et al., *The Baby Boomers’ Intergenerational Relationships*, 52 *GERONTOLOGIST* 199 (2012) (discussing how the baby boomer generation was larger than their parents’ generation, which led to social, economic, and political consequences).

<sup>109</sup> See *id.*

<sup>110</sup> U.S. Bureau of Labor Statistics, *All Employees: Coal Mining*, FED. RES. BANK ST. LOUIS, <https://fred.stlouisfed.org/series/CEU1021210001> [<https://perma.cc/7BTF-TDBG>].

<sup>111</sup> Jason Margolis, *North Carolina’s Fight to Keep its Foothold on Furniture*, *WORLD* (May 2, 2018, 2:00 PM), <https://www.pri.org/stories/2018-05-02/north-carolina-s-fight-keep-its-foothold-furniture> [<https://perma.cc/7B8E-AVY7>].

taking care, eating sensibly, sleeping adequately, and so on) and guard against some adversities by purchasing insurance.

But some of these disruptions are either uninsurable or not within the contemplation of the average person. For those disruptions, that is, we cannot expect individuals to take action to prevent or ameliorate them; nor would it be thought fair simply to let the costs of these disruptions fall on the individual and her family. Rather, we make a societal commitment to provide societal programs to help with these disruptions.

I do not have a complete theory of which of life's disruptions are or ought to be individual responsibility and which are or ought to be society's responsibility. But I would suggest that as a first pass at articulating that theory, we would probably include disruptions that workers suffer because of technological change among the list of those disruptions for which society ought to provide relief. Among the reasons for taking this position is that, without societal insurance against disruptive technology, workers might be tempted to resist losing their jobs by sabotaging or destroying the machines.

I will assume that to be the case for the remainder of this paper. In doing so, I realize I am making a huge leap that deserves much more careful consideration. Nonetheless, I shall proceed on that understanding and with due regard for the points I made in Section I—namely, that we want to provide help for those workers whose lives are disrupted by technological change in the workplace without harming the incentive to innovate. I think we can separate innovation and charity without having to adopt the ham-handed policy of preserving jobs by ordering employers not to adopt labor-saving innovations, taxing the use of robots, or the like.

### ***B. Letting the 'Invisible Hand' or Private Contracting Address Disruptive Technology***

One possibility for dealing with automation anxiety would be for society to do nothing. This would delegate to the firms, organizations, institutions, and individuals who adopt AI-related innovations the decision about whether, what, when, and how much to adopt new techniques, algorithms, machines, and the like. Similarly, it would delegate to individuals, labor unions, charitable organizations, and the like decisions about whether, what, when, and how much to provide assistance to those who are about to be or have already been dislodged from their employment by disruptive technologies. We should be comfortable with this delegation if we believe (1) that the historical record teaches us that these disruptions “work out” eventually and that there is nothing particularly different than what we examined in Section II, and (2) that there are no social benefits or costs from adopting the new technologies or that those social costs and benefits have been adequately internalized by all private

decisionmakers.<sup>112</sup>

I am skeptical that these conditions can be fulfilled in the circumstances we are considering here. That is one of two reasons why I am about to propose some regulatory policies to deal with the social costs of disruptive AI technological change.

Nonetheless, I am also aware that there have been some historical episodes in which private entities have sought to internalize *some* of the social costs of disruptive technological change. I am told by one of the premier labor historians in the United States, Jim Barrett, that automation anxiety was a source of widespread concern to workers and their employers in the immediate post-World War II period.<sup>113</sup> Apparently, the Ford Motor Company and its unionized workers fought with one another about what would happen if the employer installed job-destroying machines. Congressional hearings were held on this matter (as they would be again in the 1960s).<sup>114</sup> Professor Barrett said that union contracts at many of the automakers and in the slaughtering and meat-packing industries provided for the retraining, at company expense, of workers displaced by technological production changes.<sup>115</sup>

So, yes, it might be the case that contractual relations between employers and their employees take into account the costs that displaced workers might otherwise have to bear if they lose their jobs to automation. And that contractual internalization will, perhaps, guide employers to make socially desirable decisions about whether, what, when, and how much automation to adopt. If the employer must bear the costs of the new automation and the costs of retraining the workers displaced by the new machines, then they will clearly adopt the machines if the benefits minus the costs of dealing with the displaced workers is a significant positive sum.

There are a number of good reasons to doubt that we can rely on these private solutions to automation anxiety to achieve a social optimum. First, as we have already seen, the job losses from AI may be permanent. They may be long-term or temporary. They may push workers into far less remunerative employment. We simply are not sure what will happen. It seems very unlikely that private employers will undertake retraining and other supportive payments

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<sup>112</sup> To be “internalized” is economics-speak for the process by which social costs and benefits are brought within the maximizing calculations of private firms and private individuals. The usual presumption in economics is that private parties will ignore these social costs and benefits unless law or public policy induces them to internalize them. So, for example, a private individual may recognize the private costs and benefits of cigarette smoking, but she may not take into account the social costs that her smoking involuntarily imposes—by means of passive smoke—on others. Many entities now ban cigarette use indoors so as to minimize the potential dangers of second-hand smoke.

<sup>113</sup> Telephone Interview with James R. Barrett, Professor Emeritus, University of Illinois Department of History (Jan. 10, 2020).

<sup>114</sup> *Id.*

<sup>115</sup> *Id.*

for their workers for the lengths of time that AI disruptions may involve.

Second, even if a private employer would be willing to pay for a technologically dislodged employee's retraining, that employer would almost certainly insist that the retrained worker would work for his or her old employer. That is, the displaced workers would not be free to take the retraining that his old employer provides and then go to work for a different firm (unless, of course, the new employer would be willing to compensate the old employer for the costs of retraining).

Another problem is that the use of contracts to deal with the issues of technologically disrupted workers is unlikely to be comprehensive enough. Some employers will adopt some method of dealing charitably with their displaced workers, but not all employers will do so. Some are living on the edge of competitive viability and cannot afford to incur the substantial expenses of a compensatory scheme. Relatedly, there is unlikely to be standardization of the contractual scheme across different firms and industries, although there could be. Government involvement might be to insist on a mandatory minimum of terms in a compensatory scheme for technologically disrupted workers. But I do not approve of this method of dealing with the issue unless it is the only realistic fallback position.

A superior method of creating the right incentives for everyone involved in the disruption would be to have the government (the *federal* government so as to prevent geographical restrictions on where the retrained worker should be allowed to seek a job) provide the retraining and other expenses for the displaced workers. That is the scheme I propose below.

### C. "*Meaning and Purpose*"<sup>116</sup>

In standard microeconomic theory, working at a job is not seen as being inherently desirable. It is, rather, the sacrifice of leisure, which *is* inherently desirable. In order to persuade someone to give up leisure for work, she has to be compensated. If her leisure becomes more valuable to her, she may quit her job and enjoy more leisure. She might also look for another job that compensates her more so that she values work (and its compensation) more than leisure.

But we all recognize that there are nonpecuniary aspects (both good and bad) of working, and people clearly take those aspects into account. Someone who adores being in nature may find that the nonpecuniary returns from being a National Park Service ranger more than make up for the relatively modest monetary compensation. Being an academic has numerous nonpecuniary rewards, such as the joy of meeting bright young students who (seem to) value what one has to say and being surrounded with productive, intelligent, and

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<sup>116</sup> I have borrowed this phrase from David Susskind. SUSSKIND, *supra* note 7, at 215–16.

creative co-workers.

Even more generally, people may feel that being employed is a component of their worth to society, their family, and themselves. They are contributing to the greater good; they are pulling their weight; they are valued. Alternatively, some may feel that “it’s just a job. I can take it or leave it.”

If the former views of the social and personal value of employment are the norm, then the loss of a job means the loss of monetary compensation and of some non-monetary components of compensation. Society generally chooses to ease the job loss by providing a portion of the compensation lost. Why only a portion? The fear is that if the unemployed receive full compensation for their loss of employment income, their incentive to look for a new job will be significantly diminished.<sup>117</sup>

Economists do not devote much attention to the issue of trying to compensate the unemployed for losing the nonpecuniary positive aspects of employment. The central reason is surely that nonpecuniary benefits are difficult to monetize and quantify. They present tremendous problems in tortious injuries.<sup>118</sup>

Concerns about these nonpecuniary benefits have arisen from research in the field of happiness studies. Research has shown that, with a few exceptions, such as the loss of a spouse or partner, *ex ante* we anticipate that the effects of an adverse event on our well-being will be greater than it actually proves to be.<sup>119</sup> Unexpectedly, we adapt to adversity so that an adverse event’s effect on subjective well-being is typically temporary. For instance, suppose that you ask an avid reader what would happen to her state of subjective well-being if she were to lose her eyesight. She might predict that this would be a devastating event that would reduce her well-being significantly and, perhaps, that the reduction would be permanent. In point of fact, her reduction in well-being might be short-lived. That is because she will adapt to her lost eyesight and love of reading. For instance, she might start listening to audiobooks,

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<sup>117</sup> This is an illustration of the economic concept of “moral hazard.” Moral hazard typically arises in insurance markets. If one can insure one’s house for more than it is worth, then there is an incentive to destroy one’s house by fire or a gas explosion. Literally, the house is worth more as an insurable loss than as an abode. In this situation, someone has been tempted to behave immorally. And that is the definition of moral hazard—a situation in which someone’s behavior will change in such a way as to make an insurable loss more likely simply because they have insurance. They might not burn their over-insured house down, but they might not take as much care as they would if the insurance was for, say, eighty percent of the house’s value. I shall use the concept of moral hazard to discuss policies to deal with job losses from disruptive technology.

<sup>118</sup> By contrast, nonpecuniary costs of a job, such as danger, stress, or physical exhaustion, are relatively easy to monetize. The theory is that paying someone more to put up with these unpleasant aspects attracts applicants. We all have said, “They couldn’t pay me enough to do that job.”

<sup>119</sup> See generally M. Luhmann et al., *The Prospective Effect of Life Satisfaction on Life Events*, 4 SOC. PSYCHOL. & PERSONALITY SCI. 39 (2013).

having a friend or relative read to her, or find a new pastime that replaces book-reading. That is, we are more adaptable than we think we are or will be.<sup>120</sup>

One of the significant exceptions to this rule of adaptation has to do with losing a job. The evidence shows that losing a job causes a reduction in subjective well-being and that even if the person gets another job, the increase in well-being from having that new job does not entirely offset the loss of well-being from losing the previous job.<sup>121</sup>

We get self-worth, a sense of collegiality, a feeling of contributing to the world around us, the gratification of building something worthwhile, and more from employment. Little wonder then that when we lose a job, we lose much more than income. What is even more striking about this empirical insight is that the loss in subjective well-being from losing a job is not entirely made up for by getting another job.

How ought public policy take these matters into account? Clearly, being employed means more than being paid to give up leisure. And so, replacing the lost income (even taking out a portion to dampen moral hazard) from unemployment may not fully compensate the person who has lost his or her job from disruptive technology. We cannot sensibly insist that a former employer must keep the employee on the job. That would go too far. But we ought to bear in mind as we develop a policy for dealing with disruptive technology that having a job currently contributes more to well-being than the value of the compensation that the worker earns.

#### **D. Trying to Guide Innovation so as to Preserve Jobs**

A few economists, a retired entrepreneur, and a current philanthropist have suggested that instead of passively letting AI-informed technological change plot its own course, public policy should seek to affect the kind of technological change we enjoy.

Professor Anton Korinek of the University of Virginia Department of Economics has proposed that we steer programs in AI according to ethical and economic values rather than just economic values.<sup>122</sup> He first suggests there is a difference between ethical consideration and market values, but that they are

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<sup>120</sup> The classic article is Philip Brickman et al., *Lottery Winners and Accident Victims: Is Happiness Relative?*, 36 J. PERS. & SOC. PSYCHOL. 917 (1978).

<sup>121</sup> Richard E. Lucas et al., *Unemployment Alters the Set Point for Life Satisfaction*, 15 PSYCHOL. SCI. 8 (2013).

<sup>122</sup> Anton Korinek, *Integrating Ethical Values and Economic Value to Steer Progress in Artificial Intelligence* (Nat'l Bureau of Econ. Research, Working Paper No. 26130, 2019). The author remarks in the first footnote that this paper is an "expanded version of a chapter commissioned by the *Oxford Handbook of Ethics of Artificial Intelligence*, edited by Markus D. Dubber, Frank Pasquale, and Sunit Das, Oxford University Press, 2019." *Id.*

complementary.<sup>123</sup> If further progress in AI creates new or exacerbates existing externalities and challenges shared ethical values, then “there is scope for integrating [economic and ethical values] in order to steer technological progress.”<sup>124</sup>

An area in which a joint economic-ethical corrective may arise is in the area of superintelligence.<sup>125</sup> Superintelligence is a future state in which today’s narrow AI has expanded into general intelligence that surpasses human general intelligence.<sup>126</sup> Korinek says that “[m]arket incentives are doing their part by generously rewarding the growing capabilities of existing AI systems and by pouring hundreds of billions of dollars into the development of new ones.”<sup>127</sup> The obvious central ethical problem created by AI superintelligence is that humans would become redundant for many social and economic tasks. And that condition might lead to the rebellion of the superintelligent, as happened with the computer HAL in the movie *2001: A Space Odyssey*.<sup>128</sup>

A guard against reaching this ethical dystopia is “to realize what is going on.”<sup>129</sup> And to heighten that realization, Professor Korinek seconds a suggestion from Garcia and Janis that “innovators [should] be required to conduct Technological Impact Assessments before making significant investments in new technologies, modeled on Environmental Impact Assessments, which attempt to evaluate the likely impact of innovations on [the environment].”<sup>130</sup>

He also raises the possibility that “it may be necessary to pass regulation to compel innovators to take into account their adverse effects on society.”<sup>131</sup>

When he speculates on the farther future, he focuses on the dire possible consequences of superintelligence:

If our decisions were solely guided by economic value, then it would be logical to phase out humanity once humans become economically redundant. The arc of our material progress would then come full circle: before the Industrial Revolution, humanity started out in a Malthusian world in which our population numbers were held back

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<sup>123</sup> *Id.* at 2–7.

<sup>124</sup> *Id.* at 15–19. As an example of a new externality that might be generated by AI, Korinek cites “hacking humans, and reducing human autonomy.” *Id.* at 15.

<sup>125</sup> *Id.* at 18–19.

<sup>126</sup> *Id.* at 16–17.

<sup>127</sup> *Id.* at 16.

<sup>128</sup> KlingonSpider, *HAL 9000: “I’m sorry Dave, I’m afraid I can’t do that”*, YOUTUBE (Apr. 8, 2012), <https://www.youtube.com/watch?v=ARJ8cAGm6JE> [<https://perma.cc/UE68-23TJ>].

<sup>129</sup> Korinek, *supra* note 122, at 15.

<sup>130</sup> *Id.* at 16 (citing José García and Madeline Janis, *How to Keep the Robots from Taking Jobs*, POLITICO (May, 01, 2019, 5:07 AM), <https://www.politico.com/agenda/story/2019/05/01/how-to-keep-the-robots-from-taking-jobs-000895/> [<https://perma.cc/2MDQ-K58N>]).

<sup>131</sup> *Id.*

by lack of material resources and starvation; after the advent of superintelligence, human labor would become redundant, and the fate of all but the wealthiest would end up being driven by Malthusian forces yet again, ultimately leading to starvation and declines in the human population. Whenever humans and machines compete over scarce resources in the economy, it would be economically more valuable to use them as inputs for machines rather than for humans.<sup>132</sup>

Grim as this outlook is, it seems to be far enough removed from the present that it ought not overly influence what we do today. Humanity will certainly survive, possibly by leaving the planet for another on which to thrive.

Professor Korinek's principal admonition is to bring ethical considerations into play sooner rather than later in our thoughts about "superintelligent" AI.<sup>133</sup> I do not disagree, but I long for more specificity about what those considerations would argue about the issues we face today. In the sense that the AI innovations today will inform the AI innovations of tomorrow, Professor Korinek might say that we need to think about the ethics of AI innovations today.<sup>134</sup>

Two prominent economists who have studied various aspects of the relationships between technological change and the labor market, Daron Acemoglu and Pascual Restrepo, have argued that the market sometimes favors the "wrong kind of AI" and that time-honored market regulatory policies can improve matters.<sup>135</sup> They begin from the observation that there are market failures in innovation. In fact, they say that innovation, although motivated in part by attempts to address felt necessities of the time, has a momentum and path guided by either non-economic factors or a failure to pay attention to the social costs of some innovations.<sup>136</sup> Thus, innovation has externalities—that is, uncompensated and unbargained-for effects outside those anticipated private effects on innovators. Externalities are difficult for markets to incorporate. Because those external costs (and benefits) can be substantial, but outside the view of those immediately involved in the innovation, the invention may be good for those directly involved but bad for

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<sup>132</sup> *Id.* at 18.

<sup>133</sup> *Id.* at 19.

<sup>134</sup> In another article, co-authored with Nobel-Prize-winning economist Joseph Stiglitz, Korinek and Stiglitz elaborate on the matters we have just reviewed in a far more technical manner but reach very similar conclusions to those of the earlier Korinek article. Anton Korinek & Joseph E. Stiglitz, *Artificial Intelligence and Its Implications for Income Distribution and Unemployment*, in *THE ECONOMICS OF ARTIFICIAL INTELLIGENCE: AN AGENDA* 349, 349–90 (Ajay Agrawal et al. eds., 2019).

<sup>135</sup> Daron Acemoglu & Pascual Restrepo, *The Wrong Kind of AI?: Artificial Intelligence and the Future of Labor Demand*, 12 *CAMBRIDGE J. REGIONS ECON. & SOC'Y* 1 (2019).

<sup>136</sup> *Id.* at 7.

wide swaths of society, like those who lose their jobs as a result of adopting the innovation.

Acemoglu and Restrepo note that in cases of “market failures in innovation, the US government has historically used public-private partnerships to encourage socially beneficial research.”<sup>137</sup> As examples, they cite “the Internet, sensors, pharmaceuticals, biotech, and nanotechnology.”<sup>138</sup>

More generally, Acemoglu and Restrepo emphasize the point I raised in the previous section: “if employment creation has a social value beyond what is in the GDP statistics (for instance, because employed people are happier and become better citizens, or because broad-based growth in labour demand improves income inequality), this social value will be ignored by the market.”<sup>139</sup>

All these factors, the authors say, suggest that AI innovators tend to underestimate the social costs of most AI innovations and, therefore, undervalue the social benefits of “novel AI applications reinstating labor.”<sup>140</sup> An implication of this observation is that society may get the “wrong kind of AI.” If investors in AI are ignoring AI’s effects on labor demand, inequality, and other social values, then an implication is for society to intervene in the “right kind” of AI innovations. To the extent that these “right kind” of AI inventions can be adequately distinguished *ex ante*, this regulatory suggestion is worth considering.

Finally, the retired Microsoft founder and current philanthropist Bill Gates has argued in favor of taxing the use of robots.<sup>141</sup> The proposal, which he presented in a short interview, is not thoroughly worked out, but it is worth thinking about. Gates’s argument is that the employer of a human typically has to pay FICA taxes on his or her employees, and the employees have to pay income taxes.<sup>142</sup> Presumably, the attraction of a robot is that it can save the employer these expenses for at least one and probably several workers. If this is a benefit to the employer, as it must be, then he or she might well be taxed to surrender some of this benefit.<sup>143</sup> The proceeds of these taxes might be used for general revenue projects, but they might also be earmarked for helping the former workers retrain, relocate, and otherwise make the transition to other employment. But bear in mind that Larry Summers—the former Secretary of

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<sup>137</sup> *Id.*

<sup>138</sup> *Id.* at 8–9 (citing MARIANA MAZZUCATO, *THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC V. PRIVATE SECTOR MYTHS* (2015)).

<sup>139</sup> *Id.*

<sup>140</sup> *Id.*

<sup>141</sup> Kevin J. Delaney, *The Robot that Takes Your Job Should Pay Taxes, Says Bill Gates*, QUARTZ (Feb. 17, 2017), <https://qz.com/911968/bill-gates-the-robot-that-takes-your-job-should-pay-taxes/> [<https://perma.cc/B8QH-5LU4>].

<sup>142</sup> *Id.*

<sup>143</sup> *Id.*

the Treasury, President of Harvard University, and currently Charles Eliot University Professor at Harvard—does not think highly of Bill Gates’s robot tax proposal: “Mr. Gates’ robot tax risks essentially being protectionism against progress.”<sup>144</sup>

There are, of course, further details of such a tax that need to be studied and elaborated, but that further consideration seems worthwhile.

The European Union considered taxing businesses that had adopted robots and thereby took workers’ jobs but decided in February 2017 not to impose the tax.<sup>145</sup>

### **E. Education**

The classic solution to lost jobs due to destructive competition, as through cheaper suppliers from abroad, is to retrain through education. As Jason Furman, the head of President Obama’s Council of Economic Advisers, said, “Work has a future, and whatever it is, education will help.”<sup>146</sup>

Automation anxiety and its disruption may, however, make the education or retraining option less plausible than it has been in other circumstances. Daniel Susskind makes this simple point: “Do not prepare people for tasks that we know machines can do better than human beings.”<sup>147</sup> Thus, we cannot educate people to do repetitive, routine tasks. That would seem to point training toward teaching judgment, the exercise of leadership, and other skills at which human beings appear to have a comparative advantage. But then I learned about AlphaZero’s remarkable ability to learn how to play chess so well in four hours that it could beat the reigning computer chess champion, and I concluded that sooner or later there are going to be very few jobs left for which human beings are better than AI. As a result, I am completely dispirited by the possibility that education can help ease the effects of disruptive AI-based technological change.

### **F. Transitional Aid on the Model of Trade Adjustment Assistance**

One of the social and economic disruptions of change that our society has decided to aid is that arising from international trade. The program—Trade Adjustment Assistance (TAA)—is actually four separate programs for providing aid to workers, firms, farmers, and communities adversely affected by foreign imports. The Trade Expansion Act of 1962 and its companion piece, the Trade Act of 1974, created these four programs, administered by the U.S.

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<sup>144</sup> Lawrence Summers, *Robots Are Wealth Creators and Taxing Them Is Illogical*, FIN. TIMES (Mar. 5, 2017), <https://www.ft.com/content/42ab292a-000d-11e7-8d8e-a5e3738f9ae4> [<https://perma.cc/7WER-2858>].

<sup>145</sup> Delaney, *supra* note 141.

<sup>146</sup> SUSSKIND, *supra* note 7, at 153.

<sup>147</sup> *Id.* at 156.

Department of Labor for workers, by the U.S. Department of Agriculture for farmers, and by the U.S. Department of Commerce for firms and communities.<sup>148</sup>

The prevailing economic justification for these programs is two-pronged. First, following the general argument in favor of freer trade, we as a nation have long valued the fact that freer international trade creates incentives for the lowest-cost producers of goods and services to prosper, wherever they may be in the world. And second, U.S. consumers benefit from having the lower prices of imported goods and services. The programs have been altered slightly over time, defunded, refunded, and ultimately reauthorized in 2015.<sup>149</sup>

TAA recognizes that while there are these social benefits to freer international trade, there are also social costs to workers, farmers, firms, and communities. And if the social benefits are as large as we think they are and are certainly greater than the social costs, then we should tax away some of the social benefits from those who are benefitted by the importation of cheaper goods and services and transfer the proceeds to those who are suffering costs from those imports. Typically, there are net benefits.<sup>150</sup>

The terms and conditions for receiving aid under TAA are detailed. I do not want to overload this article with those details, though they are important. But allow me to mention a few so that I can refer to them. Those who are eligible may receive up to “117 weeks of cash payments for all workers concurrently enrolled only in full-time training (workers must be enrolled in training 8 weeks after certification or 16 weeks after layoff, whichever is later).”<sup>151</sup>

We may have concerns about the program, but I want to tout it as a model for disruptive technology losses. I am aware that there are issues with TAA; it has been trimmed by various administrations and was narrowly reauthorized in 2015. But TAA (if it works as it should) accomplishes precisely what I hope that a similar program for disruptive technological losses should—the provision of temporary assistance to those who suffer social costs while allowing the rest of society to enjoy the social benefits of the innovation.

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<sup>148</sup> Trade Expansion Act of 1962, 19 U.S.C.A. § 1801 et seq. (West 1998); Trade Act of 1974, 19 U.S.C.A. § 2101 et seq. (West 1978).

<sup>149</sup> Trade Facilitation and Trade Enforcement Act of 2015, 19 U.S.C.A. § 4301 et seq. (West 2018).

<sup>150</sup> BENJAMIN COLLINS, CONG. RESEARCH SERV., R42012, TRADE ASSISTANCE FOR WORKERS 2 (2012). A 2012 report by the Joint Economic Congressional Committee found that “TAA needs to remain an integral part of trade policy because it compensates those harmed by import competition without sacrificing the larger demonstrable benefits of trade.” CHAIRMAN’S STAFF OF THE JOINT ECONOMIC COMMITTEE, 112TH CONG., THE IMPORTANCE OF TRADE ADJUSTMENT ASSISTANCE FOR AMERICA’S WORKERS 7 (Sept. 19, 2011), [https://www.jec.senate.gov/public/\\_cache/files/b8e793cb-9abd-49f7-8c50-be97d3b1ac99/the-importance-of-trade-adjustment-assistance-for-americas-workers.pdf](https://www.jec.senate.gov/public/_cache/files/b8e793cb-9abd-49f7-8c50-be97d3b1ac99/the-importance-of-trade-adjustment-assistance-for-americas-workers.pdf) [<https://perma.cc/ZU2K-255B>].

<sup>151</sup> COLLINS, *supra* note 150, at 11.

Let me make this final argument in favor of TAA and similarly for technological job loss assistance (TJLA). An alternative to TAA—one that has been tried from time to time—is to protect workers, farmers, firms, and communities from imports by imposing extraordinarily high tariffs on foreign goods and services or by simply forbidding those imports. Those protectionist policies are ill-advised. They deny the social benefits of trade and impose higher costs on consumers so as to protect the firms and employees of those threatened by foreign competition. Consumers are, in effect, enlisted to transfer income to firms and employees threatened by foreign trade without any offsetting benefit. The beauty of TAA is that it provides some protection to firms and workers who bear the costs of low-priced imports without denying consumers the benefits of lower prices.

Similarly, TJLA would allow people to enjoy the efficiencies of AI-assisted technological change while protecting workers (and, possibly, firms) against excessive losses from the disruptions that may follow the adoption of automation.

But notice that this is *temporary* assistance and presumes that workers displaced by technological change can be identified, retrained, and re-employed.

### G. *Universal Basic Income*

Matters regarding technological unemployment reach a different level of seriousness when AI-inspired innovation has progressed so greatly that well more than half of the jobs currently filled by human beings have been taken over by AI-powered machines or algorithms.<sup>152</sup>

Although I have argued above that a “world without work” may be far in the future, Frey and Osborne, among others, have estimated that almost half of our current job descriptions may be automated in the near future.<sup>153</sup> If that happens, and there are not enough other, unautomated jobs to employ the half of current workers whose jobs have disappeared, we need to have something in place for much longer-term support.

One proposal is for Universal Basic Income (UBI). This view has been championed for a widely diverse set of reasons, such as to consolidate the many different social safety net programs into a single over-arching program,<sup>154</sup> as a means of providing longer-term support for technologically displaced workers,<sup>155</sup> and as a means of realizing the greatest possible degree

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<sup>152</sup> See generally JAMES BARRATT, *OUR FINAL INVENTION: ARTIFICIAL INTELLIGENCE AND THE END OF THE HUMAN ERA* (2015).

<sup>153</sup> See FREY & OSBORNE, *supra* note 4.

<sup>154</sup> See generally CHARLES MURRAY, *IN OUR HANDS: A PLAN TO REPLACE THE WELFARE STATE* (2016).

<sup>155</sup> See generally YANG, *supra* note 5.

of human freedom.<sup>156</sup>

The general outline of the various proposals for UBI are that everyone (or nearly everyone) in a society would receive an annual income from their government. In most but not all plans, that income is modest, meant only to provide for the necessities of life and perhaps a little more. Most proposals do not attach strings to the receipt of the UBI, although some do. The goals meant to be served are economic security or to provide a floor below which no one should be allowed to fall or to promote human flourishing.

One of the first people to propose a UBI was Thomas Paine in 1796, but proponents since then have been numerous and varied, including John Stuart Mill, Friedrich Hayek, Bertrand Russell, John Kenneth Galbraith, Martin Luther King, Jr., Charles Murray, Andrew Yang, and Philippe Van Parijs.<sup>157</sup>

Some commentators note that the government can implicitly add to this UBI by making some services available at no or nominal cost, such as education, transportation, and healthcare.<sup>158</sup>

There are, of course, lots of questions to raise about UBI. The details are tremendously important and differ depending on what goal society sees for a UBI. But there are some general questions we can flag here as an indication of the complexities that the proposal raises.

First is what Susskind calls the “admissions policy.”<sup>159</sup> Who is entitled to receive the UBI? Is it members of the community—and *all* members or only *some*, and, if the latter, which members? Do felons forfeit some or all of their UBI? What if the leaders of the community begin to exclude some members in a corrupt scheme to enrich themselves and a few selected others?

Some advocates insist that everyone in the community is to receive payments, not just a subgroup determined on the basis of their employment status, age, wealth, or other criteria. Their reasons for this universal aspect of the UBI are three. First, “if payments are funded through taxes, then the rich may receive a payment, but will also pay far higher taxes to support other people’s payments, more than making up for the income they get.”<sup>160</sup> Second, it is administratively easier to send out checks to everyone than to administer a program in which some but not all participate.<sup>161</sup> And third, according to Susskind, most important, “universal payments remove any stigma associated with claiming support. If everyone receives the payments, nobody can be labeled by society as a ‘scrounger’ and no individual will feel ashamed to have

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<sup>156</sup> See generally PHILIPPE VAN PARIJS & YANNICK VANDERBORGHT, BASIC INCOME: A RADICAL PROPOSAL FOR A FREE SOCIETY AND A SANE ECONOMY (2017).

<sup>157</sup> See SUSSKIND, *supra* note 7, at 180–83.

<sup>158</sup> *Id.* at 181.

<sup>159</sup> *Id.* at 185–87.

<sup>160</sup> *Id.* at 185.

<sup>161</sup> *Id.*

to claim theirs.”<sup>162</sup>

Another issue is where the substantial revenues to operate UBI are to come from. The program will be expensive. For example, suppose that UBI is available only to adults—people at least eighteen years old. There are approximately 256 million adults (who account for about seventy-eight percent of the total population) in the United States.<sup>163</sup> Suppose that each of them is to receive \$25,000 in UBI every year. The annual cost of the program will be enormous, about \$6.4 trillion.

The GDP of the United States was, in 2019, approximately \$21.5 trillion.<sup>164</sup> As a result, the UBI would have accounted for almost thirty percent of the entire GDP of the United States. For the sake of comparison, total military expenditures in the United States in 2018 were about \$640 billion, which was one-sixth of the total federal budget.<sup>165</sup> The total federal budget for 2018 was slightly over \$4 trillion.<sup>166</sup> Thus, assuming that UBI will not substitute for other federal programs (although it probably will), then adding UBI to existing federal expenditures (\$6.4 trillion plus \$4 trillion, or \$10.4 trillion total) would result in an explosion of federal expenditure from today’s roughly twenty percent to almost one-half of the national GDP. The country does not seem to be in the mood for such a dramatic change.

Susskind argues in favor of a Conditional Basic Income rather than a UBI.<sup>167</sup> By that he means there will be conditions imposed on recipients. Specifically, recipients will have to do something for their community or lose their stipend. He gives these examples: “caring for and supporting fellow human beings, teaching children how to flourish in the world.”<sup>168</sup>

There have been instances in which nations or cities have attempted to operate a UBI. Finland, for example, began a two-year experiment of giving 2,000 randomly selected unemployed citizens €560 a month, regardless of their other income or whether the recipient was looking for work.<sup>169</sup> The results of

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<sup>162</sup> *Id.* at 185–86. Susskind quotes Van Parijs as saying, “There is nothing humiliating about benefits given to all as a matter of citizenship.” *Id.* at 186.

<sup>163</sup> See *QuickFacts*, U.S. CENSUS, <https://www.census.gov/quickfacts/fact/table/US/PST045219> [<https://perma.cc/L5WW-XY6N>]. I am assuming that the total population is about 328 million and that the percentage of the population who are adults is approximately seventy-eight (which is approximately the percentage of those eighteen years of age or older in the total population).

<sup>164</sup> *Gross Domestic Product, Fourth Quarter and Year 2019 (Advance Estimate)*, BEA, <https://www.bea.gov/news/2020/gross-domestic-product-fourth-quarter-and-year-2019-advance-estimate> [<https://perma.cc/S2JM-PVB3>].

<sup>165</sup> *U.S. Military Spending from 2000 to 2018*, STATISTA, <https://www.statista.com/statistics/272473/us-military-spending-from-2000-to-2012/> [<https://perma.cc/W8U9-7UFB>].

<sup>166</sup> *The Federal Budget in 2018: An Infographic*, CONG. BUDGET OFF., <https://www.cbo.gov/publication/55342> [<https://perma.cc/4MG7-WYCH>].

<sup>167</sup> SUSSKIND, *supra* note 7, at 186–89.

<sup>168</sup> *Id.* at 187.

<sup>169</sup> HARARI, *supra* note 27, at 71.

the experiment were not positive.<sup>170</sup> While there was little disruption in the labor market (it has always been assumed that too much unemployment insurance would create a moral hazard problem in which recipients of insurance payments would choose not to look for work), and recipients reported an increase in their subjective well-being, there are questions about the fact that the experiment was targeted rather than universal and that the response rate to surveys of the participants was very low.<sup>171</sup>

Professor Harari reports that “[s]imilar experiments are under way in the Canadian province of Ontario, the Italian city of Livorno, and several Dutch cities. (In 2016, Switzerland held a referendum on instituting a national basic income scheme, but voters rejected the idea.)”<sup>172</sup>

He cites, as an ongoing example of a UBI that is not really advertised as a universal income, the Israeli program of treating ultra-Orthodox men:

There, about 50 percent of ultra-Orthodox Jewish men never work. They dedicate their lives to studying holy scriptures and performing religious rituals. They and their families don't starve partly because the wives often work and partly because the government provides them with generous subsidies and free services, making sure that they don't lack the basic necessities of life. Although they are poor and unemployed, in survey after survey these ultra-Orthodox Jewish men report higher levels of life satisfaction than any other section of Israeli society. This is due to the strength of their community bonds, as well as to the deep meaning they find in studying scripture and performing rituals. . . . In global surveys of life satisfaction, Israel is usually somewhere near the top, thanks in part to the contribution of these jobless poor people.<sup>173</sup>

We are not yet in a world of not-enough-jobs-to-go-around in which the UBI makes sense. And we may not get to that state of affairs for decades or ever. But it would behoove us to raise the possibility of a UBI in preparation for that world. I doubt that the proposal will be taken seriously yet. But if academics continue to think, write, and discuss UBI, and if some jurisdictions conduct experiments with a UBI, we shall learn more and more about its limitations, its administrative problems, and its unintended costs and benefits.<sup>174</sup> We shall then be better prepared to face a world in which

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<sup>170</sup> See Heiko Hiilamo, *Disappointing Results from the Finnish Basic Income Experiment*, NORDIC WELFARE NEWS (Feb. 8, 2019), <https://www.helsinki.fi/en/news/nordic-welfare-news/heikki-hiilamo-disappointing-results-from-the-finnish-basic-income-experiment> [https://perma.cc/J8ZQ-WS8Q]. Hiilamo is Professor of Social Policy at the University of Helsinki.

<sup>171</sup> *Id.*

<sup>172</sup> HARARI, *supra* note 27, at 71.

<sup>173</sup> *Id.* at 43.

<sup>174</sup> See, e.g., UGO GENTILINI ET AL., *EXPLORING UNIVERSAL BASIC INCOME: A GUIDE TO NAVIGATING CONCEPTS, EVIDENCE, AND PRACTICES* (2020).

employment accounts for much less of life's meaning and purpose.<sup>175</sup>

#### H. Summary

In this section, I have examined various proposals for dealing with the social and economic problems associated with the technological disruption of employment. I have had as an overriding goal the preservation of the incentive to innovate, on the understanding that the social benefits of innovation are likely to be large and much greater than the social costs. I have further argued that it is better to have a general policy of not trying to steer technological change so as to protect jobs but that it is both equitable and efficient to provide temporary TJLA to those who have lost jobs to technological change if there is a realistic possibility that they can be retrained for other jobs. If there is no such realistic probability, then they should be supported through UBI.

#### IV. CONCLUSION

Joseph Schumpeter characterized the process of economic growth in a capitalist society as one of “creative destruction.”<sup>176</sup> New and better products, processes, work skills, organizational forms, marketing strategies, purchasing plans, and the like arise and destroy or disrupt settled forms of employment, marketing, production, distribution, and the like. Generally speaking, this process leads to betterment—richer, happier lives—but always at a cost to some. A generous society will find a means to enjoy the benefits of improvement and to compensate those who have lost from the “creative destruction.”

For the past 200 years, we have been through a remarkable period of human betterment, and we have, to our great credit, found ways to bring along

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<sup>175</sup> After this conference, Professors Anne Case and Angus Deaton (winner of the 2015 Nobel Prize in the Economic Sciences) published *Deaths of Despair and the Future of Capitalism* (2020). The book highlights the plight of white males without a four-year bachelor's degree between the ages of forty-five and fifty-four. See generally ANNE CASE & ANGUS DEATON, *DEATHS OF DESPAIR AND THE FUTURE OF CAPITALISM* (2020). They are dying in record numbers of drug overdoses, drink-induced liver disease, and suicide in what Case and Deaton call “deaths of despair.” *Id.* These deaths were so numerous (some estimates are of 70,000 per year) that for three recent years the U.S. life expectancy figures declined for the first time in 100 years. *Id.* This problem is a testament to the importance to many, if not the vast majority of, people of having gainful employment and the devastating personal and societal consequences created by the absence of that work. I deeply wish that I had been aware of this important research before writing this paper. See Arlie Russell Hochschild, *How the White Working Class Is Being Destroyed*, N.Y. TIMES (Mar. 17, 2020), <https://www.nytimes.com/2020/03/17/books/review/deaths-of-despair-and-the-future-of-capitalism-anne-case-angus-deaton.html> [<https://perma.cc/ZD7U-6FTY>]; Atul Gawande, *The Blight: How Our Economy Has Created an Epidemic of Despair*, NEW YORKER (Mar. 16, 2020), <https://www.newyorker.com/magazine/2020/03/23/why-americans-are-dying-from-despair> [<https://perma.cc/3W2X-LXAR>].

<sup>176</sup> SCHUMPETER, *supra* note 107, at 82–83.

those who are either ill-equipped or unable to participate in the new worlds that change has created. But the challenge we face now and in the near future may be among the greatest that we have ever faced, on the same order as the challenge of climate change. In the future, AI seems poised to chip away at the tasks humans have found themselves uniquely positioned to perform. It is not mere science fiction to imagine a world in which there are fewer and fewer tasks that humans do as well as or better than AI machines or algorithms. That world presents us with profound issues. How will we find “meaning and purpose” in our lives when that has to be found outside of employment? We almost certainly can do so, and human beings of the future may look back with wonderment and pity on the fact that their forefathers put so much emphasis on the derivation of meaning and purpose in their lives from working rather than on the truly enjoyable aspects of being alive.