Taxing Innovation:
The Challenge of Regulating Job Automation

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October 2017

Acknowledgements
We are thankful for the assistance of Ground Floor Public Affairs and MsJones Design in producing this paper.
Introduction

This paper explores the issue of regulating automation and its effect on employment in the United States. In February, 2017, Microsoft co-founder Bill Gates proposed governments tax companies that automate human jobs in order to replace lost income tax revenue. In an interview with Quartz magazine, Gates said, “right now, the human worker who does, say, $50,000 worth of work in a factory, that income is taxed and you get income tax, social security tax, all those things. If a robot comes in to do the same thing, you’d think that we’d tax the robot at a similar level.”

Gates’s comments inspired local legislators in San Francisco to explore a tax on job automation. While no tax measure has been formally proposed as of this writing, San Francisco officials continue to explore the possibility. San Francisco legislation is often seen as a model for state and local jurisdictions around the country, making this a consequential conversation for employers and governments alike. Talk of a “robot tax” or “automation tax” raises questions about how to predict the way employers will leverage new technologies and what impact they will have on future employment. This paper explores those questions and address the feasibility of a tax on automation by synthesizing relevant academic work and policy conversations.

We propose that the impact of automation on employment is far more complex than Gates’s above quote would suggest, and assert that job automation is challenging to define for the purpose of regulation—at this time.

Automation is not a new phenomenon. At least since the Industrial Revolution to present day, technological advances have made forms of human work obsolete. Think of telephone operators or travel agents, for example. Yet automated technologies have also created entirely new jobs, such as web designers, software engineers, and data analysts. While mechanization and computerization defined job automation in the twentieth and early twenty-first centuries, the next wave of job automation will likely be driven by new developments in artificial intelligence (AI) and robot technology, in what some have coined the Fourth Industrial Revolution. Al may render specific job duties or entire jobs obsolete and should be taken seriously as a policy issue. For example, the introduction of autonomous vehicles will bear real consequences for truck drivers, taxi drivers, and anyone whose work happens primarily behind the wheel of a vehicle. However, many experts predict that AI may create demand for entirely new job categories, as well as increase worker productivity and enable workers to reduce time spent on repetitive tasks. We currently lack sufficient data to fully understand how AI will impact employment and how employers will utilize new automation technologies.

We conclude that any effort to tax income lost to job automation without further study would be premature. First, we need to better understand how automation will impact the job market in the next decade. As the innovation capital of the world, San Francisco employers and government officials have a unique opportunity to collaborate on this issue and collect data. We also echo the guidance of experts in the field of artificial intelligence, who suggest that investment in education and workforce training is key to ensuring American workers benefit equitably from increasing automation in the workplace and offset any potential job loss.
Recent Efforts to Regulate Job Automation

San Francisco Supervisor Jane Kim made national news in March, 2017 after calling for a hearing to explore a tax on job automation, which would be the first of its kind in the United States. Kim has suggested that a tax be levied on employers that use robots to perform tasks previously performed by humans. Revenue generated from the tax would fund workforce development programs for workers displaced by automation.

According to Kim, the overarching goal of the tax would be to redistribute the profits gained by a “handful of corporations” from automation to workers directly affected by this economic shift. Kim, whose district encompasses some of the city’s poorest neighborhoods and its wealthiest zip code, seeks to address rising income inequality. “We need to think about investments in our society that don’t exacerbate the wealth and income gaps that we already see today,” she told Fast Company. “We don’t want to become a third-world country where there’s a big divide between the very rich and very poor.” Kim reflects a broader concern that increasing use of artificial intelligence in the workplace will lead to greater wealth inequality.

Kim acknowledges the difficulties of implementing such a tax. Regulators would be challenged to codify exactly what kind of job loss is considered taxable. Kim has expressed an interest in convening a task force of employers, union leaders, and experts from academia to explore the issue further. In late August, 2017 she launched an initiative to build public support for job automation regulation at the California state level, though no state legislation has been formally proposed as of this writing.

Outside California, no other local and state governments or the U.S. federal government have actively considered regulating job automation to date. In March 2017, United States Treasury Secretary Steve Mnuchin commented, "In terms of artificial intelligence taking over the jobs, I think we’re so far away from that that it’s not even on my radar screen." Outside California, no other local and state governments or the U.S. federal government have actively considered regulating job automation to date. In March 2017, United States Treasury Secretary Steve Mnuchin commented, "In terms of artificial intelligence taking over the jobs, I think we’re so far away from that that it’s not even on my radar screen." 9

While job automation may not be on the forefront of the U.S. federal government’s agenda, regulators and legislators in the European Union have begun to wrestle with the issue. In February 2017, European Union lawmakers heard—and ultimately rejected—a proposed tax on employers who replace human workers with robots. They did, however, call for legislation to create an ethical framework for the development of robots and to establish appropriate legal liability.

Benoît Hamon, the Socialist Party’s candidate in the 2017 French presidential election, also proposed the idea of a robot tax during his campaign. Hamon’s proposed robot tax would have operated in tandem with a €750 Euro/month universal basic income for French citizens. The basic income, though well below France’s poverty line, would have been partially funded by the proposed robot tax. More recently in September 2017, Jeremy Corbyn, Leader of the Labour Party and Leader of the Opposition for the United Kingdom, proposed his own call to action to address the challenges of automation. Recognizing the inevitable productivity increase associated with technological changes, Corbyn’s robot tax would be a proactive measure to force companies to pass on the benefits “to employees through higher wages and shorter hours.”
Recent policy conversations in the United States and abroad point to increasing appetite for regulating automation and artificial intelligence in the interest of protecting workers. These are surely the first of many proposed regulations from local and national governments. Lawmakers and employers alike will be challenged to define job automation and assess its future impact on labor markets and tax revenue.

**Defining Job Automation**

The proposed regulatory efforts detailed above have been referred to interchangeably as “automation taxes” and “robot taxes.” But defining what constitutes job automation or a job-replacing robot for the purposes of taxation will not be easy. Under such legislation, if a fast-food service worker were replaced by an automated robot that performs the same function, the food establishment would then be taxed because one less human employee would mean one less tax-paying resident. Yet the impacts of automation on jobs are not usually this clear cut. One might argue that voice message machines automate secretaries, cloud storage reduces the need for file clerks, and emails have displaced postal workers. Proposals to broadly regulate automation risk opening a Pandora’s box of uncertainties.

Professors Neil Richards and William Smart define a robot as “a constructed system that displays both physical and mental agency, but is not alive in the biological sense.” They, and others, warn against the common misconception of robots as humanoid, nearly sentient beings. “The truth is, we’re surrounded by robotics all the time,” argues Alonzo Kelly, a robotics professor at Carnegie Mellon. “Your washing machine is a robot. Your dishwasher is a robot. You don’t need to have a very broad definition to draw that conclusion... Robotics will continue to be ubiquitous and fairly invisible. Systems will just be smarter and people will accept that. It’s occurring around us all the time now.” The robots that will automate future job functions will look nothing like R2-D2 or WALL-E. We may not even notice their presence.

In the real world, automating technologies cause employers to create, increase, change, improve, reduce, or eliminate jobs over time. The impacts are difficult to predict. For example, just as many voice concerns about the potential impact of self-driving vehicles today, an Economist special report on AI noted that when cars first entered the market people worried about the loss of horse-related jobs. There are surely fewer farriers today than a century ago, but their absence did not create mass unemployment. The rise of cars created countless new jobs in car manufacturing, road paving, car maintenance, roadside retail, and more. The same may prove true of self-driving cars.

It is difficult to predict today how employers will leverage AI and automation technology even ten years in the future. More data needs to be collected from employers to better understand their growth trajectories. Without that data, lawmakers who seek to tax job loss due to automation and artificial intelligence will struggle to determine what kinds of automation should be regulated. A tax that penalizes companies simply for using new technologies may fail to account for entirely new job categories brought about by those same technologies. Automation, as will be discussed below, can both eliminate and create jobs.
Automation and Employment

In 1930, economist John Maynard Keynes warned, “we are being afflicted with a new disease of which some readers may not have heard the name, but of which they will hear a great deal in the years to come - namely, technological unemployment.” Indeed, during Keynes’s lifetime, automation led to the gradual disappearance of numerous job types. Ice men, the individuals who cut and transported ice, were rendered obsolete after the invention of modern refrigeration. Typesetters were replaced by modern lithography and computerized printing presses. Switchboard operators were replaced by automatic switchboards. Human laborers once reset pins at bowling alleys, but the pinsetters were gradually replaced by machines. Lamplighters were replaced by electric street lights. Yet new, often more desirable, occupations arose to take their place.

Keynes could not have predicted what types of jobs would be created or rendered obsolete by new technologies in the mid-twentieth century. Today, economists, computer scientists, policymakers, and futurists face similar challenges in their efforts to predict how automation will change our world a decade or more in the future. Some predict significant job loss due to automation. Others predict a future defined by collaboration between people and machines, commonly referred to as multiplicity. “Multiplicity is not science fiction,” argues UC Berkeley roboticist Ken Goldberg. Rather, “a combination of machine learning, the wisdom of crowds, and cloud computing already underlies tasks Americans perform every day: searching for documents, filtering spam emails, translating between languages, finding news and movies, navigating maps, and organizing photos and videos.” In Goldberg’s view, automation in most cases changes and augments the human experience, rather than sidelining it.

This debate extends to assessments of how automation will impact employment. In their widely cited 2013 study, “The Future of Employment: How Jobs are Susceptible to Computerisation,” Oxford economist Carl Benedikt Frey and roboticist Michael Osborne estimate that 47% of total U.S. employment will be at risk of automation in the near future. Occupations with the greatest risk for automation, according to their findings, include jobs in office and administrative support, transportation, production, construction, extraction, sales, and service work.

Frey and Osborne’s dire prediction of massive job loss is indeed cause for concern, but it is important to note that their assessment does not mean that 47% of the U.S. workforce will soon find itself unemployed. Taking the multiplicity view, it means that many current job tasks are likely to change, and new job categories are likely to be created. Economists Daron Acemoglu and Pascual Restrepo argue that “other sectors and occupations might expand to soak up the labor freed from the tasks that are now performed by machines, and productivity improvements due to new machines may even expand employment in affected industries.” The Organization for Economic Cooperation and Development estimates that, while many job tasks will be automated, only nine percent of jobs are at risk of being eliminated due to automation.

For example, bank tellers survived the proliferation of automated teller machines (ATMs) since the 1980s. In the United States, ATMs reduced the average number of human tellers per bank branch from 20 in 1988 to 13 in 2004, but simultaneously led to a 43% increase in the number of urban bank branches due to the costs savings from automation. Within branches, “ATMs changed bank
employees’ work mix, away from routine tasks and towards things like sales and customer service that machines could not do.” The introduction of automation technology did not eliminate bank tellers, and in fact their numbers remained reasonably stable.

Automation may reduce the need for human labor in certain industries, but that does not mean current job categories will likely be eliminated. In fact, only one of 270 occupations listed in the 1950 US Census has since been completely eliminated by automation, according to a working paper by Harvard economist James Bessen. That one occupation? Elevator operators.

Experts agree that jobs centered around repeatable tasks are among the most likely to be automated; however, the impact of these losses may be insignificant in the broader context of labor trends. Acemoglu and Restrepo find that industrial and manufacturing jobs are the most impacted by robots, particularly in “routine manual, blue collar, assembly and related occupations; and for workers with less than a college education.” One such robot, they propose, can potentially reduce employment by 6.2 workers in a given commuting zone. Similarly, Frey and Osborne suggest possibilities for automation in agricultural work, warehouses, and hospitals. This might sound like a troubling trend, but as Jed Kolko of FiveThirtyEight points out in his article “Republican-Leaning Cities Are At Greater Risk Of Job Automation”, “routine” jobs were already in trouble by the turn of the century. With the decline of American manufacturing employment, “routine” jobs stagnated from 2000 to 2014, dropping one percent, while non-routine jobs over that same time period led to all of the job growth in the country, increasing by 30 percent. With such distinct labor trends already in play, it is clear that certain populations of workers will be impacted more significantly than others.

Policymakers and employers will need to address the impact of automation on economic inequality. As automation reduces the need for repetitive human work, it will likely have a negative impact on job opportunities for low-wage, less-educated workers. A 2016 White House report on job automation concludes automation will put “downward pressure on wages and upward pressure on inequality.” Frey and Osborne echo this claim, suggesting that low-wage service jobs may soon be susceptible to automation. Future job automation, then, may continue to exacerbate the trend of rising wealth inequality experienced by the U.S. economy since the 1970s.

Experts in the field of artificial intelligence remain remarkably divided in their predictions of how AI will impact employment. A 2014 Pew Research survey of 1,896 experts in the field of automation and artificial intelligence found that 52% of survey respondents believed technology will create more jobs than it displaces by 2025. This lack of consensus points to the need for more data on this subject, and also demonstrates that predictions of mass job loss are by no means a certainty.

**New Jobs in the Automated Economy**

Job automation certainly poses risks for the U.S. labor market, but it also presents opportunities. While automation will almost certainly cause some job loss, it may also increase the demand for skilled workers, improve worker productivity, and contribute to a healthier economy.
The development of new automation technologies may increase demand for some job categories and create entirely new ones. The 2016 White House paper on automation and the economy predicts that four sectors of employment will experience job growth as a result of automation:

- Engagement: demand for labor in which humans complement AI technologies;
- Development: need for skilled software developers and engineers;
- Supervision: need for workers to monitor, license, repair automated systems; and
- Response to paradigm shifts: dramatic changes in infrastructure will create a new need for designers, urban planners, and other experts.  

Human workers will design, build, and maintain future technologies. Automation carries the potential to create new opportunities for well-paid, technical, and creative work.

Economists and AI experts also predict that automation will lead to a direct increase in worker productivity and business revenues. A recent study released by Salesforce suggests that the adoption of new AI technologies in customer relationship management (CRM) platforms could increase global business revenues by $1.1 trillion and create 800,000 net-new jobs by 2021.  

Since the Industrial Revolution, increases in worker productivity have often led to an increase in wages and improved quality of life for workers. In the coming decades, for example, autonomous vehicles may enable workers to use their working hours more efficiently: “salespeople who currently spend a considerable amount of time driving could find themselves able to do other work while a car drives them from place to place.”  

Automation may also enable workers to reduce the time they spend on repetitive or routine tasks that bring minimal fulfillment, like driving, and instead focus on skilled work demanding uniquely human attributes. Frey and Osborne suggest that occupations with values like “fine arts,” “originality,” “negotiation,” “persuasion,” “social perceptiveness,” and “assisting and caring for others” are at relatively low-risk for automation. To the extent that automation reduces the time spent on routine tasks, it may make work more enjoyable and satisfying.

New developments in AI technology may also improve workplace and public safety. General Electric, for example, developed robots to perform what were once dangerous jobs, such as maintaining wind turbines. Similarly, the proliferation of autonomous vehicles is anticipated to reduce accidents and improve road safety for both construction workers and commuters.

Automation will radically change the economy and job market in ways we cannot predict today. As in the past, the development of new technologies will undoubtedly render some jobs obsolete. However, it seems more fitting to say that automation will change human work experience, rather than reduce employment. Machines will augment and complement human jobs. New technologies will create demand for new categories of jobs. “We can’t predict what jobs will be created in the future, but it’s always been like that,” noted Joel Mokyr, an economic historian at Northwestern University. Desirable career paths in cybersecurity or video-game design, in his example, were unthinkable a century ago.
sf.citi’s Recommendations

We at sf.citi believe the San Francisco Bay Area is well positioned to benefit from new developments in automation and AI. Government has a role to play in this process, but it should not be one of resisting change by levying a punitive tax on innovation. Rather policymakers can be far more effective if they engage with employers and challenge them to ensure the impacts of automation on workers are positive and equitable. With the appropriate leadership from and cooperation between government and business, we can ensure that new technologies serve to strengthen our economy, increase opportunities for skilled employment, and improve the wages and work experiences of Bay Area residents. We recommend that legislators and employers prepare for future economic change in three key ways:

1. **Public-Private Partnership:** We currently lack sufficient input and data on which jobs or tasks employers plan to create, change, or automate in coming years. By creating a public-private partnership between San Francisco legislators, private industry, and other stakeholders, we can begin to discuss, collaborate on, and forecast for these changing trends. For example, San Francisco could play a leading role in collecting such data by surveying local entrepreneurs and companies who utilize AI technology. The city might collect data about their predicted job growth, their planned introduction of new technologies or product lines, and how much money they have invested in AI technology. This data will help inform smart and effective policy. The task force of experts that Supervisor Kim expressed an interest in convening would be a great place to start.

2. **Invest in Training:** Employers must invest in training their workers for a more automated workplace. Companies should identify the skill sets they believe they will need in the future, and prioritize developing those skills sets in current employees. Some forward-thinking employers are beginning to do this work already. Amazon’s Career Choice program provides associates with training to pursue skilled careers in computer-aided design, aircraft mechanics, nursing, machine tool learning, and more. AT&T is training 100,000 of its current employees in the workplace skills that will be in demand in the future through its Workforce 2020 program. Salesforce created Trailhead, an educational program to help anyone get acquainted with and certified in the enterprise platform in anticipation of growing need for CRM tools. The White House report on job automation predicts, “the degree to which we fulfill the idea that AI can increase productivity and boost wages is reliant on being able [to] prep workers to handle AI and its impacts on the labor market.” In a similar vein, we must continue to support public-private partnerships through re-training efforts with the public and nonprofit sector, such as through local programs such as the TechSF apprenticeship program, YearUp, and JVS. Government should encourage and support employers in their corporate retraining efforts, as well as their participation in public and nonprofit retraining programs, through removing barriers and incentivizing participation through grants and subsidies.

3. **Prioritize a Twenty-First-Century Education:** Experts may disagree on whether automation will create or reduce job opportunities, but they widely agree that our current public education system is not adequately training young people for future work. For workers to “win the race” against automation, Frey and Osborne write, they will need to acquire creative and social intelligence-based skills. Advanced technical skills needed to build, maintain, and operate AI technologies will also be in
greater and greater demand. Quality education that is accessible to all is more important now than ever. We believe it is imperative that voters, taxpayers, and governments around the country reverse the current trend of defunding and deprioritizing public education. We must empower educators to redesign K-12 public school curricula to prepare students for skilled and lucrative careers through quality STEM, arts, and communications education. San Francisco’s public school system has already taken an important step towards this goal, committing to make computer science a central part of student learning at all grade levels from pre-K through high school. Further, many San Francisco tech companies are currently working closely with schools across the city to provide real-world STEM training to students, such as through sf.citi’s Circle the Schools program or Microsoft’s TEALS program. Fully modernizing our education system will require increased funding for schools, as well as the participation of business leaders in curriculum development.

In conclusion, we at sf.citi believe automation presents an opportunity, not a threat, to our economy in the San Francisco Bay Area. We are entering a Fourth Industrial Revolution, one in which artificial intelligence will reshape our economy as dramatically as computerization or electrification did in past technological revolutions. AI will certainly change work opportunities in the coming decades, but we do not anticipate a dystopian future in which automation causes mass unemployment. Instead, new technologies will complement human jobs and create new opportunities for workers, as has happened in the past.

Rather than rushing to levy a punitive tax against employers for utilizing new technologies, we urge lawmakers to collaborate with the business community in order to have a positive influence on how AI and other automating technologies impact workers. Together we can ensure that our region and its workers benefit from the changes to come.
Suggestions for Further Reading

Studies, Reports, and Academic Papers


Gantz, John F.; Murray, Gerry; Schubmehl, David; Vesset, Dan; Wardley, Mary. “A Trillion-Dollar Boost: The Economic Impact of AI on Customer Relationship Management.” IDC, June 2017.


News Articles


Taylor, Tess. “AT&T Invests over $1B to Retrain 100,000 Employees.” HR Dive, March 14, 2017.
Endnotes

1 Kevin Delaney, “The robot that takes your job should pay taxes, says Bill Gates,” *Quartz*, February 17, 2017.
4 Robinson, “San Francisco is Considering a Once Unthinkable Measure to Offset the Threat of Job-Killing Robots.”
12 Bershidsky, “A Robot Tax is a Bad Idea.”
32 “Artificial Intelligence, Automation, and the Economy,” Executive Office of the President, 1.
33 “Artificial Intelligence, Automation, and the Economy,” Executive Office of the President, 17.
38 Tess Taylor, “AT&T Invests over $1B to Retrain 100,000 Employees,” HR Dive, March 14, 2017.
40 “Artificial Intelligence, Automation, and the Economy,” Executive Office of the President, 2.