TEACHING THE ECONOMICS OF AUTOMATION

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Abstract

The purpose in this paper is to create a teaching module on the economics of automation. Avoiding technicalities but focusing on critical thinking, key ideas in the economics of automation are highlighted, and class discussion material is provided based on popular books published in the 2020s. Differing perspectives from these books allow for rich class discussions on topics including the risks of automation, the power of Big Tech, and policy responses for the digital economy. For ECON 101 students, Disney animation clips are provided as hooks to engage in analogy-based understanding of issues in automation. Likewise, other video clips are used to discuss the risks and dangers of automation related to jobs, scams, democracy, and political polarization. Overall, this teaching module highlights key ideas in the economics of automation, incorporates ideas from recently published books, and complements the lecture with videos to retain student interest.

Keywords: economics of automation; artificial intelligence; risks of automation; ChatGPT.

JEL Classification: A22

Introduction

After the 2007- 2008 global financial crisis (GFC), student groups protested that the focus on economics education should shift from stylized mathematical problems to real world economic issues (Earle, Moran, and Ward-Perkins, 2017). Such issues include climate change, economic inequality, racism, populism, and the topic of this paper, automation, all of which are usually not covered in ECON 101. In response, Bowles and Carlin (2020) promoted the freely accessible online CORE textbook that offers modules on economic inequality, environment, innovation, and racial inequality. However, Michell (2023) has argued that the CORE textbook introduces economics through "game theory and market imperfections," which many students without access to "tutoring and mentoring" would find hard to follow, and that it favors "stronger students and elite institutions." I have also found the CORE textbook to be fraught with information overload and advanced concepts, which defeats the purpose of reaching out to students despite the free accessibility of the textbook.

In contrast, while confirming that economics education should deal with pressing real-world issues, de Muijnck and Tieleman (2021) argue that obsessing with technicalities is inappropriate at the undergraduate level and emphasize critical evaluation of diverse ideas (pp. 69-71, 83-84). It is this approach of limiting technicalities and contrasting pluralist ideas that motivates my approach towards introducing students to real world issues like automation. This topic has been largely neglected at the ECON 101 level, as evident from the fact that various

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textbooks like Ragan (2020), Hubbard et al. (2015), Karlan et al. (2017), Parkin and Bade (2016), and Mateer and Coppock (2018) do not mention automation or artificial intelligence (AI) in the subject index. The same holds for Mankiw, Kneebone, and McKenzie (2023), the textbook I have conventionally used. Curiously, however, the previous edition of the same textbook has a news item on AI and the future of work that delves into the acquisition of start-ups by Big Tech, the issue of universal basic income (UBI) in a future without work, the need for ethics in automation, and the importance of "social and cognitive skills" for the future (pp. 294-295).

At the intermediate micro level, Besanko and Braeutigam (2014) illustrate labor saving technological progress due to robotics and capital saving technological progress that favors high skilled workers through a change in the slope of the isoquant (pp. 237-242). Overall, they explain the higher wages of skilled workers through this skilled biased technological change where the demand for skilled workers has increased relative to supply. At the intermediate macro level, Mankiw and Scarth (2020) briefly state the microeconomic fact that research is driven by the profit motive, and the patent system is not easily incorporated into macroeconomic growth models (p. 282). However, they add that technological progress has mainly benefited high-skilled workers and that addressing wage and income inequality requires more resources towards educating and training workers (pp. 64-65). Overall, the issues of AI and automation are missing even at the intermediate level, and instead the focus is on the technicalities of the isoquants in microeconomics and endogenous growth models in macroeconomics.

While the treatment of automation is lacking or technically embedded in various textbooks, popular books like *Excuse Me Professor* delve into the topic in a user-friendly manner. Specifically, in Section 46 of the book, McElroy (2015) argues that patents granted to technology companies constitute crony capitalism, that workers being replaced by robots is creative destruction, worker displacement will be temporary, and that replacement jobs will require skills like problem solving and caregiving. However, this is one position promoted by the think tank, Foundation for Economic Education, which is behind the book. Such positions must be viewed in the context of the larger literature on the economics of automation including review papers and recently published books that consolidate prior research or provide a cutting-edge view on the subject.

Overall, the limitations of the CORE text, the focus on technicalities or the absence of the issues of AI and automation in various textbooks, and the partisanship of think tank books all provide the motivation for creating a teaching module on the economics of automation. As such, the purpose in this paper is to review the key ideas in the economics of automation to prepare teaching lessons that avoid technicalities but focus on critical thinking in ECON 101 or elective topics classes. This paper is divided into five sections, where the next section delineates the key ideas in the economics of automation, based on review papers and book chapters, that can be covered in lectures. Section 3 provides questions and suggested answers based on four books that have been published in the 2020s to facilitate class discussions. These offer additional topics like the risks of automation, the power of Big Tech, and policy responses for the digital economy. Section 4 includes the use of Disney animation clips and YouTube educator Dhruv Rathee's video clips as hooks to discuss ideas in the economics of automation. Section 5 provides concluding remarks.

Key Ideas in the Economics of Automation

Automation

Before highlighting the key ideas in the economics of automation, it is important to note that automation has been part of human history. Deschacht (2021) highlights the 4th industrial revolution (AI), which was preceded by the 3rd industrial revolution (computers and communication technologies), 2nd industrial revolution (electrification and railroads), and the 1st industrial revolution (steam power). The focus in this paper is on automation based on AI and, to a lesser extent, new technology based on synthetic biology. According to Acemoglu and Johnson (2023), a common theme with all these waves of automation is that of unequal benefits (i.e., historically, power withheld the benefits of medieval technology from peasants, better ship design led to slavery, textile factories led to horrible work conditions, and advances in computers enriched a few entrepreneurs (pp. 3-5)). Despite this common element, the coming wave of automation based on AI and new technology based on synthetic biology stands out in terms of disruption on a global scale due to the risks of "AI-powered cyberattacks, automated wars, [and] engineered pandemics" (Suleyman and Bhaskar, 2023, p. 10). This is why the coming wave of automation deserves special focus and cannot simply be treated like the previous waves of automation.

A Primer for Educators

In a primer for educators, Wolla (2020) delves into the economics of AI stating that it provides a "current-issues hook" to engage students with economics. He mentions that instructors can discuss the dissipation of work for humans as horses were replaced by cars, investment in education with impending AI, and the impact of automation and AI on economic inequality. Drawing on the economics literature, he references the works of prominent economists David Autor and Daron Acemoglu. Among the key ideas, he highlights that machines both substitute and complement labor so that fears of machines replacing humans or optimism that technological change eventually creates jobs are both exaggerated.

He mentions the displacement effect of automation, which decreases labor demand and wages, is opposed by three countervailing effects. These include the productivity effect, where machines complement labor and make them more productive, thereby increasing labor demand. This has been the case of ATM machines that allowed humans to shift away from routine tasks to focus on tasks based on "creativity, building relationships, and problem solving". The second countervailing effect arises when higher productivity due to automation lowers prices, raises real income and demand for goods and services, and therefore increases labor demand. Finally, there is a countervailing effect that arises through the creation of new jobs in new industries, which increases labor demand. These jobs will require skills in areas like "robot integration and search engine optimization", caregiving for an aging population, or in services like physical training or personal services for affluent consumers.

However, despite the countervailing effects, the transition for workers towards new jobs is not smooth, as it requires learning new skills. Wolla highlights "employment polarization," as middle level jobs are replaced, and there is high demand for high-skilled workers and high supply for low-skilled workers. Additionally, there is the issue of rising inequality, as income accrues to

companies that invest in AI and automation. He notes that this has led billionaires Mark Zuckerberg and Elon Musk to support UBI and Bill Gates to support robot taxes that would finance jobs in caregiving and slow the speed of automation. Finally, Wolla highlights the suggestion that students pursue a double major to develop "problem solving, creativity, and critical thinking skills" through the liberal arts and "quantitative and technological skills" through STEM (science, technology, engineering, and mathematics) subjects.

Review of the Economics of Automation

In a review of the labor economics of automation, Deschacht (2021) distinguishes the first order effect (substitution effect) from the second order effect (scale effect). He illustrates the scale effect by stating that even as the tasks of airline pilots have been automated, the increased productivity reduced airfares, increased the demand for air travel and therefore the demand for airline pilots. Additionally, he highlights that automation does not necessarily mean displacing occupations but rather shifting tasks, as in the case of secretaries shifting from typewriting towards management tasks.

Referring to the impact of automation, he states it could lead to upskilling with skill-biased technological change or deskilling when skilled workers are replaced by unskilled workers, as in the case of artisans during the 1st industrial revolution. Moreover, he emphasizes that automation is "routine-biased" and not "skill-biased", which means that even high-skilled workers like radiologists can be replaced by AI, whereas demand for low-skilled workers in caregiving continues to grow.

On inequality, he states that the main determinants of increasing inequality are skill-biased technological change followed by "declining union power" and "import competition." Such technological change exacerbates inequality due to the "superstar phenomenon" and "winner-take-all" outcomes, where very talented people reach large markets, which widens the gap between their earnings and those of the rest. On wellbeing, he states that job quality increases with the automation of routine tasks and robots taking over work with high risk of injury. However, he adds that digital technology has also led to better monitoring and surveillance of workers, which increases the intensity of work and mental stress. Finally, on unemployment, he highlights that it may rise, as it is difficult to transition from one sector/region to another, and as the returns from automation accrue to high income earners with a higher propensity to save, which reduces aggregate demand and therefore labor demand.

Education for a Post-work Future

In a paper on a post-work future, Means (2017) mentions that classical thinkers like Mill and Ricardo argued that labor saving technology could have a negative impact on employment in the long run, whereas Say argued that new employment would rise in the long run even as workers are displaced in the short run. Likewise, where Keynes was concerned about technological unemployment, Schumpeter argued that creative destruction would create new employment. Means states that mainstream economics rejects the "Luddite fallacy" that technology destroys jobs, given the historical pattern that technology has created more jobs than it has destroyed. Moreover, it highlights that while automation displaces low-skill jobs, it creates high-skill jobs so that education and skill upgrading can temper the displacing impact of automation. Overall, based

on mainstream economics, innovation will increase productivity and employment and decrease inequality.

However, Means highlights that the benefits of automation have been appropriated by "elite owners and high-level executives." He also notes that most of the jobs created in the U.S. are in the low-skill sector and that due to "educational inflation" with more degrees awarded, there may be more workers with advanced credentials than there are jobs commensurate with their qualifications. Additionally, there is the issue of tuition costs and aversion to taking large loans, which prevents low-income individuals from accessing higher education. Thus, he argues that human capital theories fail to address rising inequality and increased precarity of employment.

Excessive Automation

In a chapter discussing AI and automation, Acemoglu and Restrepo (2019) highlight the issue of excessive automation that arises because of tax bias in favor of capital relative to labor and which leads to inefficiency and poor productivity growth (p. 199). They argue that "so-so automation technologies" contribute more to the displacement effect than the countervailing productivity effect. Additionally, they argue that the potential of AI to automate tasks is limited as in the case of tasks based on "complex reasoning, analogy-based learning, abstract problem solving, empathy, and communication skills" (p. 208). Finally, they state that if the benefits from automation are not widely shared there might be a political reaction to thwart the "adoption and development" of such technologies. Overall, they highlight the issues of "so-so technologies," the limits of AI, and the negative impact of automation on inequality.

Overall, based on the review of pedagogical and review papers, the following key ideas in the economics of automation can be highlighted in class lectures. The following shows the absence of several topics like risks of automation, the power of Big Tech, and policy responses for the digital economy, which can be incorporated by drawing from recently published books in the next section.

1. The substituting and complementing relationship of machines with human labor that lead to displacement/substitution/first order effects that displace labor versus the countervailing/productivity/scale/second order effects that increase labor demand through higher real income and creation of new tasks.
2. The impact of automation on employment and wages based on the two types of effects.
3. The nuance in the impact of automation on tasks versus jobs.
4. The impact of automation on job polarization or hollowing out of the middle class.
5. The effect of automation on upskilling and deskilling.
6. The need for programming skills through STEM subjects and for critical thinking and emotional intelligence skills through the liberal arts.
7. The issue of so-so technologies and excessive automation.
8. Excessive automation because of tax bias in favor of capital.
9. The impact of automation on economic inequality through the rise of superstar or winner-takes-all firms.
10. The limits to the role of education and the limits of AI in automating tasks.
11. Breaking the binary between the "machines displace humans" view and the "technology creates jobs" view.

Class Discussions and Book Reviews

Given rapid developments in AI and automation, several books have been published in the 2020s on the subject. While instructors highlight key ideas in the economics of automation reviewed in the previous section, they can also assign select chapters (Blanchard and Rodrik, 2021; Qureshi and Woo, 2022) for class discussions or book reviews (Susskind, 2020; Suleyman and Bhaskar, 2023; Acemoglu and Johnson, 2023). The idea behind assigning chapters or books is to facilitate critical thinking skills through class discussions and book review presentations. Peach (2023) emphasizes that discussion exposes students to a "plurality of views" and that contrasting different viewpoints is an important part of understanding beyond the abstract graphs and mathematics. Additionally, he mentions that incorporating discussion in class to promote active learning mitigates the weakness of the chalk and talk method conventionally used in economics pedagogy.

Assigning book review presentations or having class discussions based on recently published books helps complement the key ideas in the previous section with several topics like risks of automation, the power of Big Tech, and policy responses for the digital economy. Specifically, chapters 1, 5, and 7 from Qureshi and Woo (2022) can be assigned to discuss Big Tech, the impact of automation on jobs, wages, and inequality along with policy responses in the digital economy. The advantage of the book edited by Blanchard and Rodrik (2021) is that chapters can also be assigned to ECON 101 students, as they are quite short at 6 – 8 pages each. Thus, chapters 17 and 18 can be assigned to discuss automation, inequality, and policy responses to excessive automation.

Susskind (2020) can be assigned to discuss an alternative opinion to the mainstream economic view that technology will eventually create jobs or that people can adjust through education and training. A review of this book would allow discussions on finding purpose in a post-work future, the impact of automation and AI on economic inequality, and the political power of Big Tech. Suleyman and Bhaskar (2023) can be assigned to highlight the risks of AI and synthetic biology as they become increasingly cheaper and widely accessible. A review of this book would allow discussions on catastrophic outcomes, authoritarian surveillance, and the steps towards containment, which is about the capacity to control technology and its direction. Finally, Acemoglu and Johnson (2023) can be assigned to emphasize that shared prosperity is not the automatic result of automation but an economic and political choice to distribute gains and wrest the direction of technology from a narrow elite. A review of this book would allow discussion on shifting the narrative, building countervailing powers, and developing policy solutions.

What follows are questions and suggested answers to facilitate critical discussions in class based on the key ideas on the economics of automation from the previous section and additional topics of the risks of automation, the power of Big Tech, and policy responses for the digital economy based on these books.

1. What is the impact of automation on employment and wages?

Suggested answer:

The standard answer is that it depends on the relative strength of the displacing effect and the countervailing effects. If the substitution effect prevails then machines will replace workers

and employment will decline. Technologically employed workers will then compete for remaining jobs at lower wages. However, if the countervailing effects prevail then as automation increases productivity and lowers production costs, it will increase real income, spur aggregate demand, and increase labor demand. This means that employment will rise. However, wages will still depend on the types of jobs that are created as routine jobs are replaced. The wages of those with skills that are in high demand but less supply, like machine learning, will rise; the wages of workers with interpersonal skills in caregiving will depend on whether the demand from an aging population rises faster than the supply of the increasingly displaced workers; and finally the wages of services like yoga trainers and personal fitness trainers will depend on whether they cater to the elite or whether their increased supply, like that of massage therapists, will allow them relatively lower wages.

However, this standard answer can be complemented with other perspectives as follows. For introductory classes or weaker cohorts, instructors will have to provide the following information, and for elective topics classes with serious students, instructors can expect student groups to comb the books for the respective perspectives and share their findings as part of book review presentations. As student groups share their answers, they can be asked which perspective they find themselves in agreement with and this will depend on their belief on whether automation will be labor complementing or substituting. Introducing various perspectives provides a pluralist and richer understanding beyond the standard answer.

Qureshi and Woo (2022): Chapter 5 by Harry Holzer highlights the standard economics view that automation raises productivity, lowers prices, increases real income and demand, and therefore raises employment, as evident from the assembly line in the 1920s, computers in the 1980s and 1990s, and cellular phones in the 2000s (pp. 124-125). Thus, automation increases employment and wages.

Acemoglu and Johnson (2023): They state that business owners focus on automation and surveillance to control wages and weaken labor power (pp. 28, 33). They state that digital technologies have enriched entrepreneurs and investors but real wages for most workers have scarcely increased, which has led to a “two-tiered society” (p. 13). These tiers are based on the narrative that the elite deserve their wealth based on their genius and the rest are error prone who can be replaced by machines (p. 338). Thus, automation would lower wages to enrich the elite entrepreneurs and investors.

Susskind (2020): He critiques the view that automation will take over repetitive tasks leaving meaningful work for people (pp. 103-104). While there will be demand for humans for jobs like baristas, tailoring, or caring, it will not be enough to keep everyone employed (pp. 123-124). Moreover, jobs that are created include low-paid jobs like restaurant services or well-paid jobs like fitness instructors, both in the service of the wealthy (p. 110). Overall, he argues that while economists have been dismissive of technological unemployment, eventually machines will take over human tasks, as the substitution effect will eventually take over the labor complementing effect of technology (p. 99, 113).

Suleyman and Bhaskar (2023): The authors mention that while economists argue that new technology creates jobs, the coming wave is "fundamentally labor replacing," as machines will "eventually do cognitive labor more efficiently and cheaply" (pp. 178, 179). Furthermore, they state that people who get PhDs in machine learning will always be a small fraction of those that will be technologically unemployed, and that that even if Silicon Valley creates lots of jobs, it does not help if people are not able to upgrade or relocate (p. 180). Thus, automation will reduce employment.

2. What is the impact of automation on economic inequality?

Suggested answer:

Based on the review papers in the previous section, automation can lead to hollowing out of the middle class through "employment polarization," as middle level jobs are replaced. While there is high demand for high-skilled workers, not many displaced workers can compete for those jobs. For instance, it is difficult for a truck driver to upgrade skills or relocate to compete for high-tech jobs in machine learning. This means, such workers will either withdraw from the labor force or compete for low-skill jobs in the retail or hospitality sector where wages are lower due to high supply of low-skilled workers. Thus, as few high-skilled workers earn more and many low-skilled workers compete for low paying jobs, automation contributes to increased inequality.

Additionally, inequality can also rise due to the "superstar phenomenon" or "winner-take-all" outcomes, where due to random luck of the draw on good looks or singing voice, some can reach very large markets, which widens the gap between their earnings and those of the rest. On the other hand, even high-skilled workers like radiologists can be replaced by AI, as automation is "routine-biased" not "skill-biased". Overall, automation contributes to inequality where meaningful contribution like that of radiologists is undervalued and the superficial offering of those who display their bodies on websites like OnlyFans or have a viral moment online is overvalued.

This suggested answer does not account for the role of Big Tech in contributing to inequality. Thus, other perspectives from the designated books can be drawn to complement the suggested answer as follows. Students, whether through lectures by instructors or through book review presentations, can learn how various independent authors have arrived at similar conclusions on the role of Big Tech in contributing to inequality.

Qureshi and Woo (2022): They state that the benefits of digital innovation have been mainly appropriated by superstar firms based on first mover advantage, network effects, and big data (pp. 6, 7). Additionally, Big Tech has both monopoly power to increase markups and monopsony power to dictate wages (p. 10). Moreover, they state that competition policy has failed to keep the digital economy competitive (p. 7). Thus, automation increases inequality when big firms pay low wages to workers and when they drive out competition from the market.

Susskind (2020): He states that inequality has increased because of unequal returns to labor and capital and the rise of superstar firms (pp. 139, 140, 143). The economic power of superstar firms or Big Tech, which is based on big data and powerful computational power, and network or

bandwagon effects, translates to political power (pp. 197, 199, 201, 202). Thus, automation increases inequality as Big Tech exercises economic and political power to keep wages low and returns on capital high.

Suleyman and Bhaskar (2023): On Big Tech, they state that the coming wave is led by corporations that control AI processors, advanced quantum computers, and robotics (p. 187). Such "superstar" corporations acquire market power due to the first mover advantage, having more data, and hiring the best talent (pp. 188, 191). This power allows them to shift value away from labor and towards capital through surveillance in smart warehouses (pp. 191, 196). Thus, automation increases inequality through the power of Big Tech.

Acemoglu and Johnson (2023): They state that new technology is aligned with the narrative of a narrow group of powerful people (pp. 24, 27). To illustrate, they mention that profit and shareholder value maximization was projected as the common good and labor was seen as a cost to be reduced (pp. 88, 255, 290). According to this narrative, automation is about reaching parity with humans not complementing them (p. 311). Moreover, they state that digital technologies have enriched entrepreneurs and investors but real wages for most workers have scarcely increased, which has led to a "two-tiered society" (p. 13). These tiers are based on the narrative that the elite deserve their wealth based on their genius and the rest are error prone and can be replaced by machines (p. 338). Thus, they argue that automation can increase inequality by enriching the elite and by making workers redundant.

3. What can students do to cope with the coming wave of automation?

Suggested answer:

Based on the review papers, while automation displaces low-skill jobs, it creates high-skill jobs so that education and skill upgrading can temper the displacing impact of automation. Thus, there is a suggestion that students pursue a double major to develop "problem solving, creativity, and critical thinking skills" through the liberal arts and "quantitative and technological skills" through STEM (science, technology, engineering, and mathematics) subjects. However, if most of the jobs created are in the low-skill sector and if more degrees are awarded, there may be more workers with advanced credentials than there are jobs commensurate with their qualifications. Additionally, there is the issue of tuition costs and aversion to taking large loans, which makes accessing higher education difficult. Thus, the strategy of education and upgrading skills may work in the short run for some individuals but not for many others in the long run.

The authors of the designated books appear to support perspectives on education and upskilling that can be contrasted to showcase that there is no universal consensus on the issue.

Qureshi and Woo (2022): In chapter 5, Harry Holzer argues for K-12 education that emphasizes "critical thinking, creativity, communication, and social skills" and lifelong learning accounts that workers can access for retraining (pp. 136, 138).

Acemoglu and Johnson (2023): They note the limits of education and upgrading, as their benefit is dependent on the limited demand from companies (p. 418).

Suleyman and Bhaskar (2023): They state that people who get PhDs in machine learning will always be a small fraction of those that will be technologically unemployed, and that that even if Silicon Valley creates lots of jobs, it does not help if people are not able to upgrade or relocate (p. 180).

Susskind (2020): He states that economists emphasize education, lifelong learning, and training for jobs that require coding skills (pp. 155, 157, 161). However, he emphasizes the limits of this strategy, as many jobs like caregiving do not require advanced education (p. 158). Moreover, where some older workers do not have enough productive labor time left to justify incurring expenses of retraining, others may simply be unable to re-educate themselves (pp. 165, 166). He illustrates that it is not easy for truckers to become programmers, and such workers do not always have the money to relocate to find jobs (pp. 106-107, 111). Finally, he argues that machines will replace humans even in tasks requiring creativity and empathy so that there are limits to asking people to retrain or re-educate themselves.

4. Billionaires Mark Zuckerberg and Elon Musk support UBI, and Bill Gates supports robot taxes to deal with automation. Are these effective policies?

Suggested answer:

In contrast to the views of the billionaires, the standard answer is that UBI is expensive, not targeted, and that it may disincentivize work. Likewise, robot or automation taxes may be detrimental to technological progress. However, the topic on policy issues deserves to be more comprehensively addressed with the designated books. Instructors may share the following with students through lectures or ask student groups to present on policy issues through book review projects. The various policy prescriptions showcase the different perspectives of the authors and students can be asked about their opinions on the efficacy of these policy suggestions.

Suleyman and Bhaskar (2023): They suggest taxing robots, offering reskilling and education programs, and instituting UBI to address the destabilizing effects of the coming wave (pp. 261-262). Their viewpoint, as entrepreneurs unlike economists, seems to be consistent with that of the billionaires on UBI and robot taxes.

Susskind (2020): He argues for a conditional basic income as opposed to UBI so that people earn income based on their contribution to the community through artistic, cultural, educational, household, and caregiving activities (pp. 183, 187, 233). This is because technological unemployment would hollow out the sense of purpose, as the unemployed experience depression, feel aggrieved, and have a higher suicide rate than those with jobs (pp. 215, 219).

Acemoglu and Johnson (2023): They reject robot taxes, as that would neglect algorithms that instigate automation and instead support breaking up of Big Tech to incentivize “greater diversity

of innovation" (p. 405). Likewise, they do not support UBI because it is not targeted, and they instead highlight that people's wellbeing is based on their contributing to society (p. 416). On other policy solutions, they suggest not enforcing patents on surveillance technologies (p. 403). Additionally, they suggest equalizing the tax rates on labor and capital to remove the bias towards automation by reducing payroll taxes, raising corporate taxes, and closing tax loopholes (p. 407). They also support subsidies for worker training, privacy regulation on data ownership that would limit Big Tech from collecting big data, and "digital advertising tax" that would discourage "ad-based business models" (pp. 408, 411, 413).

Qureshi and Woo (2022): They highlight issues with UBI for incentivizing workers to withdraw from the labor force, the issue of robot taxes as they can discourage innovation, and instead emphasize balanced taxation of labor and capital to curb excessive automation and promote employment friendly innovation (pp. 21, 22). On other policy suggestions, they argue for adapting competition policy for the digital economy, protecting data privacy for both consumer protection and firm competition, reforming patents for innovation diffusion, promoting public R&D programs to direct technological change and curb excessive automation, allowing lifelong learning accounts to facilitate workers access to training, and international collaboration on tax policy, competition policy, and regulation of digital markets (pp. 13-18). Similarly, in chapter 7, Francois Bourguignon critiques robot taxes as it is not clear how to define a robot and distinguish it from an algorithm, just as he criticizes payroll taxes to fund worker retraining as that would incentivize more automation, redistribute income from labor to capital, and therefore exacerbate inequality (p. 207).

5. What are the risks of automation, will it enable dictators or civil society, and how can governments respond to the potential disruption of the coming wave?

Suggested answer:

The labor economics of automation focuses on the impact of automation on employment, wages, and inequality, which have been addressed as part of questions 1 and 2. Additionally, government response through policies like UBI and robot taxes have also been addressed as part of question 4. Going beyond the confines of economics, instructors can share other risks and threats of automation through their lectures or ask students to reflect on the political economy of automation through issues of the viability of democracies, rise of populism, political polarization, authoritarian surveillance, and catastrophic outcomes through book review projects. Two books touch on these issues, with Suleyman and Bhaskar (2023) focused specifically on such risks as follows.

Acemoglu and Johnson (2023): They indicate that new technology can empower civil society, as in the case of the Arab Spring where protestors used Facebook and Twitter to topple autocrats (pp. 342). However, they add that authoritarian regimes also use digital technology for surveillance and digital propaganda, which has led to hyper nationalism (pp. 341, 347). Adopting a nuanced perspective, they emphasize that "digital technology is not pro-democratic or antidemocratic" and that the direction of technology is based on choices made by "tech companies, AI researchers, and governments" (pp. 353, 378). Likewise, business models based on user engagement and digital

ads have led algorithms to promote hate speech bubbles and misinformation (pp. 357, 359, 360). All of this means that whether automation will empower civil society or weaken democracy will be based on the choices made by the actors in the economy. Thus, the authors place a caveat on digital technology empowering civil society by highlighting the risks of authoritarian surveillance, weakening of democracy, political polarization, misinformation, and hate with AI and digital technology.

Suleyman and Bhaskar (2023): They mention that the coming wave of technology and automation is contradictory in that it is "both centralizing and decentralizing" and that where it empowers groups to "live outside traditional social structures" it also supports authoritarianism (p. 17). They add that the coming wave of technology will "democratize access to power" but that governments will also harness AI to run disinformation campaigns thereby "distorting democratic discourse; manipulating elections; [and] exacerbating social divisions" (pp. 163, 173). Thus, the coming wave could lead to catastrophic outcomes as individuals obtain access to powerful technologies that weaken nation states, but also lead towards an authoritarian dystopia as governments use the new technology for mass surveillance and to curtail freedom (pp. 216). The response to catastrophic outcomes or authoritarian dystopia could be bans and boycotts of technology (stagnation), which itself is problematic as without new technology it would be "impossible to maintain living standards" (p. 219). Thus, the impact of the coming wave is contradictory in that it empowers governments and individual actors simultaneously.

In terms of risks, the authors express concerns on "AI-powered cyberattacks, automated wars, engineered pandemics", and the "existential threat to nation states" (p. 10). There is the risk that AI can instigate automated disinformation campaigns that could disrupt financial markets or amplify "sectarian or racial" divisions (pp. 167, 171). Moreover, a single experiment could cause a pandemic and a single quantum computer could make the entire world's "encryption infrastructure redundant" (pp. 106, 163). Therefore, the authors argue for steps to containment to deal with the catastrophic outcomes associated with advanced AI and synthetic biology.

While many prescribe regulation for containment, it is insufficient as technology evolves by the week and instituting regulation takes years, it may impede research and innovation, and it lessens but does not eliminate negative effects (p. 225-230). However, the authors still suggest regulation through licensing requirements on advanced AI systems and quantum computers, banning research that would instigate a pandemic and suggest policing the internet, DNA synthesizers, and instituting greater oversight (pp. 261, 273, 277). They also suggest directing a fraction of "robotics, biotech, and AI" research budgets towards technical safety and ethics research, apart from developing critic AI that would monitor and provide feedback on other AI (pp. 241, 242, 244).

To recapitulate, through the above five questions, instructors can lead class discussions where they will have to take a larger role in steering discussions for weaker or indifferent student cohorts. In an elective topics class, student groups can be assigned book review presentations with the aim of answering these five questions. The focus of these five questions is on the prominent issues in the labor economics of automation: the impact of automation on employment, wages, and inequality, the student response to automation, the power of Big Tech in contributing to inequality,

the risks and threats of automation, the political economy implications, and the policy solutions for the digital age.

These five questions comprehensively address the issues associated with automation, but they are not exhaustive. There are other angles that instructors can address. For instance, Frey (2021) highlights questions like whether automation should be used for increased competitiveness or increased leisure, whether the profits of automation should accrue to the techno-elite or shared broadly, whether capital owners or society should decide the direction of technology, and what work should be automated and what should be left to human workers. However, such questions take us beyond the confines of the above literature and will necessitate an interdisciplinary approach involving political philosophy and ethics along the lines of Sandel (2020).

Videos as Hooks

It is important to note that the above strategies of sustained class discussions and student involvement work for serious students who take elective topics classes whereas for ECON 101 students or a relatively indifferent cohort, instructors will have to assume a larger role in guiding class discussions through question prompts (Peach, 2023), reinforcing key ideas in lectures, and engaging students by using video clips as hooks. Wooten et al. (2021) state that since the Becker and Watts (1996) critique of the chalk and talk method, several instructors have focused on showcasing movie and television clips in teaching economics. Likewise, Al-Bahrani et al. (2016) highlight using music, paintings, poetry, movies, sports shows, television shows, animated cartoons, and photography in teaching Economics. Such methods are used to make economic content more relatable, increase student interest and their retention of economic ideas (Acchiardo et al., 2017).

For the purposes of this paper, seven media clips are selected to complement class lectures and to facilitate class discussions. These clips are selected in increasing order of their involvement and duration. The first four are based on classic Disney animations to appeal to ECON 101 students, the next two are based on YouTube educator Dhruv Rathee on the risks of automation, and the final audio clip is based on an interview with Daron Acemoglu for the more serious students in elective topics classes. Fair Share laws allow showing the video for non-profit educational purposes in a closed classroom (as opposed to public viewing).[2]

Disney Animations - Fauna Bakes the Cake and Merlin Enchants the Dishes

At the ECON 101 level, Knudsen and Duncan (2018) showcase Disney animations to teach economics principles and concepts. More recently, Mandzik (2022) has illustrated economics principles and concepts through Disney's *The Little Mermaid*, *Cinderella*, and *Aladdin*. The argument is that popular culture catches student interest in a way that traditional pedagogies cannot. In a similar vein, two videos from classic Disney animations can be used to connect with childhood memories and use magic as a metaphor for automation that makes baking a cake in Sleeping Beauty or washing dishes in The Sword in the Stone easier.

Instructors can show two videos from *Sleeping Beauty* that are 1:20 and 3:36 minutes in duration respectively and do not eat much into class time. The preparation time for instructors is

[2] See Fair use on YouTube: https://support.google.com/youtube/answer/9783148?hl=en

minimal and they do not have to watch the full-length animations to make the point on automation. Clip 1 shows how the fairy Fauna has a hard time baking the cake (see Figure 1), whereas clip 2 shows that when she uses magic the process flows more smoothly. The analogy here is with automation where magic can be viewed as programming a set of directions to bake the cake, as evident from Fauna's words, "just do it like it says here in the book, I'll put on the candles." Instructors can use these clips as a successful case of automation, which shows that individuals must learn to adapt and use AI, as Fauna must enchant (program/code/use AI) to get the work done. It also shows that labor complementing automation is a conscious choice, as Fauna chooses to put on the candles.

Figure 1: Fauna Bakes the Cake

Credit: DISNEY

Clip 1: https://www.youtube.com/watch?v=4Tqqui0vEMw (1:20 min)
Clip 2: https://www.youtube.com/watch?v=uaez01Y5rJU (3:36 min)

Instructors can also show two videos from *The Sword in the Stone* that are 2:01 and 3:30 minutes in duration respectively to illustrate the case of automation gone awry. In clip 1, Merlin enchants the dishes (see Figure 2) to make young Arthur's job easier by saying, "what a medieval muddle, we'll have to modernize it, start an assembly line system." However, clip 2 shows that with Merlin gone, the dishes start attacking humans. It is only when Merlin returns to undo the enchantment that the dishes stop attacking them. Instructors can use these clips to highlight the point raised by Suleyman and Bhaskar (2023) that the coming wave would render human oversight unnecessary, which is problematic, as "superintelligence" would be impossible to control, and containment is more effective with human intervention (pp. 113, 115, 234). Thus, they can

emphasize the importance of regulation through licensing requirements on advanced AI systems and quantum computers, banning research that would instigate a pandemic, policing the internet and DNA synthesizers, and instituting greater oversight (pp. 261, 273, 277).

Figure 2: Merlin Enchants the Dishes

Credit: DISNEY

Clip 1: https://www.youtube.com/watch?v=dMw01muyIf0 (2:01 min)
Clip 2: https://www.youtube.com/watch?v=HJnaXaNzEVg (3:30 min)

The Risks and Dangers of Automation – Dhruv Rathee

While the Disney animation videos are an excellent complement in ECON 101, intermediate students can be shown YouTube educator Dhruv Rathee's videos on automation that are between 18 and 22 minutes in duration and have received 8.5 million views and 2 million views as of this writing. These videos are in Hindi but are easy to follow with subtitles and are well made with excellent background research work. As Figure 3 shows, clip 1 is about the risks of AI and automation. On risks, he mentions that automation is not just making routine work redundant but also creative work as in the case of graphic designing. He highlights that individuals will have to

adapt and learn to work with AI for the jobs of the future. However, he expresses concern on the ability of people to adapt rapidly, as many are not proficient in using computers, and AI simply adds an additional complexity. On dangers, he mentions the dangers of scams and fraud where AI can be used to employ proper grammar and replicate proper accents for use in text and voice-based scams. Finally, he mentions the dangers of artificial general intelligence (AGI) where AI is proficient beyond a narrow task and highlights Elon Musk's idea of slowing down and regulating AI.

Figure 3: Artificial Intelligence and ChatGPT

Clip 1: The Truth about Artificial Intelligence and ChatGPT (22:36 min), July 16, 2023
https://www.youtube.com/watch?v=vJefOB8kec8

Instructors can use clip 1 as a hook to discuss contrasting viewpoints on the impact of automation on work. On the one hand, Acemoglu and Johnson (2023) state that digital technologies and AI cannot perform tasks that involve "social interaction, adaptation, flexibility, and communication" and that technologies like AlphaZero and GPT-3 cannot perform beyond their pretrained narrow tasks (pp. 315, 317). On the other hand, Suleyman and Bhaskar (2023) state that the coming wave is "fundamentally labor replacing," as machines will "eventually do cognitive labor more efficiently and cheaply" (pp. 178, 179). The latter viewpoint is shared by Susskind (2020) who argues that machines will replace humans even in tasks requiring creativity and empathy so that there are limits to asking people to retrain or re-educate themselves. Instructors can also use clip 1 to discuss the need for regulation as emphasized by Suleyman and Bhaskar (2023).

Figure 4 shows clip 2 where Rathee mentions the case of Facebook whistleblower Frances Haugen who testified that Facebook didn't counter misinformation and that Facebook encourages hate speech, weakens democracy, and stokes division, as algorithms recommend hateful things, fake news, and polarizing nationalistic messages within online echo chambers. This is based on the digital advertising model and machine learning, and AI only amplifies such concerns. As such, instructors can use clip 2 to highlight the point made by Acemoglu and Johnson (2023) that authoritarian regimes use digital technology for surveillance and digital propaganda, which has led to hyper nationalism (pp. 341, 347). They also state that business models based on user engagement and digital ads have led algorithms to promote hate speech, bubbles, and misinformation (pp. 357, 359, 360). Overall, instructors can use both clips to discuss the risks and dangers of automation through its impact on jobs, scams, democracy, and political polarization.

Figure 4: How Algorithms promoted Polarization and Hatred

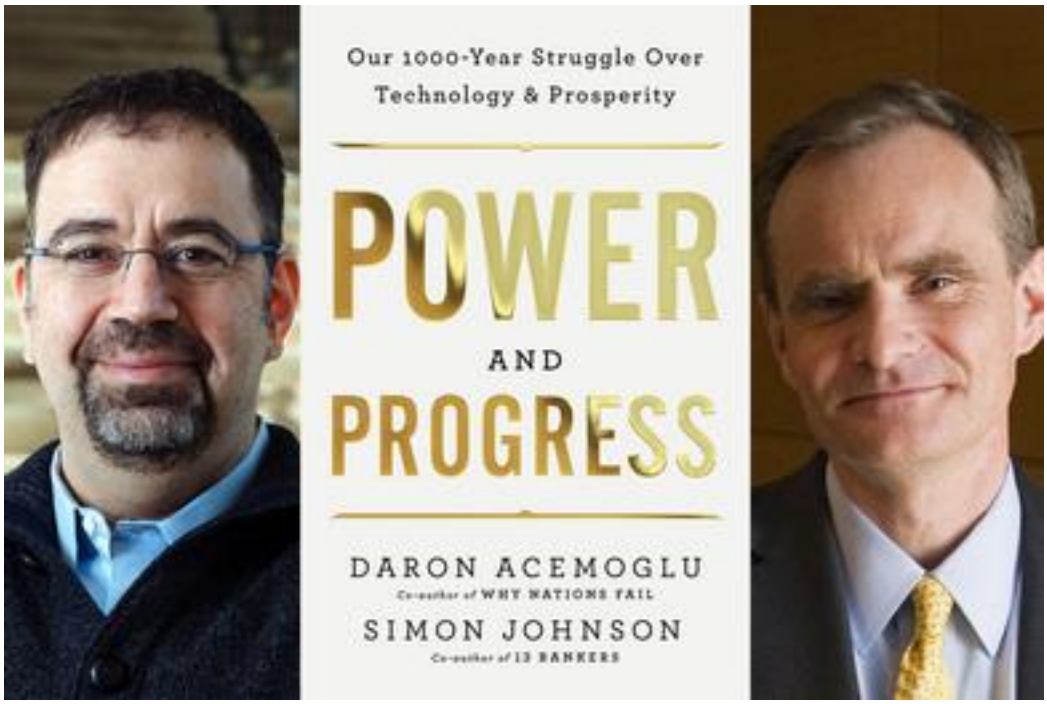
Clip 2: Facebook papers, How Algorithms promoted Polarization and Hatred, (18:24 min), Oct 28, 2021, https://www.youtube.com/watch?v=H0hy2QTqNuU

Daron Acemoglu on Power and Progress

Acemoglu has offered several online interviews on his book which vary in duration and go beyond the hour. An audio clip of around 27 minutes from VoxTalks Economics, Center for Economic Policy Research, can be played in class or assigned to students in elective topics classes working on their book review presentations. Figure 5 shows that this clip is essentially a conversation on the contents of Acemoglu and Johnson (2023). Instructors can use this clip to highlight the ideas that the direction and distribution of gains from future technology is based on

power and the narrative of a small group of people including the techno-elite. Additionally, the clip suggests a strong regulatory framework is warranted, the tax system must be reformed to remove the bias towards excessive automation that leads to "so-so technologies," and that there needs to be democratic participation on the direction of automation.

Figure 5: Daron Acemoglu on Power and Progress



Audio Clip: Power and progress, Daron Acemoglu interviewed by Tim Phillips, (27:46 min), June 2, 2023, https://cepr.org/multimedia/power-and-progress

Concluding Remarks

Given the absence of the issues of AI and automation in various textbooks, the purpose in this paper was to create a teaching module on the economics of automation. Based on two review papers and two book chapters, eleven key ideas in the economics of automation were highlighted. Avoiding technicalities but focusing on critical thinking, five questions and suggested answers were provided based on a review of four books on automation published in the 2020s. Students in elective topics classes can be assigned book review presentations based on these five questions. Differing perspectives from the four books allow for rich class discussions that can be led by instructors for relatively weaker or indifferent student cohorts on topics including the risks of automation, the power of Big Tech, and policy responses for the digital economy. For ECON 101 students, Disney animation clips can be used as hooks to engage in analogy-based understanding of automation issues. Likewise, YouTube educator Dhruv Rathee's video clips can be used to discuss the risks and dangers of automation related to jobs, scams, democracy, and political polarization. Finally, Daron Acemoglu's audio clip is offered as an option for more serious students working on book review presentations. Instructors can make use of material from this

module in part or in whole based on the preparation level of their student cohort, the time needed for preparation, and whether they are teaching ECON 101 or an elective topics course. Overall, this teaching module highlights key ideas in the economics of automation, incorporates ideas from recently published books, and complements the lecture with videos to retain student interest.

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