Automation and the Potential for Marginalization

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

For every robot added per 1000 workers, U.S. wages decline by 0.42% (Brown, 2020). Why should we worry? Consider that by 2025, automation is expected to supplant about 85 million jobs (Kelly, 2022) and this number is only likely to continue to grow in the future. Where will all of the money go? Will the wealthy get richer from these developments?

According to the International Society of Automation (n.d.), automation is, "the creation and application of technology to monitor and control the production and delivery of products and services." Additionally, it provides benefits to many industries such as manufacturing, transportation, utilities, and defense, while crossing all functions within industry from installation and integration to design and management as well (International Society of Automation, n.d.). The timeless concept of automation, however, is that its goal is to increase output with a decreased input – with or without human aid. With a widespread growth in machine learning and artificial intelligence capabilities, autonomous technologies are becoming capable of more cognitive intensive tasks, and as this technology becomes 'smarter,' it is important to consider its impact on these populations of workers, and how it may differ.

The most notable conclusion regarding automation is that it catalyzes marginalization of lower-skilled workers and worsens the wealth gap; yet this can be remedied through use of policy and educational changes. To lay the foundation of my analysis, the literature review will cover the introduction and spread of automation into the workforce, as well as an example of how it is implemented differently within a higher-skilled and lower-skilled jobs. The research I then gather is on how automation's implementation leads to a different impact in the different classes of work, and how this then drives the wealth marginalization of the lower-class. Through my analysis, I find that appropriate policy implementation and education/upskilling of workers is

necessary in order to introduce automation into the workplace without further disadvantaging the lower class, as well as to ensure it catalyzes greater productivity across the board. From this, I've gathered that the most effective way to allow automation to aid the economy, while not disadvantaging certain groups, is to implement automation with a strong foundation regarding policy that aims to tax those with heavy automation more (to encourage upskilling) and to promote worker training through incentivization.

Literature Review

Automation is a growing phenomenon due to the recent improvements in its peer technologies machine learning and artificial intelligence. Autonomous technologies have been referred to as, "new methods to improve the quality of life in general, with a better integration into society," (Chakraboty et. al, 2022, pp. xiv) businesses are seeing the capabilities of them more now than ever as they allow for a reduction in human exertion. Furthermore, the rise in use of robots rose fourfold between 1993 and 2007 (Acemoglu & Restrepo, 2020), and has only skyrocketed since then. The reason for this being a form of automation known as 'New Automation.' New Automation is the combination of both artificial intelligence and automation (Holzer, 2022). These types of technologies are bound to cause more worker displacement and inequality than previous forms of automation due to their human-like functions ranging from understanding spoken instructions to writing language or analyzing data.

While the growth in use of autonomous technologies may suggest an increase in new jobs, it simultaneously diminishes the value and livelihood of current ones. Occupations that comprise largely routine tasks are at a higher risk of decline, with the sectors most at risk being warehousing, customer service, and retail (Centre for Cities, 2018). Additionally, this shift towards an autonomous-heavy workplace will also require the retraining of about 120 million

workers in order to ensure they can properly use and troubleshoot this technology (Kelly, 2022). If workplaces don't provide such training, or workers aren't at the right education level – this puts them at risk for job loss.

Automation was initially introduced to mainly manual jobs, such as farming. While its introduction has eased labor shortages caused by rising food demand over the years (Delheimer, 2021), it has also threatened farm workers of their labor heavy jobs that tend to require little to no education. Automation in farming helps to increase output for input, as well as reduce costs and enable data-driven guidance making harvests more fruitful and decreasing consumer costs (Polly, 2021). It seems like a win for everyone; but again, consider the fact that many of the farm workers being replaced are often not educated enough to operate these new technologies or powerful enough to compete with them – putting them in a position vulnerable to unemployment. Furthermore, low-income groups tend to end up in blue collar jobs due to their lack of access to higher education. This then puts them in a weak position relative to automation because technological skills (often only taught in higher education) are necessary to work alongside these new devices.

While its origins were mainly within manual jobs, use of automation has now spread to a number of professions, including those referred to as 'higher-skilled' jobs – such as finance roles. 70-80% or more of shares traded on U.S. stock exchanges now come from automatic trading systems (Folger, 2022). The major appeal of automation in a finance field, such as trading, is "minimized emotion and improvement of order entry speed" (Folger, 2022), thus allowing traders to generate more profit in a shorter amount of time. Algorithmic trading is a form of automated trading where a company develops an algorithm and uses it to form predictions and a market opinion that then drives its trading decisions. Algorithmic trading

contributed to nearly 60-73% of all U.S. equity trading in 2018 (Shah, 2019), and in 2020, the leading 12 investment banks earned about $2 billion from algorithmic trading alone (Whittall, 2021). These numbers are a testament to how prevalent automation has become in the finance industry, yet somehow, there is little concern for job displacement in these cases. This is because automation tends to complement these workers rather than threaten them. It helps in the reduction of error-prone, time-consuming, manual processes (Sawhney, 2021) leaving more time for traders to focus on larger, more complex and fruitful trades. Sawhney (2021), states that, "forward thinking traders are now embracing it as a way to augment capabilities, raise efficiency, and raise profitability." It seems that automation only has positive connotations for those in the finance field; particularly trading. It is enabling them to make more money, and fast.

As a result of these different jobs, the new work climate requires a different set of skills and education level. As previously mentioned, it naturally puts those in lower class, lower-skilled jobs at a disadvantage and in a position vulnerable to displacement. So called, '21st century skills' are now growing in demand amongst hiring teams – these are skills such as complex analytical skills and creativity (Holzer, 2022) – skills often curated in higher levels of education than lower-skilled workers such as farmers go through. Additionally, it has been noted already that governments are going to need to provide a stronger safety net for displaced workers if no action is taken to help them secure themselves with work (Holzer, 2022).

To address these changes, an understanding of necessary education levels and policy implementation must be curated. Two strategies suggested are "creating a Universal Adjustment Benefit to support all displaced workers" and "maximize hiring through subsidized employment program," (Muro, Maxim, & Whiton, 2022) which point to the idea that automation is inherently advantageous for business leaders, while disincentivizing and worsening the situation for lower-

class workers. Another concern that comes aside from education expectations, is tax expectations (Holzer, 2022). If a majority of large-output companies depend on autonomous technologies such as robots, there then lies a gap between taxes necessary to support the government and its population, and a taxable population. A potential solution is a tax on companies with a certain percentage of their workforce being automated, which can be seen through the relationships of businesses, government, and workers later on in the discussion.

To properly analyze these aforementioned relationships between business, government, workers, and autonomous technologies, Bruno Latour's actor network theory can be used. This framework focuses on how human and nonhuman actors are enrolled in the construction of technological systems (Latour, 1992). It decenters the human by treating human and nonhuman actors symmetrically, and treats the social and technical as equivalent. The key aspect of actor network theory that will be used to perform my analysis is a script analysis. Script analyses can be done to better understand all the groups with an interest or relationship to a technology. This, paired with the lens that human and nonhuman actors are the same in terms of importance and role in a network on two different cases – a finance-related job, and a lower-skilled job like farming – allow me to evaluate how automation impacts different types of jobs in different manners, and figure out what is leading to different outcomes if this is the case.

Methods

To carry out the analysis and research on automation's varying impact, secondary sources were gathered. These sources were mainly research articles and news articles focusing on the following topics: the impact of automation on employment, educational expectations associated with an automated workplace, as well as automation's impact and implementation into both

farming and finance jobs in particular. Additionally, any pieces written on government policy or necessary policy associated with these workplace changes were looked at as well. The news and research articles spanned over the past 20 years, as automation has been implemented in different fields over a long period of time, and is still continuously developing. Most of the articles on finance automation were more recent than those related to farming. Many of the studies on the topic were done by MIT researchers, Autor and Acemoglu, known for their works on political economy.

In my review of this literature, I look at how automation is broadly influencing the workplace, and then compare its impact within the low skill and higher skill jobs (farming and finance). I then analyze how these articles approach or view the policies associated with the influence of these new technologies, and if it differs for the different jobs. Upon doing this comparison, I find the gaps causing different experiences with automation (if any). Utilizing actor network theory, I then evaluate if the impact of automation differs for different social classes and further marginalizes certain groups, and what should be done to relieve this issue.

Analysis and Discussion

Automation has a tendency to displace lower-skilled workers, as oftentimes, their jobs can become entirely automated, or the jobs that replace theirs require a skill level greater than theirs. Dizikes (2020), a social science/business/humanities writer at the MIT news office refers to this new era of workplace a, “skilled-biased technological change” in which technology tends to benefit high-skilled workers more, while the value of other workers stagnates. This makes sense as oftentimes these technologies require knowledge relating to computing skills or more technical abilities – things that are not achieved without a higher level of education.

Additionally, Dizikes (2020) states that, “where automation occurs, lower-skilled workers are not just failing to make gains; they are actively pushed backward financially.” For lower-skilled workers, automation’s introduction is either causing them to lose work or be outperformed and therefore lose their value to the company. To manual-heavy workplaces, automation is especially appealing as it can generate a significant more output and productivity without concern for workers’ conditions and needs. As stated by Brown (2020), “Robots are most likely to affect routine manual occupations and lower/middle class workers, and particularly blue-collar workers, including machinists, assemblers, material handlers, and welders.” The argument could be made that automation can also aid marginalized groups such as women or those with disabilities by making manual labor easier to complete; however, the technology is typically not implemented with the proper foundation to support such features. A piece from Quantum Foresight released last year discusses the fact that “minority groups tend to end up in jobs considered to be ‘support roles’ – these are jobs that include things like customer service, delivery workers, or front desk secretaries (Quantum Foresight, 2022). The problem is, these types of roles are the exact type vulnerable to complete automation/takeover by robots – a trend like this could further marginalize these groups by increasing unemployment. An additional concern is then the rising welfare support costs for numerous governments worldwide (Quantum Foresight, 2022). Governments will need to be able to provide for larger groups who can no longer afford basic necessities and will have a more difficult time finding a new job in the newly automated workplace.

On the other hand, automation oftentimes complements higher-skilled workers at their jobs. Consider that the technology is developed and implemented by higher-skilled workers who have the same interests as their peers in mind. It is an inherently biased technology capable of

making higher-skilled workers' jobs easier and more profitable, while completely eliminating the lower-skilled workers who oftentimes act as their support. As previously mentioned, the technology does appear to have a bias towards those with more education. As put by Dizikes (2020), "In some white-collar jobs – designer, engineer – people become more productive with sophisticated software at their side. In other cases, some forms of automation have simply replaced factory workers, receptionists, and many other kinds of employees." The technology favors those with more wealth and therefore education, making it ultimately impossible for the lower-skilled and lower-class workers to compete. This comes from the basis that "higher order cognitive and complex soft skills are needed for complementing automation technology" (Macdonald & Patrinos, 2020) – these are skills often only developed in higher levels of education such as college. The automated systems of algorithmic trading also allow traders to protect themselves from market risk more easily, as well as increase their wealth as they can now complete trades faster. While automated systems can access and apply large amounts of data to their work or predictions, the element of human interaction and client-based relationships necessary to carry out large trades is irreplicable. Because of this, traders see the technology as an opportunity, rather than threat. This is vastly different from the case of farmers, where they are instead completely replaced by robots; due to the inability to compete. While it can be argued that higher-skilled workers are also vulnerable to the displacement caused by automation, MIT and Boston University researchers found that automation accounted for half of the increase in the income gap between more-educated and less-educated workers in the U.S. (O'Dea, 2022) – further proving this theory of lower-class marginalization.

Educational differences are one of the issues driving these differences in the impact seen from automation. As predicted by chief economist Harry Patrinos and policy researcher Kevin

Macdonald, “if educations aren’t strong enough, and supply of automation-complementing skills is constrained or less elastic, more wage inequality will result,” (Macdonald & Patrinos, 2020) emphasizing the idea that without advancing the standard of education for the lower-class, or helping to upskill them, they will get left behind in terms of wage and wealth. It could be said that all are impacted by these skill changes, yet it is, “21st century skills, such as complex analytical skills and creativity” (Holzer, 2022) that continue to grow in demand. These types of skills are not developed at the primary education level, and college/higher education is oftentimes something out of reach (due to cost and preparedness) for lower-class workers. This could lead to their families being stuck within a cycle of poverty. Additionally, Brown’s study concluded that robots negatively affect workers at all education levels, though those without a college degree were impacted far worse (Brown, 2020). So, while at the surface it may seem to be a small change in primary education and re-training could ease the issue, the root of the issue is that the technology favors those with a college degree (or more), which those being displaced by it do not have or cannot afford. There is a double edged-sword as they are now losing jobs (and money), and therefore do not have the funds to further their education needed to be successful in the everchanging work environment.

The other issue alienating the lower-class is a lack of policy in place to support lower-skilled workers with the aforementioned displacement effect, giving more power to big business owners implementing and developing these technologies. Policy is key to stabilizing the situation. Studies done by Macdonald and Patrinos, as well as Gueorguiev and Nakatani lookedinto the best policy decisions that could be carried out by the government. Macdonald and Patrinos note that, “adult retraining programs are at the forefront of discussion, but many education systems are unable to provide basic skills so retraining may not ultimately give them

the skills needed to complement automation in the long run," (Macdonald & Patrinos, 2020). This illustrates how the educational differences trace back to primary education and education received at youth. Adults are difficult to 're-train' because many don't even have the skills necessary for success in the first place – they are basically learning all over again. Additionally, Geuorguieve and Nakatani's findings suggest that robot taxes and fiscal policy could be more effective approaches (Gueorguiev & Nakatani, 2021). A robot tax would likely cause hesitance on behalf of big business owner interested in exploiting the technology as it would end up being more costly than upskilling or maintaining their lower-skilled workforces. Fiscal policy would work alongside this by "taxing excess profit of firms with market power in the automated economy" (Gueorguiev & Nakatani, 2021). These two types of policies together would help deter business leaders' desire for high levels of automation in their workplace, or at least encourage them to more carefully think through the implementation of such technology.

Finally, these differences in automation's impact are what fuel its ability to catalyze wage inequality and wealth polarization. Consider the following diagram, illustrating the network associated with the introduction of automation to farming:

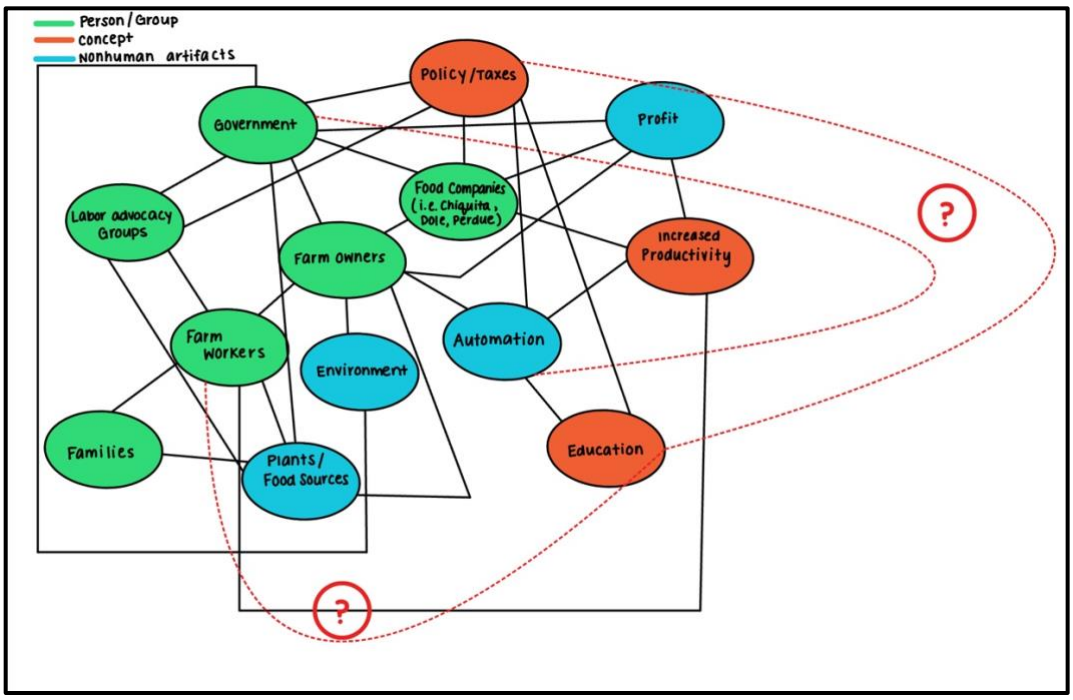

Figure 1: Actor network theory application map for automation in the farming industry. By K. Babel, 2023.

As seen above, the two gaps that exist are between the farm workers, education, and policy, as well as between government and automation. This highlights the main issue that lacks attention on this topic – a lack of policy on upskilling and re-training education for these lower-skilled, lower-class workers, as well as government involvement in improving the situation surrounding automation for those who are impacted by its negative effects. Another key component to note is how profit drives the big businesses, the government, and the larger farm owners, while not necessarily connecting directly to the farm workers themselves. So, while a farm may reap greater output and benefits from the introduction of this technology from a monetary standpoint, and the government and food companies will too – the actual workers do not see any significant standard of living improvement aside from potentially less dangerous/laborious work. Even noted in a recent article, "New technology risks widening the gap between rich and poor countries by shifting investment into advanced economies where automation is already

established. This could in turn have negative consequences… by threatening to replace rather than complement their growing labor force" (Alonso, Kothari, & Rehman, 2020). It is clear the threat is consistently towards already-marginalized groups.

Now consider the following diagram of the network developed by automation's introduction to a finance role such as trading.

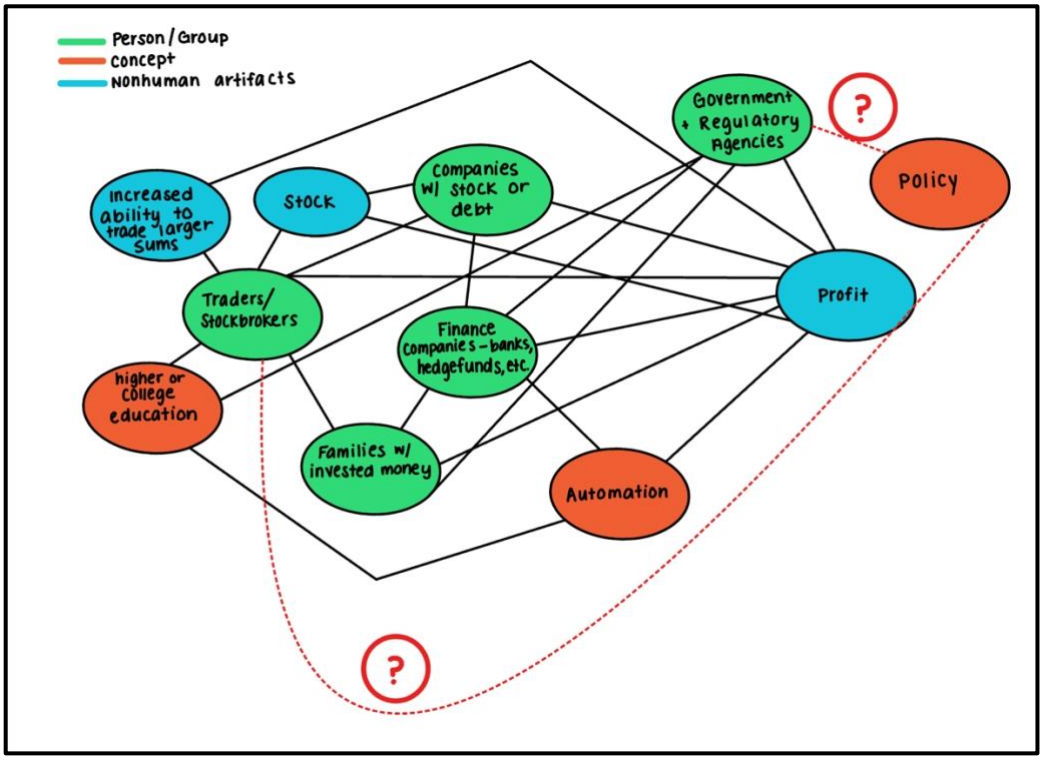

Figure 2: Actor network theory application map for automation in the finance industry. By K. Babel, 2023.

Note that the same gap exists in which there is a lack of policy focused on equitable distribution of financial benefit derived from automation. However, in this case, this does not have the same impact. Ultimately everyone in this network links to profit, even without any policy implications. This is because if such type of policy *were* introduced here, it could decrease profit across the board. Suppose there was a cap on how many trades could be done utilizing automated algorithms – this would regulate and therefore limit how much profit traders and their respective

funds or banks made, and also impact the government as their goal economy-wise is to typically have as much trade occurring as possible as it signifies a better economic standing. When things come to a standstill, it is typically a sign of weakness. While these same policy gaps exist in both networks, their impact is completely different because it would limit the upper, more educated and skilled class from accumulating more wealth, while it would help lower-skill workers stand a fair chance against the introduction of a technology that threatens their livelihoods. Additionally, the other notable difference is who the profit reaches in each case – as shown in the second diagram, automation enables the more advantaged, while in the realm of farming, it only further isolates those groups and worsens the wealth gap.

Conclusion

Through a review of different literature and statistics, it is clear that automation favors the wealthy and promotes their further success, while putting lower-skilled workers with less education at a disadvantage or worse – completely unemployed. However, if automation is introduced to the workplace with the proper environment and foundation – whether it be educational aid or policy focused on regulating its influence in the workplace and wealth distribution – it can positively complement all classes of workers in their productivity and work experiences.

If labor advocacy groups assess the findings of this research, they may find a middle ground of policymaking that could ease the transition into an automated workplace for workers – especially for lower-skilled workers. They will know which topics to address with policymakers, such as educational gaps and how taxation threats could incentivize big business leaders. Additionally, business leaders looking into implementing autonomous technologies could utilize

this information to figure out the proper environment for introducing such a technology so as to not disadvantage certain groups.

In terms of future research, researchers could build off of this study to determine how automation impacts a greater variety of jobs and skill levels. In this case, only finance roles and farming were used as basic examples due to time constraints – a larger assessment with a greater range of jobs could provide more insight and develop a more accurate framework of what is necessary when introducing autonomous technologies to a workplace without worsening the wealth gap. Finally, future research should look at whether policy and educational changes implemented by businesses will actually decrease the marginalization that the technology currently causes, and reduce the wealth gap.

Ultimately, automation is growing to be a part of all jobs within society – it does have the ability to benefit all classes of workers; so long as the government and business leaders develop the proper space for it to do so. This space would include a level of educational funding or support for those who are being displaced by automation, or need upskilling in order to manage it. Additionally, it would involve implementation of policy and agreements between the government and business leaders that either penalize businesses (through taxation) for having a certain percentage of their work automated, or ensure that additional revenue from automation helps to also increase wages of those performing the lower-skill work of the business.

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