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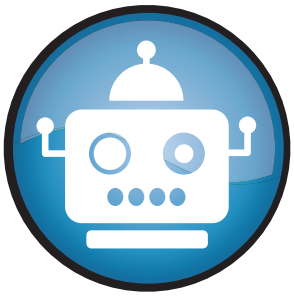

Will Robots Take Our Jobs?

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GLOSSARY

Automation: Automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices that take the place of human labor.

Human capital: The knowledge and skills that people obtain through education, experience, and training.

Law of demand: As the price of a good or service rises, the quantity demanded of that good or service falls. Likewise, as the price of a good or service falls, the quantity demanded of that good or service rises.

Physical capital: Goods that have been produced and are used to produce other goods and services. They are used over and over again in the production process; also called capital goods and capital resources.

Technological advance: An advance in overall knowledge in a specific area; also known as technological change.

> "Robots will harvest, cook, and serve our food. They will work in our factories, drive our cars, and walk our dogs. Like it or not, the age of work is coming to an end."
> —Gray Scott, futurist philosopher

"Robot Apocalypse" is a modern expression that refers to a fear of **technological advance**, but the anxiety goes back centuries.[1] In 1589, Queen Elizabeth refused to grant the inventor of a mechanical knitting machine a patent for fear of putting manual knitters out of work.[2] In the early 19th century, textile artisans called Luddites attempted to prevent or derail the mechanization of the textile industry. Even economists, such as John Maynard Keynes, have worried about "technological unemployment."[3] The fear has not receded. A recent headline from *Business Insider* suggests that "machines may replace half of human jobs."[4] Before your anxiety rises to uncomfortable levels, consider economist David Autor's warning that journalists tend to overstate the extent to which machines will substitute for human labor and ignore the positive aspects that benefit workers and create jobs.[5]

Robots, Artificial Intelligence, and Automation

What exactly is a "robot"? We might envision a Star Wars-like robot in the vein of R2-D2 or C-3PO, but a robot is any device or algorithm that does what humans once did, from mechanical combines and thermostats to dishwashers and airfare search sites.[6] And, unlike other **physical capital** or forms of technology, robots can be programmed to perform many tasks and do not need a human operator.[7] Robots are very good at doing routine or repetitive tasks. The jobs that include many of these types of tasks are most susceptible to **automation**, which means that once the technology is in place and programmed, the production process happens automatically (without human assistance). As computer processing has become faster and cheaper, it is cost-effective to have robots do more routine tasks previously done by humans. These are tasks that can be divided into steps and then into computer code for a computer to replicate. Some of these tasks are mathematical calculations, information retrieval, and data sorting. It is more difficult to automate tasks that require flexibility, judgment, intuition, creativity, and common sense. [8]

Automation does not mean that jobs with routine or repetitive tasks will simply disappear. When ATMs were introduced during the 1970s, many worried that they would replace bank branches and tellers and that employment would contract. Actually, because ATMs reduced the cost of operation, the number of bank branches increased. And while the number of tellers per branch decreased, because there were more branches, there were more employment opportunities for tellers. There were more tellers employed in 2010 than in 1980, and their duties have since expanded to include "relationship banking"—something ATMs cannot do.[9] A similar effect has occurred in auto manufacturing: While much manual human labor has been replaced by automation, cars have become more complex, requiring more labor. As a result, it takes more human labor to produce a car now than in the past.[10]

Substitute or Complement?

The way technology impacts jobs has to do with the way workers relate to the technology. It's important to differentiate between two similar terms here: physical capital and technology. Physical capital is all the tools and equipment used to produce other goods and services. Technology includes the knowledge, processes, and techniques used to produce goods and services. In other words, technology is all the intangible features embodied in the physical capital. Think of an iPhone—for a business, it is physical capital, but the difference between the original iPhone and the iPhone 10 is a difference in technology.

Physical capital, in its current state of technology, often substitutes for human labor. In fact, that is often the reason it is developed. But technology also complements labor; it raises the output in ways that lead to a higher demand for labor. For example, think of the spreadsheet software on your computer. It can be used to organize information into columns, but it can also be used as a high-powered calculator to process thousands of pieces of data at one time. The development of spreadsheet software during the early 1980s made repetitive calculations simpler and faster. In fact, the spreadsheet replaced the work that bookkeepers used to do in ledgers with simple adding machines and calculators—it substituted for the labor of bookkeepers. But spreadsheets also created demand for people who could analyze numbers in new and interesting ways, such as accountants and management consultants.[11] Why? Remember the **law of demand**: As the price of something decreases, the quantity demanded of that good increases. Because the spreadsheet reduced the price of calculations (a cost to firms), it *increased* the *quantity* of calculations demanded. As more calculations were demanded, the demand for data analysis performed by accountants and management consultants increased as well. So, the spreadsheet was a substitute for bookkeepers but a complement to the work of accountants and consultants—higher-skilled jobs. And the growth in accounting and analytical jobs since the 1980s has been much larger than the loss of bookkeeping jobs.[12]

In fact, as some sectors contract due to technology (substitution), other (complementary) sectors arise . In 1900, 41 percent of the U.S. workforce was employed in agriculture; by 2000 that share had fallen to 2 percent, mostly due to substituting capital for labor.[13] While agricultural jobs became a smaller part of the labor force, manufacturing, service, and repair of farm machinery increased. As passenger cars displaced the horse and buggy (and the jobs associated with them) during the 1920s, motel and fast-food industries rose up to serve the "motoring public."[14]

Changes in technology will likely change the types of jobs available and what those jobs pay. As technology substitutes for routine work, economists suggest that polarization will likely result. This means that many jobs in the "middle" will disappear through automation, but the number of low-skill/low-income jobs and high-skill/high-income jobs will see gains. In both cases, it is because these types of jobs are difficult to automate. Low-skill jobs often require skills such as adaptability, physical mobility, and interpersonal interaction—food preparation and serving, cleaning and janitorial services, home healthcare, hair styling—which are difficult to replicate through automation. On the other side are "abstract" jobs that require skills such as problem-solving, intuition, creativity, and persuasion; in the job market these are professional, technical, and managerial positions. These workers generally have a lot of education, and the jobs require inductive reasoning, communication, and specialized skills.[15] Some economists worry that in addition to jobs migrating to the two ends of the skills spectrum, the gap between high-income workers and middle- and low-income workers will grow even wider.[16]

Preparing For Change

The transition from an agricultural economy in 1900 to an industrial economy in later decades coincided with a change in the education system. In 1900, the typical American had only a common school education, equivalent to six or eight years of formal schooling. From 1910-1940, the United States engaged in the high school movement and became the first nation in the world to deliver universal high school education to its citizens. The fraction of youths enrolled in U.S. high schools increased from 18 percent to 71 percent.[17] This constituted a dramatic increase in the **human capital** of the American work force, which enabled the economy to make the transition from agriculture to industry. Similarly, as the economy employs more robots and automation, the need for manual and repetitive labor will decrease, and the demand for computer programmers, engineers, and problem solvers will increase.

And, like the transition from agriculture to industry, investments in human capital by parents, students, and governments will play an important role in the preparation of workers. Andrew McAfee, an economist who has researched the topic, suggests that students pursue a double major, one in liberal arts (to develop problem-solving, creativity, and critical-thinking skills) and another in the sciences (to develop quantitative and technological skills).[18] This pairing reflects what many economists suggest about the jobs of the future, where human skills and judgment will be bundled with technological automation. For workers to be employable, they must acquire the skills necessary to ensure that technology is a complement rather than a substitute for their human capital. And education will not end with a high school or post-secondary education; employability will mean constantly upgrading skills and education.

The Future: Intolerable Abundance or Continued Scarcity?

While humans have long feared technology and robots automating all the jobs of society, one might wonder if that is such a bad thing. Remember that while robots can produce goods and services, they don't consume in the way humans do. We currently live in an economy where most people exchange their labor resources for income, and then they use their income to purchase goods and services. And we live in a world where there are not enough resources to fulfill everyone's wants; in other words, we live in a condition of scarcity. But if we're in a world where robots do the work, then goods and services are plentiful, and the demand for labor is greatly reduced (a post-scarcity world).[19] This futuristic, post-scarcity world poses new problems, such as how will goods and services be distributed among people? And who will pay taxes? Mark Zuckerberg (Facebook)[20] and Elon Musk (Tesla)[21] suggest that the benefits of automation be used to fund continuous education and universal basic income.[22] Bill Gates suggests that the government should tax the work done by robots to compensate the workers they replace.[23] Economist Larry Summers disagrees with Bill Gates. He says that because robots provide society with many benefits, taxing (and thereby reducing) them is counterproductive.[24] Summers, and others, suggest that subsidizing education and training is a more effective means of supporting people who lose their jobs to robots.

Conclusion

Considering a world where distribution (not scarcity) is the central problem is interesting, but many economists see this as needless worry. Productivity-enhancing technology has changed the economy in dramatic ways over the past two centuries, and it has not made human labor obsolete. Nor has it eliminated the problem of scarcity. Herbert Simon, economist, computer scientist, and Nobel laureate, wrote in the 1960s (another period of automation anxiety), "Insofar as they are economic problems at all, the world's problems in this generation and the next are problems of scarcity, not of intolerable abundance. The bogeyman of automation consumes worrying capacity that should be saved for real problems."[25] In short, many economists see the current wave of new technology and automation as a trend that has been occurring for most of human history, and one that will continue in the future. The challenge is in equipping future workers with the skills they need to be competitive and productive in a changing economy. ■

NOTES

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[13] Autor (2014; see footnote 5).

[14] Jackson, Kristin. "The World's First Motel Rests Upon Its Memories." *Seattle Times*, April 25, 1993; http://community.seattletimes.nwsource.com/archive/?-date=19930425&slug=1697701.

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[16] Regalado, Antonio. "When Machines Do Your Job." *MIT Technology Review*, July 11, 2012; https://www.technologyreview.com/s/428429/when-machines-do-your-job/.

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[19] Autor (2015; see footnote 8).

[20] Sodha, Sonia. "Mark Zuckerberg's Got Some Cheek, Advocating a Universal Basic Income." *Guardian*, July 10, 2017; https://www.theguardian.com/commentisfree/2017/jul/10/mark-zuckerberg-universal-basic-income-facebook-tax.

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Federal Reserve Bank of St. Louis *Page One Economics®*:

"Will Robots Take Our Jobs?"

After reading the article, complete the following:

1. What types of jobs are most likely to be automated? What types of tasks are difficult to automate?

2. Does automation mean fewer jobs in an industry? Why or why not? (Clue: Consider the impact of ATMs on banking jobs.)

3. How can technology both complement and substitute for human labor? Provide an example.

4. How does education play a role in preparing workers for the changing needs of employers? How should students prepare for the expected changes in the labor market?

5. Adjusting for the future:
   a. What does Bill Gates propose?

   b. What does economist Larry Summers propose?