Opportunity Occupations and the Future of Work

From 19th-century workers smashing textile factory machines to John Maynard Keynes's musing on technological unemployment, worries and passions about machines replacing workers are hundreds of years old. More recently, robots and computers (through artificial intelligence) are replacing a growing number of human skills, and this has become an important topic of conversation in public policy. It is also increasingly on the minds of workers and students making decisions about their investments in skills and career preparation.

Over the past several years, the Federal Reserve System has examined opportunity occupations and opportunity employment, which are good-paying jobs for workers who do not have a college degree. Some 65 percent of the U.S. population over age 25 didn't attend college or complete a four-year degree.[1] Federal Reserve research has found that a host of occupations exist for U.S. workers without a bachelor's degree that pay at least the national median wage, though their accessibility varies by state and metropolitan area.

However, such research carries the implication that these are good jobs that will enable workers to earn good wages in the future, and these occupations are worth pursuing. To date, this research has not been matched with other work that examines how technological changes affect these occupations. As a result, the research might highlight to students or to workers looking to change careers or invest in their skills occupations in which people may be increasingly supplanted by automation or artificial intelligence. This article draws on prior research to examine how susceptible opportunity employment is to automation.

Automation: boon or bane?
There are widely divergent views on whether automation is on the whole beneficial or a threat to large segments of the workforce. A 2017 report by the McKinsey Global Institute (MGI) is in the optimist camp, citing business performance benefits, productivity growth potential for businesses, and gross domestic product growth, and it assumes displaced workers will find other forms of employment. One example of this trend is arguably the sharp growth in analyst and accounting employment that occurred at the same time as a sharp decline in workers in bookkeeping jobs with the introduction of spreadsheet software like Microsoft Excel.

Additionally, artificial intelligence and machine learning have the potential to increase productivity by improving and lowering the cost of predictions, thus reducing the uncertainty of risky decision making. Some academics are hopeful that such increased productivity has the potential to reverse, or at least

mitigate, a slowdown in productivity growth, not just in the United States but in other advanced economies as well.

On the other side of the debate are fears of mass unemployment caused by automation and robots among some academics and the general public and concerns over wage stagnation in developing countries. Various researchers have highlighted the uneven geographic and industry distribution of job creation and replacement as a result of technological change within the United States, as well as an increase in economic inequality.[2]

Estimating automation in occupations
Both the methodologies and estimates of the prospects of automation for individual occupations or the labor market as a whole vary widely. To estimate opportunity employment that may be affected by automation, I use data on the technical automation potential of occupations from the 2017 MGI report as well as data on the probability of computerization by occupation. The former analyzes automation by examining occupational activities, which are then broken down into capabilities, each of which is assigned an assessment of complexity and technological advancement. The end result is a set of estimates of "the percentage of work time that could be automated by adapting currently demonstrated technology" for most U.S. occupations. The latter uses O*NET data to establish a probability of computerization for 702 occupations.
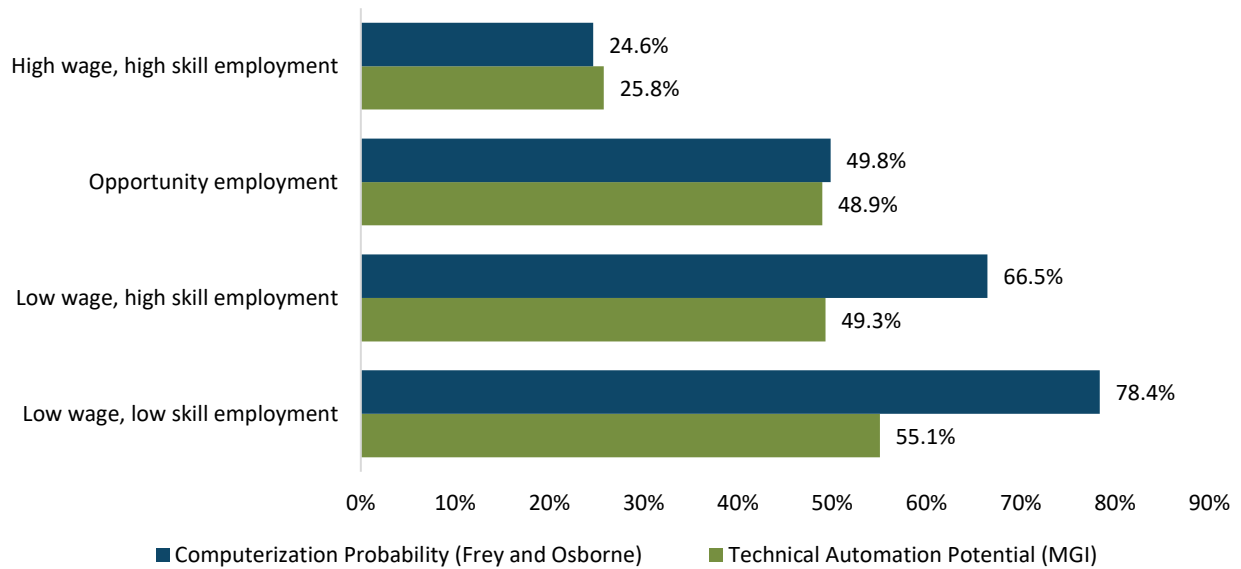
The MGI report estimates the potential for automation at 47 percent of U.S. employment. Frey and Osborne estimate that 47 percent of U.S. employment is at high risk of automation within the next two decades, 19 percent is at medium risk, and 33 percent is at low risk.[3] They find that automation particularly affects low-wage and low-skill positions and service occupations. However, a 2016 Organization for Economic Co-operation and Development (OECD) paper that examined occupational tasks estimated that 9 percent of employment is at high risk (70 percent probability) for automation, a significantly lower figure.

Despite the variations in estimates and methodology, these data, particularly when they align, give us some sense of how susceptible opportunity employment is to technological change. Still, the results need to be interpreted with some caution. Much uncertainty remains, as predicting technological change, even on short time horizons, is difficult, given the nonlinear nature of technological advances. Additionally, research and high-quality data are lacking on various aspects of the nature of work, "key micro level processes (e.g., skill substitution and human-machine complementarity)," and there is "insufficient understanding of how cognitive technologies interact with broader economic dynamics and institutional mechanisms," which all limit the ability to measure the effects of artificial intelligence and automation.

Opportunity employment and automation
Frey and Osborne find a negative relationship between wages or educational attainment and computerization potential. They find occupations with high wages and educational attainment the least susceptible to computerization, and low-wage and low-skill occupations the most susceptible to computerization. The OECD report finds a similar relationship.

Automation potential by wages and skill levels (2017)

High wage, high skill employment	24.6% / 25.8%
Opportunity employment	49.8% / 48.9%
Low wage, high skill employment	66.5% / 49.3%
Low wage, low skill employment	78.4% / 55.1%

■ Computerization Probability (Frey and Osborne)   ■ Technical Automation Potential (MGI)

Note: High and low skill is determined by the demand for employees with a four-year college degree. The bars represent averages weighted by employment. Here, low wage falls below the national median wage, high wage above it.
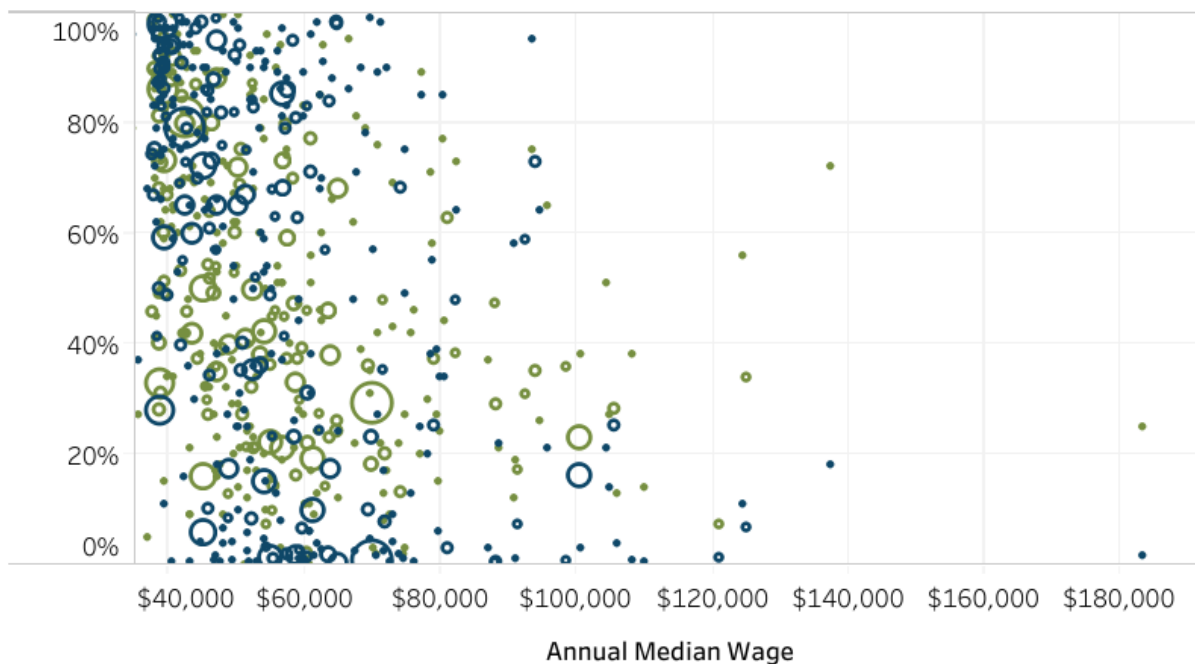Source: Author's calculations using Manyika et al. 2017, Frey and Osborne 2017, Burning Glass Technologies, and U.S. Bureau of Labor Statistics' Occupational Employment Statistics, 2017

To examine how the automation potential for opportunity employment differs from the rest of the labor market, I assign shares of employment in each occupation into four groups based on both the educational expectations of employers and the wages earned, using national data from the U.S. Bureau of Labor Statistics' Occupational Employment Statistics and online job advertisement data from Burning Glass Technologies. The chart shows weighted averages for Frey and Osborne's probability of computerization and MGI's technical automation potential for each of these four groups.

I find similar results to Frey and Osborne, with the average computerization probability significantly higher in low-wage occupations, particularly those where employers do not require a four-year college degree. While the average probability of computerization for opportunity employment is lower than that for low-wage, high-skill positions, by about 16.7 percentage points, at 49.8 percent, it is still more than double the average computerization probability of high-wage occupations where employers prefer a bachelor's degree.

When examining the MGI estimates, the average share of time susceptible to automation in opportunity employment is still significantly higher, almost double that of high-wage, high-skill employment. However, in these estimates, the gap between the average share of time susceptible to automation in opportunity employment and low-wage employment is much smaller. In fact, in MGI's estimates, opportunity employment is about as susceptible to automation as is low-wage but college-educated employment. And the average automation percentage for employment in low-wage occupations where employers do not require a bachelor's degree is just 5.8 percentage points greater.

Occupation Title	Estimated Opportunity Employment	Technical Automation Potential	Computerization Probability
Registered Nurses	1,845,073	29%	0.9%
Heavy and Tractor-Trailer Truck Drive..	1,747,875	81%	79.0%
Bookkeeping, Accounting, and Auditi..	952,159	86%	98.0%
First-Line Supervisors of Retail Sales ..	866,481	33%	28.0%
Licensed Practical and Licensed Voca..	702,593	16%	5.8%
Carpenters	692,834	50%	72.0%
Automotive Service Technicians and ..	639,605	73%	59.0%
Electricians	631,041	42%	15.0%

Computerization Probability   Technical Automation Potential

Note: Only occupations with at least 10 percent opportunity employment were included in the graph.
Source: Author's calculations using Manyika et al. 2017, Frey and Osborne 2017, Burning Glass Technologies, and U.S. Bureau of Labor Statistics' Occupational Employment Statistics, 2017

Breaking down the results by occupation for those that provide opportunity employment produces a mixed picture. Blue-collar occupations—including machinists, maintenance workers, carpenters, welders, painters, and automotive mechanics—appear more frequently at high risk of computerization, or generally have higher shares of their time that are susceptible to automation. Similarly susceptible are white-collar opportunity occupations that contain a large share of routine tasks, such as various types of clerks, tax preparers, and secretaries and assistants in the legal industry. Indeed, this matches

with findings in the MGI report that "physical activities in highly structured and predictable environments, as well as the collection and processing of data" are most susceptible to automation.

However, white-collar occupations that require greater social intelligence and creativity—including supervisory positions such as in retail or construction, or teachers and school counselors—are at the low end of the automation potential or computerization probability distributions.

Among the 10 most prevalent occupations in terms of opportunity employment, Frey and Osborne consider truck drivers, bookkeeping and accounting clerks, and carpenters at high risk of computerization, at 79 percent, 98 percent, and 72 percent probability, respectively. The MGI data find similarly high percentages for the technical automation potential estimate for truck drivers (81 percent) and bookkeeping and accounting clerks (86 percent). However, they estimate a lower share of time that is susceptible to technical automation for carpenters, at 50 percent.

Notably, the most prevalent health care occupations in terms of opportunity employment, registered and licensed practical nurses, are both estimated to be at low risk for computerization, at 0.9 percent and 5.8 percent probability, respectively. The MGI data also estimate the percentage of time that could be automated in either occupation as relatively low, 29 percent and 16 percent, respectively. Electricians are an example of a prevalent blue-collar opportunity occupation that Frey and Osborne estimate to be at low risk of computerization.

What's next?
Regardless of whether automation is a threat, an opportunity, or a mixed blessing for middle-skills workers, there will be a need for upskilling or reskilling for many. Displaced workers will need to be able to handle increasingly technical or social intelligence skills, and workers that see part of their tasks automated will need to adapt. All workers will need to adopt a willingness to engage in lifelong learning.

Educational institutions will need to adapt curricula to match skills that are in demand in the labor market today and in the future, and to the extent they aren't already, will need to be able to deliver such education online, accessible 24/7. Many employers will have to retrain at least part of their workforce to remain competitive, for example, by offering online training courses in new technology to their existing workers.[4] This is particularly relevant for those employers already facing challenges hiring new technology workers in a tight labor market. Sector partnerships can bridge these two worlds, and can help adapt regional workforce development to the changing technological needs of a local labor market.[5] Businesses will need to work with educational institutions to certify training credentials important to their industry.

Policymakers could consider incentivizing "outskilling," a practice where employers give workers slated for or at high risk of layoffs training and support to land another job in an in-demand occupation at another company. The benefits for companies can include reduced reputational and brand damage, and increased job performance, productivity, and tenure from remaining workers, with ensuing lower turnover and hiring costs.[6] Policymakers could secure the retraining of a subset of workers with relatively limited resources compared with traditional training programs and unemployment benefits.

Finally, to better understand where the threats and opportunities of automation will affect workers, and to better align training and educational programs with the future needs of the labor market, better data on skills and the nature of work are needed.

While there is much uncertainty over the impact of automation on opportunity employment, and while, on average, this category of workers will likely be less affected as compared with workers in low-wage

occupations, it is clear that many of these occupations are changing. Going forward, research on opportunity employment should take those jobs' susceptibility to automation into account. Although occupations are unlikely to be equally affected, with some health care, education, and managerial occupations less susceptible to automation, and some routine physical and white-collar ones more so, all workers, employers, and policymakers will need to adapt to this changing world.

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[1] U.S. Census Bureau's Current Population Survey, 2018.

[2] For instance, within the United States, Boston is considered least at risk, with 38.4 percent of employment at risk from automation, while Fresno, California, is most at risk, with 53.8 percent. For more information, see Frey, Carl B., Michael A. Osborne, and Craig Holmes (2016, January). "Technology at Work v2.0: The Future Is Not What It Used to Be." Citi GPS: Global Perspectives & Solutions; Moretti, Enrico (2013). *The New Geography of Jobs*. New York: Mariner Books; Frey, Carl B. and Michael Osborne (2015, February). "Technology at Work: The Future of Innovation and Employment." Citi GPS: Global Perspectives & Solutions; and Furman (2016, July 7). "Is This Time Different?"

[3] These percentages are rounded and thus do not add up to 100.

[4] For examples of such employers and employer reskilling strategies, see, for instance, Fuhrmans, Vanessa (2019, October 27). "How a Company's Aging Workforce Retrained Itself for the Cloud." *Wall Street Journal*; and Weber, Lauren (2019, April 19). "Why Companies Are Failing at Reskilling." *Wall Street Journal*.

[5] Holzer, Harry J. (2015). "The U.S. Approach to Higher Education and Workforce Development: Separate Parts in Search of a Whole." In *Transforming U.S. Workforce Development Policies for the 21st Century*, Carl Van Horn, Tammy Edwards, and Todd Greene, eds. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 105–127.

[6] Weber, Lauren (2020, January 6). "A Counterintuitive Fix for Robot Driven Unemployment." *Wall Street Journal*; and Salisbury, Allison D. (2019, November 18). "The Rise of Outskilling: Why Are a Growing Number of Employers Preparing Workers for Their Next Job?" *Forbes*.