



Advanced Technologies Effect on Workforce – An Evaluation Using Multiple Methodologies

Benjamin Bolitzer, *U.S. Government Accountability Office*

**INTOSAI Working Group on Evaluation of
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About GAO

- The Government Accountability Office is the U.S. government's audit institution and is part of the legislative branch.
- We support Congress in meeting its constitutional responsibilities, and help improve the performance and ensure the accountability of the federal government. We provide Congress with timely information that is objective, fact-based, nonpartisan, nonideological, and balanced.
- On this engagement, we were asked to examine workforce issues related to the adoption of advanced technologies

Prior / Other GAO Work

- In 2018, the CG convened a panel from government, academia, industry, and the non-profit sectors. The forum considered the implications of AI for a variety of sectors.
 - The group made recommendations to policy makers – but noted that these recommendations involved tradeoffs.
 - As the group noted, further research was needed to understand the implications of AI on training and education for the jobs of the future.
- In 2019, GAO also released a report on specifically on advanced technology and the trucking industry

Our Research Objectives on This Engagement

1. What is known about selected federal agency efforts to track and monitor the adoption and workforce effects of advanced technologies?
2. What is known about how the adoption of advanced technologies affects the U.S. workforce?
3. What considerations led selected firms to adopt advanced technologies and what risks did they face?
4. How has technology adoption affected the workforce at selected firms?

Terminology and Background

- We use the term “advanced technologies” to encompass a range of current and emerging technologies that may affect the U.S. workforce (e.g., robotics, machine learning)
- Varying conclusions from researchers on the number of jobs at risk of being automated
 - Frey & Osborne: 47 percent of U.S. jobs are in occupations at high risk of automation by 2030
 - McKinsey: 23-44 percent of U.S. work hours could be automated by 2030
 - Arntz, Gregory, and Zierahn: 9 percent of U.S. workers hold jobs at high risk of automation
- Differing workforce effects: substitution, complementarity, increased product demand, job changes, redesign of operations

What is known about selected federal agency efforts?

- **Department of Commerce Has Started Tracking Technology Adoption and Resulting Workforce Effects**
 - New 2017 Annual Business Survey (ABS), a joint effort by Commerce and the National Science Foundation, asks firms about use of advanced technologies, and workforce effects
 - Census also plans to expand the Annual Survey of Manufactures and Annual Capital Expenditures Survey to collect information on robotics expenditures
 - None of the survey results will be available until late 2019 and later
- **Commerce and DOL Face Challenges Tracking the Workforce Effects of Advanced Technologies:**
 - Identifying which new and emerging technologies to track
 - Trends and effects appear at different levels
 - Causes of trends are complex and diverse

How will adoption affect the U.S. workforce?

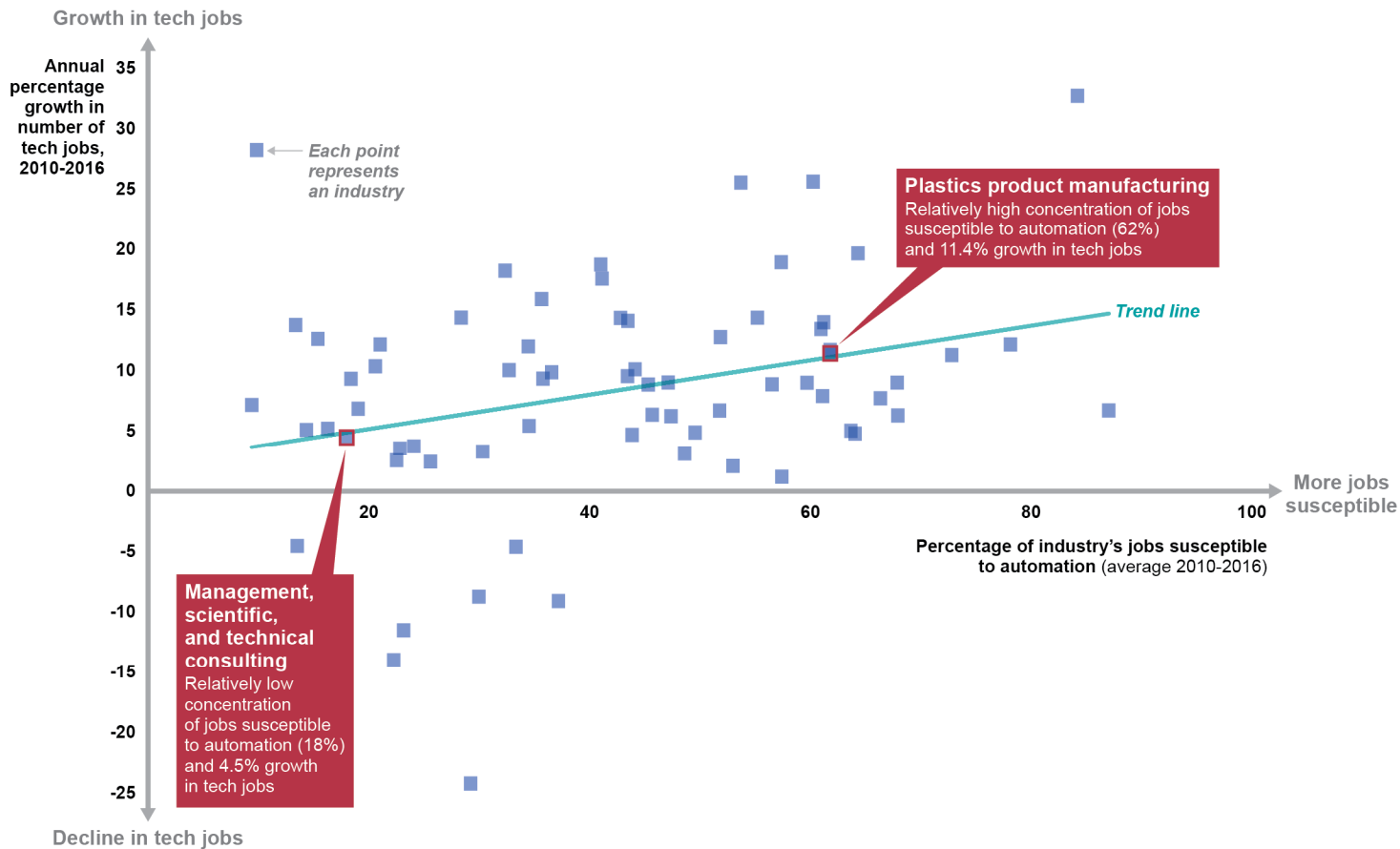
- Federal household and employer surveys, such as the Current Population Survey, the American Community Survey, the Occupational Employment Statistics, and the Job Openings and Labor Turnover Survey can provide useful information about changes in the U.S. workforce over time
- However, these sources do not provide information on the causes of these employment shifts
- We analyzed occupations that Frey and Osborne identified as susceptible to automation to determine whether changes due to advanced technologies are appearing in employment data



Characteristics of Workers in Jobs Susceptible to Automation (2016 American Community Survey)

- Workers with lower levels of education and Hispanic workers are more likely to hold jobs in occupations identified by Frey and Osborne as susceptible to automation
 - 60.7 percent of workers with a high school degree or less hold these types of jobs, as compared to 46.7 percent of workers with some college, 26.9 percent of workers with a bachelor's degree, and 11.3 percent of workers with a graduate degree
 - 54.1 percent of Hispanic workers hold these types of jobs, as compared to 46.4 percent of Black workers, 40.0 percent of White workers, and 35.9 percent of Asian workers
- Workers in occupations identified by Frey and Osborne as susceptible to automation earn less on average than other workers—about 17.2 percent less, after controlling for factors that may affect wages

Correlation between Concentration of Jobs Susceptible to Automation and Growth in Tech Jobs



Source: GAO analysis of employment data from the American Community Survey (ACS), 2010-2016. | GAO-19-257

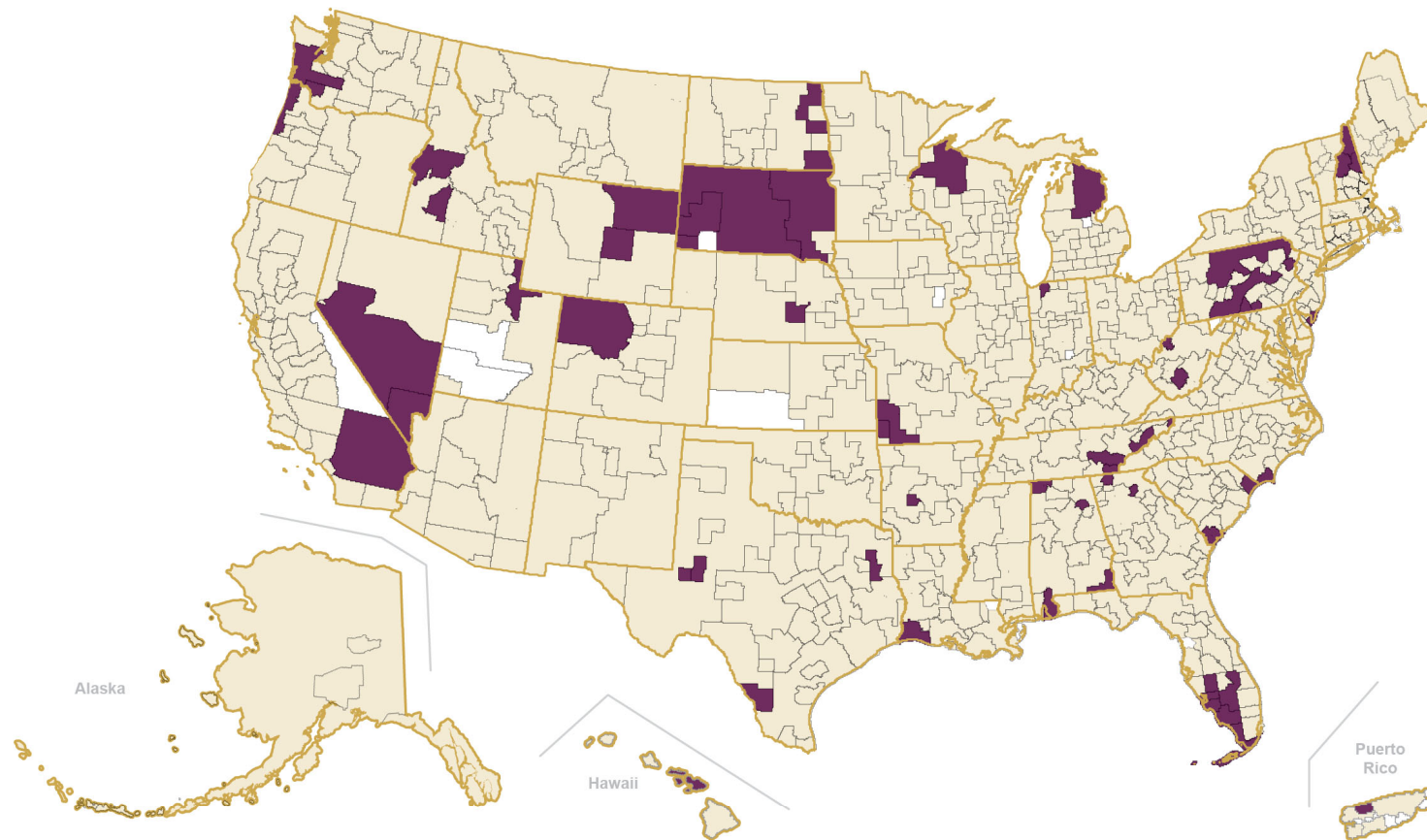
- Industries with higher concentrations of jobs susceptible to automation were more likely to have experienced significant growth in their concentration of tech jobs, 2010-2016
- This suggests that growth in tech jobs may be an indicator of industries' preparation for, or adoption of, advanced technologies



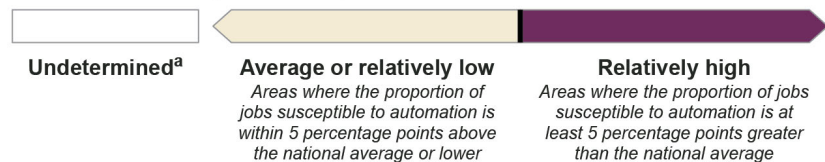
Occupations Susceptible to Automation Did Not Experience Meaningfully Higher Job Loss Rates

- Our analysis of ACS data showed no correlation between an industry having a higher concentration of jobs susceptible to automation and employment decreases/increases in that industry
- We also found no meaningful differences in the relative rate of job losses between workers in occupations susceptible to automation and those in other occupations
 - We analyzed job losses in the Current Population Survey's Displaced Worker Supplement, defined as where the position or shift was abolished or there was insufficient work to do
- There could be a number of reasons we did not find a relationship between susceptibility to automation and employment changes in both analyses:
 - A relationship does not exist
 - Such a relationship is too complex to measure in these ways
 - It is too soon to observe the employment effects of automation
 - Our analysis covered a period of overall economic growth, which could obscure or overwhelm other employment trends

Geographic Concentration of Jobs Susceptible to Automation



Concentration of jobs susceptible to automation



Source: GAO analysis of data from the May 2017 Occupational Employment Statistics (OES). | GAO-19-257

What has been the effect on selected firms?

- Site visits with 16 firms that are using advanced technologies in their operations
 - Interviewed managers and workers
 - Observed firms' use of technologies
 - Varied in size, industry sector, types of technologies used, and location
 - Meant to be illustrative, not generalizable
- Interviews with 7 firms that develop advanced technologies



Motivations for Firms to Adopt Advanced Technologies

- Cost savings was a primary consideration for most firms we talked with
 - Reducing operational costs
 - Opening up production line space
 - Saving costs related to medicines going missing
- Improving job quality and worker safety
 - Reducing dangerous and dull work
 - Increasing value-added work
- Helping recruitment and retention
- Product-related motivations
 - Improving product quality
 - Expanding product offerings
 - Supply chain reliability



Risks for Firms When Adopting Advanced Technologies

- Reliability of technology
 - Firm size might affect risk tolerance or willingness to experiment with new technologies
 - Companies often build manual redundancies into operations
- Usefulness of individual technologies varies based on a firm's context and the maturity of the technology
- Working with new tech developer companies that may go out of business or be bought out by a larger firm
- Operational slowdowns
- Worker concerns
- Some firms decide not to adopt advanced technologies after weighing these risks

Workforce Effects of Technologies at Firms: Changes in Worker Roles, Tasks, and Skills

- Firms we met with emphasized the following roles and tasks as a result of the adoption of advanced technologies:
 - Interactive work
 - Cognitive work
 - Higher-skilled work
 - Monitoring work
 - Less physically taxing work
 - Simplified work
 - Lower-skilled work
 - Adaptability to changing daily demands



Source: A small manufacturer of rubber stamps and embossing seals. © 2018 the stamp manufacturer. | GAO-19-257

- Workers who can adapt to changes may experience positive effects, while workers who are unable to adjust may be negatively affected

Workforce Effects of Technologies at Firms: Complexity of Observing Effects

- The iterative and sometimes lengthy nature of firms' adoption of advanced technologies can delay workforce effects
 - The absence of short-term effects of technology adoption does not necessarily preclude long-term implications
 - Example: Slower growth rates in workforce size over time, relative to revenue growth rates
- The complexity of workforce adjustments can make it difficult to determine or measure the effects of technology adoption on workers
 - Example: Fewer job opportunities might be available in the future for workers with certain skills
- How quickly workforce reductions materialize for firms (and the decision to rely on attrition or layoffs) can vary greatly – depending on the firm's turnover rate

Conclusions

- Comprehensive data on firms' adoption and use of advanced technologies do not currently exist, which prevents federal agencies and others from fully monitoring the spread of advanced technologies and any subsequent changes to employment levels or structural shifts in the tasks and skills associated with jobs
- Observations from our visits to firms illustrate the complex and varied workforce effects that result from firms' adoption of advanced technologies
- Certain groups of workers may be disproportionately affected, and will be in greater need of programmatic or policy supports
- Better data could be used by policymakers and DOL to proactively design and fund worker training programs that meet the job needs of the future

Results of Our Work

- GAO recommended that DOL develop ways to use existing or new data collection efforts to identify and systematically track the workforce effects of advanced technologies.
- DOL agreed with GAO's recommendation and plans to identify and recommend data collection options to fill gaps in existing information about how the workplace is affected by new technologies, automation, and artificial intelligence.
- DOL also stated that it will continue coordinating with the Census Bureau on research activities in this area.

Our full report is available at:

<https://www.gao.gov/products/GAO-19-257>

Questions?