BROOKINGS

RESEARCH

Robotization and occupational mobility

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→ Beyond job losses and wage declines, technology shocks also affect workers' long-term career prospects.

→ The likelihood of workers transitioning to better-paid occupations has fallen sharply since the year 2000, in part due to industrial robot adoption.

→ When workers' expected lifetime earnings decline, they invest less in housing, pursue less education, and are more likely to support populist political candidates.

→ Policies focused narrowly on job losers will miss the impact on many other workers experiencing changes in their long-term job prospects.

Introduction

When policymakers discuss the impact of new technologies on workers, the conversation typically centers on two questions: How many jobs will be lost, and what will happen to wages? While these are useful starting points, a growing body of research suggests that technology's effects on workers extend well beyond these immediate employment and earnings outcomes. Robotization and AI, in particular, stand to reshape the entire career trajectories of workers.

The economic consequences of technological change on work have been extensively studied: Research has found that computers changed the demand for different skills, with [routine tasks particularly vulnerable to displacement ↗](#). This task displacement due to automation has been shown to [increase wage inequality in the U.S. ↗](#) Individual firms that adopt robots have been found to [expand their overall employment ↗](#) and to become more [productive ↗](#), but this may come at the expense of competitors or production workers within the adopting firms that are replaced by the technology. As a

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result, the adoption of industrial robots in particular [has been linked to significant job losses and wage declines ↗](#) in U.S. labor markets between 1990 and 2007.

Yet, focusing solely on immediate employment and wage changes may understate how workers are impacted by new technologies at work. Job displacement has long-lasting effects that persist well beyond the initial shock, with much of the harm occurring [as displaced workers move to lower-paying firms and occupations ↗](#). For example, historical evidence shows that 19th-century artisan shoemakers [suffered permanent lifetime earnings losses ↗](#) when automated production displaced their craft, as they found themselves unable to access comparable career paths afterward—and this shock even lowered the career prospects of their children, who were unable to follow their fathers into their occupation. Even nowadays, many occupations require tacit knowledge and connections for workers to succeed (e.g. [economists ↗](#), [doctors ↗](#)), which are lost when workers are forced to switch careers due to technological change.

Moreover, even if workers do not experience displacement, their job mobility may still be impacted by new technologies. Workers may find it harder to move to better-paying or higher-ranked positions within organizations.

This evidence points to a crucial dimension of technological change: when technology disrupts traditional pathways to advancement, workers may find themselves stuck in lower-paying positions even if they remain employed. The anxiety this generates may help explain why public concern about robotization often exceeds what job loss statistics alone would predict.

In this article, we explore what has happened to career mobility in recent decades and how it is connected to technological change. We argue that robotization doesn't just affect what workers earn today—it also reshapes their entire career trajectory, including their ability to move up to better-paying jobs in the future. As a result, understanding economic anxiety surrounding automation—and reactions to it in the economic and political realms—requires thinking about what happens to long term expectations about career prospects, not just about current jobs and wages.

The broader decline in occupational mobility

Research has documented an apparent decline in upward mobility in the United States. For example, [studies on intergenerational mobility ↗](#)—the likelihood that children will

their parents—find that the fraction of 30-year-olds earning more than

their parents did at the same age fell from approximately 90% for those born in 1940 to roughly 50% for those born in the 1980s. Considering individual careers, occupational mobility—the rate at which workers change occupations—has also [fallen since the 1990s ↗](#). These mobility trends matter because much of lifetime wage growth [comes from workers moving to better-paying positions ↗](#) rather than from the wage increases within the same job. When these transitions become less frequent or less likely to result in higher pay, workers' lifetime earnings can suffer even if current wages remain stable. [One study shows ↗](#) that Danish workers that were forced to switch to lower-paying occupations because of trade liberalization experienced significant, negative lifetime earnings effects.

Similar dynamics likely apply to technological shocks. In [recent work ↗](#), we document that the likelihood of transitioning from one occupation to another declined in the U.S. from 2000 to 2015, and this change asymmetrically lowered the likelihood of transitioning to a better-paid job rather than a worse-paid job over a 5-year horizon (see Figure 1).

FIGURE 1

5-year transitions to better- / worse-paid jobs by time period

2000-2005   2005-2010   2010-2015
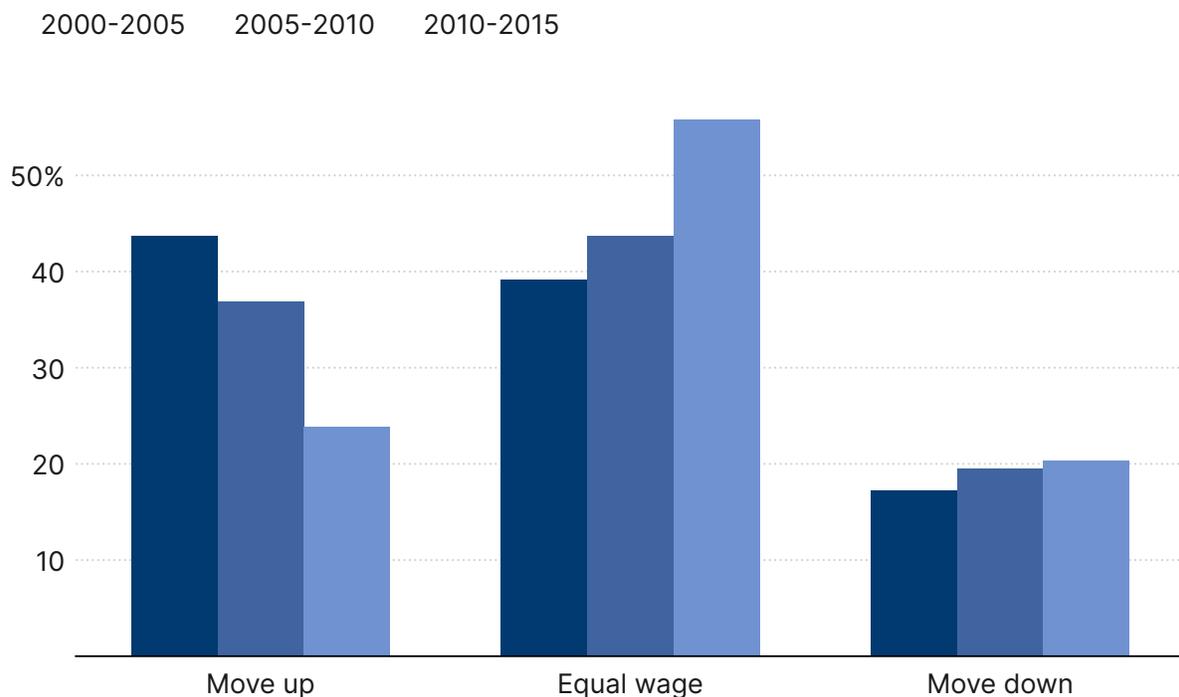
Note: Figure reproduced from Petrova et al. 2024

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Measuring career trajectories using "career values"

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To understand how technological change affects long-term career prospects, we need measures that go beyond current wages and employment and are also able to incorporate these effects on occupational mobility. In our research, we develop such a measure—what we call "career value"—that captures the expected present value of a worker's lifetime earnings based on their current occupation and local labor market.

The concept builds on the idea that when people decide whether to take a new job, pursue additional education, or move to a new city, they don't just consider their current paycheck. They also think about where a job might lead—the promotions, skill development, and transitions to better-paying occupations that could follow. That is, workers consider future earnings, not just current pay, when making career decisions. This aligns with previous research showing that expected career trajectories influence occupational choices ↗. Our contribution is to construct an empirical measure that combines observed transition patterns with wage data to quantify what an occupation is "worth" in career terms at a particular moment in time from the perspective of a worker.

We define an occupation's "career value" as the present discounted value of expected lifetime earnings, taking into account the probability of transitioning to other occupations and the wages those occupations pay. This measure provides information beyond a worker's current wage, as a job with moderate current pay but good advancement opportunities—e.g., a construction foreman position that often leads to becoming a lead in project management—may have a higher career value than a job with slightly better immediate pay but no possibilities for advancement.

To construct this measure empirically, we combine two data sources. First, we analyze more than 18 million resumes from Burning Glass Technologies (now Lightcast), collected from job boards between 2000 and 2017. This allows us to trace actual career paths that workers have followed—seeing, for example, how often production workers transition into management roles or how frequently administrative assistants move into sales positions.

Second, we merge these transition patterns with historical data on wages by occupation and location from the Bureau of Labor Statistics, which we adjust for inflation to reflect changes in real wages over time. The result is a forward-looking measure of what workers can expect to earn over their careers given their current occupation and the prevalence of jobs at particular wages in their local labor market.

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Applying this framework to U.S. labor markets reveals patterns consistent with the broader mobility decline documented in other research, while adding new detail about how these trends vary across occupations and regions. Between 2000 and 2008, local market career values grew by about 0.9% on average. But between 2008 and 2016, they actually declined by 0.1%. This stagnation occurred despite continued real wage growth during this period. The culprit? A significant deterioration in occupational mobility.

Between 2000 and 2016, the direct contribution of wages to career values increased by about $16,100 (in year 2000 dollars), holding occupational mobility constant. But the contribution from career paths—the value of being able to move to better-paying occupations—declined by $12,500, nearly offsetting those wage gains. This pattern holds when we look at specific career paths. In 2004, production workers (those in manufacturing occupations) frequently transitioned into management, architecture and engineering, and other higher-paying occupation groups. By 2016, these upward transitions had become notably less common, while exits to similar- or lower-paying jobs increased.

How robot adoption erodes career opportunities

While multiple factors likely contribute to declining occupational mobility, our research identifies automation—specifically, the adoption of industrial robots—as one significant driver. This finding complements [existing evidence on robot automation's effects on employment and wages ↗](#) while revealing an additional channel through which technology affects workers. We measure local exposure to robots by combining International Federation of Robotics data on robot deployment with information about local industry composition. Using this data, we designate areas with more employment in robot-intensive industries as having greater exposure to automation. This is necessarily an imperfect proxy for actual robot adoption, which is [empirically more concentrated than industry composition would suggest ↗](#), but captures part of the automation pressure experienced by local areas.

To isolate causal effects rather than mere correlations, we use robot adoption patterns in European countries as an instrument for U.S. adoption. The logic is that technological advances in robotics affect adoption across countries, but European labor market conditions are unlikely to directly cause changes in U.S. career prospects independent of automation.

Our key finding is that one additional industrial robot per 1,000 workers lowered local career values by approximately 1.5%—or about $3,360—and these effects are

concentrated in high-manufacturing areas.

Where does this decline come from? We decompose the career value effect into its component parts:

- About two-thirds of the decline stems from lower wages, with robot adoption pushing down what workers earn in their current and potential future occupations.

- About one-third stems from deteriorating career paths, such that, even holding wages constant, workers became less likely to transition into higher-paying occupations.

The career path effects are especially important because they reveal something that a simple wage analysis would miss. Automation isn't just reducing what specific jobs pay; it's disrupting the stepping stones workers need to advance their careers.

Who is affected most? Automation effects by education, experience, and gender

The effects of robot adoption vary significantly across workers with different characteristics.

Education provides only limited protection. Even college-educated workers face significant negative effects from local robot exposure, with statistically similar declines across education levels.

Experience matters but in unexpected ways. We find a U-shaped relationship between experience and career value effects. Workers with moderate experience levels (6-20 years) face the largest negative impacts on their career paths. The most junior workers (0-5 years) and most senior workers (20+ years) are somewhat shielded and experience smaller (but still negative) effects.

This pattern may reflect the different ways automation affects workers at various career stages. Early-career workers have more flexibility to redirect their careers. Senior workers have accumulated human capital and connections that make them less substitutable. But mid-career workers, who have likely invested in human capital specific to their occupational trajectories, see substantial deteriorations in their expected career paths.

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Gender differences reveal a complex picture. Men experience larger overall career value declines than women. The difference comes primarily from career path effects: Men's advancement opportunities deteriorate more sharply in response to robot adoption. However, the individual-level data reveals additional nuance. Women are actually more likely than men to be demoted from management roles in areas experiencing high robot exposure. Yet women also respond to automation by investing more in education. This educational response may explain why women's aggregate career value declines are smaller despite facing greater demotion risk.

Effects on decisions about the future: Housing, education, and politics

If career values represent workers' forward-looking expectations about lifetime income, changes in these values should affect forward-looking decisions, such as investments in housing and education or perhaps even voting behavior.

To test this hypothesis, we can't simply regress local outcomes on local career values because many factors affect both career prospects and decisions like home purchases. Instead, we use a proxy for variation in local occupations' career values by using career values in the same occupations in geographically distant labor markets. The logic is that distant labor market conditions affect local career values (through national trends in occupation-specific wages and transitions) but don't directly cause local housing or education decisions.

Using this approach, we find robust effects:

1. Housing investment declines with career values. A standard deviation increase in career values leads to approximately 23% more new housing permits per capita.[1]

2. College enrollment responds to career opportunities. Higher career values predict increased pursuit of higher education, with a one standard deviation improvement associated with a 1.1 percentage point increase in the share of the population obtaining a college education.

3. Voting patterns shift. We find that declining career values predicted an increased vote share for Donald Trump in the 2016 presidential election. Controlling for the 2012 Republican vote share, a one standard deviation decrease in career values was associated with approximately 0.67 percentage points higher Trump support.

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These findings make intuitive sense: families who expect higher lifetime earnings are more likely to invest in homeownership and to build new homes rather than remain in existing rental housing. Workers invest in human capital when they expect that investment to pay off through better career trajectories. Moreover, while we are cautious about making strong causal claims regarding voting behavior, our finding is [consistent with research ↗](#) linking [economic anxiety ↗](#) and disrupted expectations to [support for populist candidates ↗](#).

Policy implications of considering career value effects

These findings connect to ongoing policy debates about how to help workers adapt to technological change. Current approaches—such as [Trade Adjustment Assistance ↗](#), a U.S. federal program that provides assistance such as retraining, income support, or relocation allowances, to workers displaced by foreign trade—focus primarily on those who lose jobs. But if technological change operates partly by closing off advancement opportunities, workers who remain employed may also need support.

Our findings suggest several implications for policymakers concerned about automation's effects on workers:

Think beyond immediate job displacement. Current policy discussions focus heavily on workers who directly lose their jobs to automation. Our research shows that the potential effects are much broader, affecting career advancement for workers throughout local economies, including those in occupations with no direct automation exposure. Policies targeting only displaced manufacturing workers will miss the majority of affected workers. On the other hand, the long-run effects of technology on labor are not always negative: New technologies can also generate new types of jobs that enable high-paying career paths that previously did not exist. Policymakers should be mindful of not letting regulation that protects one group hinder the career prospects of others.

Career mobility deserves policy attention. Many policies aim to support wage levels through minimum wage laws, earned income tax credits, and similar mechanisms. Our research suggests that policies supporting career advancement, such as the U.S. Department of Labor's Registered Apprenticeship programs which combine paid work experience [with structured mentorship and portable credentials ↗](#), or education and re-skilling programs offered by employers [through education platforms like Guild ↗](#) may be equally important for workers' long-term prosperity. This becomes particularly relevant when policies that aim to preserve current employment and wages at all cost may hinder workers' transition into new career paths that have better long-run

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prospects. For example, forcing autonomous vehicles to have human attendants to protect employment for taxi operators is unlikely to provide a long-run career for the human working as a passive observer of the vehicle.

Geographic effects matter. The concentration of negative effects in high-manufacturing areas has implications for place-based policies. Communities experiencing significant automation may benefit from targeted investments in economic diversification, support for entrepreneurship, and infrastructure that enables broader labor market access.

Aggregate measures can miss what matters. Traditional economic indicators such as unemployment rates or average wages may not capture the erosion of opportunity that workers experience. As a result, policymakers may miss a more general perception of economic decline and anxiety about future career paths, as declining career values can coexist with stable employment and even rising wages if the paths to advancement are closing. Policymakers should consider developing and tracking measures of career mobility alongside traditional labor market indicators.

Looking ahead: What about AI?

Our study focuses on industrial robots through 2016—before the emergence of generative AI tools like ChatGPT. But our framework provides a template for understanding how any labor-saving technology affects workers.

If AI follows the pattern of industrial robots, we should expect effects that extend far beyond the specific occupations where AI is deployed. White-collar workers whose tasks are automated may compete for other positions, disrupting career ladders throughout the service economy. The workers most affected may not be those whose current jobs are automated but those whose paths to advancement are blocked. For example, to the extent that jobs in AI-exposed occupations [decline more for early-career workers ↗](#), this may disrupt traditional career ladders. However, it may be too early to tell whether such impacts will be large, as evidence so far [does not yet show major disruptions in the labor market. ↗](#)

The career value approach we develop offers a way to measure these effects as they unfold. Rather than waiting to observe actual displacement, researchers and policymakers can track changes in occupational transition patterns to identify emerging disruptions before they fully materialize.

Understanding these dynamics is essential as we enter an era of even more transformative technological change. The AI revolution will likely create similar patterns of disrupted career paths and eroded opportunities, extending well beyond the specific tasks that algorithms can perform. Meeting this challenge will require policies that address not just job losses and wage declines but the broader erosion of career opportunity that technological change can bring.

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Footnotes

1. Here, we use housing permits as a proxy for changes in demand for housing as an observable proxy for changes in the total quantity of housing demanded, which – absent shifts in housing supply – will capture shifts in the housing demand curve.

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