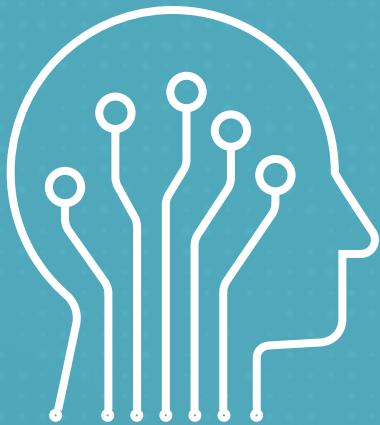


EXECUTIVE SUMMARY



AUTOMATION and ARTIFICIAL INTELLIGENCE

How machines are affecting people and places

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The power and prospect of automation and artificial intelligence (AI) initially alarmed technology experts for fear that machine advancements would destroy jobs. Then came a correction, with a wave of reassurances.

Now, the discourse appears to be arriving at a more complicated, mixed understanding that suggests that automation will bring neither apocalypse nor utopia, but instead both benefits and stresses alike. Such is the ambiguous and sometimes-disembodied nature of the “future of work” discussion.

Which is where the present analysis aims to help. Intended to clear up misconceptions on the subject of automation, the following report employs government and private data, including from the McKinsey Global Institute, to develop both backward- and forward-looking analyses of the impacts of automation over the years 1980 to 2016 and 2016 to 2030 across some 800 occupations. In doing so, the report assesses past and coming trends as they affect both people and communities and suggests a comprehensive response framework for national and state-local policymakers.

In terms of **current trends**, the report finds that:

1. Automation and AI will affect tasks in virtually all occupational groups in the future but the effects will be of varied intensity—and drastic for only some. The effects in this sense will be broad but variable:

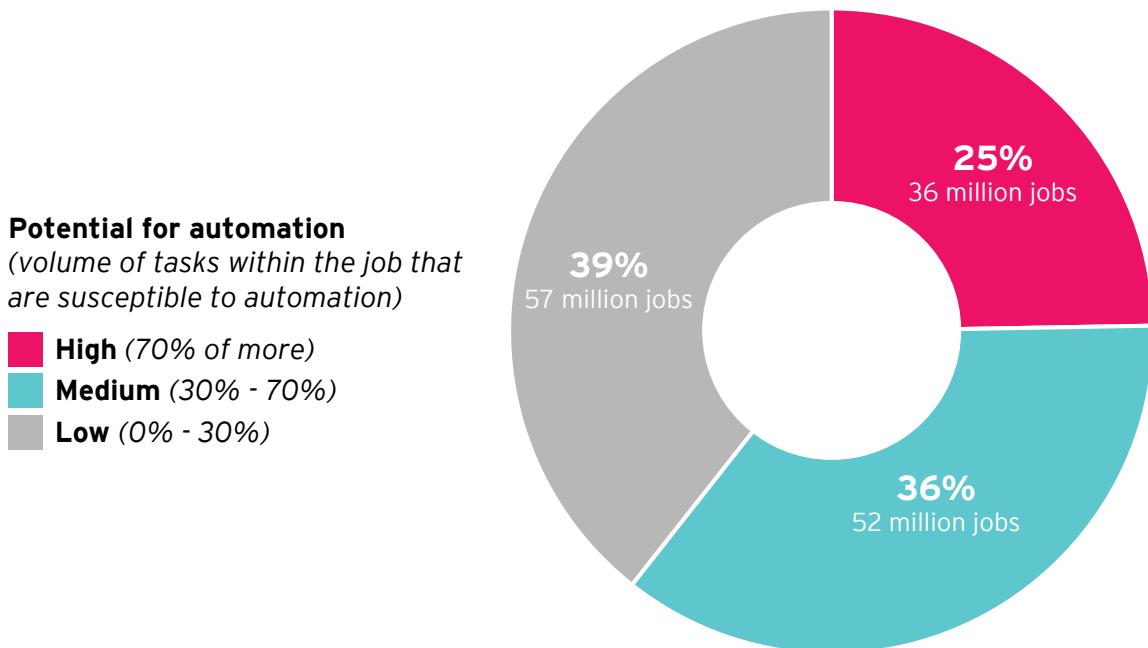
- Almost no occupation will be unaffected by the adoption of currently available technologies.

- Approximately 25 percent of U.S. employment (36 million jobs in 2016) will face high exposure to automation in the coming decades (with greater than 70 percent of current task content at risk of substitution).
- At the same time, some 36 percent of U.S. employment (52 million jobs in 2016) will experience medium exposure to automation by 2030, while another 39 percent (57 million jobs) will experience low exposure.

FIGURE 5

Most jobs are not highly susceptible to automation

Shares of employment by automation potential



Source: Brookings analysis of BLS, Census, EMSI, and McKinsey data

2. The impacts of automation and AI in the coming decades will vary especially across occupations, places, and demographic groups.

Several patterns are discernable:

- “Routine,” predictable physical and cognitive tasks will be the most vulnerable to automation in the coming years.

Among the most vulnerable jobs are those in office administration, production, transportation, and food preparation. Such jobs are deemed “high risk,” with over 70 percent of their tasks potentially automatable, even though they represent only one-quarter of all jobs. The remaining, more secure jobs include a broader array of occupations ranging from complex, “creative” professional and technical roles with high

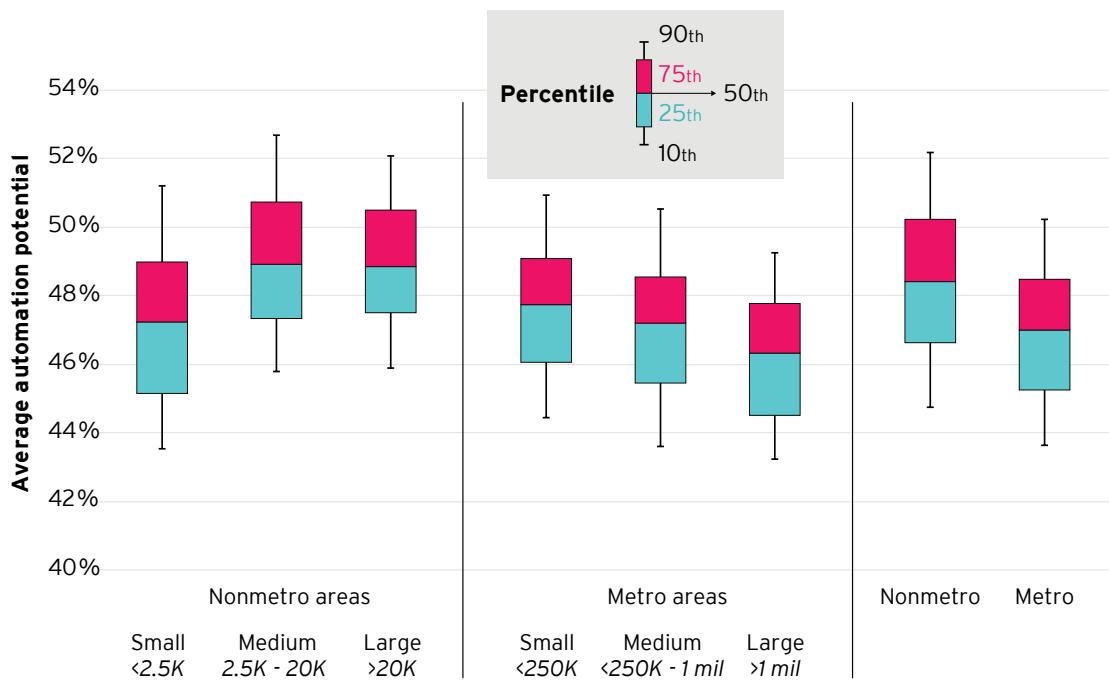
educational requirements, to low-paying personal care and domestic service work characterized by non-routine activities or the need for interpersonal social and emotional intelligence.

Near-future automation potential will be highest for roles that now pay the lowest wages. Likewise, the average automation potential of occupations requiring a bachelor’s degree runs to just 24 percent, less than half the 55 percent task exposure faced by roles requiring less than a bachelor’s degree. Given this, better-educated, higher-paid earners for the most part will continue to face lower automation threats based on current task content—though that could change as AI begins to put pressure on some higher-wage “non-routine” jobs.

FIGURE 8

Smaller, more rural places will face heightened automation risks

County distribution by community size type, 2016

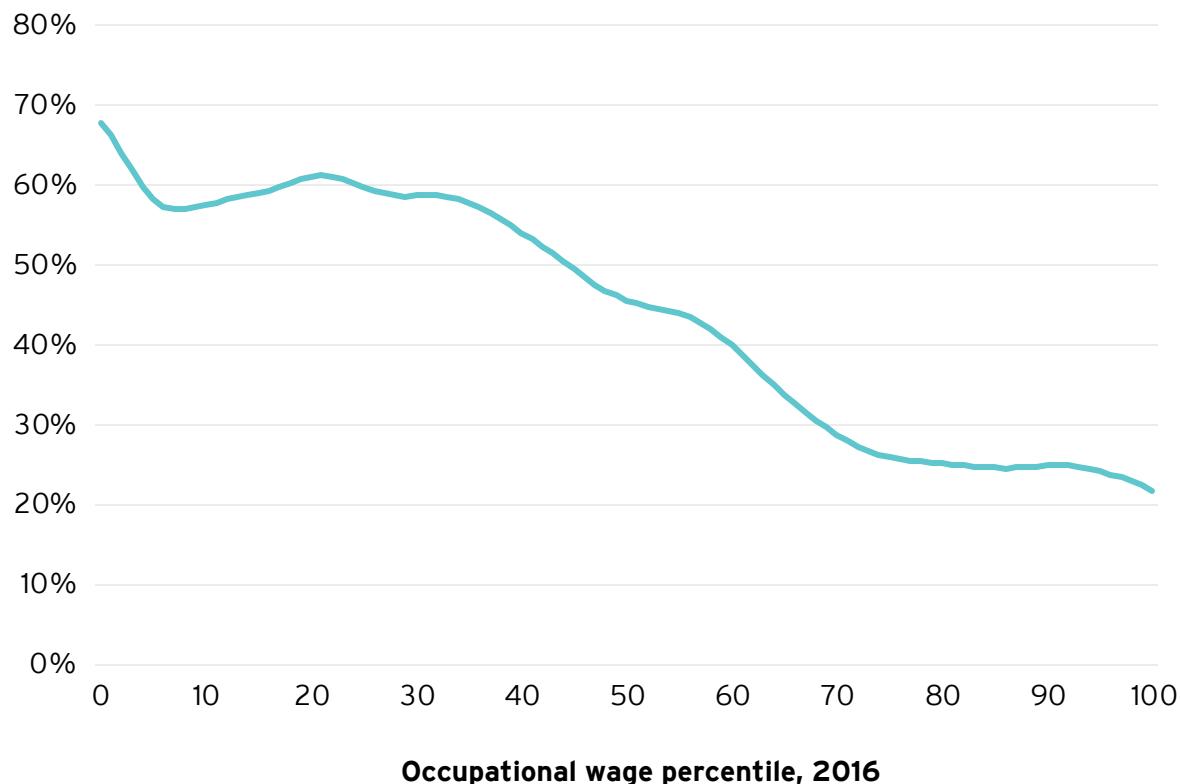


Source: Brookings analysis of BLS, Census, EMSI, Moody's, and McKinsey data

FIGURE 6

The lowest wage jobs are the most exposed to automation

Automation potential. United States, 2016



Note: Figures have been smoothed using a LOWESS regression
Source: Brookings analysis of BLS, Census, EMSI, and McKinsey data

- **Automation risk varies across U.S. regions, states, and cities, but it will be most disruptive in Heartland states.** While automation will take place everywhere, its inroads will be felt differently across the country. Local risks vary with the local industry, task, and skill mix, which in turn determines local susceptibility to task automation.

Large regions and whole states—which differ less from one another in their overall industrial compositions than do smaller locales like metropolitan areas or cities—will see noticeable but not, in most cases, radical

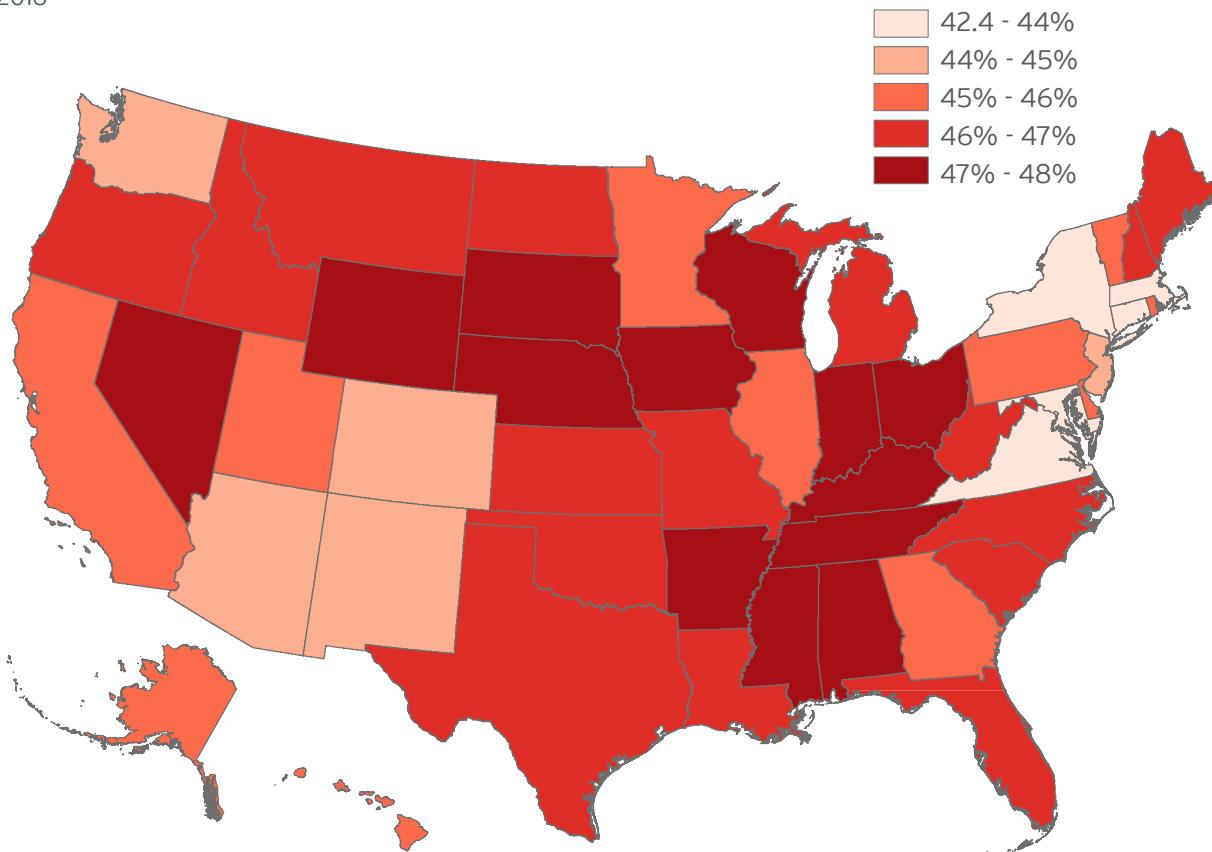
variations in task exposure to automation. Along these lines, the state-by-state variation of automation potential is relatively narrow, ranging from 48.7 and 48.4 percent of the employment-weighted task load in **Indiana** and **Kentucky** to 42.9 and 42.4 percent in **Massachusetts** and **New York**, as depicted in Map 2.

Yet, the map of state automation exposure is distinctive. Overall, the 19 states that the Walton Family Foundation labels as the **American Heartland** have an average employment-weighted automation potential of 47 percent of current tasks, compared with 45 percent in the rest of the country. Much

MAP 2

Average automation potential by state

2016



Source: Brookings analysis of BLS, Census, EMSI, Moody's, and McKinsey data

of this exposure reflects Heartland states' longstanding and continued specialization in manufacturing and agricultural industries.

- **At the community level, the data reveal sharper variation, with smaller, more rural communities significantly more exposed to automation-driven task replacement—and smaller metros more vulnerable than larger ones.** The average worker in a small metro area with a population of less than 250,000, for example, works in a job where 48 percent of current tasks are potentially automatable. But that can rise or decline. In small, industrial metros like **Kokomo, Ind.** and **Hickory, N.C.** the automatable share of work reaches as high as 55 percent on

average. By contrast, small university towns like **Charlottesville, Va.** and **Ithaca, N.Y.**, or state capitals like **Bismarck, N.D.** and **Santa Fe, N.M.**, appear relatively well-insulated.

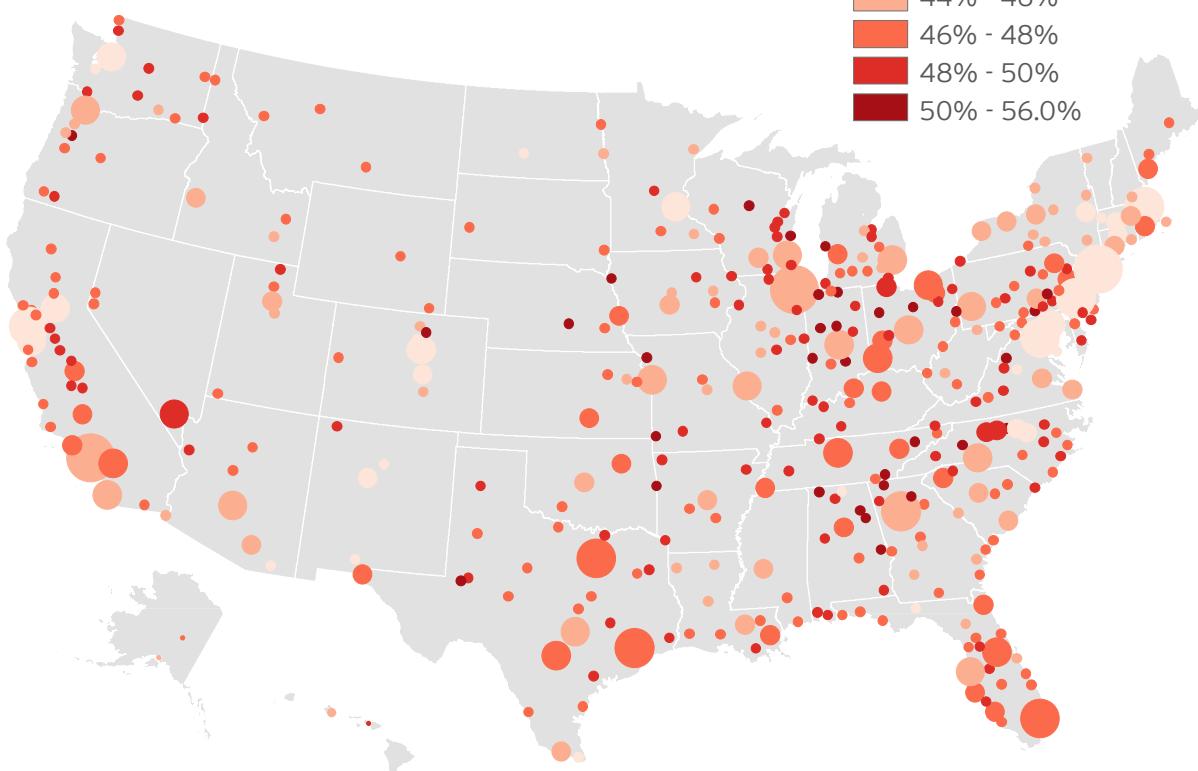
As to the 100 largest metropolitan areas, it is also clear that while the risk of current-task automation will be widely distributed, it won't be evenly spread. Among this subset of key metro areas, educational attainment will prove decisive in shaping how local labor markets may be affected by AI-age technological developments.

Among the large metro areas, employment-weighted task risk in 2030 ranges from 50 percent and 49 percent in less well-educated

MAP 4

Average automation potential by metropolitan area

2016



Source: Brookings analysis of BLS, Census, EMSI, Moody's, and McKinsey data

locations like **Toledo, Ohio** and **Greensboro-High Point, N.C.**, to just 40 percent and 39 percent in high education attainment metros like **San Jose, Calif.** and **Washington, D.C.**

Following Washington, D.C. and San Jose among the larger metros with the lowest current-task automation risk comes a “who’s who” of well-educated and technology-oriented centers including **New York**; **Durham-Chapel Hill, N.C.**; and **Boston**—all with average current-task risks below 43 percent. These metro areas relatively protected by their specializations in durable professional, business, and financial services occupations, combined with relatively large education and health enterprises.

- **Men, young workers, and underrepresented communities work in more automatable occupations.** In this respect, the sharp segmentation of the labor market by gender, age, and racial-ethnic identity ensures that AI-era automation is going to affect demographic groups unevenly.

Male workers appear noticeably more vulnerable to potential future automation than women do, given their overrepresentation in production, transportation, and construction-installation occupations—job areas that have above-average projected automation exposure. By contrast, women comprise upward of 70 percent of the labor force in relatively safe

occupations, such as health care, personal services, and education occupations.

Automation exposure will vary even more sharply across age groups, meanwhile, with the young facing the most disruption. Young workers between the ages of 16 and 24 face a high average automation exposure of 49 percent, which reflects their dramatic overrepresentation in automatable jobs associated with food preparation and serving.

Equally sharp variation can be forecasted in the automation inroads that various racial and ethnic groups will face. Hispanic, American Indian, and black workers, for example, face average current-task

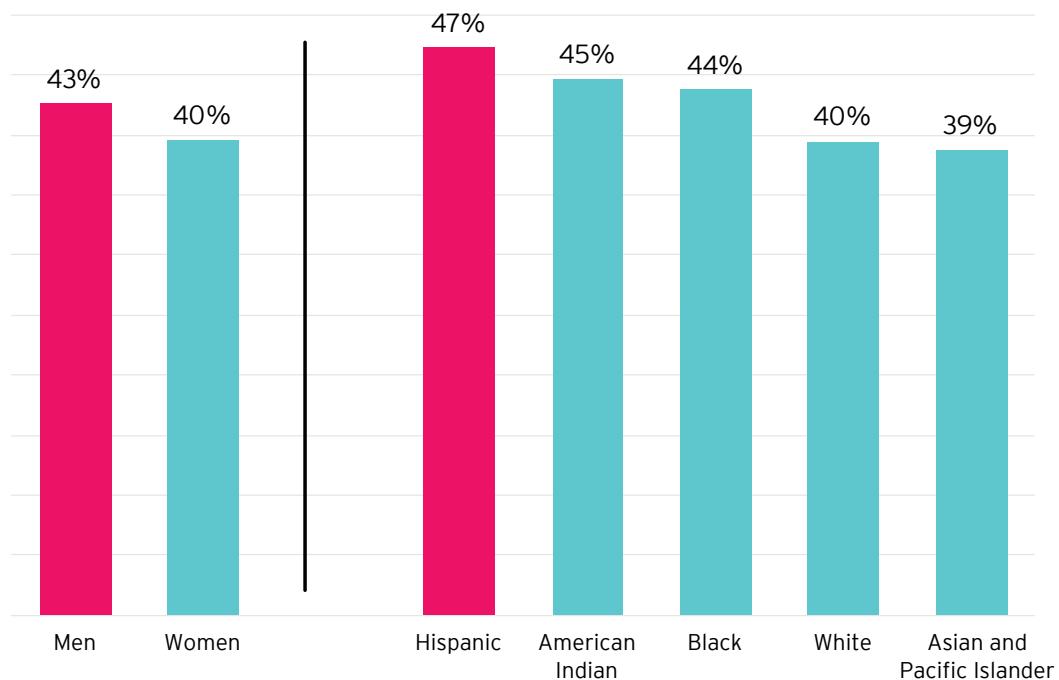
automation potentials of 47 percent, 45 percent, and 44 percent for their jobs, respectively, figures well above those likely for their white (40 percent) and Asian (39 percent) counterparts.

Underlying these differences is the stark over- and underrepresentation of racial and ethnic groups in high-exposure occupations like construction and agriculture (Hispanic workers) and transportation (black workers). Black workers have a slightly lower average automation potential based on their overrepresentation in health care support and protective and personal care services, jobs which on average have lower automation susceptibility.

FIGURE 10

Automation exposure breaks sharply along demographic lines

Average automation potential by gender and race, 2016

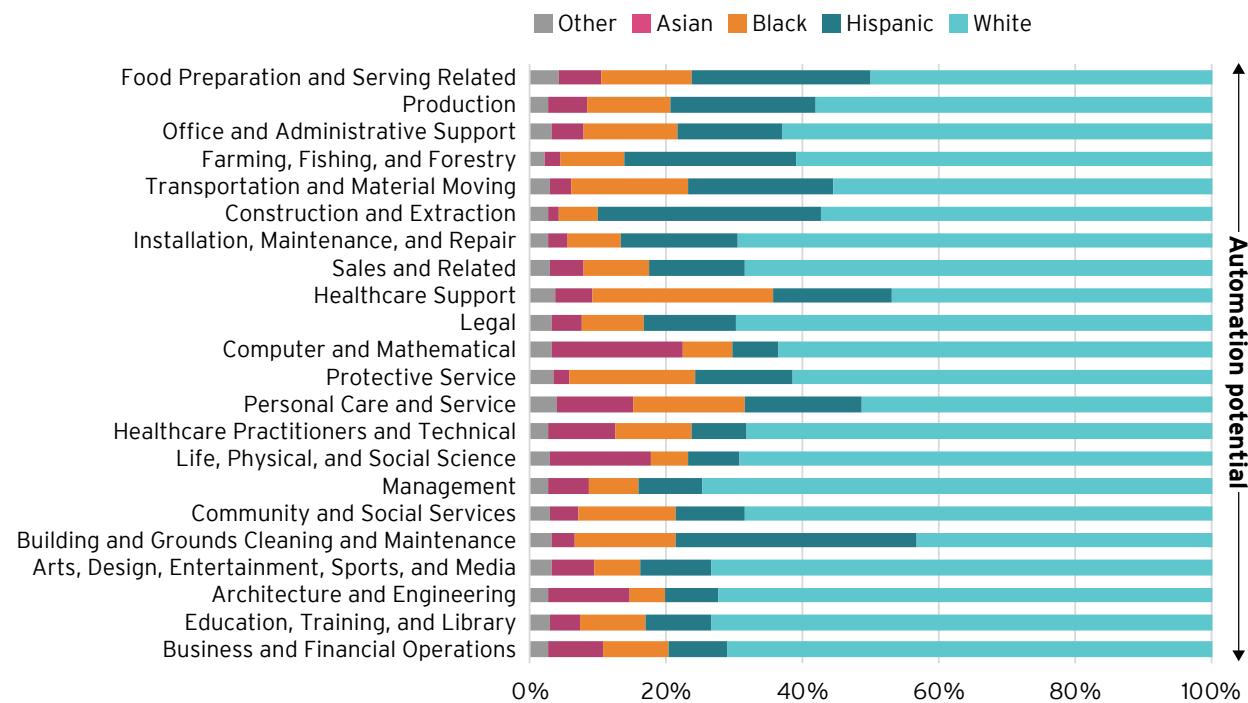


Source: Brookings analysis of 2016 American Community Survey 1-Year microdata

FIGURE 11

Black and Hispanic workers are concentrated in more automatable occupations

Shares of occupation group, 2016



Source: Brookings analysis of American Community Survey 1-year microdata

3. To manage and make the best of these changes five major agendas require attention on the part of federal, state, local, business, and civic leaders.

To start with, government must work with the private sector to **embrace growth and technology** to keep productivity and living standards high and maintain or increase hiring.

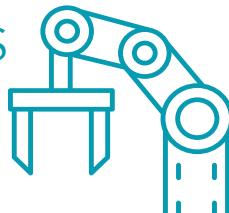
Beyond that, all parties must invest more thought and effort into ensuring that the labor market works better for people. To that end, the appropriate actors need to:

- **Promote a constant learning mindset**
 - Invest in reskilling incumbent workers
 - Expand accelerated learning and certifications
 - Make skill development more financially accessible
 - Align and expand traditional education
 - Foster uniquely human qualities
- **Facilitate smoother adjustment**
 - Create a Universal Adjustment Benefit to support all displaced workers
 - Maximize hiring through a subsidized employment program

- **Reduce hardships for workers who are struggling**
 - Reform and expand income supports for workers in low-paying jobs
 - Reduce financial volatility for workers in low-wage jobs
- **Mitigate harsh local impacts**
 - Future-proof vulnerable regional economies
 - Expand support for community adjustment

If the nation can commit to its people in these ways, an uncertain future full of machines will seem much more tolerable.

FIVE POLICY STRATEGIES FOR ADJUSTING TO AUTOMATION



Embrace growth and technology

Run a full-employment economy, both nationally and regionally

Embrace transformative technology to power growth

Promote a constant learning mindset

Invest in reskilling incumbent workers

Expand accelerated learning and certifications

Make skill development more financially accessible

Align and expand traditional education

Foster uniquely human qualities

Facilitate smoother adjustment

Create a Universal Adjustment Benefit to support all displaced workers

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Reduce financial volatility for workers in low-wage jobs

Mitigate harsh local impacts

Future-proof vulnerable regional economies

Expand support for community adjustment

Source: Metropolitan Policy Program at Brookings





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