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The future of work in America

People and places, today and tomorrow

July 2019

McKinsey Global Institute

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MGI is led by three McKinsey & Company senior partners: Jacques Bughin, Jonathan Woetzel, and James Manyika, who also serves as the chairman of MGI. Michael Chui, Susan Lund, Anu Madgavkar, Jan Mischke, Sree Ramaswamy, and Jaana Remes are MGI partners, and Mekala Krishnan and Jeongmin Seong are MGI senior fellows.

Project teams are led by the MGI partners and a group of senior fellows and include consultants from McKinsey offices around the world. These teams draw on McKinsey's global network of partners and industry and management experts. The MGI Council, which includes leaders from McKinsey offices around the world and the firm's sector practices, includes Michael Birshan, Andrés Cadena, Sandrine Devillard, André Dua, Kweilin Ellingrud, Tarek Elmasry, Katy George, Rajat Gupta, Eric Hazan, Acha Leke, Scott Nyquist, Gary Pinkus, Sven Smit, Oliver Tonby, and Eckart Windhagen. In addition, leading economists, including Nobel laureates, advise MGI research.

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Preface

Automation technologies promise to deliver major productivity benefits that are too substantial to ignore. They are also beginning to reshape the American workplace, and this evolution will become more pronounced in the next decade. Some occupations will shrink, others will grow, and the tasks and time allocation associated with every job will be subject to change. The challenge will be equipping people with the skills that will serve them well, helping them move into new roles, and addressing local mismatches.

This report represents the next stage in our ongoing body of research into the capabilities, potential, and economic impact of these technologies. This work began with *A future that works: Automation, employment and productivity,* in which we analyzed the automation potential of every occupation by looking at the extent to which its constituent activities can be handled by currently demonstrated technologies. In *Jobs lost, jobs gained: Workforce transition in a time of automation,* we examined the potential for both job displacement and job growth to assess the potential net impact in multiple countries, as well as the implications for occupations, skills, and wages. Earlier this year, we published *The future of women at work: Transitions in the age of automation,* exploring more targeted demographic effects in countries around the world by looking through the lens of gender. Now this report continues our exploration by examining the impact on local economies and demographic groups in the United States, placing automation in the context of other ongoing labor market trends that have affected places and people. Its starting point is a geographic segmentation produced for *America at work: A national mosaic and roadmap for tomorrow,* a research collaboration between McKinsey & Company and the Walmart Foundation.

This research was led by Susan Lund, an MGI partner based in Washington, DC; James Manyika, chairman and director of MGI, based in San Francisco; Liz Hilton Segel, a New York–based senior partner who serves as managing partner for McKinsey in North America; André Dua, an MGI Council member and a senior partner in New York; Bryan Hancock, a partner in Washington, DC; and Scott Rutherford, a senior partner in Washington, DC. Brent Macon led the project team, which included Veena Advani, E.B. Armstrong, Stephanie Bell, Shannon Glick, Megan Hastings, Josh Roberts, and Kelsey Schroeder. Arthur Bianchi, Gurneet Singh Dandona, Ryan Luby, Vivien Singer, Alok Singh, and Soyoko Umeno were instrumental in providing modeling, analytics, and data support.

We are grateful to the academic advisers who challenged our thinking and added new insights: Martin Neil Baily, the Bernard L. Schwartz Chair in Economic Policy Development and a Senior Fellow in Economic Studies at the Brookings Institution; and Laura Tyson, distinguished professor of the graduate school and faculty director of the Institute for Business & Social Impact, Haas School of Business, University of California, Berkeley.

This project benefited immensely from the expertise and perspectives of many McKinsey colleagues. Our US Future of Work steering committee, who generously gave their time and considerable industry insights to this project, included senior partners Kweilin Ellingrud, Katy George, Sajal Kohli, Asutosh Padhi, Thomas Seitz, Navjot Singh, Shubham Singhal, and Virginia Simmons. We also thank Sapana Agrawal, Sruti Balakrishnan, Federico Berruti, Arianna Camacho, Davis Carlin, Yaasna Dua, Pablo Illanes, Mike Kerlin, Lani Marsden, Duwain Pinder, Kate Lazaroff-Puck, Saurabh Sanghvi, Rachel Schaff, Matt Thomas, Carolina Toth, and Rob Whiteman.

This report also benefited from the colleagues, advisers, and collaborators involved the earlier research efforts mentioned above, particularly Gayatri Agnew, Angie Cooper, Kathleen McLaughlin, and Sean Thurman from the Walmart Foundation; McKinsey colleagues Steve Begley and Cassidy Tanner; and MGI colleagues Michael Chui, Mekala Krishnan, and Sree Ramaswamy. Along the way, we received valuable insight from conversations with employers and local leaders across the country and from our involvement in taskforces including the Aspen Institute Future of Work Initiative and the Markle Foundation's Rework America Initiative.

This report was produced by MGI executive editor Lisa Renaud, editorial production manager Julie Philpot, senior graphic designer Patrick White, and designer Laura Brown. We also thank our colleagues Dennis Alexander, Tim Beacom, Deadra Henderson, Richard Johnson, Lauren Meling, and Rebeca Robboy for their contributions and support.

This report contributes to MGI's mission to help business and policy leaders understand the forces transforming the global economy and prepare for the next wave of growth. As with all MGI research, this work is independent, reflects our own views, and has not been commissioned by any business, government, or other institution. We welcome your comments on the research at MGI@mckinsey.com.

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July 2019

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In Brief

The future of work in America

Much of the research on automation, including our own, has focused on the potential for job displacement and has taken a national-level view. This report looks beneath the national numbers to examine the present and potential future of work for different people and places across America. Local economies across the country have been on diverging trajectories for years, and they are entering the automation age from different starting points. Our view incorporates the current state of local labor markets as well as the jobs that could be lost and gained in the decade ahead.

— Our analysis of 315 cities and more than 3,000 counties shows that the United States is a mosaic of local economies with widening gaps between them. Twenty-five megacities and high-growth hubs, where 96 million people live, have generated most of the nation's job growth since the Great Recession. These are the nation's most dynamic places, with high-growth industries, many high-wage jobs, and young, educated workers but notable inequality. By contrast, 54 trailing cities and roughly 2,000 rural counties, collectively home to 78 million people, have older and shrinking workforces, higher unemployment, and lower educational attainment. Between these extremes are thriving niche cities and a larger "mixed middle" with modest economic growth; 94 million people live in these segments.

— These diverse starting points affect whether communities will have the momentum to offset automation-related displacement. The same 25 cities and peripheries that led the post-recession recovery could capture 60 percent of US job growth through 2030. The mixed middle and trailing cities are positioned for modest job gains, but rural counties could see a decade of flat or even negative net job growth. These shifts are occurring when geographic mobility is at historic lows.

— The next wave of automation will affect occupations across the country, displacing many office support, food service, transportation and logistics, and customer service roles. At the same time, the economy will continue to create jobs, particularly roles in healthcare, STEM fields, and business services, as well as work requiring personal interaction. While there could be positive net job growth at the national level, new jobs may not appear in the same places, and the occupational mix is changing. The challenge will be in addressing local mismatches and help workers gain new skills.

— Labor market outcomes vary across demographic groups today, and automation could amplify these patterns. Individuals with a high school degree or less are four times more likely to hold highly automatable roles than those with bachelor's degrees. Given educational disparities, Hispanic and African-American workers may be hit hardest, with 12 million displaced. Nearly 15 million jobs held by young people could be lost, raising questions about career pathways. Workers over age 50 hold an additional 11.5 million at-risk jobs. The share of middle-wage jobs may shrink as growth concentrates at the high and low ends of the wage scale.

— Employers seeking to make the most of automation for innovation and productivity will need to manage complex transitions. The challenges vary depending on the nature, mix, and geographic footprint of their workforces, as we illustrate through profiles of six types of employers. The questions facing a retail or food chain with a distributed customer-facing workforce, for example, are not the same as those for an employer with a geographically concentrated white-collar workforce. All employers will need to make adept decisions about strategy, investment, technology, workflow redesign, talent needs and training, and the potential impact on the communities in which they operate.

— Communities need to prepare for this wave of change, focusing in particular on job matching and mobility, skills and training, economic development and job creation, and support for workers in transition. They can draw on a common toolbox of solutions, but the priorities vary from place to place—from affordable housing in major cities to digital infrastructure that enables remote work in rural counties.

Without bold, well-targeted interventions, automation could further concentrate growth and opportunity. But these trends are not set in stone. It is possible to turn this period of technological change into an occasion to create more rewarding jobs and build better learning systems and career pathways. The United States needs the energy and ingenuity of its private and public sectors, as well as local coalitions working on the ground in communities. A fresh commitment to investing in people and places can lift up more Americans from coast to coast.

America is a mosaic of local economies on diverging trajectories

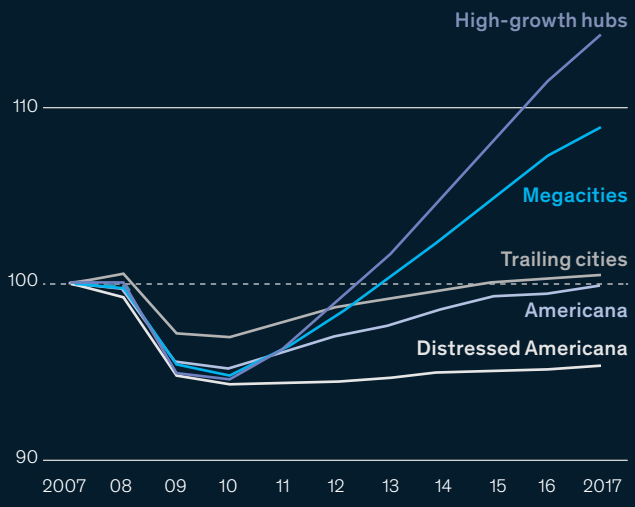
Automation could widen existing disparities

13 community segments have varying economic and demographic profiles

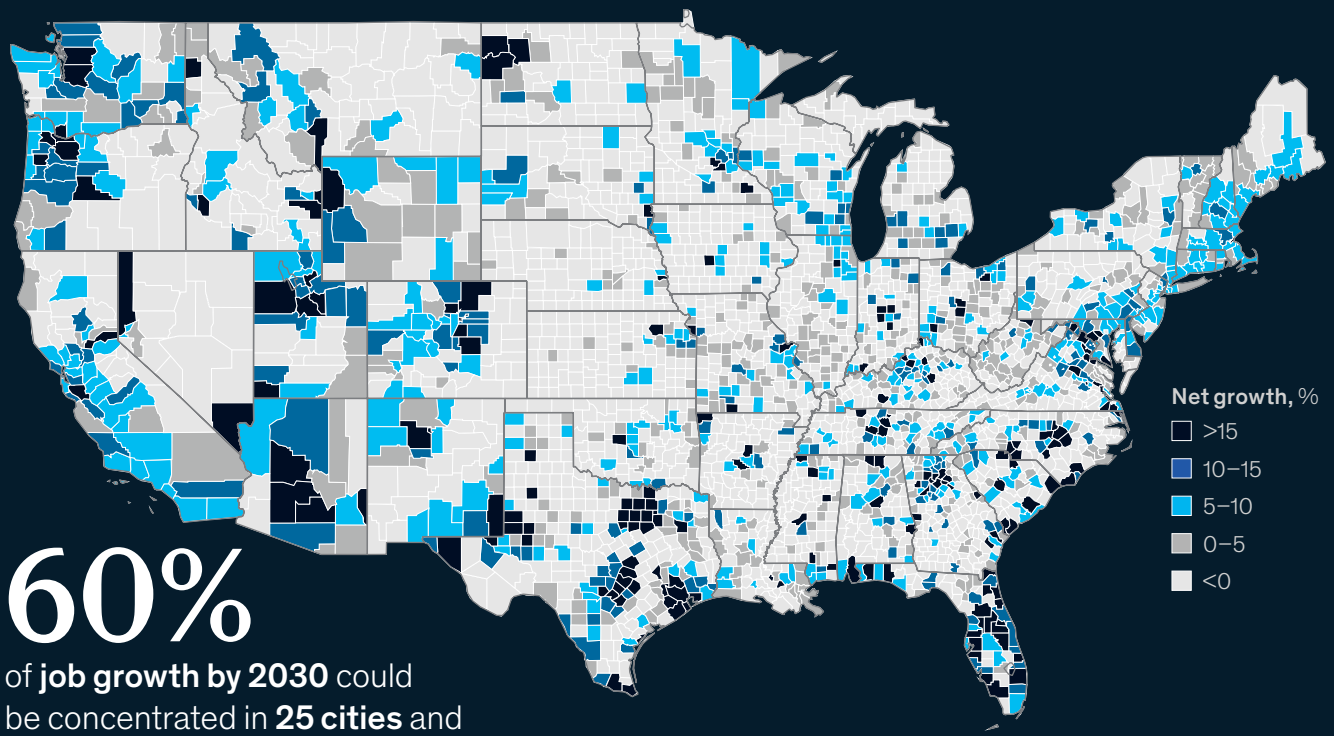
Economic dynamism: Most → Least

Urban core Megacities; High-growth hubs	63 counties	30% of US population
Periphery Urban periphery	271 counties	16% of US population
Niche cities Small powerhouses; Silver cities; College-centric towns	89 counties	6% of US population
Mixed middle Stable cities; Independent economies; America's makers	325 counties	24% of US population
Low-growth/rural areas Trailing cities; Americana Distressed Americana; Rural outliers	2,365 counties	24% of US population

Employment change for select community segments, % of 2007 employment



Estimated net job growth in midpoint adoption scenario, 2017–30, %



60%

of **job growth by 2030** could be concentrated in **25 cities** and their peripheries

Potential workforce displacement in midpoint adoption scenario, 2017–30

14.7M
Young workers age 18–34

11.5M
Workers over age 50

11.9M
Hispanics and African Americans

4x
Higher displacement risk for workers with high school diploma or less

McKinsey Global Institute

Source: McKinsey Global Institute analysis

Executive summary

The US labor market looks markedly different today than it did two decades ago. It has been reshaped by dramatic events like the Great Recession but also by a quieter ongoing evolution in the mix and location of jobs. In the decade ahead, the next wave of technology may accelerate the pace of change. Millions of jobs could be phased out even as new ones are created. More broadly, the day-to-day nature of work could change for nearly everyone as intelligent machines become fixtures in the American workplace.

Until recently, most research on the potential effects of automation, including our own body of work, has focused on the national-level effects. Our previous work ran multiple scenarios regarding the pace and extent of adoption. In the midpoint case, our modeling shows some jobs being phased out but sufficient numbers being added at the same time to produce net positive job growth for the United States as a whole through 2030.[1] But the national results contain a wide spectrum of outcomes, and this report goes one step further to explore those variations. Automation is not happening in a vacuum, and the health of local economies today will affect their ability to adapt and thrive in the face of the changes that lie ahead.

Our analysis of more than 3,000 US counties and 315 cities finds they are on sharply different paths. Twenty-five megacities and high-growth hubs, plus their peripheries, have generated the majority of job growth since the Great Recession. By contrast, 54 trailing cities and roughly 2,000 rural counties that are home to one-quarter of the US population have older and shrinking workforces, higher unemployment, and lower educational attainment. Automation technologies may widen these disparities at a time when workforce mobility is at historic lows.

The labor market could become even more polarized. Workers with a high school degree or less are four times as likely as those with a bachelor's degree to be displaced by automation. Reflecting more limited access to education, Hispanic workers are most at risk of displacement, followed by African Americans. Jobs held by nearly 15 million workers ages 18–34 may be automated, so young people will need new career paths to gain an initial foothold in the working world. Roughly 11.5 million workers over age 50 could also be displaced and face the challenge of making late-career moves. The hollowing out of middle-wage work could continue.

The future of work is not just about how many jobs could be lost and gained. Technology is altering the day-to-day mix of activities associated with more and more jobs over time. The occupational mix of the economy is changing, and the demand for skills is changing along with it. Employers will need to manage large-scale workforce transformations that could involve redefining business processes and workforce needs, retraining and moving some people into new roles, and creating programs for continuous learning. This could be an opportunity to upgrade jobs and make them more rewarding. The choices that employers make will ripple through the communities in which they operate.

[1] This research builds on MGI's automation and job creation models, which have formed the basis of previous research reports including *A future that works: Automation, employment, and productivity* (January 2017), and *Jobs lost, jobs gained: Workforce transitions in a time of automation* (November 2017).

Local economies have been on diverging trajectories for years

Cities and counties across the United States are entering this period of technological and labor market change from different starting points. We used a mathematical clustering method to categorize all US counties (and, for counties in urban core areas, the cities with which they are associated) into 13 segments using more than 40 variables reflecting their economic health, business dynamism, industry mix, labor force demographics, and other characteristics (Exhibit E1).[2] This approach reveals that the differences between local economies across the country are more nuanced than a simple rural-urban divide or regional variations. (See the technical appendix in the full report or visit www.mckinsey.com/futureofworkinamerica for a full list of the cities and counties in each segment.)

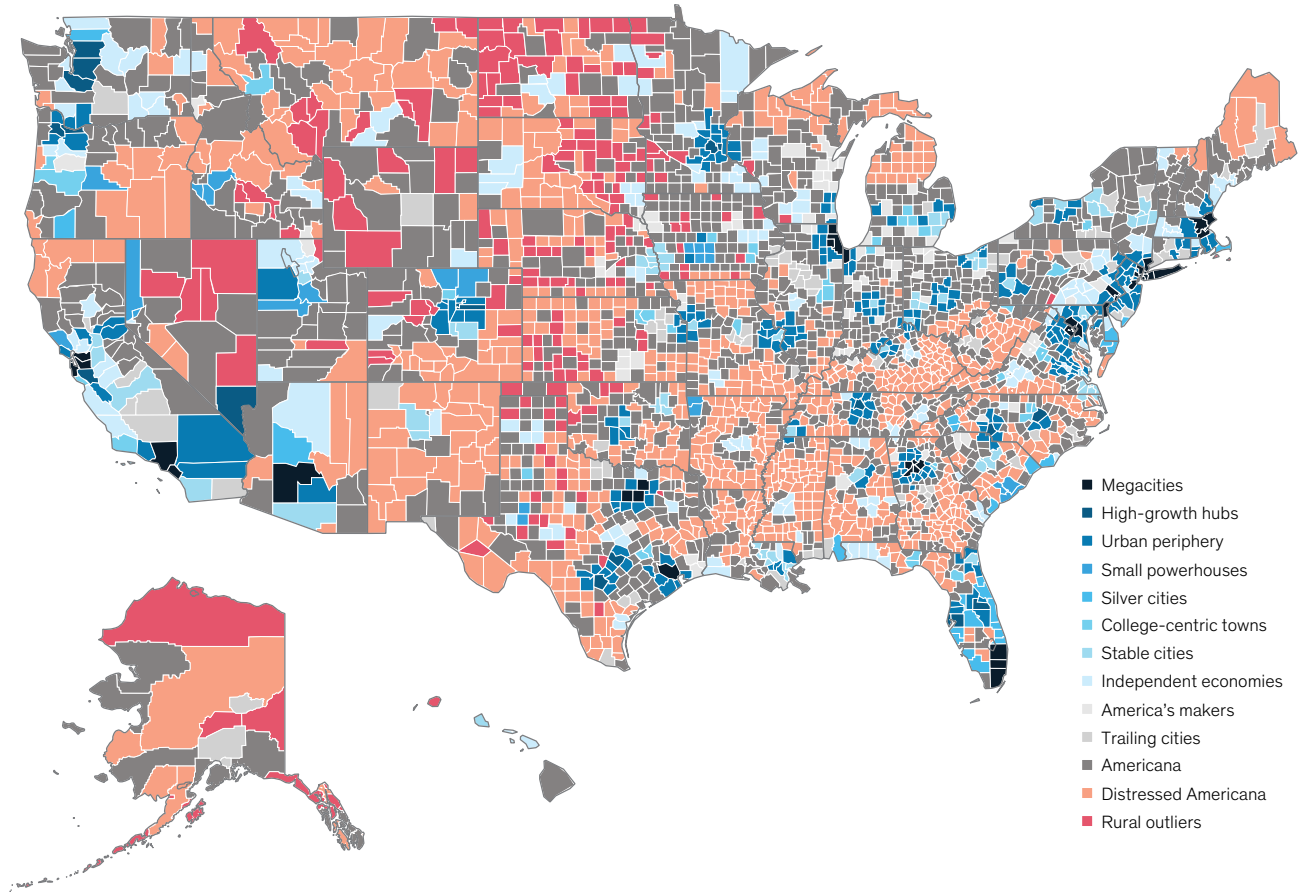
Our 13 archetypes can be grouped into five segments with common patterns (Exhibit E2):

— **Urban core**. Twenty-five megacities and high-growth hubs account for roughly 30 percent of the US population and are the nation's most dynamic places. The high-growth industries of high tech, media, healthcare, real estate, and finance make up a large share of these local economies. These cities have higher incomes, faster employment growth since the Great Recession, high net migration, and younger and more educated

Exhibit E1

The United States is a complex mosaic of local economies, with 13 distinct community archetypes.

Map of county types (color-coded by segment)



Source: McKinsey Global Institute analysis

[2] For this effort, we updated the county segmentation used in *America at work: A national mosaic and roadmap for tomorrow* (2019), a research collaboration between Walmart and McKinsey & Company. Our database includes indicators for all 3,113 US counties.

workforces than the rest of the country—but also high levels of income inequality. Many are experiencing congestion and affordable housing shortages.

— **Urban periphery**. These 271 counties are the extended suburbs of US cities. Home to 16 percent of the US population, they also have seen strong net migration, attracting people moving out of cities in search of more space. In most of these counties, a large

Exhibit E2

Community segments have varying demographic and economic profiles.

More economically favorable — Less economically favorable

		Examples	Economic indicators: Household income, $ thousand	GDP growth, 2012–17, CAGR[1]	Empl. growth, 2012–17, CAGR	Net migration 2010–17,[2] %	Poverty rate, %	Industry mix: GDP in high-growth industries,[3] %	Labor market: Pop. over age 55, %	Pop. with BA or higher, %
Urban core	Megacities *12 cities, 74.3M people*	New York, NY San Francisco, CA	68.8	2.5	2.2	3.2	14.2	48.0	24.5	38.5
	High-growth hubs *13 cities, 21.6M people*	Seattle, WA Austin, TX	65.6	3.7	3.0	7.4	13.4	44.4	23.1	40.0
Periphery	Urban periphery *271 counties, 52.2M people*	Arlington, VA Riverside, CA	69.0	2.5	2.1	4.1	10.2	29.6	28.0	29.4
Niche cities	Small powerhouses *11 cities, 5.0M people*	Provo, UT Reno, NV	63.5	4.9	3.6	8.7	12.0	35.3	24.8	33.5
	Silver cities *19 cities, 6.8M people*	The Villages, FL Prescott, AZ	53.7	2.4	2.7	11.9	13.3	40.7	40.4	29.2
	College-centric towns *26 cities, 6.1M people*	Chapel Hill, NC South Bend, IN	55.1	1.9	1.7	3.7	18.9	38.1	23.5	43.2
Mixed middle	Stable cities *36 cities, 39.3M people*	Detroit, MI Columbus, OH	55.6	1.6	1.4	0.6	15.7	41.2	26.3	32.1
	Independent economies *94 cities, 26.0M people*	Little Rock, AR Providence, RI	57.9	2.0	1.6	3.3	13.7	36.7	27.4	29.3
	America's makers *50 cities, 11.2M people*	Grand Rapids, MI Greensboro, NC	52.7	1.6	1.2	0.2	14.4	29.4	28.0	25.0
Low-growth and rural areas	Trailing cities *54 cities, 14.8M people*	Bridgeport, CT Flint, MI	53.2	0.3	0.3	–2.0	16.4	33.7	26.8	24.2
	Americana *1,118 counties, 44.0M people*	Cameron, TX Caddo Parish, LA	48.7	1.1	0.5	–1.1	15.4	23.5	31.6	19.2
	Distressed Americana *972 counties, 18.1M people*	Coahoma, MS Pittsylvania/ Danville, VA	38.9	0.5	0.0	–2.4	20.8	23.0	33.9	15.9
	Rural outliers *192 counties, 1.5M people*	Kauai County, HI Juneau Borough, AK	57.5	1.1	0.0	–1.2	10.4	21.3	34.2	22.5

[1] Compound annual growth rate.
[2] Calculated as total net migration between 2010 and 2017 divided by 2017 population.
[3] Information; finance and insurance; real estate / rental leasing; professional, scientific, and technical services; and healthcare and social assistance.
Note: This exhibit shows only a sample of the more than 40 variables used in a clustering analysis to segment communities across the United States.

Source: US Census American Community Survey, Moody's Analytics; McKinsey Global Institute analysis

share of the population works in nearby urban areas. Healthcare, retail, logistics, and local services are large parts of these local economies.

— **Niche cities**. These 56 much smaller towns and cities, home to 6 percent of the US population, have found success by building on unique features. In college-centric towns, a major research university dominates the local economy. Silver cities, many of which are in Florida, are fast-growing retirement destinations. Small powerhouses, such as Bend, OR, and Provo, UT, have built economic clusters around technology and other industries; they have the fastest economic growth rates and second-highest rate of net migration across our archetypes. All niche cities are attracting both workers and companies with a low cost of living and a high quality of life.

— **Mixed middle**. Almost one-quarter of the nation's population is found in these 180 stable cities (such as Cincinnati and St. Louis), smaller independent economies (such as Lancaster, PA, and Winston-Salem, NC), and the manufacturing hubs that we call "America's makers" (such as Rockford, IL, and Oshkosh, WI). Neither thriving nor in distress, these places have slower economic and job growth, higher unemployment, and workforces with slightly lower educational attainment than those in urban core cities. Some of America's makers are on an upward trajectory, while others are in decline.

— **Low-growth and rural areas**. This group, which includes 54 trailing cities and more than 2,000 rural counties, is home to one-quarter of the US population. Many trailing cities, such as Flint, MI, and Bridgeport, CT, are former industrial towns with struggling economies. Rural counties encompass somewhat better-performing places (Americana) and struggling areas (distressed Americana). In these segments, populations are older, unemployment is higher, and educational attainment is lower than the national average. Things are somewhat brighter in the 192 rural outlier counties that have found some success with tourism or mining and energy.

25

urban areas accounted for >2/3 of US job growth since 2007

The economic performance of these segments has been diverging for decades, and that trend accelerated after the Great Recession. While all areas of the country lost employment during the downturn, job growth since then has been a tale of two Americas. Just 25 cities (megacities and high-growth hubs, plus their urban peripheries) have accounted for more than two-thirds of job growth in the last decade (Exhibit E3). By contrast, trailing cities have had virtually no job growth for a decade—and the counties of Americana and distressed Americana have 360,000 fewer jobs in 2017 than they did in 2007.[3]

Population growth has also tilted toward urban America. High-growth hubs, small powerhouses, and silver cities have grown by more than 10 percent since 2007, and most urban peripheries are also growing. Residents have been moving out of megacities, stable cities, America's makers, and trailing cities, but immigration has more than offset the losses in megacities and stable cities. By contrast, populations in rural Americana counties grew by less than 1 percent—and distressed Americana is shrinking.

One of the most profound changes of the past two decades has been the "hollowing out" of middle-wage jobs.[4] Our analysis finds that middle-wage jobs accounted for 49 percent of employment in 1997 but only 41 percent in 2017.[5] More Americans have been climbing into higher income brackets or slipping out of the middle class altogether. Some 2.9 million middle-wage roles—including jobs in construction, manufacturing, and office support—vanished between 2007 and 2012, although some were regained in the recovery. But this

[3] See also Enrico Moretti, *The New Geography of Jobs,* Boston, MA: Houghton Mifflin Harcourt, 2012; and Clare Hendrickson, Mark Muro, and William A. Galston, *Countering the geography of discontent: Strategies for left-behind places,* Brookings Institution, November 2018.

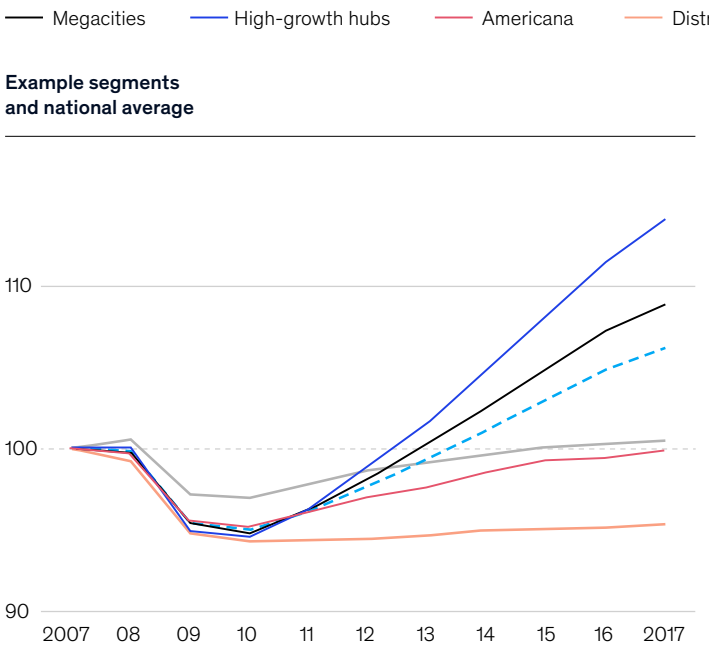
[4] See David H. Autor and David Dorn, "The growth of low-skill service jobs and the polarization of the US labor market," *American Economic Review,* August 2013, Volume 103, Number 5.

[5] Low-wage jobs are those paying less than $27,500 annually; middle-wage jobs pay $27,500–$54,200 annually; high-wage jobs pay more than $54,200 annually (all figures in 2017 dollars).

Exhibit E3

All segments lost jobs during the Great Recession, but employment gains during the recovery have been heavily concentrated in urban areas.

Annual employment by segment, % of 2007 employment



	Jobs gained as share of 2007 workforce, %	Total jobs gained 2007–17, thousand
Megacities	9	3,100
High-growth hubs	14	1,544
Urban periphery	11	2,049
Small powerhouses	16	350
Silver cities	7	162
College-centric towns	8	238
Stable cities	3	689
Independent economies	6	754
America's makers	3	141
Trailing cities	0	24
Americana	0	(27)
Distressed Americana	–5	(332)
Rural outliers	5	42
National total	**6**	**8,735**

Source: Moody's Analytics; McKinsey Global Institute analysis

trend has not played out evenly across the country. While states such as Florida, Maryland, and Rhode Island all saw middle-wage jobs vanish over the last decade, many others, from West Virginia to Utah, have seen middle-wage jobs grow in construction, mining and energy, and other sectors.

3.6%

of Americans moved between counties or states in 2017

Growing economic divergence might have been expected to prompt more people to move from distressed areas to thriving job markets. Yet geographic mobility in the United States has eroded to historically low levels. While 6.1 percent of Americans moved between counties or states in 1990, only 3.6 percent did so in 2017. Furthermore, when people in rural segments and less vibrant cities do move, it is usually to places with a similar profile rather than to megacities or high-growth hubs (Exhibit E4). Differentials in the cost of living, ties with family and friends, and a growing cultural divide all partially explain these patterns, but more research is needed to understand them fully.

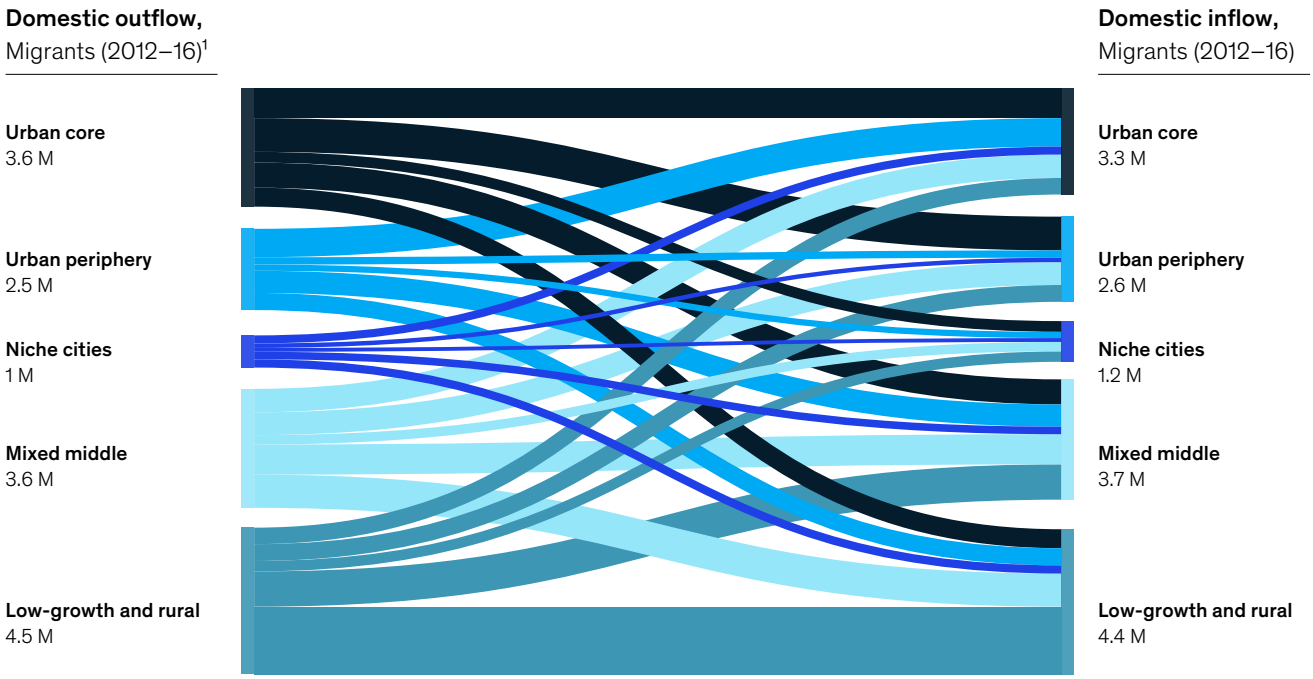
Automation will not be felt evenly across places or occupational categories

Previous MGI research has found that less than 5 percent of occupations can be automated in their entirety, but within 60 percent of jobs, at least 30 percent of activities could be automated by adapting currently demonstrated technologies.[6] What lies ahead is not a sudden robot takeover but a period of ongoing, and perhaps accelerated, change in how work is organized and the mix of jobs in the economy. Even as some jobs decline, the US economy will continue to create others—and technologies themselves will give rise to new occupations. All workers will need to adapt as machines take over routine and some physical tasks and

[6] See two earlier McKinsey Global Institute reports: *A future that works: Automation, employment and productivity* (January 2017) and *Jobs lost, jobs gained: Workforce transitions in a time of automation* (November 2017). We analyze the automation potential of every occupation by looking at the extent to which its constituent activities and associated capabilities can be handled by currently demonstrated automation technologies.

Exhibit E4

Americans in lower-growth areas are not migrating to high-growth places.



[1] Analysis excludes all migration within a core-based statistical area that is within the same segment (e.g., migration from one New York City CBSA megacity county to another).

Source: US Census Bureau County-to-County Migration Flows 2012-2016, McKinsey Global Institute analysis

as demand grows for work involving socioemotional, creative, technological, and higher cognitive skills.[7]

Almost
40%
of Americans are in occupational categories that could shrink by 2030

Building on our earlier research, we modeled scenarios with varying timelines for the widespread adoption of automation technologies in the American workplace. Throughout this report, we focus on the midpoint adoption scenario.[8] Our model shows some local economies experiencing more disruption than others. At the high end of the displacement spectrum are 512 counties, home to 20.3 million people, where more than 25 percent of workers could be displaced. The vast majority (429 counties) are rural areas in the Americana and distressed Americana segments. In contrast, urban areas with more diversified economies and workers with higher educational attainment, such as Washington, DC, and Durham, NC, might feel somewhat more muted effects from automation; just over 20 percent of their workforces are likely to be displaced. These differences are explained by each county and city's current industry and occupation mix as well as wages.[9]

The coming wave of automation will affect some of the largest occupational categories in the US economy, such as office support, food service, production work, and customer service and retail sales (Exhibit E5). Nearly 40 percent of current US jobs are in occupational categories that could shrink between now and 2030. A common thread among shrinking roles is that they involve many routine or physical tasks. Because these roles are distributed across the country, no community will be immune from automation-related displacement.

[7] *Skill shift: Automation and the future of the workforce,* McKinsey Global Institute, May 2018.

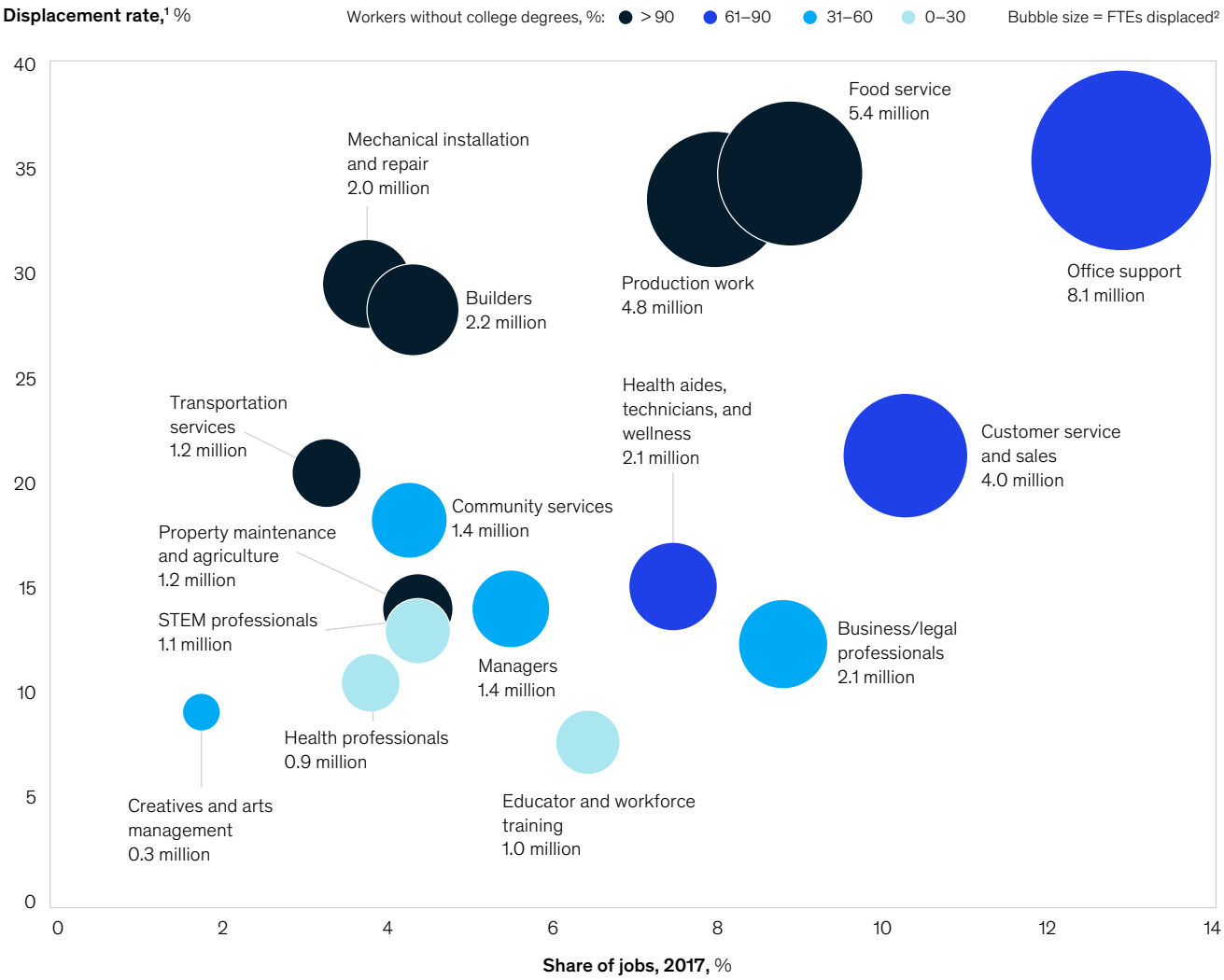
[8] See also Mark Muro, Robert Maxim, and Jacob Whiton, *Automation and artificial intelligence: How machines are affecting people and places,* Metropolitan Policy Program at Brookings, January 2019.

[9] The pace of disruption from automation will depend on how rapidly companies adopt the new technologies. We model a range of different adoption scenarios based on historical experience that take local wage differentials into account. Our modeling is not intended to produce a forecast; it is a mechanism for assessing and sizing a range of potential outcomes. See the technical appendix in the full report for more detail on methodology and potential limitations.

Exhibit E5

The largest occupational categories in the US economy have the highest potential displacement rates.

Occupational categories by share of US employment and displacement rate[1] through 2030, midpoint adoption scenario



[1] Based on the share of automatable activities for occupations within each category.
[2] Full-time equivalents displaced in midpoint automation scenario by 2030. In office support, for example, technology could handle the activities that account for more than 35 percent of all hours worked, or the equivalent of 8.1 million full-time workers.

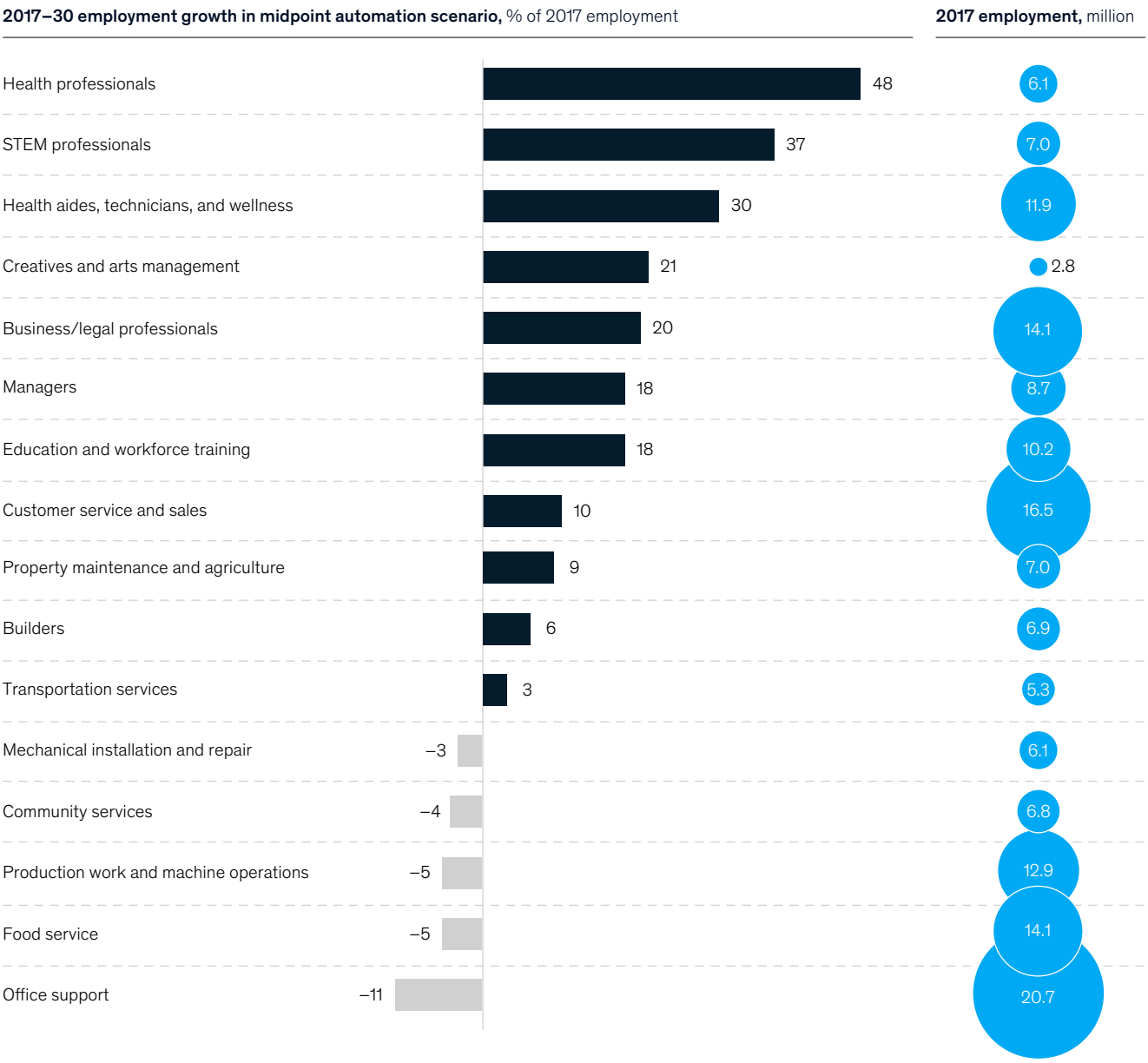
Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

These losses will not necessarily manifest as sudden mass unemployment. Many occupations are likely to shrink through attrition and reduced hiring. This has already been occurring in office support roles, for instance. Offices once populated by armies of administrative assistants, research librarians, and payroll and data clerks now run with leaner support teams and more digital tools. Administrative assistants, bill collectors, and bookkeepers lost a combined 226,000 jobs from 2012 to 2017.

Even as some occupations decline, the US economy should continue to grow and create new jobs in the years to 2030. But the occupational mix of the economy is evolving and could do so at an even faster pace in the decade ahead. While employment in categories such as office support and food service may decline, our scenario suggests strong job growth in healthcare, STEM occupations, creatives and arts management, and business services (Exhibit E6). Growth and displacement may occur even within the same occupational category. In customer service and retail sales, for example, counter attendants and rental clerks may decline, but more workers could be added to help customers in stores or to staff distribution centers.

Exhibit E6

In the decade ahead, health and STEM occupations could post rapid growth while office support, food service, and manufacturing production jobs could decline.



Note: This exhibit displays net job growth, factoring in both job losses due to automation and expected job creation. Customer service and sales, for instance, is one of the occupational categories with the largest number of potential displacements, yet our model finds that enough jobs will be added over the same period to produce positive net growth overall.

Source: McKinsey Global Institute analysis

Growth in transportation services may seem surprising as autonomous trucks and cars appear to be making rapid advances. In reality, it could take years to surmount the technical and regulatory hurdles to their deployment and for companies to replace the extensive capital assets already on the roads.

A look at some of the fastest-growing job categories of the past five years reveals that shifts are already occurring.[10] The economy is adding jobs that make use of new technologies—not only software developers and information security analysts but also solar panel installers and

[10] David H. Autor, *Work of the past, work of the future*, Richard T. Ely Lecture, American Economic Association Annual Meeting, Atlanta, GA, January 4, 2019.

wind turbine technicians. A society with increasing affluence has more demand for personal services, creating work for massage therapists, concierges, and fitness trainers. Healthcare roles such as hearing aid specialists and personal care aides are expanding. Creative jobs, such as video editors, makeup artists, and fashion designers, are another growth area. There are more family therapists, psychologists, and community service managers—roles involving the kind of interpersonal interaction and empathy that machines cannot provide. At the same time, technology is likely to create new jobs we cannot imagine today; academic research suggests that about 8 to 9 percent of jobs by 2030 will be ones that barely exist today.[11]

Despite new occupations and overall job growth, one worrisome trend could continue: the hollowing out of middle-wage jobs. Our analysis suggests that by 2030, they could decline as a share of national employment by 3.4 percentage points. Our model shows employment in low-wage jobs declining by 0.4 percentage point, while employment in the highest-wage jobs grows by 3.8 percentage points.[12] The growth of high-wage roles can be realized only if workers can obtain the necessary education and skills. Forging career pathways to help people move up and finding sources of future middle-wage jobs will be essential to sustaining the US middle class (see Box E1, "Mapping new career pathways to enable economic mobility").

All Americans will need to cultivate new skills to remain relevant in a more digital and knowledge-intensive economy. The biggest effect of automation will not necessarily be in sidelining people but in augmenting what they do. As machines perform some tasks, the time that is freed up can be reallocated into different, and often higher-value, activities. More workers will need to work side by side with machines and use them to become more productive.

Box E1

Mapping new career pathways to enable economic mobility

Although technology may displace some workers, it can also be part of the solution for re-engaging them—by identifying career pathways and logical job moves based on the skills an individual already has.

Using data from Economic Modeling Specialists International, we can match displaced workers with growing occupations that utilize compatible skills and require similar education credentials—even some with the same or higher median wages. For example, 900,000 bookkeepers, accountants, and auditing clerks nationwide, with a median annual salary of $39,240, may see their jobs phased out in the decade ahead. But their skills are highly compatible with less automatable occupations such as insurance underwriter (median salary of $69,760), loan officer ($64,660), credit analyst ($71, 290), and claims adjuster ($64,900). Workers might need to acquire new credentials or add specific skills to make some of these moves. This type of analysis can be applied at the level of a city, country, state, or industry.

Identifying career pathways in this way can not only help people clarify a course of action in a time of change; it can put more people on the path to upward mobility. Employers, too, can use a similar approach in their internal workforce transformations to map whether employees in declining roles have complementary skills that could make them a good fit for growing roles and determine what kind of additional training they might need to fill the gaps.

[11] Jeffrey Lin, "Technological adaptation, cities, and new work," *Review of Economics and Statistics,* May 2011, Volume 93, Number 2.

[12] Based on the median salary of jobs in 2017. We define middle-wage jobs as those in the middle 40 percent in the income distribution. This analysis does not account for different wage growth or decline over time.

In the decade ahead, local economies could continue to diverge

Workforce transitions will play out differently in local communities across the United States. Our findings suggest that net job growth through 2030 may be concentrated in relatively few urban areas, while wide swaths of the country see little employment growth or even lose jobs (Exhibit E7).[13]

25

urban areas could generate 60% of US job growth through 2030

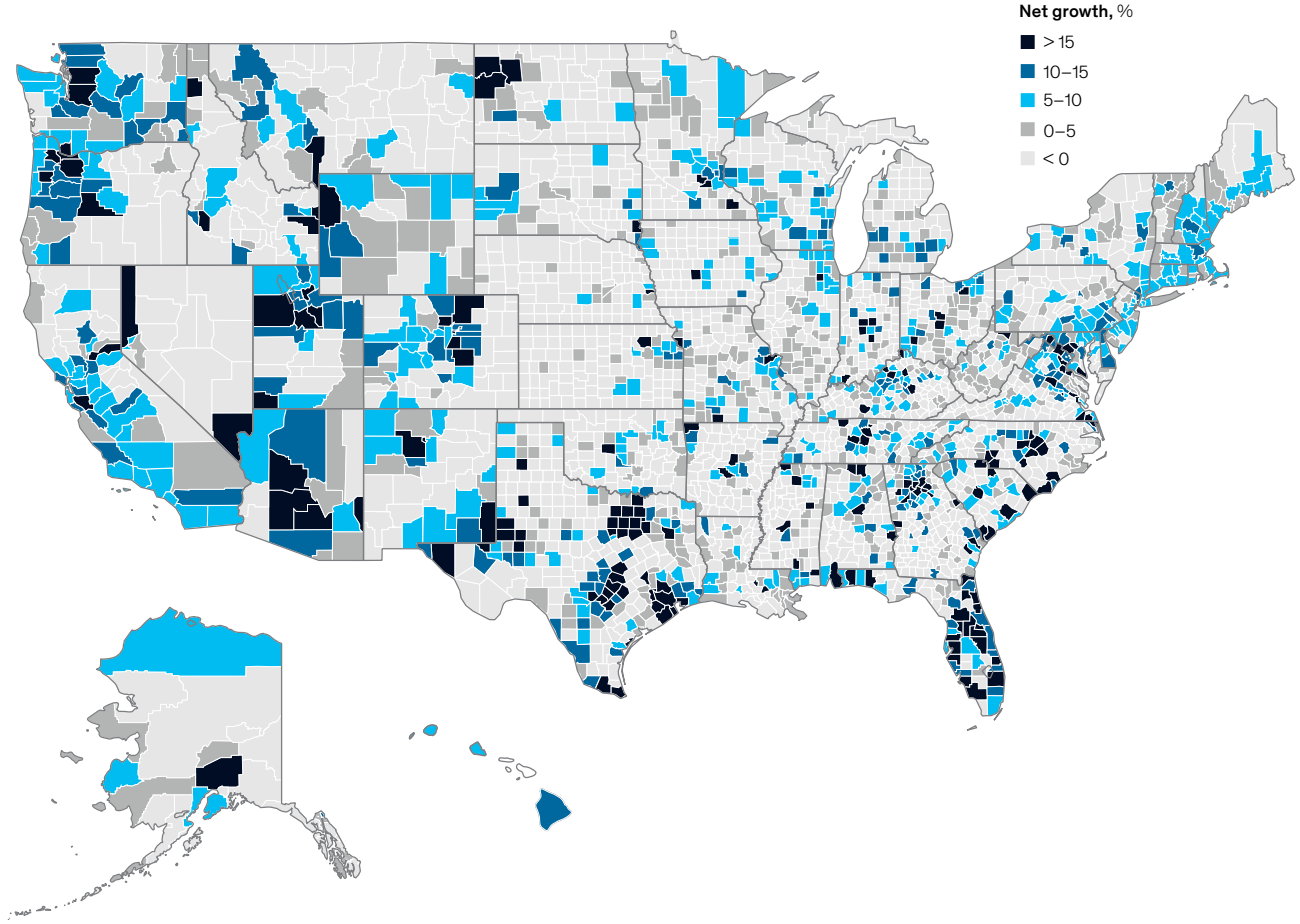
The 25 megacities and high-growth hubs, plus their peripheries, may account for about 60 percent of net job growth by 2030, although they have just 44 percent of the population. Individual standouts like Phoenix and Austin have diverse economies and high concentrations of the tech and business services that may boost job creation. But even the most thriving cities will need to connect marginalized populations with better opportunities.

Some niche cities are also well positioned. Small powerhouses could enjoy 15 percent employment growth on average by 2030, fueled in many places by technology businesses. Silver cities are riding a wave of growth as the retirement-age population swells. Employment in this segment could grow by 15 percent as seniors drive demand for healthcare and other services—and as more of them continue working past traditional retirement age. College-centric towns may see 11 percent employment growth over the next decade; they can build on their well-educated talent pools.

Exhibit E7

In our midpoint adoption scenario, net job creation through 2030 is concentrated in some urban counties, while rural areas lose jobs.

Estimated net job growth in midpoint adoption scenario, 2017–30, %



Source: McKinsey Global Institute analysis

[13] These results should not be read as forecasts. As in our previous research, we model a likely scenario to indicate the scale and direction of what could occur.

-3%

potential job growth through 2030 in distressed Americana counties

On the other end of the spectrum, the decade ahead could be a rocky one for rural America. Low-growth and rural areas as a group account for 20 percent of jobs today but could drive as little as 3 percent of job growth through 2030. Our model indicates anemic 1 percent employment growth over the entirety of the next decade in the more than 1,100 rural Americana counties. Rural outlier counties should continue to sustain growth through natural resources and tourism, although they may manage job growth of only 3 percent. The picture is worst for the roughly 970 distressed Americana counties that are entering the decade in poor economic health. Our model suggests that these areas could experience net job loss, with their employment bases shrinking by 3 percent.

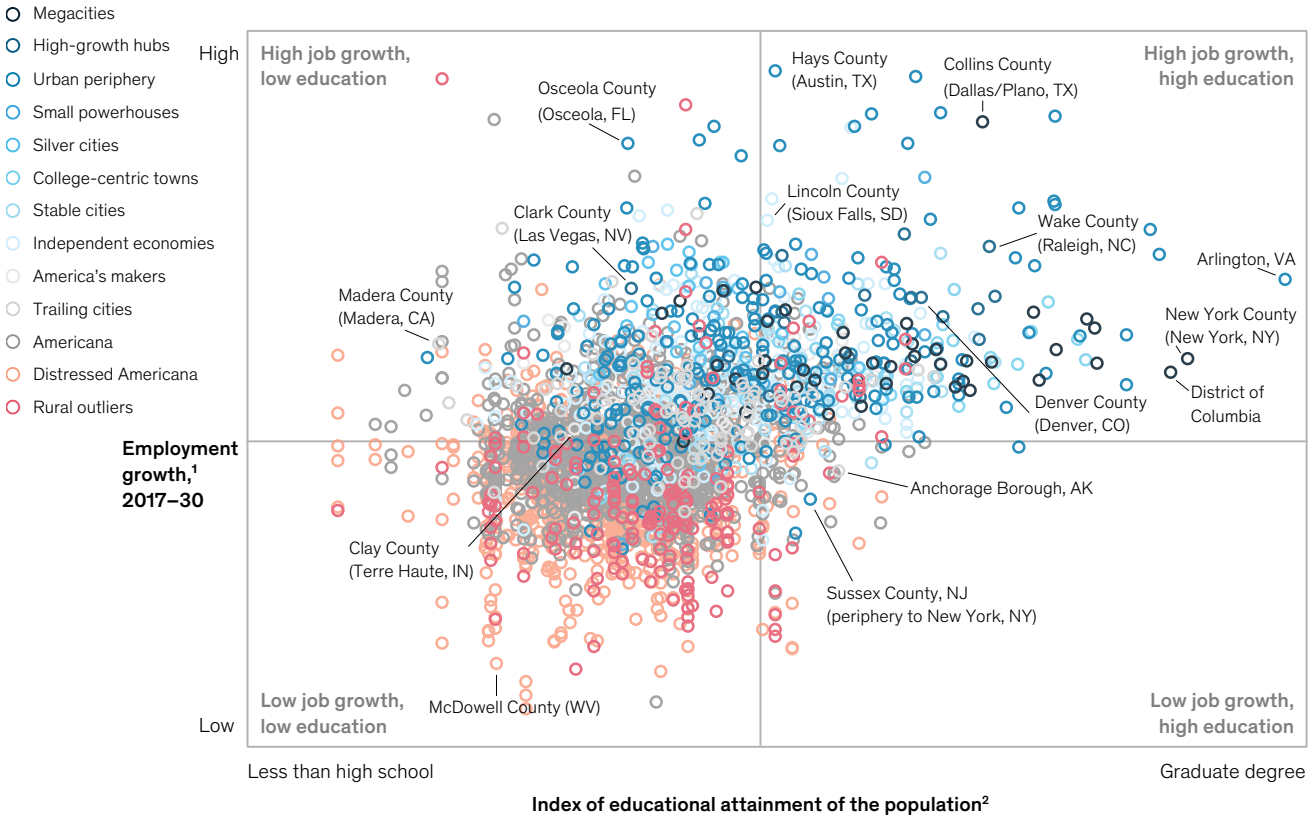
The mixed middle cities are positioned for modest jobs gains. Some could manage to accelerate growth, but in a period of change and churn, others could slip into decline. Many stable cities and independent economies have relatively educated workforces and could become attractive regional outposts for corporations looking to expand into lower-cost locations. America's makers may see mixed results; they will need clear strategies to shift to advanced manufacturing and rebuild local supply chains.[14]

Exhibit E8 shows that correlation between the educational attainment of individual communities and their future economic prospects. Most fast-growing cities fall into the upper right quadrant, with highly educated workforces and more robust employment growth; the reverse is true for rural counties, many of which are concentrated in the lower left quadrant.

Exhibit E8

Urban counties, with higher levels of education, are positioned for stronger job growth.

County average educational attainment and employment growth in midpoint adoption scenario, 2017–30



[1] Midpoint adoption scenario. Counties above the line have positive growth, and counties below the line have negative growth.
[2] Scaled from 0-10 where 0 is less than high school, 2.5 is high school, 5 is some college, 7.5 is bachelor's degree, and 10 is graduate degree, multiplying the share of each by its value.

Source: Integrated Public Use Microdata Series (IPUMS ACS); McKinsey Global Institute analysis

[14] *Making it in America: Revitalizing US manufacturing,* McKinsey Global Institute, November 2017.

Some stable cities and independent economies combine relatively lower education levels with high job growth potential, raising questions about the quality of the jobs they are generating. Notably few places combine high education levels with poor employment prospects.

Less educated workers are most likely to be displaced, while the youngest and oldest workers could face unique challenges

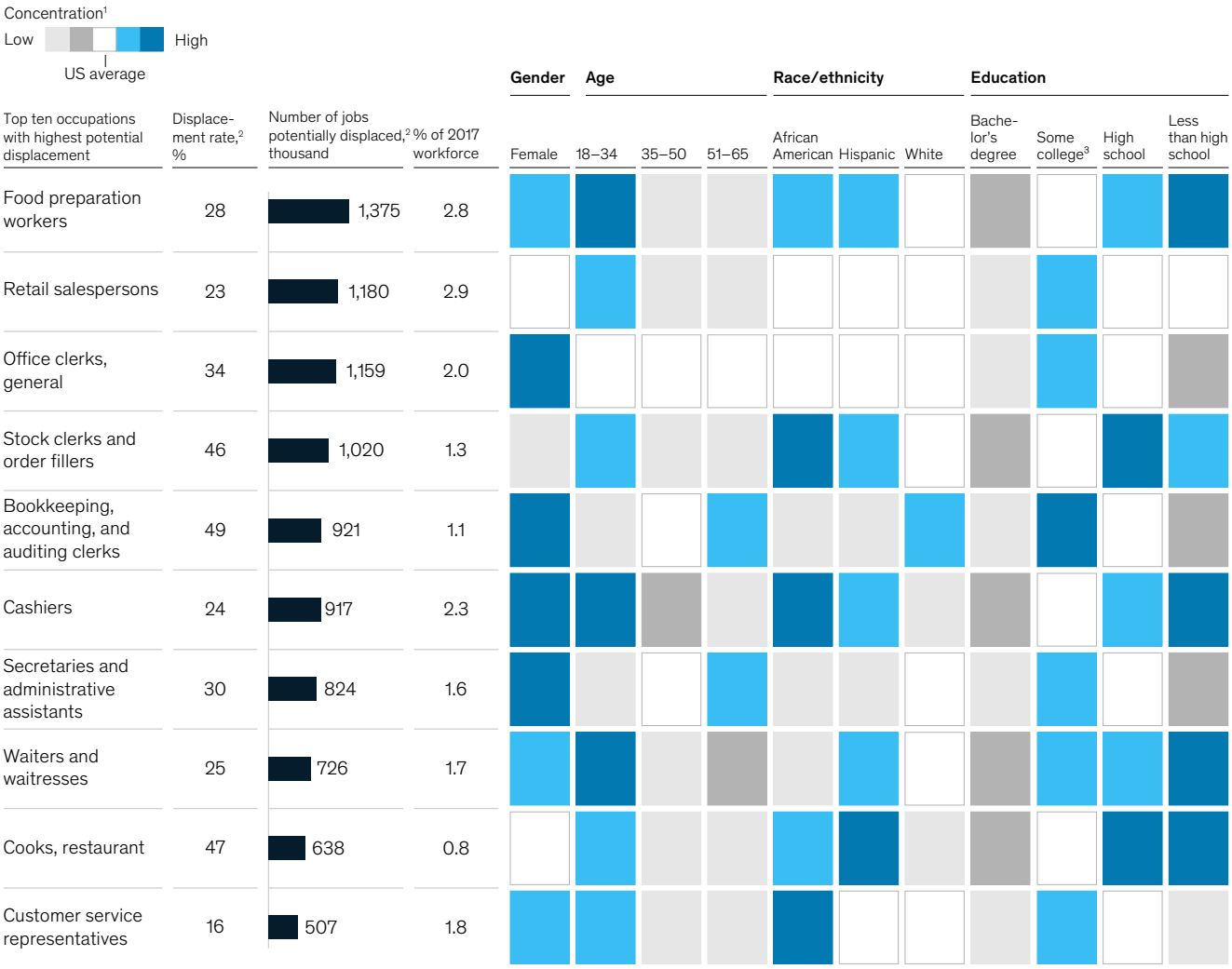
The effects of automation will vary across specific demographic groups (Exhibit E9). Understanding who holds the occupations with the highest automation potential today and which workers are best positioned for future job growth is an important first step for designing targeted interventions and training programs. Our findings suggest that automation could disproportionately affect workers in already underrepresented racial groups.

Workers with the lowest levels of educational attainment are at greatest risk

Education does not automatically confer job skills, but we rely on educational attainment as a proxy for skills—and it stands out as a key indicator of displacement risk from automation. We find that individuals with a high school degree or less are four times more likely to be in a

Exhibit E9

Some occupations with high displacement potential have skewed demographic concentrations.



[1] Measured by comparing share of persons fitting each demographic profile in an occupation with share in total US workforce.
[2] 2030 midpoint adoption scenario.
[3] Includes associate's degrees.

Source: US Bureau of Labor Statistics, Integrated Public Use Microdata Series (IPUMS ACS) 2017; McKinsey Global Institute analysis

highly automatable role than individuals with a bachelor's degree or higher—and as much as 14 times more vulnerable than someone with a graduate degree.

For a number of years, job postings have shown persistent "degree inflation." One report found that almost two-thirds of job postings for executive assistants, for example, now call for a bachelor's degree when only 19 percent of those employed in those roles at the time of the study held those degrees.[15] Breaking this trend by focusing on the specific skills needed in a given job, rather than on degree requirements, can vastly increase the number of qualified job applicants and create opportunities for more people.

25.5%

potential displacement rate for Hispanic workers

Because some minority groups have lower educational attainment, we find they are more vulnerable to being displaced by automation. Hispanic workers, for instance, are overrepresented in food service roles and have the highest rate of potential displacement among all minority groups, at 25.5 percent (7.4 million individuals). For African Americans, the potential displacement rate is 23.1 percent (4.6 million individuals). White workers have a potential displacement rate of 22.4 percent, and Asian-American workers have the lowest rate, at 21.7 percent. Particularly in places such as California, Texas, and Florida, all of which have large concentrations of Hispanic workers, targeted retraining and job placement programs will be needed.

Automation will pose particular challenges for young and old workers

Automation will affect workers across age brackets, but both the youngest and oldest segments of the labor force face unique risks.

14.7M

young workers are in highly automatable jobs

Young people will need new career paths to build skills and gain a foothold into the working world. Tens of millions of Americans can think back to their first jobs in retail or food service—roles that gave them valuable soft skills and experience that propelled them on their way. But these are the very roles that automation could phase out. Roughly 14.7 million workers under age 34 could be displaced by automation; almost half of them are in roles with high separation rates, so employers may not see a clear business case for retraining and redeploying them. It will be important to create a wider variety of pathways from high school to work, perhaps through apprenticeship.

11.5M

workers over age 50 at risk

On the opposite side of the generational divide, some 11.5 million US workers over the age of 50 could be displaced by automation. While some of these workers are close to retirement, others have years to go. One study looking at labor market recovery after recessions found that displaced workers ages 55 to 64 were 16 percentage points less likely to be re-employed at the time of follow-up surveys than workers ages 35 to 44.[16] While some displaced older workers who have spent much of their career doing one thing may not be willing or able to make a drastic change, millions more might embrace the opportunity to train for different lines of work.

While both men and women could be displaced by automation, women may be better positioned for future job growth

Many of the specific jobs most at risk from automation skew heavily toward one gender or the other. Men, for example, make up the majority of drivers and assembly line workers, while administrative assistants and bookkeepers are predominantly female. Overall, women represent 47 percent of the displaced workers in our midpoint automation scenario, while men are 53 percent. Based on the current gender share of occupations, our modeling suggests that women could capture 58 percent of net job growth through 2030, although the gender balance in occupations can and does change over time. Much of this is due to women's heavy representation in health professions and personal care work.

[15] *Moving the goalposts: How demand for a bachelor's degree is reshaping the workforce,* Burning Glass Technologies, September 2014.

[16] Henry S. Farber, *Job loss in the Great Recession and its aftermath: US evidence from the Displaced Workers Survey,* NBER working paper number 21216, May 2015.

58%

share of net job growth that women could capture

But these growing categories consider only jobs that exist today. Recent research notes that men are more heavily represented in "frontier" jobs involving cutting-edge technologies, which may position them for other jobs that have yet to emerge.[17] Improving the representation of women in the tech sector is a priority. A 2018 report that surveyed 279 companies with a combined workforce of 13 million found that progress on improving gender diversity has stalled, despite the fact that more women than men earn college degrees.[18] Overall, this period of change is an opportunity for many women to move into more productive, better-paying work.[19]

The opportunities and challenges for employers depend on their workforce characteristics and geographic footprint

To take full advantage of what automation technologies can do for innovation and productivity, employers will need to rethink business processes and workflows—all of which may require large-scale workforce transformations. Several factors will shape their decisions: the state of their current digital initiatives, the share of current work that machines can handle, whether technology complements existing labor or substitutes for it, the diversity of current roles, the education level of the current workforce, turnover rates, and the customer experience.

Large-scale workforce transformation requires vision and adept leadership from the entire management team—and it has implications for the company's overall strategy, operations, talent needs, capital investment, geographic footprint, diversity goals, and external reputation. As the demand for labor shifts across the country, these changes will affect the geography of consumer purchasing power.

Every company will forge its own path. But some common considerations exist, particularly for companies with similar profiles. While not exhaustive, Exhibit E10 profiles the opportunities and challenges for six types of employers with varying workforce characteristics, geographic concentrations, and density of automatable activities.

For example, a company with a large, nationally distributed frontline workforce, such as those in retail, food service, and hospitality, can raise productivity through labor-saving automation.[20] Retraining and redeploying workers into other roles, for instance in distribution centers or customer experience roles, might make sense. With high turnover rates in entry-level roles, however, companies may not see a clear business case for retraining. But it is wrong to assume that training cannot pay off for these workforces; many employers have found that offering learning programs and upward pathways can reduce attrition rates and enhance employee engagement.[21] This period of transition could be a once-in-a-generation opportunity to transform many "dead-end" jobs into more interesting and rewarding work. Because these employers will be making decisions that affect millions of low-wage workers, they could affect many local communities.

The challenges look very different for geographically concentrated businesses with white-collar workforces. Automation and AI technologies could replace millions of workers in middle- to high-wage accounting, finance, business, legal, and support functions. Many of these workers have college degrees, with low turnover and attrition, presenting companies with meaningful decisions regarding redeployment. Their challenge will be determining when to hire external talent with digital skills and when retraining and redeploying committed workers who already know the company's business and culture is feasible.

[17] David H. Autor, *Work of the past, work of the future*, Richard T. Ely Lecture, American Economic Association Annual Meeting, Atlanta, GA, January 4, 2019.
[18] *Women in the Workplace 2018*, McKinsey & Company and LeanIn.Org.
[19] For more on this topic, see *The future of women and work: Transitions in the age of automation,* McKinsey Global Institute, June 2019.
[20] Steven Begley, Bryan Hancock, Thomas Kilroy, and Sajal Kohli, "Automation in retail: An executive overview for getting ready," May 2019, McKinsey.com.
[21] See, for instance, Zeynep Ton, *The Good Jobs Strategy: How the Smartest Companies Invest in Workers to Lower Costs and Boost Profits*, Boston, MA: Houghton Mifflin Harcourt, 2014.

Exhibit E10

Employers' opportunities and challenges depend on company footprint and workforce characteristics.

Size of workforce | Share of workers with bachelor's degree | Automation displacement rate

Workforce characteristics	Examples	Description	Key challenges
White-collar workforces 25M–30M | 35–45% | 20–25%	Insurance Banking HQ functions Gov't agencies	Concentrated footprint, middle- and high-skill workforce with low turnover. Process automation can enhance efficiency but may displace workers.	• Retraining and redeployment to new roles within the company, especially digital • Hiring required tech talent
Nationwide customer-facing 15M–20M | 15–25% | 25–30%	Retail Food service Hospitality	Nationally dispersed geographic footprint. Majority of workforce is in lower-skill jobs with high turnover.	• Economics of retraining may be challenging given high turnover • Reskilling and redeployment (into managers, delivery, other new customer experience roles)
Movers and builders 10M–15M | 5–15% | 20–25%	Parcel delivery Warehouses Construction	Mix of local and national footprint. Largely middle-skill workforce, some with specialized skills. High diversity of occupations and automation potential.	• Training employees to integrate, operate, and maintain technologies • Finding adjacent middle-skill occupations to redeploy workers
Specialized practitioners 5M–10M | 50–60% | 10–15%	Healthcare Education Professional services	Middle- to high-skill workforce. Automation complements labor and reduces routine tasks, allowing more time on highest-value-added work.	• Continuous learning to adopt new technology • Finding new business models that leverage technology, including remote service delivery
STEM-based workforce 5M–10M | 65–75% | 10–15%	Pharmaceutical Tech Software	Highly specialized, high-skill workforce with concentrated geographic footprint. High pace of sector technology change.	• Attracting and retaining top talent and continuous learning • Rethinking location strategy based on cost and access to talent
Makers and extractors 5M–10M | 5–15% | 25–30%	Manufacturing Oil and gas Mining	Geographically concentrated. Low- to middle-skill workforces performing physically intensive and repetitive tasks. Lower turnover.	• Building technical capabilities; attracting talent to remote areas or retraining existing employees • Potential for community disruption

Note: "Archetype" refers to organizations with particular workforce characteristics, largely determined by work activities and related skills, workforce mobility and churn, and geographic footprint. "Examples" highlight sectors in which these workforce characteristics are common, although they are not universal or exhaustive. The "key challenges," too, are highlights rather than a comprehensive list.

Source: McKinsey Global Institute analysis

Local business leaders, policy makers, and educators will need to work together to chart a new course

The next decade will bring every community new challenges—but also new opportunities to boost innovation, productivity, and inclusive growth. Even in the nation's most prosperous cities, large populations are already struggling to find a place in the new economy and keep up with the rising cost of living. But in general, cities are more diversified and have more resources and investment flows on which to draw. Reinvention will be a harder task for trailing cities, some manufacturing towns, and rural counties that never bounced back from the Great

Recession. Without forward-thinking interventions, the disparities separating America's communities could widen.[22]

The good news is that there is a growing tool kit of potential solutions, and many promising pilots are under way. The relative priorities will vary from place to place, and each community will need to determine what is most urgent and set its own agenda (Exhibit E11). Wherever they choose to begin, the growing urgency for coordinated action from local business leaders, policy makers, educators, and other stakeholders from coast to coast is clear.

Exhibit E11

Communities face different future of work challenges.

	Key priorities
Urban core *Megacities* *High-growth hubs* 	• Increase affordable housing near employment centers • Involve employers in creating high school and community college programs to develop key skills needed in growing fields • Target job training and placement to low-income and marginalized populations • Improve transportation links within city and with periphery
Urban periphery 	• Attract investment in high-value businesses to diversify beyond local services • Link tertiary education programs to urban employers to create talent pipeline • Improve transportation links with city and within periphery
Niche cities *Small powerhouses* *Silver cities* *College-centric towns* 	• Promote startup clusters and innovation (technology businesses in small powerhouses, healthcare in silver cities, university spin-offs in college-centric towns) • Adopt varying local strategies: silver cities need to attract young workers in growing industries; college-centric towns need to prevent brain drain and address poverty rates
Mixed middle *Stable cities* *Independent economies* *America's makers* 	• Create a clear value proposition and economic development strategy to attract investment to create a thriving economic cluster • Facilitate entrepreneurship through incentives, access to capital, and streamlined regulation • Retrain and redeploy workers at scale to avoid unemployment and slow-growth downward spiral
Low-growth and rural areas *Trailing cities* *Americana* *Distressed Americana* *Rural outliers* 	• Identify potential anchor industries that can be growth engines building on local advantages (e.g., low-cost land) • Improve / update skills through high school completion programs, apprenticeships, training boot camps • Expand digital infrastructure and teach digital skills to enable remote work

Source: McKinsey Global Institute analysis

Connecting workers with opportunities

A central challenge in the automation age will be connecting millions of displaced workers to new, growing jobs. Some may need to change jobs within the same company, and employers would provide the necessary training in these situations. But many workers may need to switch employers or make even bigger moves to different occupations in new locations.

[22] For a comprehensive discussion of potential policy interventions, see *The work ahead: Machines, skills, and US leadership in the twenty-first century,* Council on Foreign Relations, Independent Task Force Report number 76, 2018; *America at work: A national mosaic and roadmap fortomorrow*, Walmart, 2019; and Ethan Pollack, Alastair Fitzpayne, and Conor McKay, *Automation and a changing economy,* Aspen Institute Future of Work Initiative, April 2019.

A survey of US households found that over half of workers displaced between 2005 and 2015 found their next job in a different industry.[23] For these workers, governments and other stakeholders can help to make local labor markets more fluid and easier to navigate.

In a more technology-driven world, job-matching efforts can be aided by a range of new digital tools and should run on easily accessible digital platforms. New online tools can assess an individual's skills, suggest appropriate career choices, and clarify which jobs are in demand and the credentials needed to obtain them.[24] Many efforts are under way to centralize and standardize information on skills, job postings, and credentials.[25] The Markle Foundation's Skillful initiative brings together employers, state governments, technology experts, and educators to improve job matching.

Geography itself can be a barrier to connecting to new opportunities, given the declines in Americans' mobility. It is sometimes suggested that people should simply leave distressed places and move to where the jobs are. But this greatly oversimplifies the weight of this decision for individuals who may have deep personal and family ties to the places where they live, as well as economic barriers to leaving. Addressing the affordable housing shortage in the fastest-growing urban areas would enable people who *do* want to move for better opportunities to do so (and would create demand in the construction sector at the same time). Because there is a national benefit to improving labor market fluidity, policy makers might consider providing relocation assistance or tax credits, as they have for other investments, such as home energy efficiency.

Retraining workers and providing lifelong learning

Workforce skills have been a growing concern in the United States for many years. Now new and higher-level skills are in demand, including not only digital skills but also critical thinking, creativity, and socioemotional skills. The skills needed in fast-growing STEM roles, in particular, are continuously evolving. The old model of front-loading education early in life needs to give way to lifelong learning. Training and education can no longer end when workers are in their twenties and carry them through the decades.

Employers will be the natural providers of training and continuous learning opportunities for many workers. For instance, Walmart's Academy is designed to allow high-performing associates to move into management. Toyota's Advanced Manufacturing Technician program integrates a two-year technical degree curriculum with paid part-time employment. SAP quantified an expected skills gap, then mapped comprehensive "learning journeys" to help thousands of employees transition into new roles through in-house classroom training courses and boot camps, job shadowing, and on-the-job practice.[26]

Many workers who need to switch employers or change occupations will need training options outside the workplace. All levels of government, nonprofits, education providers, and industry associations can play a role here. Midcareer workers need to continue paying their bills while they train for the next chapter in their careers; they require short, flexible courses that follow the boot camp model, teaching new skills in weeks or months rather than years.

Across the country are numerous examples of industry-specific training programs delivered through local educational institutions that result in job placements. Georgia's Quick Start, for instance, is a state-funded program that provides customized workforce development training at no cost to qualified businesses; it covers industries such as advanced

[23] *Addressing America's reskilling challenge*, US Council of Economic Advisers, July 2018.
[24] *Online talent platforms: Connecting workers with opportunity in the digital age*, McKinsey Global Institute, June 2015.
[25] Major efforts are under way to create a consistent taxonomy to describe workforce skills. The US Chamber of Commerce Foundation and the Lumina Foundation have launched the T3 Innovation Network to create an open data ecosystem to centralize information on skills, credentialing, and the needs of the economy and to standardize how skills are defined across industries and employers. A nonprofit called Credential Engine is creating an online registry to make information about the thousands of varying credentials across the country more transparent and searchable.
[26] "Building the workforce of tomorrow, today," *McKinsey Quarterly,* November 2018.

manufacturing and bioscience. The online company Coursera offers an eight-month Google-designed IT support certificate program that has drawn tens of thousands of trainees. Udacity, another online learning company, offers "nanodegrees" in areas including data science, programming, and cloud computing.

4x

higher risk of displacement for workers with high school diplomas or less

The millions of Americans who did not complete high school will be hit hardest by automation. The Michigan 23+ program aims to reach them with an online program offering high school diplomas, workforce credentials, guidance, and job placement. The American Association of Community Colleges' Plus 50 initiative provides grants to hundreds of individual institutions across the country for workforce training programs geared to participants over age 50.

The challenge ahead is to scale up the most successful programs. Using data to track employment outcomes will be essential so that funding can be channeled into what works and individuals can make more informed choices about their own training and careers. The most effective programs will need to be replicated across cities, regions, and industries.

Creating tailored economic development strategies to boost job creation

Every community, from the most dynamic to the most distressed, faces economic development issues that need to be solved at the local and regional level. Priorities may vary across different community segments, and individual cities and counties will need highly tailored strategies. For megacities and high-growth hubs, the priorities may be connecting disadvantaged populations with new opportunities, adding affordable housing, and improving transportation. The communities in the mixed middle segment need to accelerate economic growth and focus on entrepreneurship and skills development.

For rural counties, the road is tougher. Many of these places lack the economic base or the inflows of investment or people to create new jobs. No amount of workforce retraining can solve the bigger challenge of lack of economic activity. Individual companies can help to ease this strain by considering whether there is a business case for establishing operations in more affordable parts of the country that need the investment.

Turning around places that have lost their economic dynamism is a multiyear journey, but it is possible. Each community will have to take inventory of its assets, such as available industrial space, natural attractions, local universities, and specialized workforce skills.[27] That data can form the basis of an economic development plan built around a growth engine industry that can create jobs and spillover effects. The next step is attracting investment, which does not have to come from within the United States. Subsidies and tax incentives can be part of the tool kit, but they need to be backed by a rigorous business case. Incentives for brownfield investment could help legacy firms modernize and grow. Almost every city and county has pockets of poverty that need special attention. Stabilizing the most distressed neighborhoods may take extra investment and targeted efforts (such as blight removal, home and infrastructure repair, and additional community services).

The growing acceptance of remote working models could be a positive trend for creating jobs in rural counties, whether full-time work-at-home employee roles or contract work. But it will take a push to continue building out fast, affordable broadband in the regions that still need service. The Rural Innovation Initiative, recently launched in nine communities nationwide, is building outposts for workers in the downtowns of rural cities, aiming to spur professional collaboration and nurture tech talent across the country.

[27] See James Fallows and Deborah Fallows, *Our Towns: A 100,000-Mile Journey into the Heart of America,* New York, NY: Pantheon Books, 2018.

Supporting workers in transition

In this period of technological change, the United States will need to look at modernizing and strengthening the social safety net to support people transitioning between jobs. Workers displaced from full-time roles experience an average 35 percent loss of earnings, due to gaps in employment or working fewer hours at a new job.[28] Some of the people most likely to be affected are already living paycheck-to-paycheck. For them, even a short period of disruption could provoke tremendous stress.[29]

Supporting them can take many forms: longer and more flexible income support programs during periods of unemployment, relocation assistance, training grants, and earned income tax credits. Because unemployment insurance is administered at the state level, this is an opportunity for state governments to innovate and lead. In addition, establishing tax incentives for employers to offer job retraining could help to head off some potential displacements before they occur.

Portable benefits—tied to the worker rather than the employer—could offer stability to people who need to move between opportunities and geographies. Benefits could be universal for full-time, part-time, and independent workers, and they could be prorated so that contributions are tied to hours worked for different employers. A broader system of portable benefits can offer more stability and free more Americans to strike out on their own and become entrepreneurs.

Wages and purchasing power are real concerns. Although a tighter labor market may increase wage growth in the short term, it will take sustained growth to counter the trend of wage stagnation, which dates to the 1980s.[30] In the decade ahead, if displacement leaves more uncredentialed workers competing for the jobs that remain, this surplus labor could flood the market and again drive down wages at the lower end of the pay scale. Policy makers and employers alike cannot ignore the implications if a large share of the population is falling behind.

The United States does not have to let opportunity concentrate in a limited number of places, some of which are straining at the seams, while others wither. Policy choices, along with increased public and private investment in people and in the places that need it, can create more inclusive growth. Companies can make a difference by recognizing that talent is available all over the country and investing alongside other entities to realize untapped potential. The nation will need the combined energy and ingenuity of many local coalitions from coast to coast, united not in fighting against technology but in preparing US workers to succeed alongside it.

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[28] Henry Farber. "Employment, hours, and earnings consequences of job loss," *Journal of Labor Economics*. Volume 35, number S1, July 2017.

[29] Conor McKay, Ethan Pollack, and Alastair Fitzpayne, *Automation and a changing economy, Part I: The case for action,* Aspen Institute Future of Work Initiative, April 2019.

[30] Jay Shambaugh et al., *Thirteen facts about wage growth*, The Hamilton Project, Brookings Institution, September 2017.


ENTRANCE
VISA

1 Local economies are on diverging paths

In virtually any thriving city across the United States, you can hop in a car, drive for a while, and find yourself in a very different America. Your journey may start off in a swirl of commuters, construction cranes, and economic activity, but it could deposit you in a town with shuttered storefronts that feels drained of both energy and prospects. Places matching these extremes may be separated by short distances, but the gap in their economic circumstances can make them seem like separate worlds.

Geographic disparities have grown as the top-performing US cities pull away from the rest of the economy.[31] Yet the dynamics at play are not as simple as the heartland versus the coasts, or even a rural-urban divide. Not all cities are created equal, and not all rural areas are struggling. The US economy is an amalgam of thousands of local economies with different characteristics and nuances.

Our research begins with data on more than 3,000 US counties, grouped into 13 archetypes. This database enables us to peer beneath national-level statistics and spot more localized patterns. Gaps in economic performance have been widening over time, and these trends accelerated after the Great Recession. A limited set of cities have generated the lion's share of job growth and economic momentum since then, while trailing cities and many rural areas have been running in place or losing ground. The most prosperous cities exert a kind of gravitational pull, concentrating more and more of the nation's young, educated workers. Meanwhile, people and jobs have been slowly seeping out of struggling areas in a self-reinforcing cycle.

These patterns matter because the past may be a prologue to future trends. Each community's starting point will affect its adaptability as employers adopt automation technologies more widely in the decade ahead.[32]

The United States is a mosaic of 13 community archetypes

The US labor market is far from homogenous; it is more accurate to think of it as a mosaic made up of many distinct local markets. Cities and counties across the United States are entering this period of technological and labor market change from different starting points.

We used a mathematical clustering method to categorize all US counties (and, for counties in urban core areas, the cities with which they are associated) into 13 segments (Exhibits 2 and 3). Ten of these segments are urban, and three are rural. To create and refine the categories, we used indicators of economic health, business dynamism, industry mix, labor force demographics, and other characteristics (see Box 1, "Data and methodology"). For the full list of all US cities by segment, see the technical appendix. The full list of US counties is available online at www.mckinsey.com/futureofworkinamerica.

[31] See, for example, Enrico Moretti, *The New Geography of Jobs,* Boston, MA: Houghton Mifflin Harcourt, 2012; and Clare Hendrickson, Mark Muro, and William A. Galston, *Countering the geography of discontent: Strategies for left-behind places,* Brookings Institution, November 2018.

[32] Our definition of automation incorporates any technology that performs activities that a human worker would otherwise perform, including robotics (machines that perform physical activities), artificial intelligence (software algorithms that perform calculations and cognitive activities), autonomous vehicles, and business process automation (software that performs cognitive tasks to automate workflows).

Box 1

Data and methodology

For this research, we built extensive county- and city-level databases, combining data from public and private sources to evaluate the historical trajectory, current state, and future prospects of each US community. We assessed each one based on more than 40 variables related to its economic health, labor market characteristics, industry mix and business dynamism, innovation, development indicators, and socioeconomic factors (Exhibit 1).

We began our analysis for this report utilizing the county archetypes from a recent McKinsey & Company research collaboration with Walmart, *America at work*.[1] That research segments all US counties into eight archetypes, with special focus on characterizing the different types of rural county segments. In this work, we conducted a secondary city segmentation of 315 core-based statistical areas (as defined by the US Office of Management and Budget). We ultimately grouped US cities into a wider variety of urban segments than were used in the *America at work* report while also combining some of its rural archetypes.

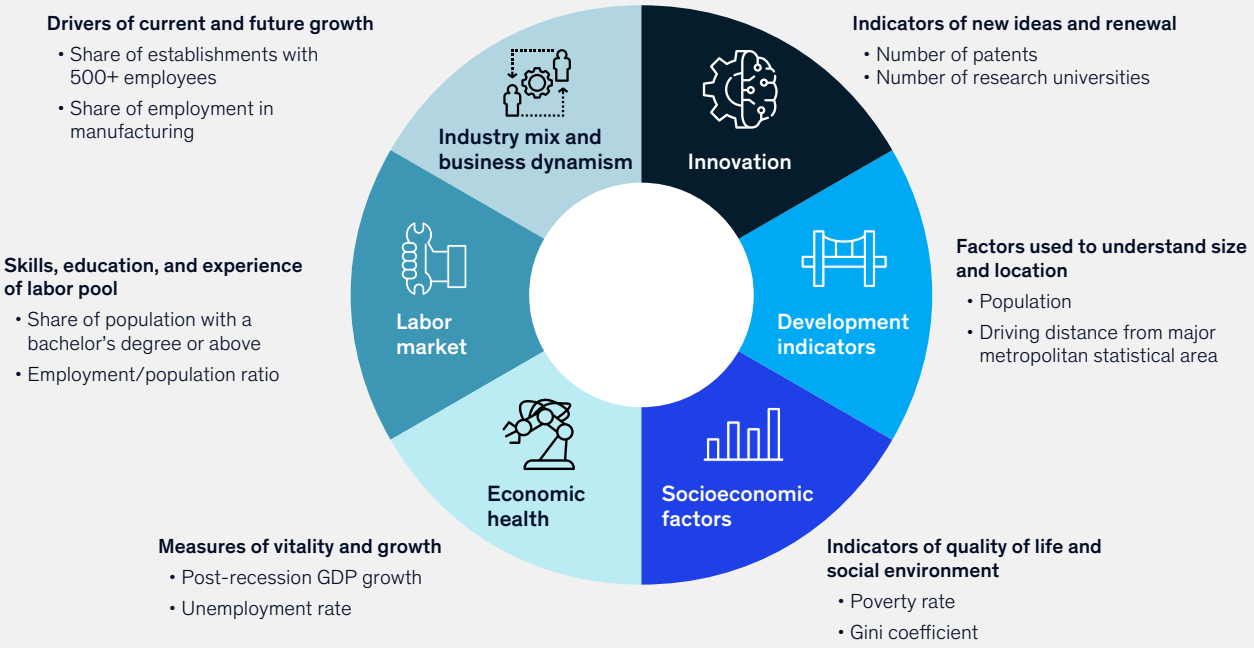
In both reports, the segmentation of US cities and counties employed a technique known as hierarchical clustering analysis. It groups places into clusters based on similar patterns across several of their variables in an iterative process to determine the optimal groupings that minimize within-cluster variance. To finalize our 13 community archetypes, clusters identified in the clustering analysis output were reviewed by several experts in local US development. Though population size was not initially used to segment the 315 cities, it became a logical distinguishing factor in splitting apart segments that otherwise would have been too large (for example, stable cities and independent economies).

See the technical appendix for further detail on methodology.

Exhibit 1

We used more than 40 variables to segment cities and counties into 13 archetypes.

Example variables



Source: McKinsey Global Institute analysis

[1] *America at work: A national mosaic and roadmap for tomorrow,* Walmart, 2019.

Urban core segments

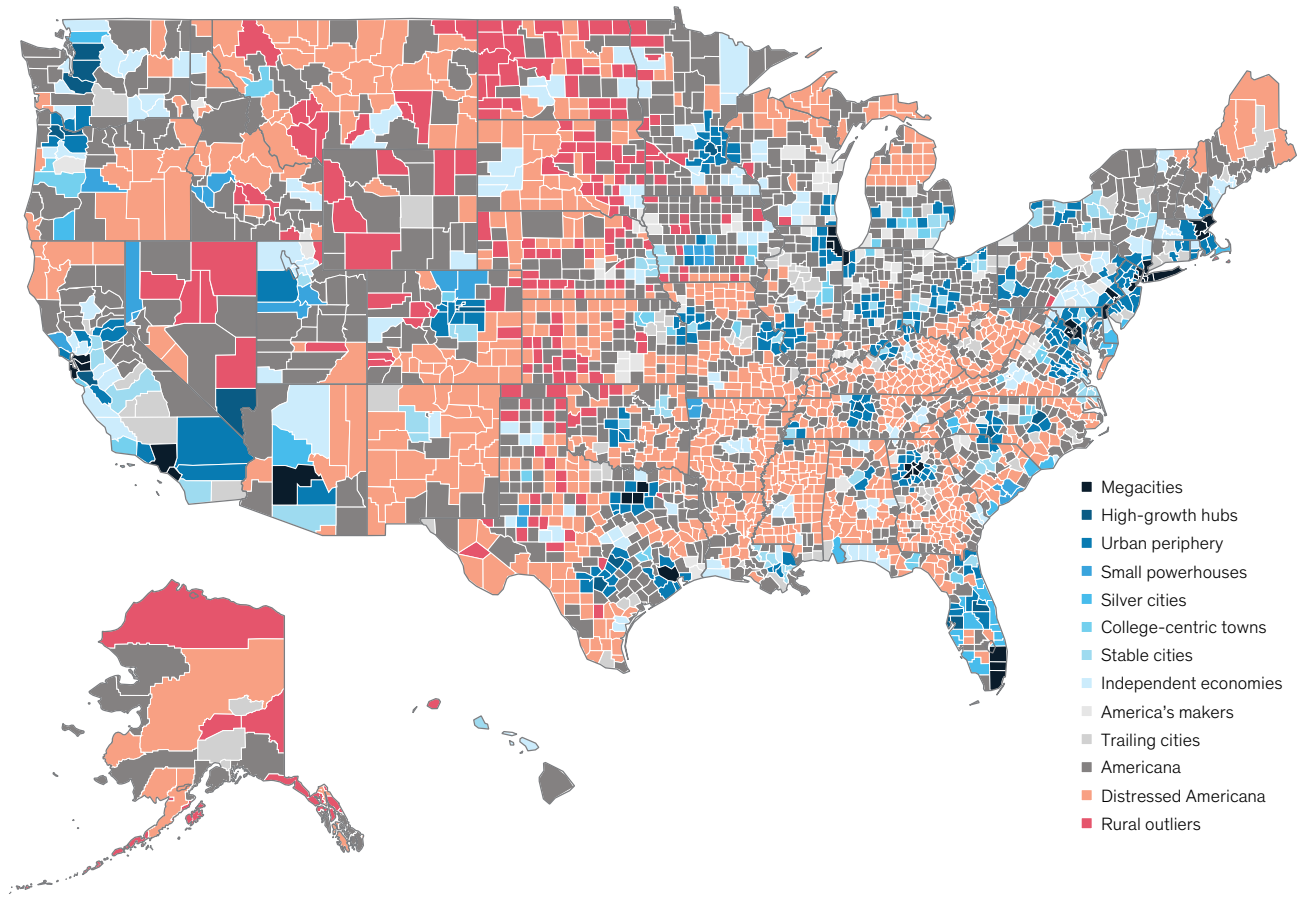
These are the nation's most dynamic local economies. Their workforces are younger and more highly educated than those in any other segment (with the exception of college-centric towns). The high-growth industries of tech, media, healthcare, real estate, and finance account for a greater share of these economies than in other parts of the country. Academic research has found that urban agglomeration in tech industries leads to growth across sectors as service providers reap the benefits of expanded economic activity.[33]

— **Megacities.** This group includes some of the largest urban areas in the country, home to 23 percent of the nation's population. In alphabetical order, they are Atlanta, Boston, Chicago, Dallas, Houston, Los Angeles, Miami, New York, Philadelphia, Phoenix, San Francisco, and Washington, DC. Although their median household income and GDP per capita are among the highest in the nation, megacities have higher income inequality than any other segment. The need for infrastructure upgrades and affordable housing is growing.[34]

Exhibit 2

The United States is a complex mosaic of local economies, with 13 distinct community archetypes.

Map of county types (color-coded by segment)



Source: McKinsey Global Institute analysis

[33] Enrico Moretti, *The New Geography of Jobs,* Boston, MA: Houghton Mifflin Harcourt, 2012.
[34] See *Housing affordability: A supply-side tool kit for cities,* McKinsey Global Institute, October 2017; and *A tool kit to close California's housing gap: 3.5 million homes by 2025,* McKinsey Global Institute, October 2016.

— **High-growth hubs.** These 13 medium-size cities, home to 7 percent of the nation's population, are Austin, Charlotte, Denver, Las Vegas, Minneapolis, Nashville, Orlando, Portland (OR), Raleigh, San Antonio, San Jose (Silicon Valley), Seattle, and Tampa–St. Petersburg. They have recently become hotbeds of innovation, experiencing high employment and GDP growth. In many of these cities, rapid growth is straining transportation systems.

The urban periphery

These 271 counties, found on the outer edges of more than 50 metropolitan statistical areas, are typified by suburban and exurban areas such as Arlington County, VA, and Riverside County, CA. They are distinct from the core of the nearest major city but have complementary economies that emphasize local services. Home to 16 percent of the US population, urban periphery counties as a group have higher household income and lower poverty rates than any other segment (but very low GDP per capita since much of their population works in the adjacent cities). The subset of periphery counties near megacities and high-growth hubs has enjoyed spillover effects from booming growth in the urban core.

Niche cities

All niche cities are attracting both workers and companies with a lower cost of living and a higher quality of life than many larger, more congested urban hubs can offer.

— **Small powerhouses.** These 11 smaller cities are home to less than 2 percent of all Americans and have less than half the population of high-growth hubs on average. But they are the fastest-growing segment in terms of GDP, population, and jobs; some have built economic clusters around technology and other industries. They also have young, educated workforces. The segment includes Bend, Boise, Charleston, Des Moines, Fayetteville (AR), Fort Collins, Greeley, Midland, Provo, Reno, and Santa Rosa.

— **Silver cities.** Typified by places such as The Villages (FL) and Prescott (AZ), these 19 retirement destinations are home to 2 percent of Americans. They account for not only the oldest populations on average but also the highest net migration rate as the baby boom generation continues to retire. Healthcare services are a major driver of economic growth.

— **College-centric towns**. In these 26 small cities, home to 2 percent of the population, major research universities have an outsize economic footprint. Despite high educational attainment, they also have high poverty rates. These cities include Charlottesville, Durham, Gainesville, Lansing, Missoula, and South Bend.

The mixed middle

The coming period of technological change will challenge the mixed middle to accelerate modest economic growth and move up—or risk falling into actual distress.

— **Stable cities.** Thirty-six cities, home to 12 percent of the nation's population, have posted only modest post-recession GDP and population growth. Some were more prosperous in the past but have fallen on harder times and need to reinvent themselves. They are neither thriving nor in distress, but circumstances could tip the balance in either direction. They do have infrastructure and density on their side if they can manage to accelerate growth. This group is typified by places such as Albuquerque, Baltimore, Cleveland, Detroit, Indianapolis, Jacksonville, Kansas City, Louisville, Memphis, Milwaukee, New Orleans, Omaha, Pittsburgh, Salt Lake City, San Diego, St. Louis, Tucson, Tulsa, and Virginia Beach.

— **Independent economies.** These 94 cities are smaller than stable cities but have similar characteristics (although lower GDP per capita and lower income inequality). This segment, home to 8 percent of the population, includes places such as Corpus Christi, Flagstaff, Harrisburg, Little Rock, Providence, and Rochester.

— **America's makers**. Fifty locations, home to roughly 3 percent of the population, are manufacturing hubs. This is a highly bifurcated segment. Some of these cities (such as Greenville, SC) have posted strong GDP and population growth, while others (like Springfield, OH) are in decline.

Exhibit 3

Community segments have varying demographic and economic profiles.

More economically favorable — Less economically favorable

		Examples	Economic indicators: Household income, $ thousand	GDP growth, 2012–17, CAGR[1]	Empl. growth, 2012–17, CAGR	Net migration 2010–17,[2] %	Poverty rate, %	Industry mix: GDP in high-growth industries,[3] %	Labor market: Pop. over age 55, %	Pop. with BA or higher, %
Urban core	Megacities *12 cities, 74.3M people*	New York, NY San Francisco, CA	68.8	2.5	2.2	3.2	14.2	48.0	24.5	38.5
	High-growth hubs *13 cities, 21.6M people*	Seattle, WA Austin, TX	65.6	3.7	3.0	7.4	13.4	44.4	23.1	40.0
Periphery	Urban periphery *271 counties, 52.2M people*	Arlington, VA Riverside, CA	69.0	2.5	2.1	4.1	10.2	29.6	28.0	29.4
Niche cities	Small powerhouses *11 cities, 5.0M people*	Provo, UT Reno, NV	63.5	4.9	3.6	8.7	12.0	35.3	24.8	33.5
	Silver cities *19 cities, 6.8M people*	The Villages, FL Prescott, AZ	53.7	2.4	2.7	11.9	13.3	40.7	40.4	29.2
	College-centric towns *26 cities, 6.1M people*	Chapel Hill, NC South Bend, IN	55.1	1.9	1.7	3.7	18.9	38.1	23.5	43.2
Mixed middle	Stable cities *36 cities, 39.3M people*	Detroit, MI Columbus, OH	55.6	1.6	1.4	0.6	15.7	41.2	26.3	32.1
	Independent economies *94 cities, 26.0M people*	Little Rock, AR Providence, RI	57.9	2.0	1.6	3.3	13.7	36.7	27.4	29.3
	America's makers *50 cities, 11.2M people*	Grand Rapids, MI Greensboro, NC	52.7	1.6	1.2	0.2	14.4	29.4	28.0	25.0
Low-growth and rural areas	Trailing cities *54 cities, 14.8M people*	Bridgeport, CT Flint, MI	53.2	0.3	0.3	–2.0	16.4	33.7	26.8	24.2
	Americana *1,118 counties, 44.0M people*	Cameron, TX Caddo Parish, LA	48.7	1.1	0.5	–1.1	15.4	23.5	31.6	19.2
	Distressed Americana *972 counties, 18.1M people*	Coahoma, MS Pittsylvania/ Danville, VA	38.9	0.5	0.0	–2.4	20.8	23.0	33.9	15.9
	Rural outliers *192 counties, 1.5M people*	Kauai County, HI Juneau Borough, AK	57.5	1.1	0.0	–1.2	10.4	21.3	34.2	22.5

[1] Compound annual growth rate.
[2] Calculated as total net migration between 2010 and 2017 divided by 2017 population.
[3] Information; finance and insurance; real estate / rental leasing; professional, scientific, and technical services; and healthcare and social assistance.
Note: This exhibit shows only a sample of the more than 40 variables used in a clustering analysis to segment communities across the United States.

Source: US Census American Community Survey, Moody's Analytics; McKinsey Global Institute analysis

Low-growth and rural
As a group, these segments have slower economic and employment growth, older populations, and less educated workforces. Their populations have been shrinking.

— **Trailing cities.** Home to 5 percent of the population, these 54 cities exhibit signs of distress. They posted the slowest GDP growth of any segment from 2012 to 2017. The list includes places such as Atlantic City, Flint, Hartford, Topeka, and Youngstown. Some are former industrial towns, and several (such as Warner Robins, GA, and Fayetteville, NC) are near military bases.

— **Americana.** Spanning more than 1,100 counties and 14 percent of the nation's population, these rural areas post lower economic performance than neighboring cities and urban peripheries but are relatively stable.

— **Distressed Americana**. These 972 rural counties, home to 6 percent of the population, are predominantly Southern, farther from major cities, and shrinking. These counties have the lowest household income, the highest poverty rates, and the lowest educational attainment of any segment. While 43 percent of young adults (ages 25 to 34) in megacities and high-growth hubs have bachelor's degrees or higher, the corresponding share is just 16 percent in distressed Americana. As of 2017, 8.3 percent of households in distressed Americana were receiving Social Security disability benefits, a sharply higher share than in any other segment.

— **Rural outliers.** An additional 192 small counties (with less than 1 percent of the population) have relatively robust economies based either on natural resources or tourism. They have notably higher household income than the other rural segments, and lower poverty and unemployment rates than most segments.

Since the Great Recession, 25 cities have set the pace for growth

The Great Recession dealt a heavy blow to the entire country. Across all community archetypes, the employment base eroded by anywhere from 3 to 6 percent during the depths of the downturn.

25

urban areas generated >2/3 of US job growth since 2007

But the recovery has been a tale of two Americas. Just 25 cities (megacities and high-growth hubs, plus their urban peripheries) have accounted for more than two-thirds of post-recession job growth (Exhibit 4). By contrast, trailing cities have been running in place for a decade when it comes to job growth—and Americana and distressed Americana communities have fewer jobs today than they did in 2007.

These dynamics are consistent with previous MGI research that found the top-performing cities pulling away from the rest of the country due to both rising labor income and wealth effects.[35] Many of the most thriving cities have experienced tech and real estate booms. Venture capital is an indicator of entrepreneurship, particularly in the tech industry. One study found that just five metro areas (San Francisco, New York, San Jose, Boston, and Los Angeles) accounted for more than 72 percent of the nation's total venture capital investment in 2016.[36]

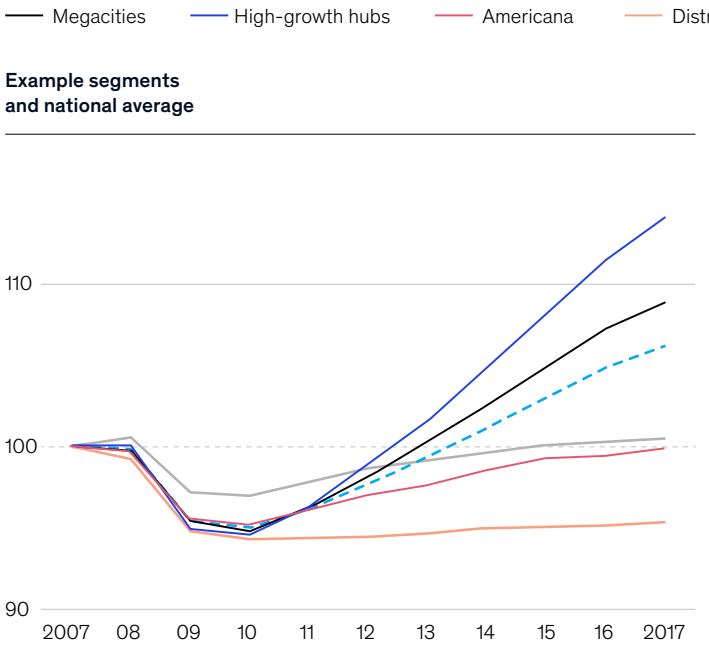
Each community's past economic performance has been influenced by its concentration of the industries that suffered the biggest contraction during the downturn, most notably construction and manufacturing, and of the industries that led the recovery. Local economies where the hardest-hit industries had a large footprint suffered. By contrast, healthcare,

[35] *Superstars: The dynamics of firms, sectors, and cities leading the global economy,* McKinsey Global Institute, October 2018.
[36] Richard Florida, "Venture capital remains highly concentrated in just a few cities," CityLab, October 3, 2017, available at https://www.citylab.com/life/2017/10/venture-capital-concentration/539775/.

Exhibit 4

All segments lost jobs during the Great Recession, but employment gains during the recovery have been heavily concentrated in urban areas.

Annual employment by segment, % of 2007 employment



	Jobs gained as share of 2007 workforce, %	Total jobs gained 2007–17, thousand
Megacities	9	3,100
High-growth hubs	14	1,544
Urban periphery	11	2,049
Small powerhouses	16	350
Silver cities	7	162
College-centric towns	8	238
Stable cities	3	689
Independent economies	6	754
America's makers	3	141
Trailing cities	0	24
Americana	0	(27)
Distressed Americana	–5	(332)
Rural outliers	5	42
National total	**6**	**8,735**

Source: Moody's Analytics; McKinsey Global Institute analysis

food service, and professional services have added the most jobs in the decade following the recession.

Population growth has also become uneven, with distressed areas shrinking

Population growth is a marker of economic health. When it is driven by migration, it is a sign that people are attracted to a given region and finding opportunities there. The size of the labor force is a component of economic growth, and a larger labor pool provides a solid tax base to support the nonworking young and old populations and local services.

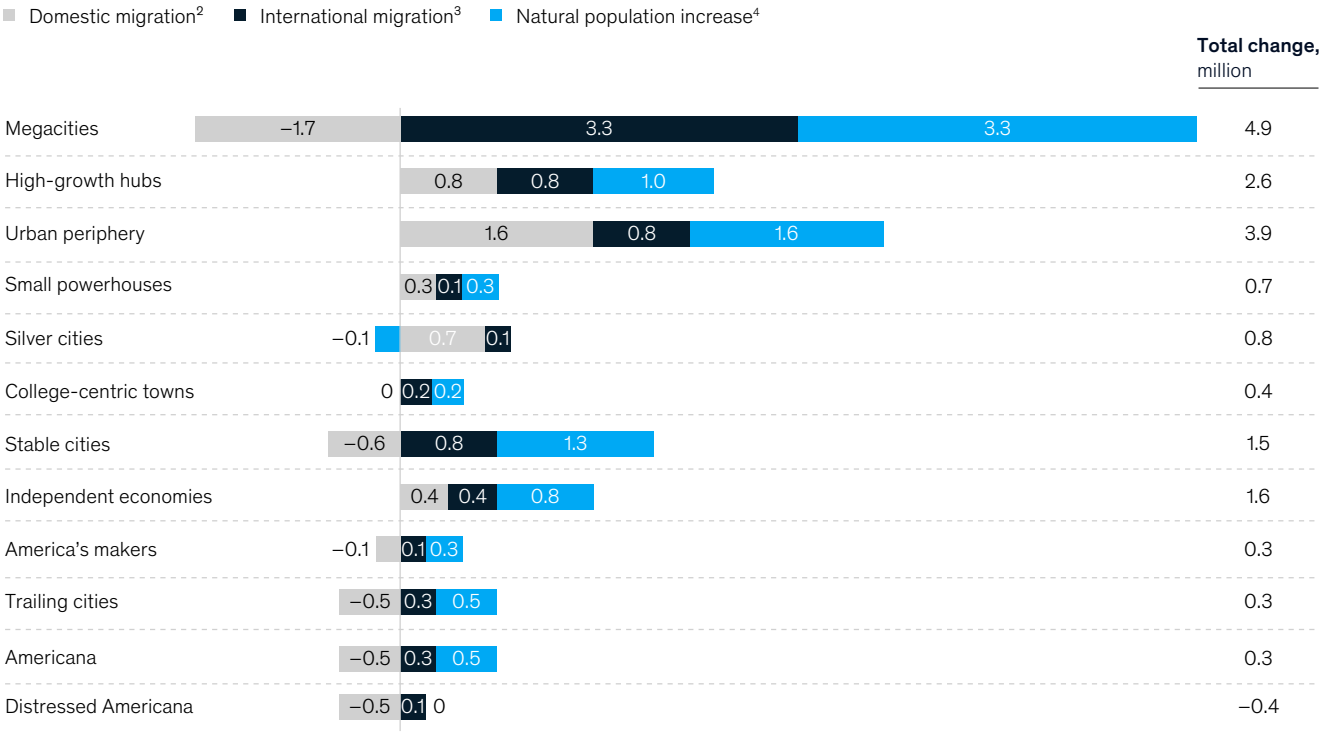
The high-growth hubs, small powerhouses, and silver cities segments each grew by more than 10 percent as a whole. However, many of the fastest-growing places were urban peripheries and independent economy counties. Although some individual rural Americana counties saw strong population growth, the segment overall grew by less than 1 percent, and distressed Americana counties in aggregate shrank in population (Exhibit 5). As people in many rural communities see their opportunities narrowing, many choose to stay anyway because of their deep roots—but others pack up and move away.

Both domestic and international migration contribute to population growth and declines. Some 1.7 million Americans have moved out of megacities since 2010, but those losses were more than offset by the arrival of 3.3 million immigrants. To give just one example, some 458,000 Americans—a number almost equivalent to the entire population of Reno, Nevada—left Los Angeles for other parts of the country, with many of them discouraged by the soaring cost of housing. But Los Angeles County still grew as it welcomed 319,000 immigrants and added 486,000 people through natural population increases. Stable cities, too, saw some 642,000 Americans move away, but immigrant arrivals also offset that decline. By contrast,

Exhibit 5

People have been moving out of the largest US cities, but those losses have been more than offset by immigration and natural population increases.

Population changes 2010–17,[1] million



[1] All migration data are for April 2010 to July 2017. Rural outliers excluded due to small numbers.
[2] Domestic in- and outmigration reflects population movement within the United States (excluding Puerto Rico).
[3] Any change of residence across the borders of the United States. This includes net international migration of the foreign born; net migration between the United States and Puerto Rico; net migration of natives to and from the United States; and net movement of the armed forces population between the United States and overseas.
[4] The difference between births and deaths.

Source: US Census Bureau, 2010–17 population estimates; McKinsey Global Institute analysis

trailing cities and rural counties are attracting fewer international migrants, which precipitates further declines as the population ages.

At the state level, the highest-growth states from 2010 to 2017 were predominantly in the South and the West. The biggest jumps in overall population were in Texas (up 13.0 percent), Utah (12.7 percent), North Dakota (12.5 percent), Florida (12.0 percent), and Colorado (11.9 percent). Florida had the biggest percentage increase from domestic migration as many first-wave baby boomers retired to the Sunshine State.[37] People move for more than just economic opportunity; they are also drawn by factors such as warmer climates, the natural environment, and lower state and local taxes.

A recent study on "brain drain" at the state level examined outmigration of highly educated homegrown talent from each state and whether the states are able to compensate by attracting highly educated movers. In 2017, states with brain drain included Alaska, Connecticut, Delaware, Idaho, Iowa, Montana, New Hampshire, North Dakota, Oklahoma, South Dakota, Vermont, and West Virginia. These states lost highly educated talent—and the associated jobs in knowledge industries—to states with more dynamic metropolitan areas. States that experienced net brain gain included California, Colorado, Illinois, Maryland,

[37] Based on "Estimates of the components of resident population change: April 1, 2010 to July 1, 2017," US Census Bureau, Population Division.

Massachusetts, Minnesota, New Jersey, New York, Oregon, Rhode Island, Virginia, and Washington.[38] Highly educated talent is increasingly concentrated in a set of larger "superstar" cities.[39]

Other US labor market trends have played out with regional variations

After a long, sluggish recovery, the US labor market has finally bounced back from the recession. Although unemployment is historically low today, a number of strains persist. Some of them are trends that have been building for years, unrelated to the business cycle.

Geographic mobility has been declining, and patterns indicate that Americans prefer to live in familiar environments

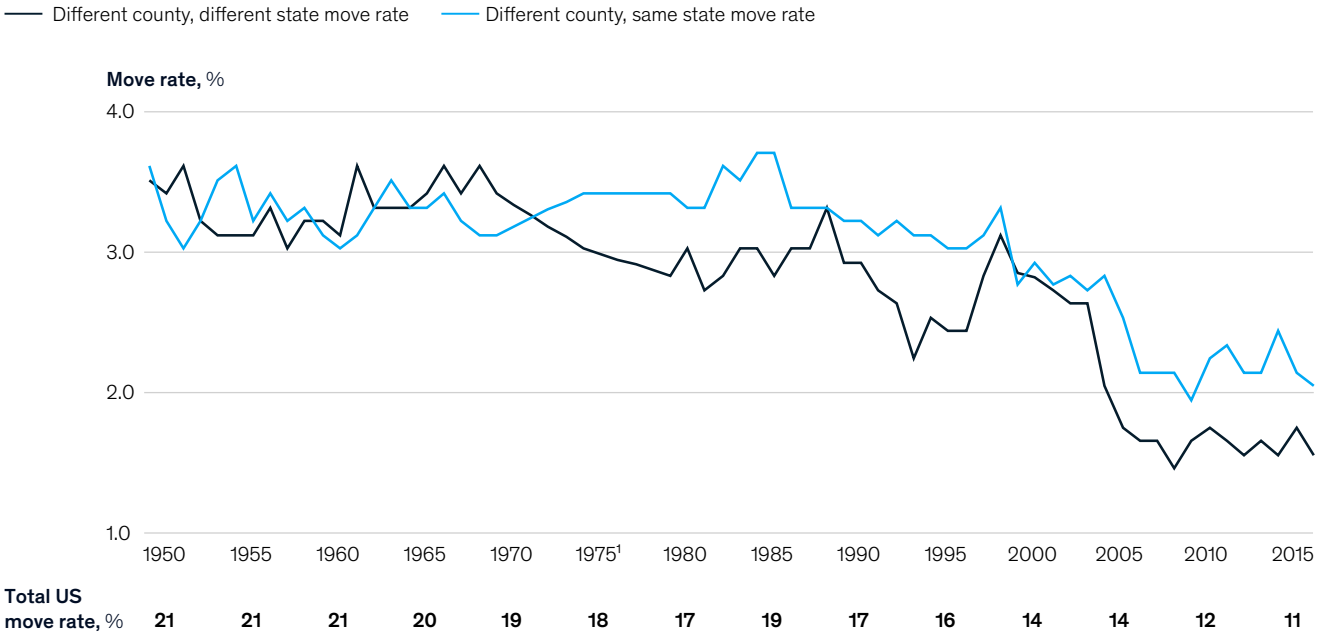
The United States has always considered itself a nation on the move—and indeed its population has historically been more mobile than those of other countries. Because there are sharp city-level differences in productivity, the free flow of workers between locations historically aided labor market efficiency and helped drive productivity growth. In recent decades, that trend has reversed.[40] Although 16.4 percent of Americans made a move in 1990, less than 10 percent did so in 2017.[41]

Most of the decline is due to a drop in intracounty moves, but in addition, fewer Americans are moving across state lines. Just 1.5 percent of Americans moved to a different state in 2017, down from 2.9 percent in 1990 (Exhibit 6). There are multiple causes for this decline (see Box 2, "Stuck in place: Why aren't more Americans moving for work opportunities?").

Exhibit 6

Geographic mobility has declined over time and is currently at historically low levels.

Intercounty move rates, 1950–2017[1]



[1] Data for 1971–74 and 1976–79 extrapolated as no comparable question was asked during those years.

Source: US Census Bureau; McKinsey Global Institute analysis

[38] *Losing our minds: Brain drain across the United States,* Social Capital Project, Joint Economic Committee of the US Congress, April 2019.

[39] Richard Florida, "When it comes to skills and talent, size matters," CityLab, July 6, 2017, citylab.com/equity/2017/07/when-it-comes-to-skills-and-talent-size-matters/531411/; Donald R. Davis and Jonathan I. Dingel, *The comparative advantage of cities,* NBER working paper number 20602, October 2014.

[40] Raven Molloy, Christopher L. Smith, and Abigail Wozniak, *Declining migration within the US: The role of the labor market,* Finance and Economics Discussion Series number 2013-27, Federal Reserve Board, April 2014.

[41] US Census Bureau Current Population Survey 1948–2018.

Box 2

Stuck in place: Why aren't more Americans moving for work opportunities?

Imagine a stock clerk in Omaha who loses her job. She could look for a similar position locally, hoping for match her former salary of just under $28,000. Another option would be moving to San Francisco, where the economy is booming and the median salary for the same position is $35,240—well above what she could make if she stays put. But the latter option may leave her in worse economic shape despite the higher salary. The average rent on a two-bedroom apartment is $1,025 in Omaha, but $4,542 in San Francisco. In April 2019, a gallon of gas cost $2.55 in Omaha and $3.83 in San Francisco. Furthermore, her partner has a steady job in Omaha that would be lost in any move, and her mother is nearby to help with childcare.

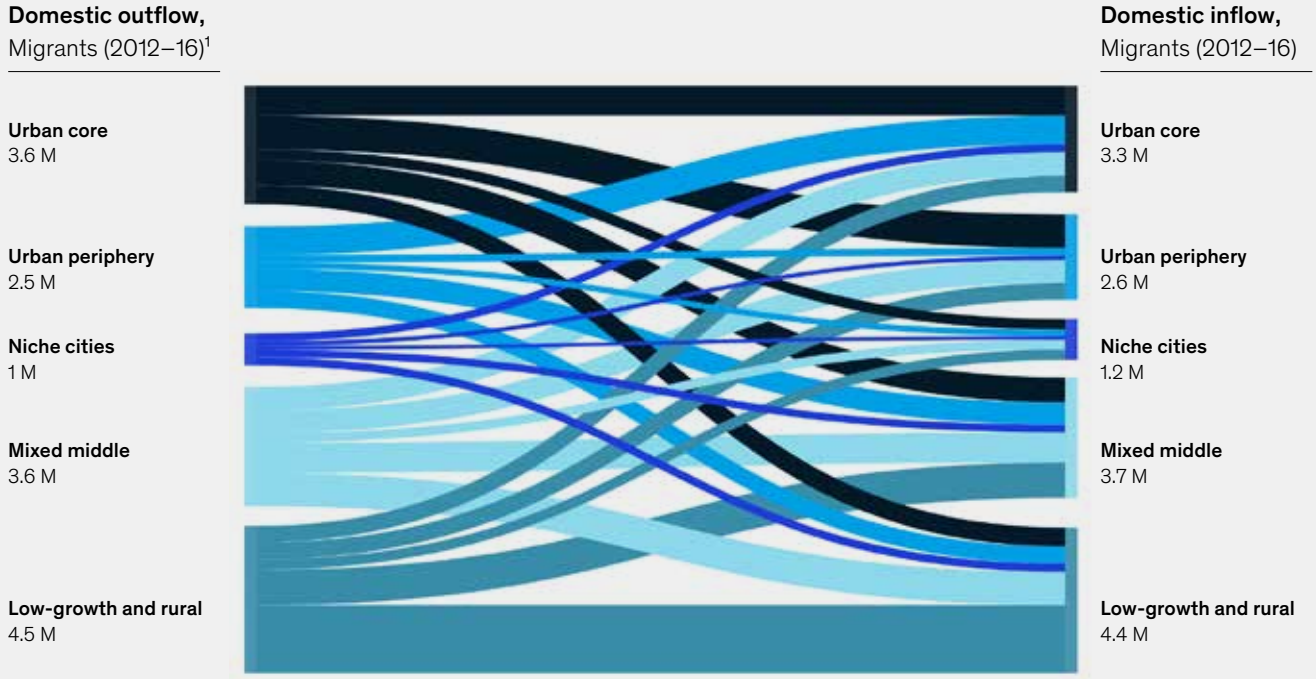
Variations in the cost of living—and particularly in housing costs—are a clear contributing factor holding back geographic mobility in the United States. The cities offering the greatest job opportunity also happen to be expensive places to live. Many of the nation's largest and most dynamic cities have severe affordable housing shortages, and people in distressed areas may have difficulty selling their homes. The phenomenon of underwater homeowners has not disappeared; one recent study found that 5.2 million homeowners were severely underwater in 2017.[1]

Yet the cost of living is not the only thing holding people in place. There are multiple causes, including a growing web of occupational licensing requirements that vary by state and reluctance to move for jobs that may not last.[2] One recent study finds that the role of family and friends, as well as a desire to stay in a place with familiar norms and values, is more important in these decisions than is commonly recognized.[3] Many people have deep ties to where they live.

Interestingly, when Americans do move out of their county, they tend to move to places with a profile similar to the one they left behind. City dwellers tend to stay in cities or move to the suburbs, while people who live in rural areas generally stay in the country (Exhibit 7). Assuming that people will simply move from distressed areas to more thriving cities would involve a reversal of the current status quo.

Exhibit 7

Americans in lower-growth areas are not migrating to high-growth places.



[1] Analysis excludes all migration within a metropolitan statistical area that is within the same segment (e.g., migration from one New York City CBSA megacity county to another).

Source: US Census Bureau County-to-County Migration Flows 2012-2016, McKinsey Global Institute analysis

1 A home is "under water" when the outstanding balance on the mortgage loan exceeds the market value of the property. Alexandre Tanzi and Marie Patino, "US housing wealth diverges between 'underwater' and 'equity rich,'" Bloomberg, May 10, 2019.

2 Raven Molloy, Christopher L. Smith, and Abigail Wozniak, *Declining migration within the US: The role of the labor market*, Finance and Economics Discussion Series number 2013-27, Federal Reserve Board, April 2014; Clare Hendrickson, Mark Muro, and William A. Galston, *Countering the geography of discontent: Strategies for left-behind places*, Brookings Institution, November 2018; Conor McKay, Ethan Pollack, and Alastair Fitzpayne, *Automation and a changing economy part II: Policies for shared prosperity*, Aspen Institute Future of Work Initiative, April 2019.

3 Gizem Kosar, Tyler Ransom, and Wilbert van der Klaauw, *Understanding migration aversion using elicited counterfactual choice probabilities*, staff report number 883, Federal Reserve Bank of New York, April 2019.

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decline in share of middle-wage jobs over the past two decades

Middle-wage jobs have declined across the United States, but some areas have bucked the trend

Over the past two decades, the United States has lost a significant number of middle-income jobs.[42] These roles have always been a cornerstone of upward mobility; someone with a high school diploma could get technical training and land a job that paid enough to support a middle-class life. But those jobs have been drying up. Consistent with other research, our own analysis shows the share of middle-wage jobs decreasing from 49 percent of all US jobs in 1997 to 41 percent in 2017. With employment growth occurring at the high and low ends of the wage scale, more Americans are climbing into higher income brackets—or slipping out of the middle class altogether. This hollowing out has contributed not only to income inequality but also to the sense of polarization that is seeping into other parts of American life.

Middle-wage jobs have been disappearing for years, but the losses accelerated dramatically during the Great Recession.[43] Between 2007 and 2012, the United States lost 2.9 million jobs with median wages between $27,000 and $54,000, compared to losses of just under 600,000 for both low- and high-wage jobs.[44] The hollowing-out trend eased from 2012 to 2017, with 4.2 million middle-wage jobs added (nearly as many as added low-wage jobs and topping the number of added high-wage jobs). The biggest losses during the immediate aftermath of the recession hit builders, manufacturing production workers, and office support workers. Since then, about half of the lost construction jobs have been restored, but middle-wage office support jobs have not reappeared.

The hollowing-out pattern has been geographically uneven. While states such as Florida, Maryland, and Rhode Island all saw more than 7 percent of their middle-wage jobs vanish from 2007 to 2017, many others managed to bolster them (Exhibit 8).

[42] See David H. Autor and David Dorn, "The growth of low-skill service jobs and the polarization of the US labor market," *American Economic Review,* August 2013, Volume 103, Number 5.

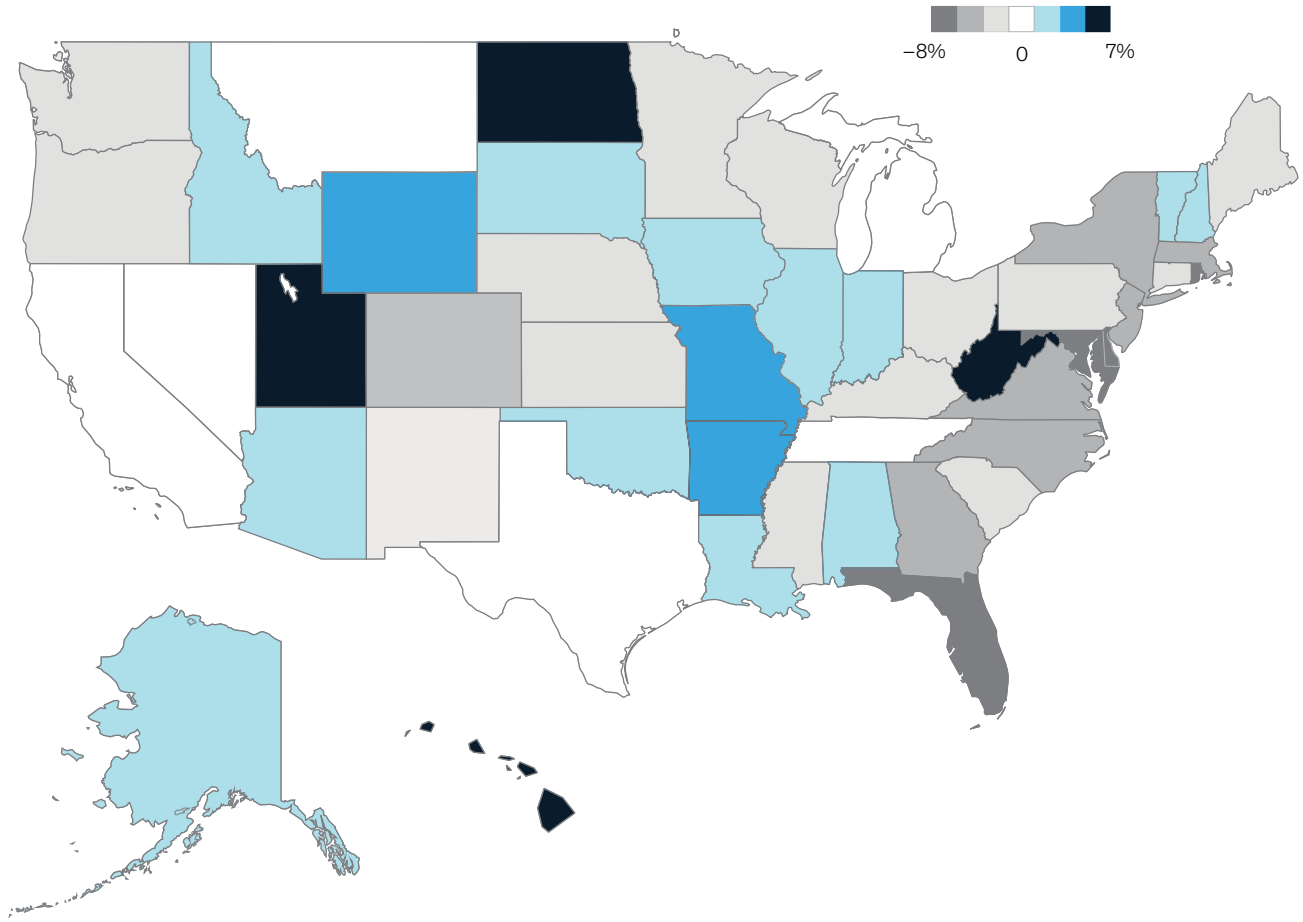
[43] Nir Jaimovich and Henry E. Siu, *Job polarization and jobless recoveries*, National Bureau of Economic Research working paper number 18334, August 2012, revised November 2018.

[44] Low-wage jobs are those paying less than $27,500 annually; middle-wage jobs pay $27,500–$54,200 annually; and high-wage jobs pay more than $54,200 annually (all figures in 2017 dollars).

Exhibit 8

Over the last decade, the share of middle-wage jobs has declined at the national level—but this trend is concentrated in some states.

2007–17 change in share of middle-wage jobs, %



Note: Here we focus only on employment changes, holding 2017 wage categorization constant. Wage categories are defined relatively for each state. Middle-wage jobs are those between the 30th and 70th percentile of the wage distribution. Assumes median annual wage for all employment in an occupation.

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

Independent work is more concentrated in urban areas

Independent work is not a new phenomenon, but official statistics have never captured it well, particularly regarding those who use side work to supplement their primary income.[45] Looking at the US Census Bureau's data on the share of self-employed workers in a given area and growth in nonemployer establishments suggests that independent work is more common in urban areas.

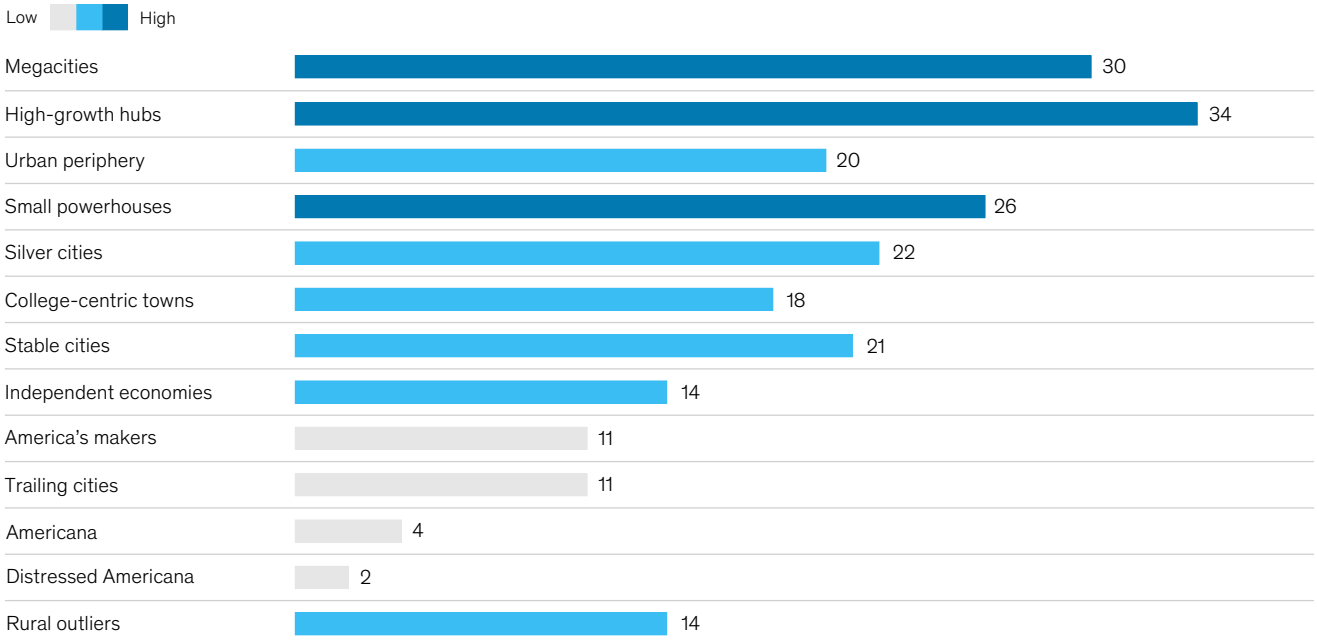
A new development regarding independent work is the growth of the so-called gig economy, which involves people providing their labor services through on-demand digital marketplaces. Fueled by the rise of digital apps such as Uber, Lyft, Postmates, DoorDash, and Grubhub, independent work has grown three times faster in high-growth hubs than in trailing cities and nearly 10 times faster than in rural county segments (Exhibit 9). While workers in rural areas can benefit from the rise in remote work, these types of geographically based on-demand services require higher population density.

[45] *Independent work: Choice, necessity, and the gig economy*, McKinsey Global Institute, October 2016. Since then, the US federal government released its first update of the Contingent Worker Supplement in 13 years. It found that 10.1 percent of US workers (or 15.5 million people) derived their primary income from on-call, temporary or contract work.

Exhibit 9

Independent work is growing more urban.

Growth in nonemployer establishments, 2006–16, %



Source: US Census Bureau data on nonemployer establishments; McKinsey Global Institute analysis

For most Americans, the labor market that matters is the one where they live—and where they live increasingly affects their prospects. Regional variations have always existed, even within the same state. Over time, multiple forces have turned variations into widening gaps. In the decade ahead, the wider adoption of automation technologies will introduce yet another element of change. In the next chapter, we look at how the next generation of digital technologies could change the nature of jobs and the US occupational mix.

2 The evolution of jobs and skills

Technology has always reshaped the workplace—from the cotton gin, the steam engine, and Henry Ford's assembly lines to the typewriter, the switchboard, and the copy machine. In the past two decades, digital technologies have altered the day-to-day fabric of work for millions. Drivers have gone from memorizing local streets to relying on GPS, while architects have gone from hand drafting to AutoCAD. Ubiquitous smartphones mean that many US workers are always plugged in, and more of them are able to work from anywhere.

The next generation of digital tools will bring even more far-reaching changes in the decade ahead. Robots can assemble cars, deliver food, and handle dangerous, dirty tasks on industrial sites. Systems enabled by machine learning can provide customer service, manage logistics, personalize marketing, optimize pricing in real time, spot defects and fraud, and analyze medical records. Automation technologies work 24/7, without distractions or sick days.[46]

Millions of jobs with a high share of automatable tasks could be phased out in the decade ahead. Others will be created, more than making up for those losses in many scenarios—although they may be different occupations located in different places (a topic we will return to in Chapter 3).

A simple ledger of jobs lost and gained is only the surface of the story. Automation technologies are likely to transform the vast majority of jobs. Americans will need to work side by side with machines, using them to become more productive.[47]

Since machines are well suited for rote and manual tasks, this type of work will account for fewer and fewer of the hours worked across the US economy over time—and the skills that match up with machine capabilities will lose value in the labor market. At the same time, demand is growing for skills that machines cannot provide: creativity, empathy, critical thinking, and the ability to program and operate technology systems themselves.[48] Whether or not they actually make a job move, people who have done one type of work throughout their careers will be challenged to adapt—and often to stretch their skills.

[46] Our definition of automation incorporates any technology that performs activities that would otherwise be the responsibility of a human worker, including robotics (machines that perform physical activities), artificial intelligence (software algorithms that perform calculations and cognitive activities), autonomous vehicles, and business process automation (software that performs cognitive tasks to automate workflows).

[47] David H. Autor, "Why are there still so many jobs? The history and future of workplace automation," *Journal of Economic Perspectives*, Summer 2015, Volume 29, Number 3, pp. 3–30.

[48] Will Markow, Debbie Hughes, and Matthew Walsh, *Future skills, future cities: New foundational skills in smart cities*, Burning Glass Technologies, Business Higher Education Forum, and Center for Innovative Technology, 2019.

Occupational shifts are already under way

Automation-related job losses are not likely to manifest as sudden mass unemployment. Some occupations are likely to shrink through attrition and gradually reduced hiring, and many of these declines would represent a continuation of past and current trends.

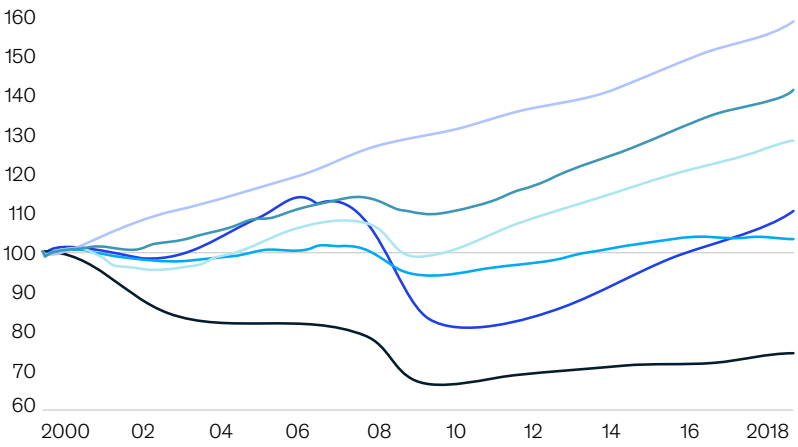
Office support roles, for instance, have one of the highest future displacement rates. But these jobs have been evaporating for a number of years as companies reduced hiring. Offices that were once populated with armies of administrative personnel, research assistants, librarians, and payroll and data clerks already run today with leaner support teams and more digital tools like software and smartphones. From 2000 to 2017, the number of bookkeepers and accounting and auditing clerks declined by 8 percent, for example, falling from 1.7 million to 1.5 million.

The decline of manufacturing employment in the United States began in the late 1990s. From 2000 to 2017, the sector shed 5.5 million jobs. Those losses were driven by a combination of factors, including increased trade competition and earlier waves of automation (Exhibit 10).

Exhibit 10

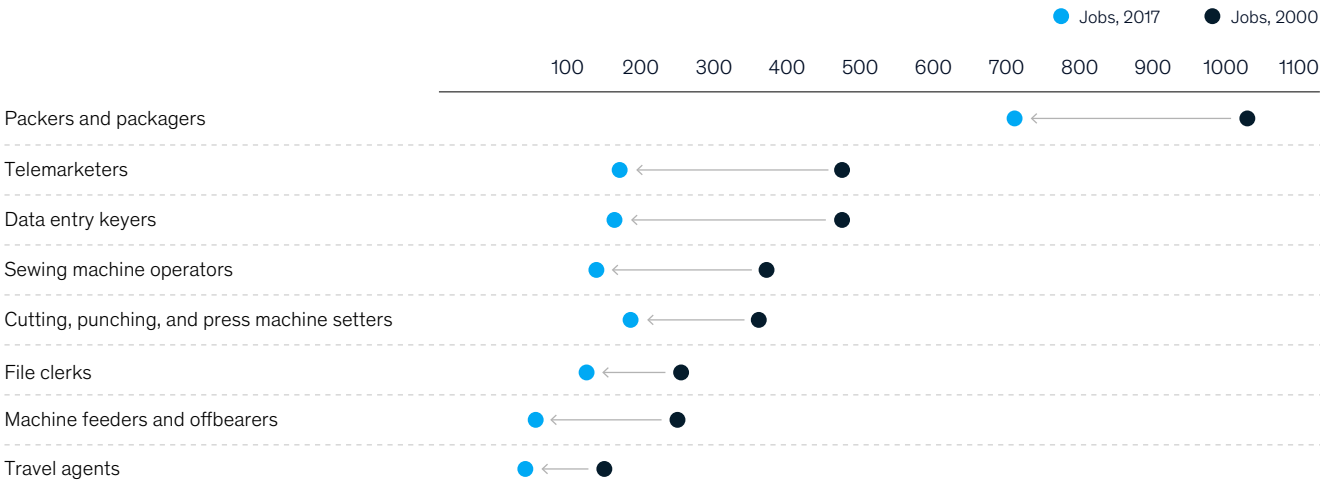
Manufacturing employment has declined by more than 25 percent since 2000.

Employment growth for select industries since 2000



Industry	Employment, million 2000	2017
Education and healthcare	15.3	24.1
Leisure and hospitality	11.9	16.7
Professional and business services	16.7	21.3
Construction	6.8	7.5
Retail trade	15.3	15.8
Manufacturing	17.3	12.8

Employment totals over time, example declining occupations, thousand



Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

More recently, job losses have been mounting in the retail sector as national chains struggle with online competition and heavy corporate debt burdens. Since 2017, more than 15,000 stores are estimated to have closed nationwide.[49] The pace is accelerating: According to Coresight research, US retailers closed almost 6,000 stores in the first four months of 2019, more than in all of 2018. The continuing growth of e-commerce could amplify the occupational changes within the industry as more tasks shift to supply chain and distribution.

As the economy has evolved, many of the occupations posting the biggest gains in the recent past have been low-wage jobs. Looking specifically at the period from 2012 to 2017, 36 percent of job growth was in occupations with a median wage of less than $30,000. Of the ten occupations that represented more than one-third of all job growth, half paid less than $30,000 (Exhibit 11). The single fastest-growing occupation was personal care aide, a category that added 1.1 million jobs and grew by 107 percent during the period. But these workers have a median wage of just over $23,100.

Automation could cause significant displacement in office support, food service, production, and customer service

MGI has produced an extensive body of work on automation and jobs.[50] At the core of this research is a detailed model we have developed to analyze more than 800 occupations

Exhibit 11

Ten occupations accounted for more than one-third of total job growth from 2012 to 2017, and half were low-wage service jobs.

Top-growing occupations by net job change, 2012–17

Occupation	Net jobs added 2012–17, thousand	Growth, %	2017 median annual wage, $ thousand
Personal care aides	1,050	107	23
Food preparation and serving workers	632	21	20
Laborers and freight movers	567	26	27
Customer service representatives	468	20	33
Sales representatives	332	49	53
General and operations managers	313	16	100
Cooks	276	28	25
Registered nurses	273	10	70
Software developers	263	45	102
Waiters and waitresses	252	11	21

Note: Low-wage jobs are defined as having median annual wages of less than $30,000.
Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

[49] Abha Bhattarai, "'Retail apocalypse' now: Analysts say 75,000 more US stores could be doomed," *Washington Post,* April 10, 2019.
[50] See, for example, the following McKinsey Global Institute publications: *A future that works: Automation, employment, and productivity,* January 2017; *Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages,* November 2017; *Notes from the AI frontier: Insights from hundreds of use cases,* April 2018; and *Skill shift: Automation and the future of the workforce,* May 2018. For a discussion of technology and productivity, see *Solving the productivity puzzle: The role of demand and the promise of digitization,* February 2018.

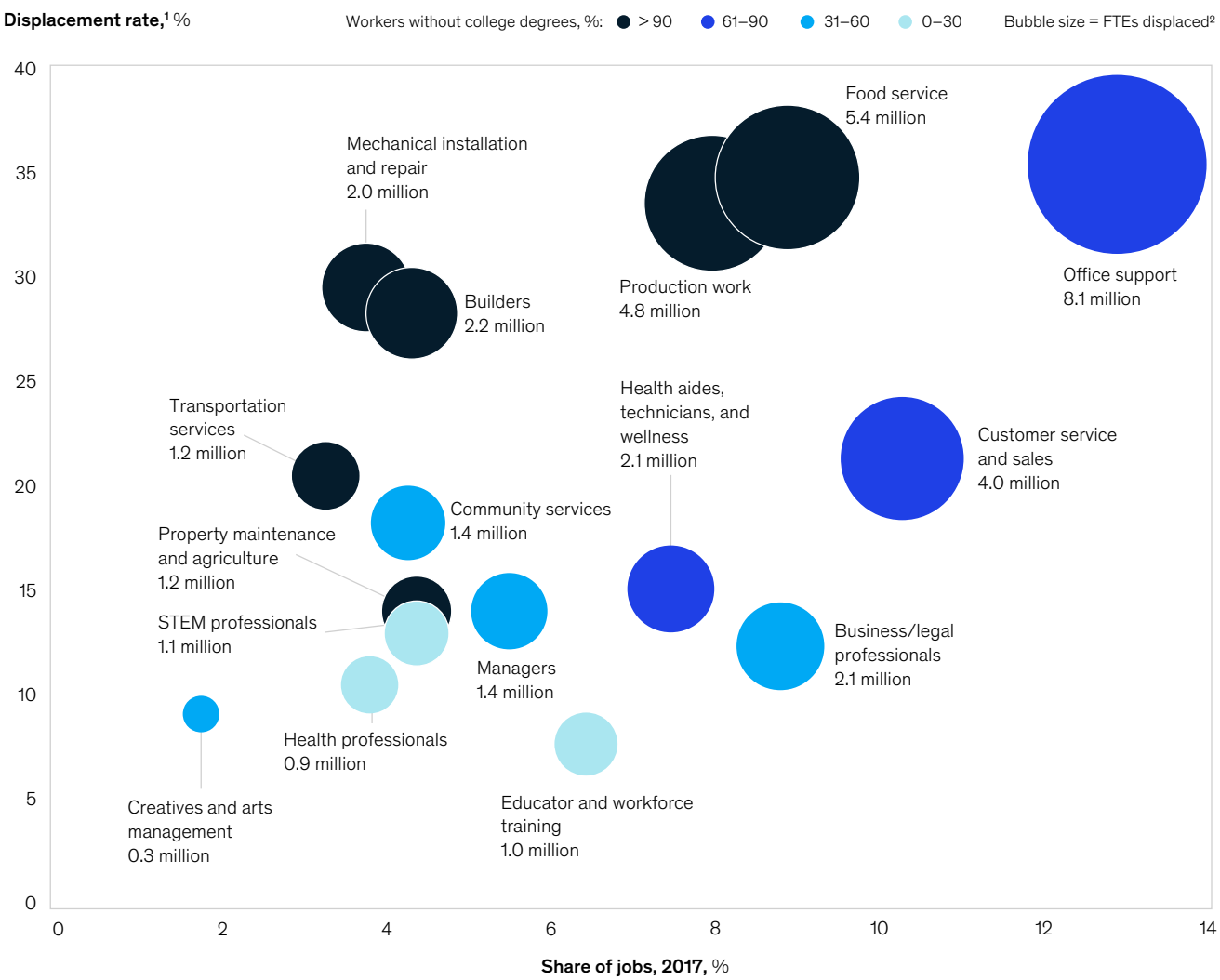
and determine what share of their constituent activities can be handled by currently proven technologies. We run three scenarios based on slower and faster adoption rates by US employers. Part of this involves factoring in local wage rates to gain a more granular view of where companies have greater incentives to automate. (See the technical appendix for more details, including a discussion of the potential limitations of our modeling.) Our midpoint adoption scenario shows that annual work hours equivalent to 39 million full-time jobs could be automated by 2030.[51]

The largest occupational categories in the US economy are also the ones with the greatest potential for automation-related displacement in our model. Office support roles could be hardest hit, with 8.1 million jobs at risk by 2030, out of a 2017 workforce of 20.7 million (Exhibit 12).[52] As customers place orders on self-service screens and robots flip hamburgers,

Exhibit 12

The largest occupational categories in the US economy have the highest potential displacement rates.

Occupational categories by share of US employment and displacement rate[1] through 2030, midpoint adoption scenario



[1] Based on the share of automatable activities for occupations within each category.
[2] Full-time equivalents displaced in midpoint automation scenario by 2030. In office support, for example, technology could handle the activities that account for more than 35 percent of all hours worked, or the equivalent of 8.1 million full-time workers.

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

[51] This will not necessarily translate neatly into 39 million lost jobs. Some jobs that can be partially automated may be combined so that fewer workers are needed but some continue in their roles. However, we use "jobs" as a proxy in this report to convey the magnitude of potential displacement. Our modeling is not intended to produce a forecast; it is a mechanism for assessing and sizing a range of potential outcomes.

[52] Alexander Edlich, Fanny Ip, and Rob Whiteman, "How bots, algorithms, and artificial intelligence are reshaping the future of corporate support functions," November 2018, McKinsey.com.

8.1M

office support jobs could be phased out by 2030

5.4 million of the 14.1 million current food service jobs could be lost by 2030. Production roles could continue to shrink as more factory lines are automated, putting 4.8 million out of 12.9 million current jobs at risk.[53] Some 4.0 million out of 16.5 million customer service and sales jobs could also be lost, although different types of occupations could be added, resulting in net job growth in this category. The coming wave of automation will be notable for the range of sectors and individual occupations it can touch.

Some of the categories at risk have heavily skewed demographics, raising the prospect of concentrated displacement. In many of the roles with the highest displacement rates, more than 60 percent of workers do not have college degrees. Older female workers typically fill office support occupations, whereas food service workers are disproportionately young. Hispanics are heavily represented in both food service and manufacturing production, and they have the highest potential displacement rate of the racial groups we analyzed. Chapter 4 explores the demographics of displacement in greater detail.

Looking ahead to 2030, the occupational mix of jobs will change further

Technological revolutions throughout history have created new types of work even as they made some existing occupations obsolete. The Internet disrupted many industries and eliminated many jobs. But it also gave rise to new roles such as web developers, app developers, social media marketers, search engine optimization consultants, and user experience designers—and even Uber drivers, Airbnb hosts, Instagram influencers, and YouTube stars. Academic research suggests that by 2030, about 8 to 9 percent of jobs will be occupations that barely exist today.[54]

Our research suggests that new job creation could more than offset displacement of workers through 2030 in multiple scenarios. But the mix of jobs will not look the same. Even as employment declines in office services, manufacturing, food service, and back-office government functions, our modeling shows strong growth in healthcare and STEM occupations; and creative and arts management (Exhibit 13).

Growth and displacement may occur simultaneously within the same occupational category. The business and legal category, for instance, could add accountants (430,000) and management analysts (304,000) as more automatable roles such as legal assistants (18,000) and insurance underwriters (13,000) shrink. While some jobs within the customer service and sales category (such as telemarketers, parking lot attendants, and travel agents) are likely to shrink, economic growth in the decade ahead could lead to overall net job gains.

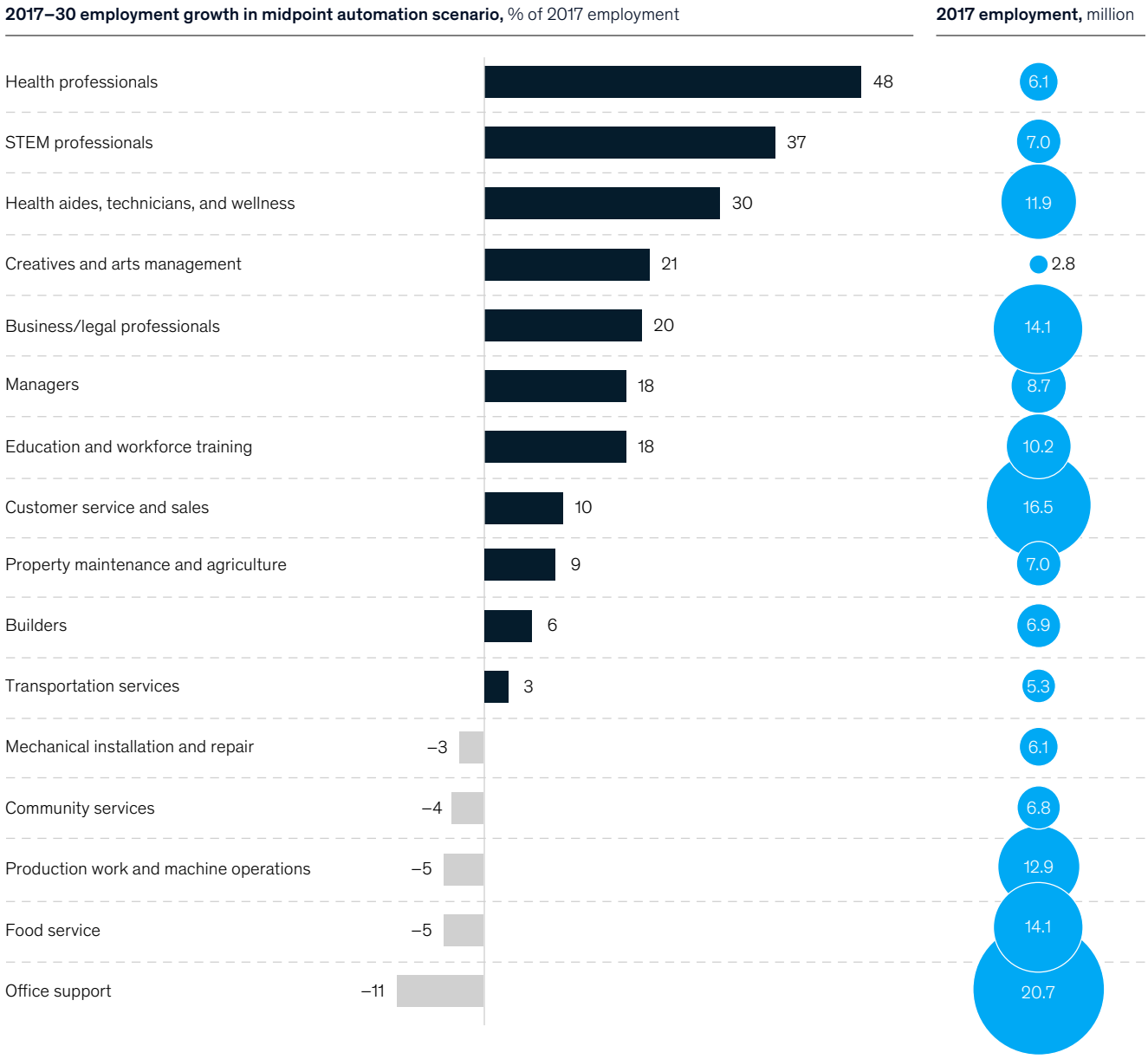
Some occupations are experiencing labor shortages today despite the fact that they are expected to decline over the long term. Truck drivers and a host of transportation-related occupations are in demand now but could be at risk with autonomous and semi-autonomous vehicles under development. Yet it may take years for these vehicles to be widely deployed due to technical and regulatory hurdles as well as the expense of replacing the extensive capital assets already on the roads.

Exhibit 14 shows a sampling of the fastest-growing jobs of the future as indicated by our model. In technology roles, software developers, solar panel installers, and web and user experience designers will all see surging demand. Another expanding category involves providing personal services to affluent consumers who increasingly value experiences; labor economist David Autor has dubbed this category "wealth workers."[55] These roles include massage therapists, self-enrichment instructors, and exercise physiologists. Creative

[53] Michael Chui, Katy George, James Manyika, and Mehdi Miremadi, "Human + machine: A new era of automation in manufacturing," September 2017, McKinsey.com.
[54] Jeffrey Lin, "Technological adaptation, cities, and new work," *Review of Economics and Statistics,* May 2011, Volume 93, Number 2.
[55] David H. Autor, *Work of the past, work of the future,* Richard T. Ely Lecture, American Economic Association Annual Meeting, Atlanta, GA, January 4, 2019.

Exhibit 13

In the decade ahead, health and STEM occupations could post rapid growth while office support, food service, and manufacturing production jobs could decline.



Note: This exhibit displays net job growth, factoring in both job losses due to automation and expected job creation. Customer service and sales, for instance, is one of the occupational categories with the largest number of potential displacements, yet our model finds that enough jobs will be added over the same period to produce positive net growth overall.

Source: McKinsey Global Institute analysis

occupations are also projected to grow, as machines have not (so far) replaced our desire to see live performances or beautiful design. Finally, demand is rising for roles that use socioemotional skills to provide care; these include occupational therapists, psychologists, and drug treatment advisers.

However, it is also important to look at future job growth in absolute numbers rather than simply growth rates. Our model shows personal care aides adding 825,000 jobs by 2030, second only to growth in registered nurses (which may add up to 1.6 million new jobs). Jobs will be added for software developers and general managers, but also for laborers, freight movers, and salespeople. Even as automation reduces the rate of growth for some of these

Exhibit 14

Jobs involving new technologies, personal services for affluent customers, healthcare for an aging population, creativity, and empathy are expected to grow rapidly.

Illustrative examples of fast-growing occupations, 2017–30

		% growth
Frontier tech	Software developers	**79**
	Solar photovoltaic installers	**70**
	Wind turbine service technicians	**54**
	Nuclear engineers	**47**
	Aerospace engineers	**43**
	Electrical engineering technicians	**33**
Wealth workers	Massage therapists	**88**
	Exercise physiologists	**67**
	Agents of artists and athletes	**49**
	Dietitians and nutritionists	**48**
	Landscape architects	**34**
	Animal caretakers	**29**
Healthcare	Physical therapist aides	**69**
	Nurse practitioners	**65**
	Physician assistants	**63**
	Physicians and surgeons	**62**
	Hearing aid specialists	**53**
	Personal care aides	**39**
Creatives	Dancers	**54**
	Interior designers	**42**
	Multimedia artists and animators	**41**
	Merchandise displayers and window trimmers	**37**
	Musicians and singers	**34**
	Actors	**33**
	Curators	**30**
Socioemotional support	Social and community service managers	**43**
	Occupational therapy aides	**41**
	Training and development specialists	**40**
	Clinical, counseling, and school psychologists	**27**
	Residential advisers	**26**
	Psychologists	**21**

Source: McKinsey Global Institute analysis

roles, they may still increase in absolute numbers in the coming decade, reflecting their huge positions in the economy today and ongoing economic growth in the years ahead.

Middle-wage jobs may grow more slowly than high-wage jobs, continuing the trend of hollowing out the middle class

The loss of middle-wage jobs and the resulting polarization in the job market is a long-term historical trend.[56] Our analysis, described in Chapter 1, finds that the loss of middle-wage jobs as a share of overall employment accelerated dramatically during the Great Recession, but then eased from 2012 to 2017 as some manufacturing and construction jobs came back.

-3.4 p.p.

potential decline in share of middle-wage jobs by 2030

Looking forward, future displacement resulting from automation could cause this hollowing-out trend to return. Our modeling shows the share of middle-wage workers in the labor force decreasing by 3.4 percentage points through 2030, falling to 36.2 percent.[57]

Our findings suggest a loss of middle-wage jobs driven by declines in office support roles, such as data entry keyers (shrinking by 45 percent); production jobs, including sewing machine operators (48 percent); and government positions such as postal service mail sorters (40 percent). On the other end of the spectrum, four of the six fastest-growing job categories have more than 80 percent of jobs in high-paying roles (Exhibit 15).

[56] David H. Autor, *The polarization of job opportunities in the U.S. labor market: Implications for employment and earnings*, Center for American Progress and The Hamilton Project, Brookings Institution, April 2010.

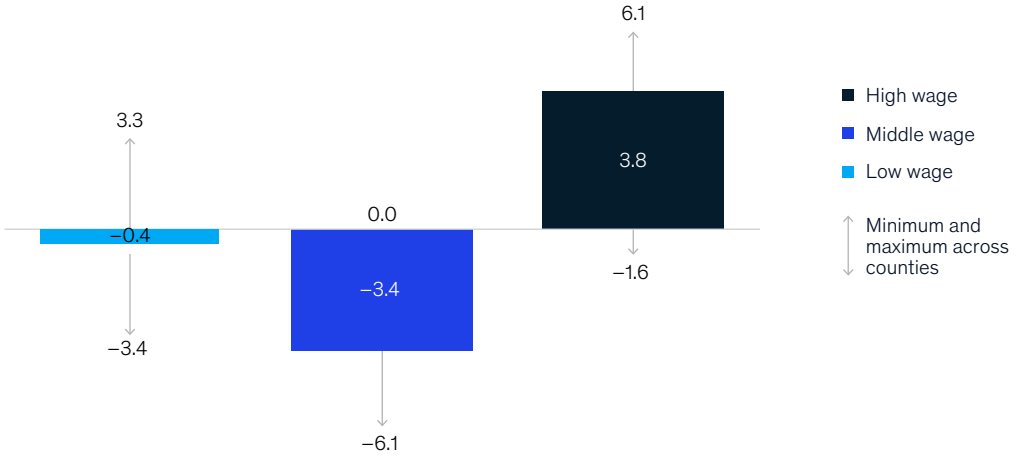
[57] Low-wage jobs are those paying less than $27,500 annually; middle-wage jobs pay $27,500–$54,200 annually; and high-wage jobs pay more than $54,200 annually (all figures in 2017 dollars). This analysis does not account for different wage growth across occupations. Based on history, it is possible for low-wage jobs to become middle-wage jobs and for high-wage jobs to fall to the middle-wage bracket.

While middle-wage jobs shrink, the share of high-wage jobs could rise by 3.8 percentage points, reaching 34.2 percent of the labor force. This trend will require training and education for a large portion of the workforce. Forging career pathways to help people move up and finding sources of future middle-wage jobs will be essential to sustaining the US middle class.

Exhibit 15

The share of middle-wage jobs could decline in the next decade as the US economy adds more high-wage jobs.

Change in share of US employment by wage tercile,[1] 2017–30, %



Occupational categories by wage band,[1] %	Low	Mid[2]	High	2017–30 growth, %
Managers	4		96	18
Health professionals	6		94	48
STEM professionals	10		90	37
Business/legal professionals	20		80	20
Educator and workforce training	13	26	61	18
Creatives and arts management	3	54	43	21
Community services	20	55	26	–4
Mechanical installation and repair	4	79	17	–3
Office support	10	76	14	–11
Builders		89	11	6
Production work	36	58	6	–5
Health aides, technicians, and wellness	57	37	6	30
Transportation services	16	80	4	3
Customer service and sales	67	31	2	10
Property maintenance and agriculture	87		13	9
Food services	90		10	–5

[1] Based on 2017 wages.
[2] Mid-wage jobs are those between the 30th and 70th percentile of the wage distribution. Assumes median annual wage for all employment in an occupation. Growth from 2017–30 holds 2017 wage categorization constant.

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

These occupational shifts will require major workforce transitions and new skills

Nearly 40 percent of current US jobs are in occupational categories that are likely to shrink between now and 2030. Not all of them will be displaced. These jobs are declining rather than disappearing altogether, and many people are likely to remain in them. But they may need to learn new skills to adapt to a changing workplace. The workers who do lose their jobs will need to look beyond what they do today and consider moving to a similar occupation or even an entirely new field.

Almost

40%

of current US jobs are in occupational categories that could shrink by 2030

A recent survey of human resources professionals asked which skills they believe will become more important for entry-level jobs in the next three to five years. The top responses were adaptability (62 percent), initiative (49 percent), critical thinking (49 percent), and creativity/innovation (46 percent).[58]

To assess the potential shift in demand for workforce skills, MGI created a taxonomy of 25 skills, grouping them into five broad categories: physical and manual, basic cognitive, advanced cognitive, socioemotional, and technological. Given our projected shifts in occupations, we find that demand will grow significantly for work that involves technological and socioemotional skills. At the same time, demand will decline for activities that primarily require basic cognitive or physical and manual skills (Exhibit 16).[59]

The largest decline comes in demand for activities that primarily require only basic literacy and numeracy skills as machines take over some of the work performed by retail cashiers, food service workers, administrative assistants, bookkeepers, and call center workers.

We also foresee a continuing decline in demand for physical and manual activities. That does not mean that everyone who does physical work will be sidelined. In fact, physical and manual skills were the most widely used skill category in 2017—and they will continue to be in 2030, even as their share declines. While many policy makers and educators focus on the skills needed for a more digital, knowledge-based economy, some physical work will always need doing. Indeed, there are perennial shortages in some skilled trades such as plumbing and electrical work—and buildings will always need plumbing and electricity.

Demand for specific types of skills is already shifting

The shifting demand for skills is already apparent in recent hiring trends and consistent with what other researchers have observed. One recent study found that jobs involving high levels of personal interaction grew by nearly 12 percentage points as a share of the US labor force from 1980 to 2012.[60] Researchers at the Brookings Institution found that the share of jobs in the US economy using higher-level digital skills rose from 4.8 percent in 2002 to 23 percent in 2016. They also found that the digital content of many jobs—including roles such as registered nurses, human resources specialists, and automotive technicians—rose by 50 percent or more during this period.[61]

[58] *SHRM/Mercer survey findings: Entry-level applicant job skills,* Society for Human Resource Management and Mercer, October 2016.
[59] *Skill shift: Automation and the future of the workforce,* McKinsey Global Institute, May 2018. Note that Exhibit 17 shows a view that has been slightly updated and adjusted since May 2018; see the technical appendix for details.
[60] David J. Deming, *The growing importance of social skills in the labor market,* NBER working paper number 21473, August 2015, revised June 2017.
[61] Mark Muro et al., *Digitalization and the American workforce*, Brookings Institution, November 2017.

Exhibit 16

Automation and AI could shift demand for different types of workforce skills.

Change across all sectors, 2017–30

			Skills that are becoming more important		
Skill category	Physical and manual	Basic cognitive	Higher cognitive	Social and emotional	Technology
2017 hours worked, billion	102	57	71	62	34
Change in hours worked by 2030, %	–2	–14	8	29	48
Skills	▼ General equipment operation and navigation ▼ Inspecting and monitoring	▼ Basic data input and processing ▼ Basic literacy, numeracy, and communication	▲ Creativity ▲ Complex information processing and interpretation	▲ Entrepreneurship and initiative ▲ Leadership and managing others	▲ Advanced IT skills and programming ▲ Basic digital skills

Source: McKinsey Global Institute analysis

Our own analysis of job posting data over the past three years shows this shift playing out in real time.[62] The skills that employers are seeking in prospective hires indicate how the day-to-day content of jobs is evolving.

Consider the changing requirements for actuaries, professionals who quantify and price risk. Although machine learning systems and AI are highly relevant in this field, demand for actuaries is rising rather than falling. Actuaries are not being phased out by machines; they are using them to perform faster and more sophisticated analysis. A comparison of job listings for actuaries since 2016 shows a growing emphasis on advanced quantitative and computational skills, including statistical modeling, as well as product design. Predictive analytics, the programming language Python, and strategic management have emerged as requested skills since 2016 (Exhibit 17). Job postings for market research analysts are asking for newer programming languages and insight into the customer experience. They have begun to ask for expertise in strategic management, data science, and machine learning.

[62] Using EMSI's proprietary job posting data, we pulled a month-by-month view of the skills requested in job postings for 10 occupations of interest. We looked at the average rate of mentions in three-month periods to smooth seasonal irregularities in the data across a 31-month period from September 2016 to February 2019. We compared the ten most frequently requested skills in the first three months and last three months of this period and identified whether the original skills requested increased or decreased in frequency of mentions. We also flagged new skills that emerged in the data set over this period that were not among the ten most frequently requested.

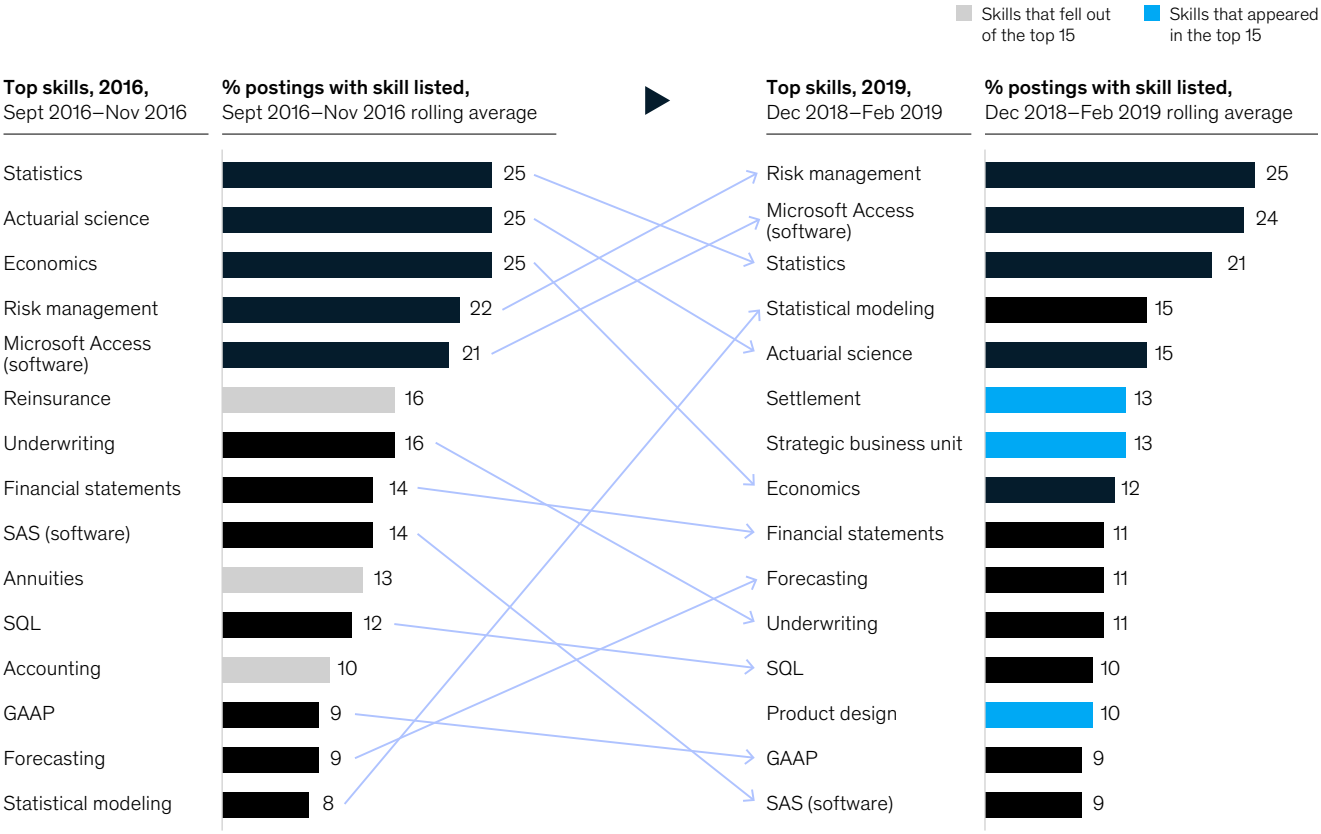
Less technical or specialized roles are also changing. Job postings for light truck or delivery drivers show a decrease in mentions of repetitive tasks such as packaging and labeling plus an increase in mentions of customer satisfaction, customer interaction management, and service delivery.

These postings offer a hint of the deeper ways that day-to-day workflows are changing. They also indicate that the future of work is not something that remains far over the horizon. It is already arriving.

Exhibit 17

Over time, job postings for actuaries show growing emphasis on strategic skills and advanced analytical techniques.

Frequently mentioned skills in job postings for actuaries, 2016–19



Source: EMSI job posting data, September 2016-February 2019 monthly extracts; McKinsey Global Institute analysis

Our analysis shows that there will likely be enough work for Americans in the future, but work will not look the same. The jobs of the future do not match up neatly against the jobs that could be lost because of skill requirements—and they may not take root in the same locations, an issue we explore in the next chapter. The United States will face the dual challenges of connecting people with opportunities and preparing them to succeed.

3 Mapping the impact on places

Cities and counties are entering this decade with varying degrees of economic health and vibrancy, and the spread of automation technologies may widen these disparities.

The automation of work will occur everywhere, but the impact will not be felt evenly. The most highly automatable occupational categories—office support, food service, and customer service and retail sales—are part of the fabric of every community. But they make up a larger share of employment in some places than in others, and these differing concentrations translate into higher displacement rates.

Yet displacement is only part of the story. Even as some jobs are being phased out, the US economy will continue to generate new ones. Locations with a higher representation of healthcare, technology, and professional occupations are better positioned for future job growth.

Looking forward to 2030, our modeling indicates that 25 megacities and high-growth hubs plus their peripheries could account for a majority of the nation's net job growth, just as they did in the decade following the Great Recession. But the road looks much tougher for rural America, where many places are already struggling. Job growth could stay flat for the next decade in many rural counties—and the most distressed could even see employment continue to shrink. Meanwhile, the mixed middle segments and trailing cities are positioned for only modest job gains, in line with the national average.

The United States is already characterized by sharp regional differences. Economic growth and the most highly educated, affluent workers are becoming concentrated in the nation's most dynamic cities. Meanwhile, the economy seems to be leaving small towns and rural areas behind. Without targeted interventions, America's economic and societal divides could widen in the coming years.

In our midpoint adoption scenario, automation-related displacement varies across local economies

In our midpoint automation adoption scenario, 23 percent of US workers could be displaced across the nation as a whole by 2030. This is not necessarily alarming, since workers are always changing jobs, and the United States has a dynamic labor market. But the national number contains a wide range of outcomes for specific locations. In the least affected local economies, the rate could be as low as 18 percent. In the hardest-hit places, up to one-third of workers could be displaced.

These variations reflect differing local occupational mixes and the relative concentration of highly automatable roles.[63] Elkhart, IN, for example, is home to multiple makers of recreational vehicles, boats, and musical instruments. Thirty-nine percent of local employment is in

[63] We analyze the automation potential of every job by looking at how many of its constituent activities can be handled by adapting currently demonstrated technologies; the higher the share of automatable tasks, the higher the likelihood of displacement. We define "highly automatable" jobs as those in top quartile of all jobs ranked by potential displacement rate.

production work. Because of this concentration, Elkhart's potential displacement rate is almost 29 percent, above the national average.

On the other end of the spectrum are places with a high share of jobs that are less susceptible to automation and have lower potential displacement rates. Many of them are megacities and high-growth hubs. The share of STEM professionals in Seattle, for example, is nearly double the national average—and our modeling puts the city's potential displacement rate below the national average, at just over 22 percent. Another area with a below-average potential displacement rate is North Carolina's Research Triangle (Durham, Chapel Hill, and Raleigh), an area with a high share of educators, STEM professionals, and health professionals.

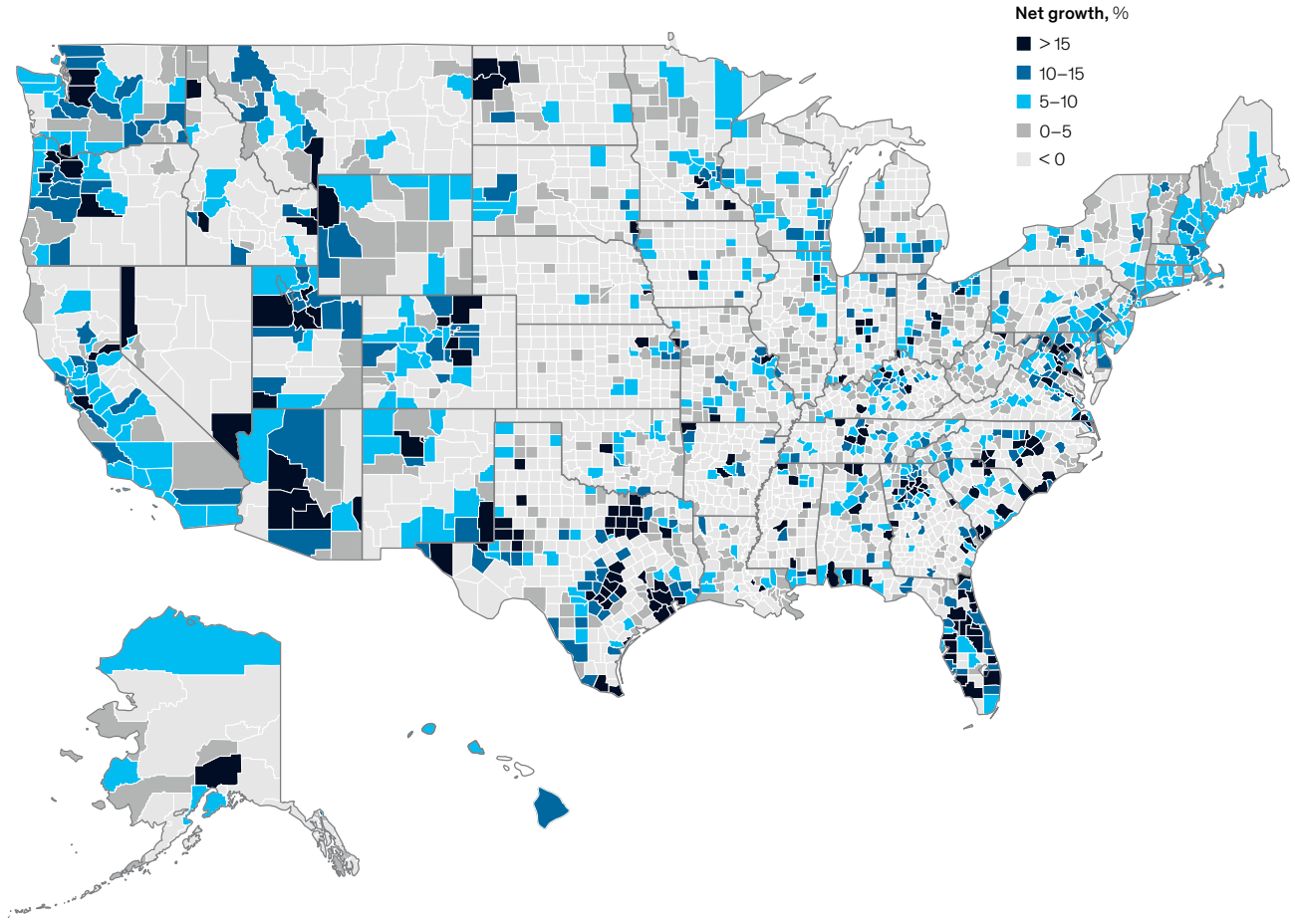
Net job growth through 2030 could be concentrated in a small number of urban areas

Automation and new job creation will happen simultaneously—and the combined impact looks very different in local communities across the United States. We find that net job growth is likely to be concentrated in urban areas, while rural areas could experience flat or even negative job growth (Exhibits 18 and 19). Places with more robust and diverse economies, better-educated populations, and more innovation are better positioned to attract people and foster employment growth.

Exhibit 18

In our midpoint adoption scenario, net job creation through 2030 is concentrated in some urban counties, while rural areas lose jobs.

Estimated net job growth in midpoint adoption scenario, 2017–30, %

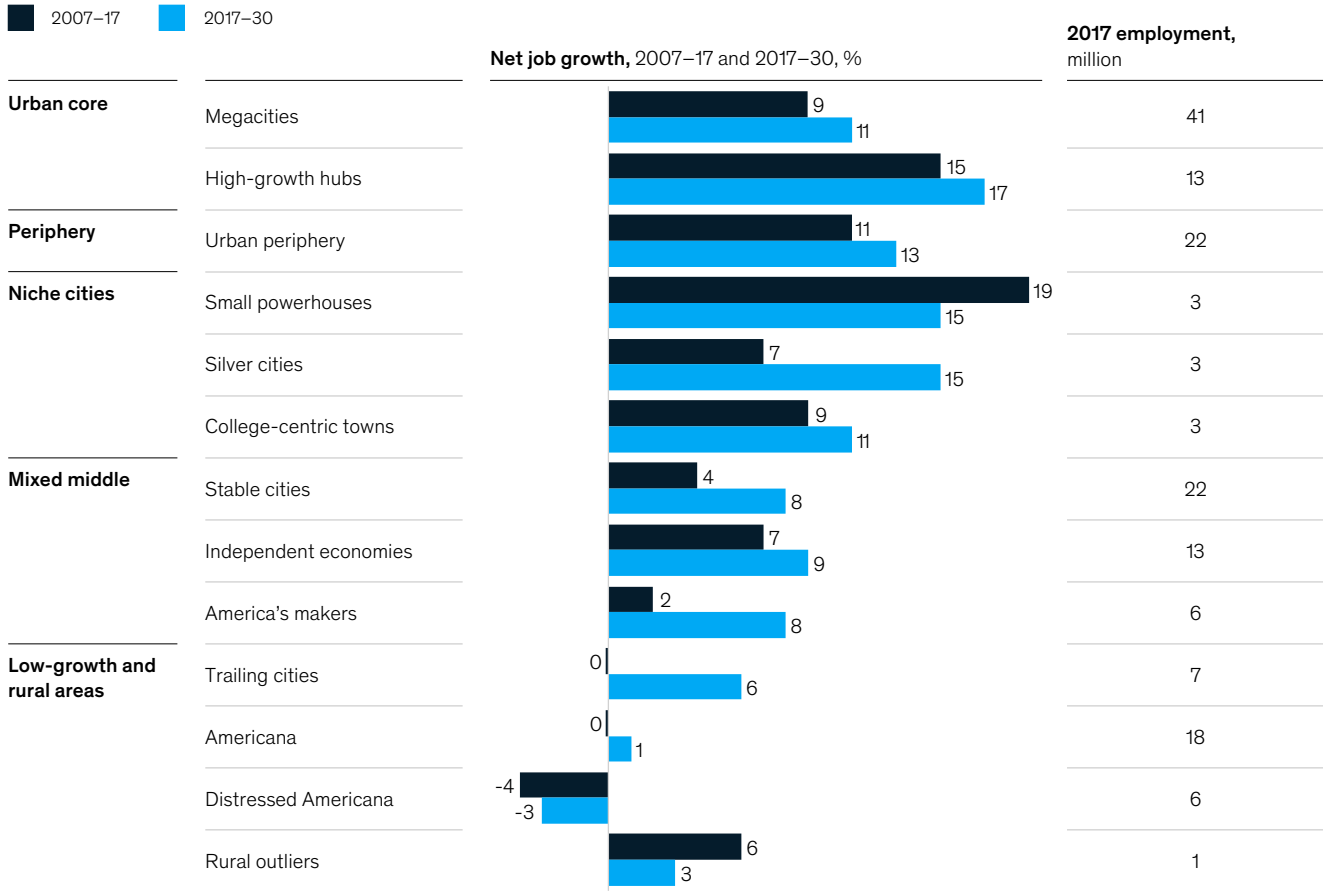


Source: McKinsey Global Institute analysis

Exhibit 19

The urban core, urban periphery, and niche cities are positioned to have the strongest future employment growth.

Projected net job growth by segment



Source: Moody's Analytics; McKinsey Global Institute analysis

25

urban areas could account for 60% of US job growth through 2030

The trend of urban agglomeration appears likely to continue. The 25 megacities and high-growth hubs, along with their peripheries, appear set to account for 60 percent of job growth through 2030, even though they make up only 44 percent of US employment today (Exhibit 20). As a group, megacities experience 11 percent employment growth through 2030 in our model, while high-growth hubs do even better, with 17 percent job growth.

Individual standout cities such as Phoenix and Austin have diverse economies, including high concentrations of the tech industries and business services that should drive job creation. But even the most thriving cities will need significant retraining and job matching initiatives to connect their lowest-wage workers with better opportunities.

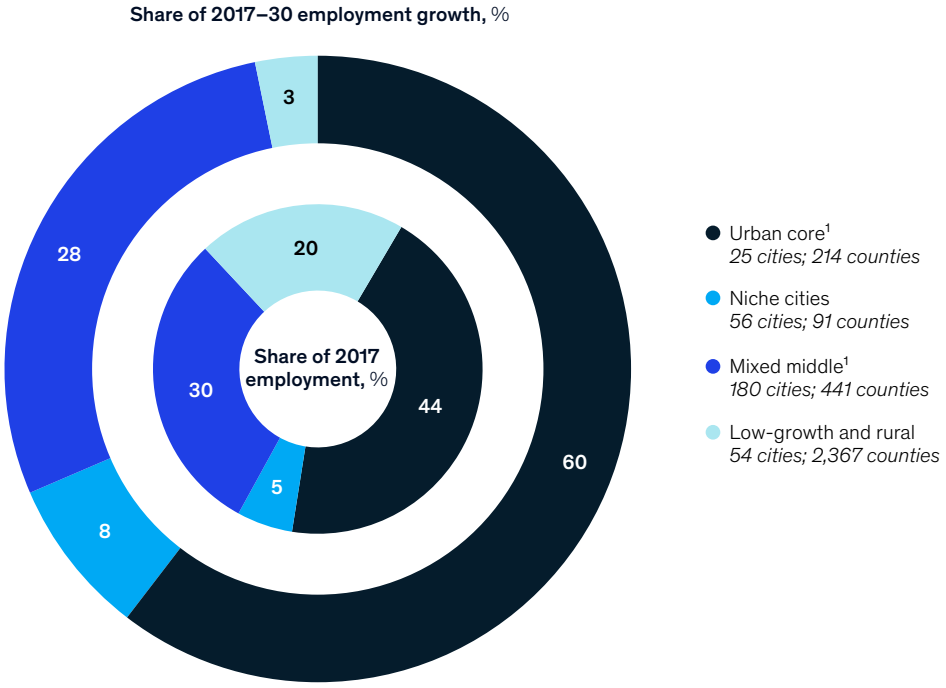
Niche segments are also well positioned. Silver cities are riding a wave of growth as the retirement-age population swells. Employment in this segment could grow by 15 percent as seniors drive demand for healthcare and other services—and as more of them continue working past traditional retirement age. College-centric towns can build on the strengths of well-educated labor pools and innovation ecosystems to add STEM, healthcare, creative, and other jobs depending on the local institution's specialties, creating potential for 11 percent employment growth over the next decade.

On the other end of the spectrum, the decade ahead could be a rocky one for rural America. There could be as little as 1 percent employment growth over the entirety of the next decade

Exhibit 20

In our modeling, just 25 cities and their peripheries account for 60 percent of US job growth through 2030.

Net job growth in midpoint adoption scenario, 2017–30, %



[1] Urban periphery counties are split across the urban core and mixed middle categories. Each one is categorized with the city to which it is adjacent.
Source: McKinsey Global Institute analysis

in the more than 1,100 Americana counties. The 192 rural outlier counties can continue to rely on natural resources and tourism, although they may manage job growth of only 3 percent.

-3%

potential job growth through 2030 in distressed Americana counties

The picture is worst for the 972 distressed Americana counties that are entering the decade in poor economic health, with older and shrinking populations. While the overall economy continues to grow, our model indicates that these areas could experience net job loss, with their employment bases shrinking by 3 percent. Given that even trailing cities appear poised for 6 percent employment growth, the rural-urban economic divide could widen.

Between the two extremes are the other segments that make up the mixed middle. Our model shows their modest employment growth continuing in line with national averages, with gains of 8 percent for stable cities, 9 percent for independent economies, and 8 percent for America's makers. It should be noted, too, that these averages disguise a wide range of outcomes, with some places posting much stronger job growth and others experiencing net job losses. In a period of change and churn, the challenge for these segments will be focusing on economic development and education initiatives in a bid to accelerate growth—or risk falling into decline.

Differences in occupational mix and educational attainment explain the widening gaps across America

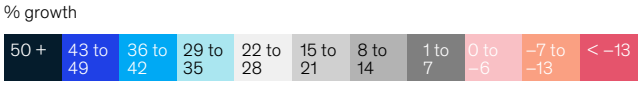
One of the main drivers of geographic divergence across the United States is the occupational mix in different places. Many types of service occupations—including those in healthcare, retail, and office support—are found in every community. But other occupations are more concentrated, and their prevalence explains local differences (Exhibit 21). STEM jobs, for instance, are more concentrated. Our model shows them growing by 37 percent in megacities, 47 percent in high-growth hubs, and 41 percent in the urban periphery. By contrast, it shows them growing by just 29 percent in trailing cities, 23 percent in Americana, and 16 percent in distressed Americana—and that growth will occur from a smaller base. A similar pattern is apparent with creative roles and with business and legal jobs. Agglomeration becomes self-reinforcing over time as places with specific industry clusters, local knowledge bases, and innovation ecosystems continue to attract talent and foster new business formation.

Some of the occupations likely to post little growth or even decline nationally may actually increase in high-growth areas. Transportation service jobs, for instance, are projected to grow by just 3 percent nationally. Yet our model shows them growing by 12 and 11 percent in small powerhouses and silver cities, respectively, while declining by 6 percent in distressed Americana. Food service jobs appear set to decline by more than 10 percent in Americana, distressed Americana, and rural outlier counties as purchasing power shifts away from these segments. Meanwhile, food service jobs could increase slightly in silver cities and high-growth hubs.

Exhibit 21

While healthcare jobs could be added nationwide, other growth categories could be more concentrated in urban areas.

Employment growth in midpoint scenario, 2017–30, %



Occupational category	Mega-cities	High growth hubs	Urban periphery	Small power-houses	Silver cities	College-centric towns	Stable cities	Indepen-dent economies	America's makers	Trailing cities	Americana	Distressed Americana	Rural outliers	**Total job growth,** %
Health professionals														48
STEM professionals														37
Health aides, technicians, and wellness														30
Creatives and arts management														21
Business and legal professionals														20
Managers														18
Education and workforce training														18
Property maintenance and agriculture														9
Customer service and sales														10
Builders														6
Transportation services														3
Mechanical installation and repair														–3
Community services														–4
Food services														–5
Production work and machine operation														–5
Office support														–11
Total job growth, %	11	17	13	15	15	11	8	9	8	6	1	–3	3	**9**

Source: McKinsey Global Institute analysis

Exhibit 22 shows how the patterns of expected net job growth in our model vary for places with differing levels of educational attainment.[64] Counties with high educational attainment and high expected employment growth, in the upper right quadrant, are dominated by urban segments and the urban periphery. These areas can build on their existing concentrations of high-growth, high-wage STEM jobs, business and legal professions, and the most specialized healthcare roles. Areas in the upper left quadrant could maintain employment growth, even with lower education attainment. Nearly all silver cities are in this category, as well as more than half of trailing cities and America's makers counties. The challenge for these areas will be to ensure that the jobs being added are not predominantly low-wage roles. In the bottom left quadrant are counties with worse employment prospects and low educational attainment. Most distressed Americana and rural outlier counties fall into this quadrant, along with a majority of Americana counties. These counties will need to focus on expanding training and educational opportunities for their residents while pursuing economic development strategies to spark job growth. There are notably few areas with high educational attainment and declining employment prospects.

Wage differentials dampen the potential impact of automation in rural areas

Our modeling of automation adoption is dependent on local wage rates. In areas with lower wages, employers have less of an incentive to adopt new technologies and need technology prices to fall to create a compelling business case for automation. This factor dampens the potential impact of automation in lower-wage areas and raises it in high-cost megacities and high-growth hubs. Without taking into account these differences, the divergent paths across the country would be even starker.

Moreover, low-wage counties may be able to use their affordability to attract businesses from high-cost areas. Already some companies have found that call centers, warehouse distribution centers, and back-office functions can be profitably located in lower-cost parts of the country, and in some cases even moved back to the United States from offshore locations. Some companies are rethinking their geographic footprint across the country as the soaring cost of housing and commercial real estate, congestion, overburdened infrastructure, and tight labor markets are becoming barriers to doing business in some megacities and high-growth hubs.[65]

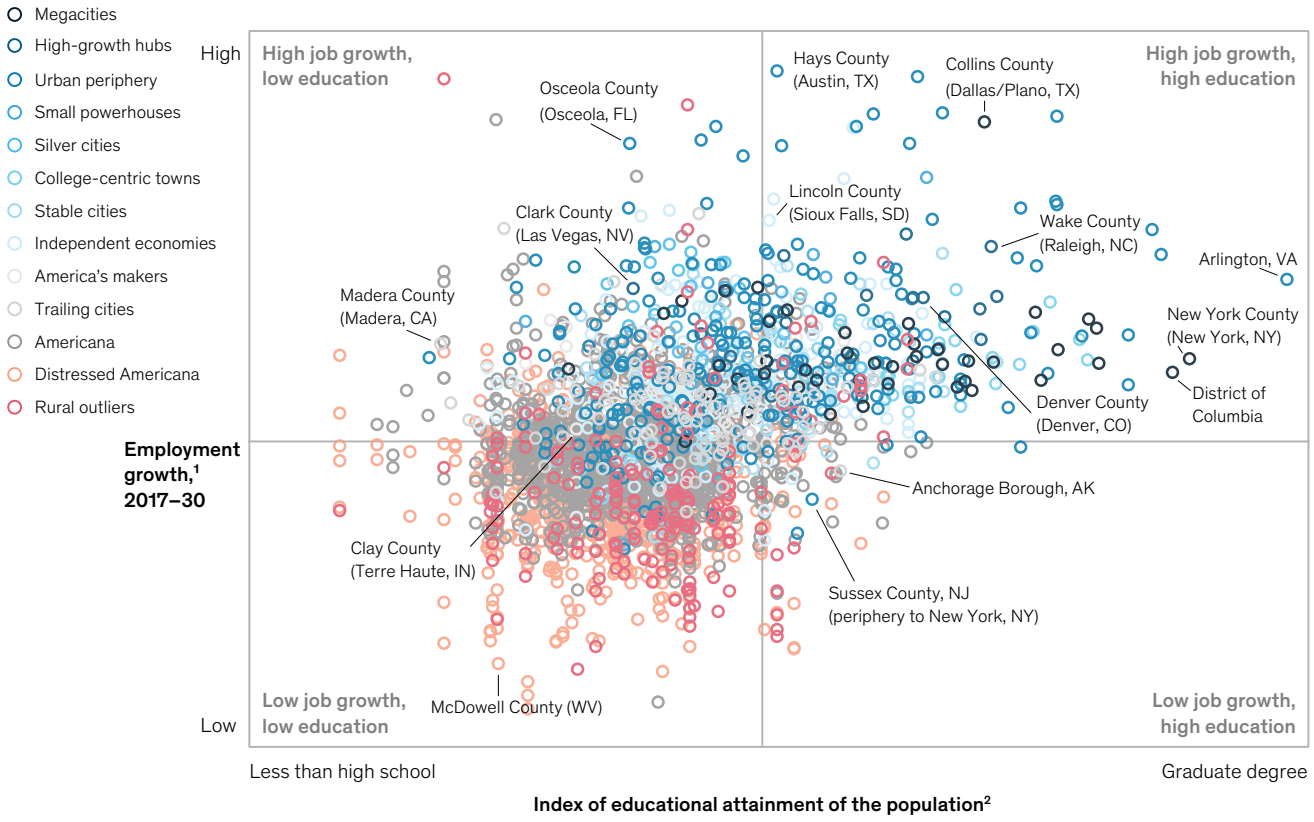
[64] Recent research from the Brookings Institution similarly found that metro areas with larger shares of college-educated workers had lower shares of workers in what it deems to be high-risk occupations. See Mark Muro, Robert Maxim, and Jacob Whiton, *Automation and artificial intelligence: How machines are affecting people and places,* Metropolitan Policy Program, Brookings Institution, January 2019. This research defines high-risk occupations as those in which more than 70 percent of tasks have the technical potential to be automated. While our research also finds a link between educational attainment and projected displacement rates, our model shows a slightly weaker correlation. In addition to looking at the technical potential for automation, we also consider the potential adoption of automation technologies by companies over the next decade. Some jobs may be highly automatable, but if wages are low, employers have fewer incentives to adopt expensive technology systems. We therefore also factor in wage differentials across the country.

[65] See, for example, Natt Garun, "Google's 2019 expansion plans will put offices in 24 out of 50 states," The Verge, February 13, 2019; Kevin Roose, "Silicon Valley is over, says Silicon Valley," *New York Times,* March 4, 2018; Kris B. Mamula, "Apple's expansion plans include more jobs in Pittsburgh, $1 billion campus in Austin," *Pittsburgh Post-Gazette,* December 13, 2018; Jamie McGee, "Time zone and talent: Why San Francisco companies are choosing Nashville offices," *Nashville Tennessean,* November 26, 2018; and Associated Press, "Spokane mayor seeking to lure jobs and residents to city," *US News and World Report,* May 27, 2019.

Exhibit 22

Urban counties, with higher levels of education, are positioned for stronger job growth.

County average educational attainment and employment growth in midpoint adoption scenario, 2017–30



[1] Midpoint adoption scenario. Counties above the line have positive growth, and counties below the line have negative growth.
[2] Scaled from 0-10 where 0 is less than high school, 2.5 is high school, 5 is some college, 7.5 is bachelor's degree, and 10 is graduate degree, multiplying the share of each by its value.

Source: Integrated Public Use Microdata Series (IPUMS ACS); McKinsey Global Institute analysis

Box 3

State of the states

As expected, states with more high-growth urban segments and fewer trailing cities and rural counties tend to have a better outlook for net employment growth. Population movement is another major driver; recent migration trends have seen Americans moving toward the South and the coasts. Exhibit 23 details the potential net job growth in our model at the state level through 2030.

Leading the way with 19 percent job growth (more than double the national average of 9 percent), Texas can rely on multiple urban areas to drive growth. Megacities Dallas and Houston and high-growth hubs Austin and San Antonio are leaders in energy and real estate. They are also increasingly hubs of technology and innovation. Midland, a small powerhouse, has the highest GDP per capita of any city ($153,000). The state has created a business-friendly environment and focuses heavily on economic development. But a side effect of the booming economy is inequality; the statewide poverty rate is 14.7 percent. According to the American Immigration Council, 17 percent of Texans are immigrants, and an additional 15 percent of residents are native-born US citizens with at least one immigrant parent. Additionally, 13.1 percent of Texans between the ages of 25 and 34 have less than a high school education (the fifth-highest share in the nation). It will be imperative to ensure access to good education, particularly digital skills, to ensure that the burgeoning population can capture employment opportunities.

Ohio, by contrast, could see below-average job growth of 6.6 percent by 2030. Three stable cities—Cincinnati, Cleveland, and Columbus—and their periphery counties account for more than 50 percent of Ohio's population. More people are moving to Columbus in particular; Franklin County's population increased by 11.4 percent from 2010 to 2017. It has also become one of the Midwest's startup hubs, ranking third in the 2017 Kauffman Index of Growth Entrepreneurship (after Washington, DC, and Austin). However, the promising signs in Columbus are not apparent in other parts of the state. Ohio has no megacities, high-growth hubs, or small powerhouses. In 65 of its 88 counties, manufacturing employs 15 percent or more of the population. Places like Canton, Marion, and Youngstown have been hit hard by the erosion of manufacturing employment, and people are moving out of many of the state's distressed areas. The challenge for Ohio will be twofold: trying to vault its stable cities into the ranks of high-growth hubs, and identifying sector strategies to fuel growth in counties statewide.

Box 3

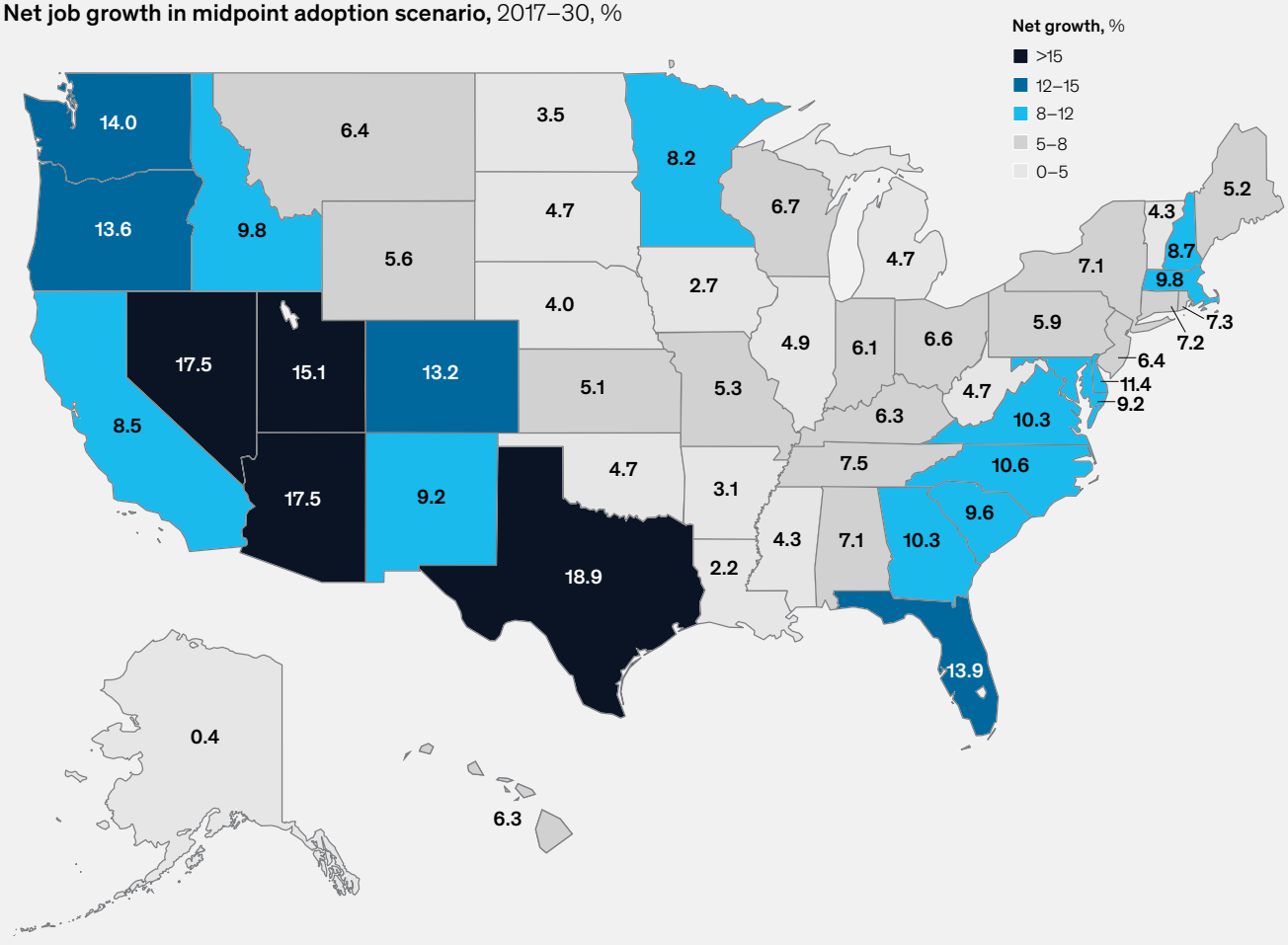
State of the states (cont.)

Colorado is an example of increasing diversity leading to statewide growth. While high-growth hub Denver is the state's economic engine, Boulder and Colorado Springs have also been driving growth. People are moving to Colorado from other parts of the country; Denver's population of college-educated young adults grew by 47 percent between 2000 and 2012. The state's industry mix has expanded, adding more agriculture, tourism, aerospace, and technology to existing industries such as natural resources and mining, manufacturing, and finance and real estate. Boulder, in particular, has a vibrant startup community. However, not all counties in Colorado are growing equally. Our model shows only 33 out of Colorado's 64 counties experiencing positive employment growth between 2017 and 2030. Policy makers will need to push for inclusive growth and identify regional economic strategies for the counties that could be left behind.

Exhibit 23

States in the West and Southeast could experience the biggest gains in net employment.

Net job growth in midpoint adoption scenario, 2017–30, %



Source: Moody's Analytics; McKinsey Global Institute analysis

Geographic mismatches between people and jobs may grow at a time when workforce mobility has declined

Changing demand for certain occupations could result in localized mismatches between workers and jobs in some locations. Our model is not a dynamic employment forecasting model, and labor markets will rebalance and adjust over time. Companies could also choose to move some operations to other parts of the country, relieving some of these pressures. But extrapolating occupational growth trends across geographies does highlight the potential for localized mismatches, at least during a transition phase.

The areas most likely to have surplus labor are slower-growing cities and rural counties. Distressed Americana could find that it has more workers than jobs, even as population growth flattens. High-growth urban areas, in contrast, could need to attract more people to fill vacancies.

These gaps in labor supply and demand show up in specific occupations and could affect roughly 13 million jobs nationwide. Our model shows notable shortfalls of labor in occupations such as software developers, registered nurses, personal care aides, and home health aides. Shortages of doctors and other key medical professionals are already an issue in some rural counties, and these needs could grow more acute, given their older populations and declining health indicators. On the other end of the spectrum, occupations such as bookkeepers, cashiers, and waiters and waitresses could have labor surpluses, indicating that people who have done these jobs in the past may need to prepare to change roles.

Part of the solution could involve more people moving to where the jobs are. But the mobility of the US workforce has waned over the last 25 years (see Chapter 1 for a more in-depth discussion of this trend). The rate of households moving across county or state lines has declined by nearly half since 1990.

Automation will not play out in the same way across different parts of the country. Nor will it affect demographic groups equally. Understanding who holds the occupations with the highest automation potential today is an important first step for designing targeted interventions and training programs. Chapter 4 looks at exactly who is at risk.

4 Mapping the impact on people

Discussions about automation often veer into the complexities of the technology or labor market dynamics. But at the heart of it, displacement and change affect real people. Tens of millions of Americans may need to switch jobs or even occupations to find new ways to support themselves. Some of the people most likely to be affected by automation are already living paycheck to paycheck. A recent survey of US household finances found that roughly 40 percent of households could not cover a $400 unexpected expense without needing to sell something or borrow money.[66] For these people, even a short period of disruption could provoke tremendous stress. The implications of displacement also go beyond economics. For many people, work is a source of their identity and self-worth.

Tens of millions of these individual stories could play out over the next decade, which means that the United States has no time to lose in setting up larger-scale retraining programs, better matching systems, and safety net support.

Designing and targeting the right interventions starts with identifying exactly who is at risk of displacement. Overlaying our modeling of the automation potential of various occupations with data on who holds those jobs today paints a picture of uneven and concentrated effects, since many occupations have highly skewed demographics (Exhibit 24).

This chapter also looks at the potential demographic effects through the prisms of race, age, and gender. We find that educational attainment emerges as a critical factor determining displacement risk. College and advanced degree holders are not immune from automation, but they will enjoy greater security relative to people with no postsecondary training—and if they do have to change jobs, they will have a wider range of opportunities.

Education is a significant predictor of displacement risk

Education does not automatically confer job skills, and the value of a degree in the job market can vary greatly depending on the major and the institution. We have analyzed potential automation displacement by educational attainment because of a lack of a consistent national taxonomy and granular data on skills.[67] For a number of years, job postings have shown persistent "degree inflation." One report found that almost two-thirds of job postings for executive assistants, for example, now call for a bachelor's degree when only 19 percent of incumbents in those roles at the time of the study held those degrees.[68] Breaking this trend by focusing on the specific skills needed in a given job, rather than degree requirements, can vastly increase the number of qualified job applicants and create opportunities for more people.[69]

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[66] *Report on the economic well-being of U.S. households in 2017*, Board of Governors of the Federal Reserve System, May 2018.

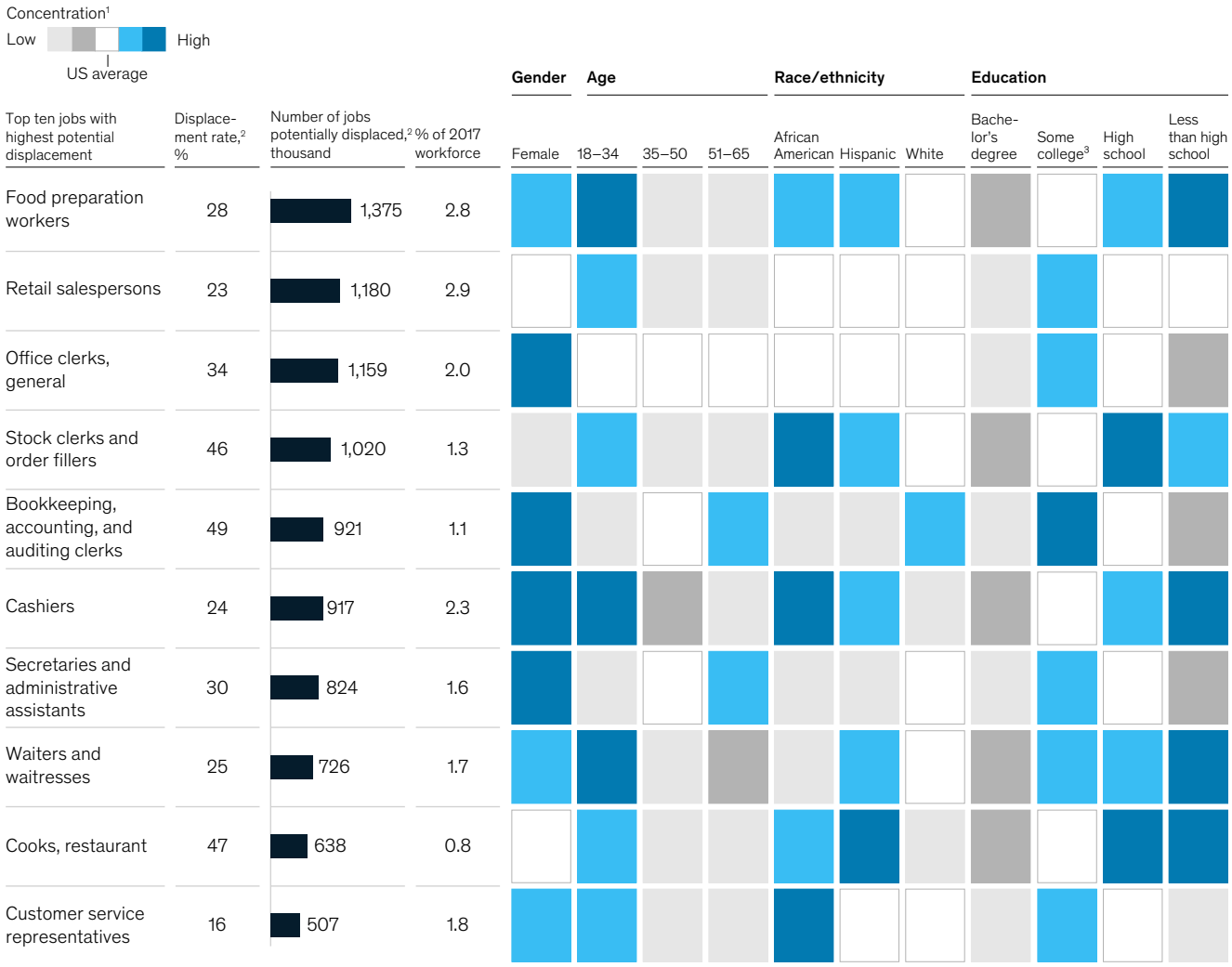
[67] Major efforts are under way in the United States to create a consistent taxonomy to describe workforce skills. The US Chamber of Commerce Foundation and the Lumina Foundation have launched the T3 Innovation Network to create an open data ecosystem to centralize information on skills, credentialing, and the needs of the economy and to standardize how skills are defined across industries and employers. A nonprofit called Credential Engine is creating an online registry to make information about the thousands of varying credentials across the country more transparent and searchable.

[68] *Moving the goalposts: How demand for a bachelor's degree is reshaping the workforce,* Burning Glass Technologies, September 2014.

[69] Skillful, an initiative by the Markle Foundation, LinkedIn, and the state of Colorado, works with employers to create job postings for high-demand roles based on skills rather than degrees with the goal of enabling people to shift occupations and roles.

Exhibit 24

Some of the jobs with highest displacement potential have skewed demographic concentrations.



[1] Measured by comparing share of persons fitting each demographic profile in an occupation with share in total US workforce.
[2] 2030 midpoint adoption scenario.
[3] Includes associate's degrees.

Source: US Bureau of Labor Statistics, Integrated Public Use Microdata Series (IPUMS ACS) 2017; McKinsey Global Institute analysis

It is well established that workers with a high school diploma or less have limited prospects in the US labor market.[70] Our research finds that their prospects are shrinking over time, particularly if they do not undertake additional training to prepare them for specific jobs.

We find that individuals with a high school degree or less are four times as likely to be in a highly automatable role than individuals with a bachelor's degree or higher.[71] They are 14 times more vulnerable than someone with a graduate degree. People with no postsecondary education account for 78 percent of the overall displacement our model anticipates across the United States in the midpoint adoption scenario. They make up 93 percent of the potential losses in food service, 78 percent in office support, 92 percent in production work, and 83 percent in customer service and retail.

As middle-wage jobs have disappeared over the years, postsecondary credentials have become increasingly necessary for workers to have a chance at upward mobility and economic security—despite the fact that roughly two-thirds of US workers lack college

[70] See, for example, Ariel J. Binder and John Bound, *The declining labor market prospects of less-educated men,* NBER working paper number 25577, February 2019.
[71] Highly automatable roles have displacement rates in the top quartile of all occupations. Examples include aircraft cargo handling supervisors (55 percent), dishwashers (53 percent), and wellhead pumpers (52 percent).

degrees. According to Bureau of Labor Statistics (BLS) data, the median wage for holders of bachelor's degrees was 68 percent higher than the median for those with only high school diplomas in 2016. This eventually turns into a significant lifetime earnings premium.[72] Now, because some automation and AI technologies substitute for lower-skill labor but complement higher-skilled labor, automation could further widen existing gaps in the opportunities available to high-wage college-educated workers and less educated workers in low-wage jobs.

4x

higher displacement risk for workers with high school diplomas or less

Millions of people with no postsecondary education could be set adrift over the next decade in a labor market where their experience has declining relevance—and this, along with addressing localized mismatches in the most distressed counties, will be one of the defining policy challenges. With many applicants for the remaining positions that do not require postsecondary education, wages could come under further pressure at the low end of the pay scale.[73] This is a particular challenge for places where a high share of the population has only a high school diploma or less (including Americana and distressed Americana counties, and states such as Louisiana, Mississippi, New Mexico, and Texas).

Displaced workers without college degrees will need training that readies them for new types of work—including, in some cases, more challenging work that requires basic digital skills. The good news is that, consistent with other research and BLS projections, we see some fast-growing occupational categories emerging that do not require postsecondary education, some of which are middle- or even high-wage jobs (Exhibit 25).[74]

Hispanics stand out as the ethnic group with the highest potential displacement rate

After we control for education, race does not emerge as a significant predictor of displacement risk. But because race and educational attainment are correlated, minority groups that have more limited access to quality education could be hit harder (Exhibit 26). Automation could widen existing educational, income, and wealth disparities.

25.5%

potential displacement rate for Hispanic workers

Hispanic workers stand out as having a potential displacement rate that is three percentage points higher than the national average in our model. Although both high school completion rates and college enrollment have been increasing steadily for Hispanics over the past two decades, they have lower levels of high school completion and postsecondary educational attainment than the general population. Fifty-six percent of Hispanic workers have only a high school diploma or less, compared to 36 percent of the US workforce as a whole. This affects the jobs they hold today and their prospects for being displaced in the future.

More than one-quarter of Hispanic workers, or seven million people, are in jobs that could be automated in our midpoint scenario. Sixty-five percent of that displacement could occur in five states: California, Texas, Florida, New York, and Illinois. This list is not wholly surprising due to the sheer size of these states and their Hispanic populations, but it nevertheless indicates pockets of potential distress that state and local governments will need to address.

Future job creation trends also do not favor some occupations in which Hispanic workers are highly represented. If we assume that the racial breakdown of various occupations today remains constant over time, we find that non-Hispanic whites account for 63 percent of all jobs today but could see 68 percent of job growth in the future. Meanwhile, Hispanics account for 17 percent of current jobs but only 10 percent of job growth in our model through 2030.

[72] Jay Shambaugh et al., *Thirteen facts about wage growth,* The Hamilton Project, Brookings Institution, September 2017.
[73] David H. Autor, *Work of the past, work of the future,* American Economic Association Annual Meeting, Atlanta, GA, January 4, 2019.
[74] See also Anthony P. Carnevale et al., *Good jobs that pay without a BA,* Georgetown University Center on Education and the Workforce and JPMorgan Chase & Co., 2017.

Exhibit 25

Some fast-growing occupations do not require bachelor's degrees.

Associate's degree or some college

Occupational category	Occupation	Annual median wage, $ thousand	2017 jobs, thousand	2017–30 growth, %
Health and wellness	Magnetic resonance imaging technologists	70	37	58
	Physical therapist assistants	57	91	54
	Licensed practical and licensed vocational nurses	45	733	54
	Radiologic technologists	58	208	41
STEM	Industrial engineering technicians	54	64	51
	Mechanical drafters	55	65	49
Managers	Construction managers	91	408	42
Business and legal	Cost estimators	63	220	38
Mechanical installation and repair	Electrical power-line installers and repairers	69	123	29

High school

Occupational category	Occupation	Median wage, $ thousand	2017 jobs, thousand	2017–30 growth, %
Builders	Structural iron and steel workers	53	71	33
	Elevator installers and repairers	79	22	26
	Supervisors of construction workers	64	610	19
Production work and machine operations	Supervisors of production and operating workers	59	621	30
Mechanical installation and repair	Maintenance workers, machinery	46	90	21
Customer service and sales	Hairdressers, hairstylists, and cosmetologists	25	625	18

Note: Occupations are categorized based on which educational attainment level is the plurality.
Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

African-American workers also have a higher displacement rate (23.1 percent) than white workers (22.4 percent). Previous McKinsey research found that while 43 percent of the US workforce is in slow-growing, low-paying support roles, that share is 56 percent for African-Americans.[75] They are heavily represented in certain highly automatable occupations including assemblers and fabricators, stock clerks and order fillers, cooks, and postal service workers. Many of their 4.6 million jobs at risk are concentrated in the Southeast.

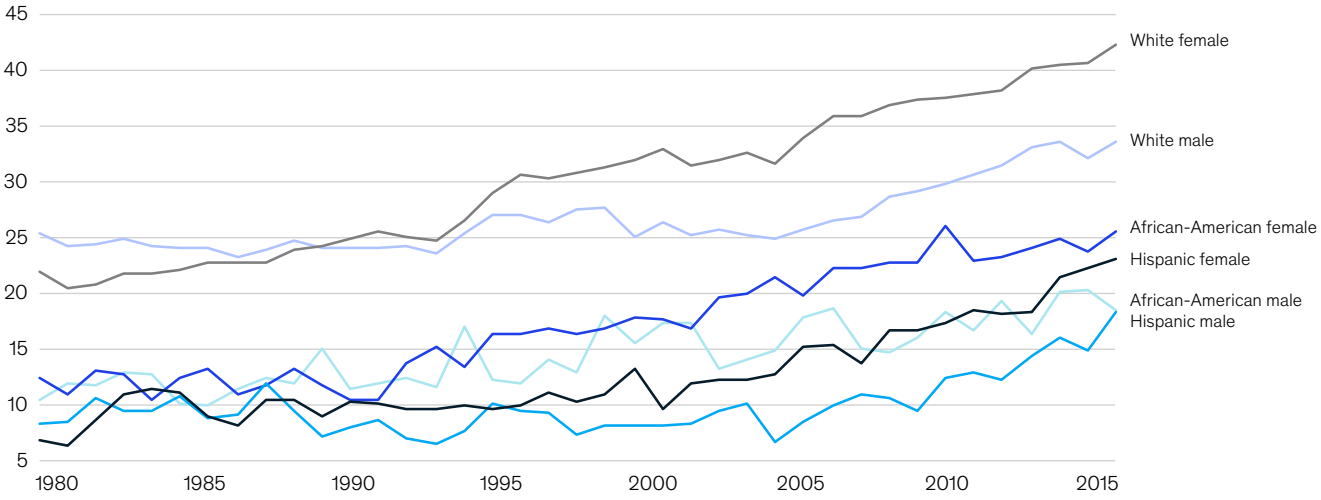
Displacement of Hispanic and African-American workers will occur in different jobs. For Hispanics, food service jobs are the single largest category. They are also concentrated in builders and in property maintenance and agriculture roles. For African-Americans, office support roles are the single largest category. They are also concentrated in health aides, technicians and wellness roles, and in some local government jobs (Exhibit 27). African Americans are better positioned for future job growth due to their representation in healthcare.

[75] David Baboolall, Duwain Pinder, Shelley Stewart III, and Jason Wright, "Automation and the future of the African-American workforce," November 2018, McKinsey.com.

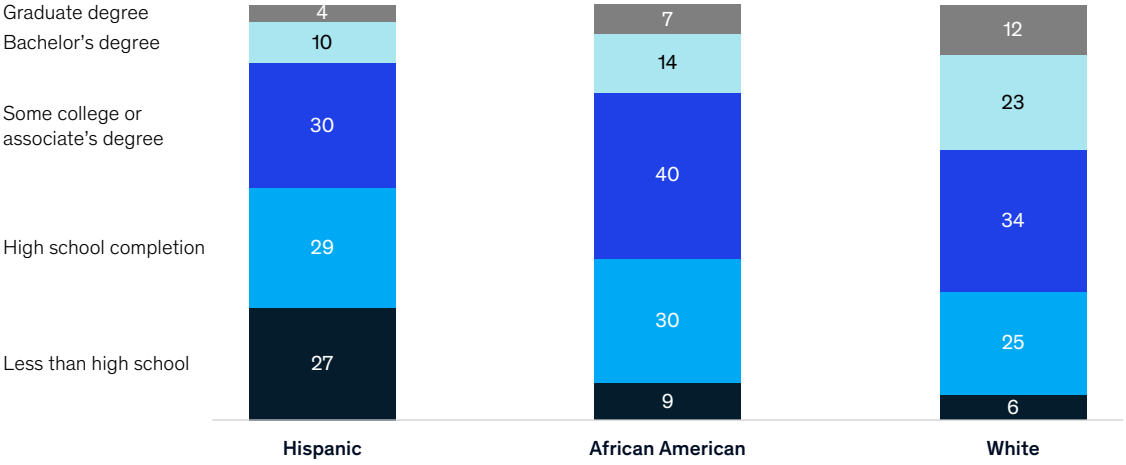
Exhibit 26

Although college attendance has risen, educational attainment levels vary significantly by race and gender.

Share of people aged 25–29 with four years of college or more, %



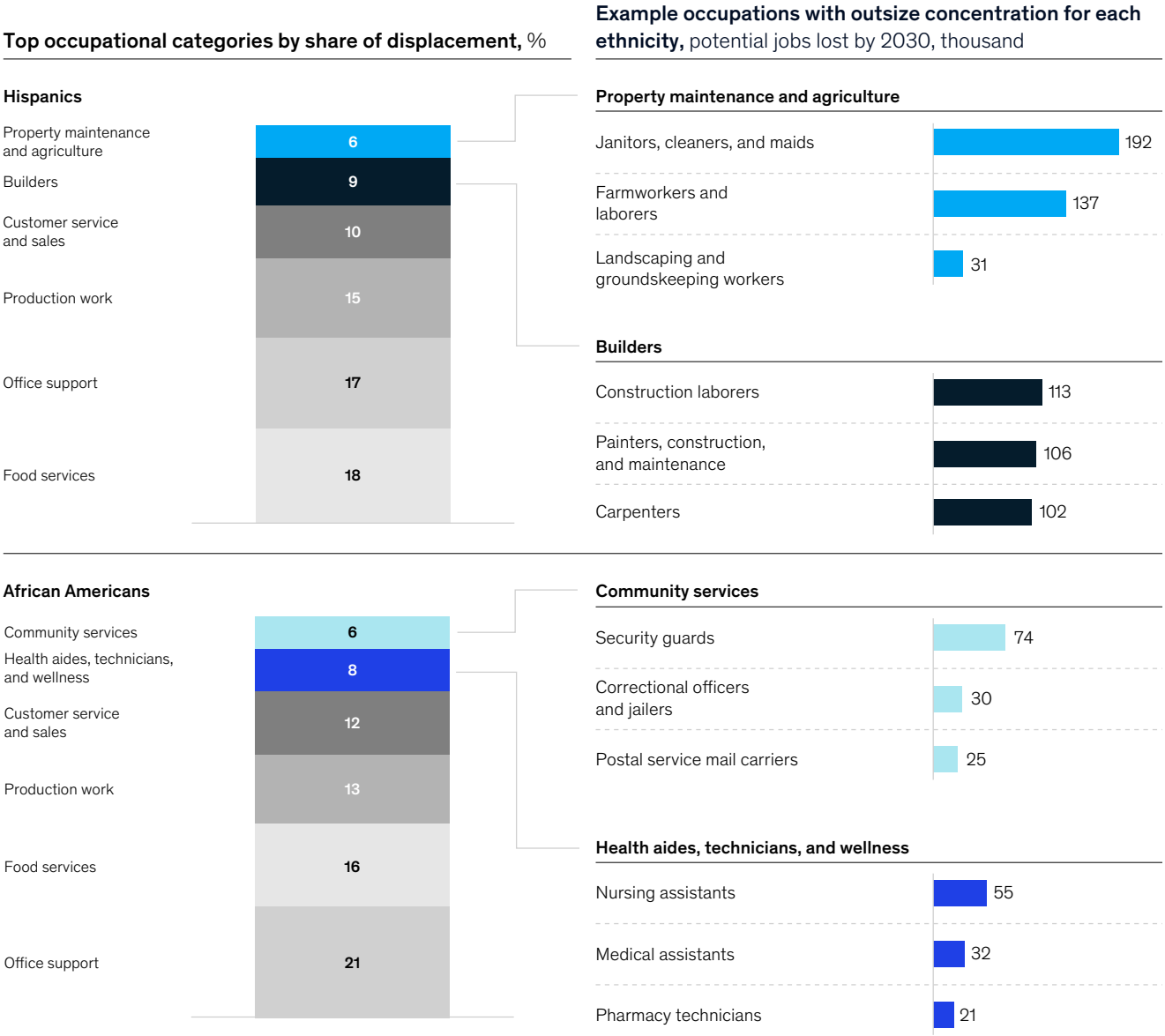
Share of 2017 jobs by education level, %



Source: US Census Bureau; McKinsey Global Institute analysis

Exhibit 27

Outside of the top categories, the specific jobs with the largest displacement potential vary for Hispanics and African Americans.



Source: US Bureau of Labor Statistics; Integrated Public Use Microdata Series (IPUMS); McKinsey Global Institute analysis

Automation will pose particular problems for the youngest and oldest segments of the labor force

Automation will affect workers of all ages. In fact, middle-aged workers are almost as likely to be in highly automatable roles as workers on either end of the age spectrum. But the youngest and oldest segments of the labor force face unique risks.

Young people ages 18 to 34 hold almost 40 percent (14.7 million) of the jobs potentially lost in our modeling. Our findings about the impact on young workers are consistent with recent OECD research that identified similar risks in other countries.[76]

[76] Ljubica Nedelkoska and Glenda Quintini, *Automation, skills use and training,* OECD Social, Employment and Migration working paper number 202, 2018.

14.7M

young workers are in highly automatable jobs

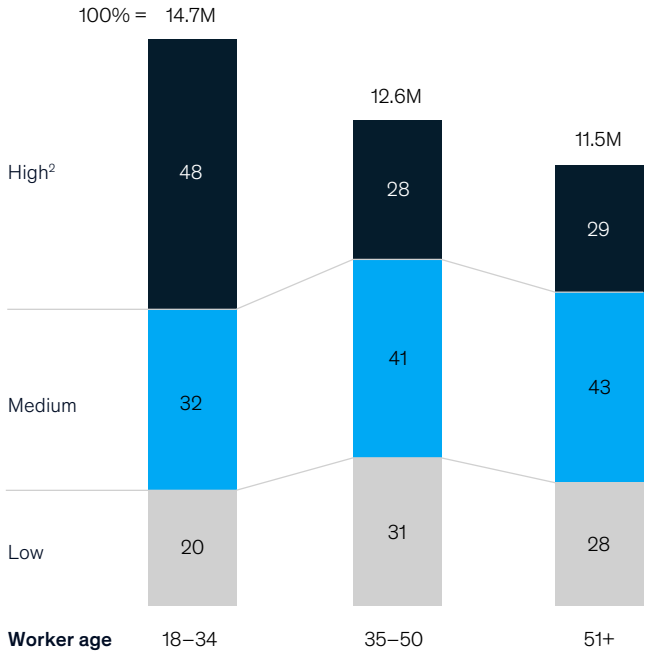
Tens of millions of Americans can think back to their first jobs in retail, food service, or clerical work—roles that gave them valuable soft skills and experience that propelled them on their way. But these are the very roles that automation could phase out. Young people will need new career paths to build credentials and gain their initial foothold in the working world.

Nearly half of young workers are in jobs with high separation rates (Exhibit 28).[77] In these situations, companies may not have clear incentives to offer training to help entry-level workers move into more demanding roles using technology, leaving their career paths unclear. The transition from education to employment has already become less predictable in the United States. Labor force participation among young people ages 16 to 24 has been declining for a number of years, falling from 66 percent in 2000 to 56 percent in 2017.[78] While some of this may be due to more young people continuing their education, part of the decline may also be due to discouragement.

Exhibit 28

Younger workers facing displacement are more likely to work in roles with high separation rates.

Jobs lost in 2030 by worker age group and separation rate,[1] % of total losses



[1] Separation calculated as average annual forecasted labor force exits or occupational transfer as a share of employment in an occupation, based on historical demographic data in occupation.
[2] High separation rates are 11.8 to 24.4 percent; medium are 9.5 to 11.8 percent, and low are 2.5 to 9.5 percent.

Source: US Bureau of Labor Statistics; McKinsey Global Institute analysis

On the opposite side of the generational spectrum, some 11.5 million Americans over age 50 are in roles that could be automated. The largest occupations at risk are in office support, with more than 1.3 million jobs potentially lost in administrative assistants, bookkeepers, and office clerks alone (Exhibit 29). While some of these workers are close to retirement, others have years to go. Many want to keep working or lack the savings to retire early. Unfortunately,

[77] *QWI Explorer,* US Census Bureau, Center for Economic Studies, qwiexplorer.ces.census.gov/static/explore.html#x=0&g=0.
[78] Adrienne L. Fernandes-Alcantara, *Youth and the labor force: Background and trends,* US Congressional Research Service, August 2018.

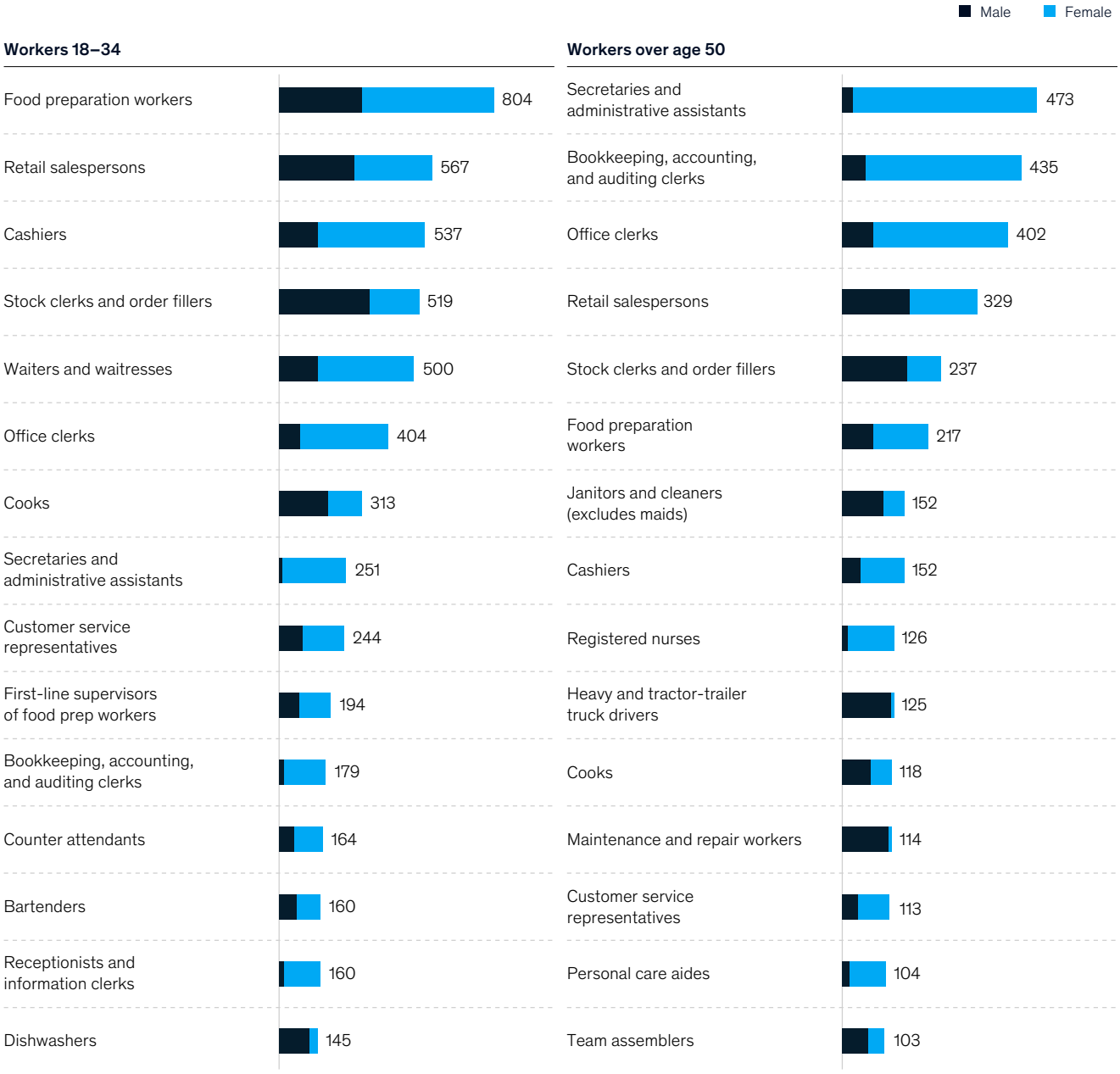
more than half of people who enter their fifties working full time are likely to experience some type of employer-driven job loss or forced retirement.[79]

For some older workers who are not retrained or moved into new positions by their current employers, job hunting may be daunting. A 2018 AARP survey of US workers over age 45 found that 45 percent believe ageism is a major reason they would not be able to find another job quickly, and 16 percent believe they have been passed over in the hiring process because of their age.[80] Furthermore, while the prospect of a drastic career change may not be appealing to some older workers who have spent years in one field, others might embrace the opportunity to train for a completely different line of work. Despite stereotypes, one recent

Exhibit 29

Younger and older workers could experience displacement in different occupations.

Top jobs by displacement, jobs lost by 2030, thousand



Source: McKinsey Global Institute analysis

[79] Peter Gosselin, "If you're over 50, chances are the decision to leave a job won't be yours," ProPublica, December 28, 2018.
[80] *The value of experience: AARP multicultural work and jobs study: Chartbook for total respondents,* AARP, July 2018.

survey by Dropbox found that older IT workers were significantly less likely than their younger colleagues to be stressed by using technology in the workplace and were better at using multiple devices.[81]

Men could be displaced at slightly higher rates than women, and women could be better positioned for future growth

58%

share of net job growth that women could capture

Some of the specific jobs most susceptible to automation skew heavily toward one gender or the other. Men, for example, make up the majority of automotive service technicians, production workers, and warehouse and logistics workers, while administrative assistants and bookkeepers are predominantly female. At an occupational category level, our model shows that three-quarters of female net job decline could occur as office support roles shrink, while 80 percent of net job losses for men could occur in food service, manufacturing production, and machine operations. Because they are concentrated in roles involving repetitive, physically intensive work, men could be displaced at higher rates than women (24 percent compared to 22 percent).

Women could be better positioned to capture future job growth. If we assume that the current gender breakdowns of all occupations remain constant through 2030, women could account for 58 percent of net job growth.[82] They are highly concentrated in a number of high-growth occupational categories, such as healthcare and personal care work. In fact, almost half of potential net job growth for women could come in healthcare-related professions (Exhibit 30). Yet many women who need to transition into new and better jobs will have to overcome persistent structural barriers to do so (see Box 4, “Women’s work”).

[81] Alison DeNisco Rayome, “Myth busted: Older workers are just as tech-savvy as younger ones, says new survey,” TechRepublic, August 10, 2016.
[82] While we base this analysis on historical patterns, gender concentrations could change in the future.

Box 4

Women's work

As automation disrupts the labor market, this period of change could yield progress—or setbacks— for women in the world of work.

Recent research by MGI on women and the future of work finds that globally, 40 million to 160 million women may need to transition between occupations by 2030, often into higher-skilled roles. If they make these transitions, women could find more productive, better-paid work; if they don't, they could face a growing wage gap or drop out of the labor force altogether.[1]

There are a number of hopeful signs: Women are already heavily represented in fast-growing sectors such as healthcare, for example. The fact that more jobs require higher education also tends to favor women, who have been outpacing men in the United States in attaining both bachelor's and advanced degrees for years. Since high-wage knowledge jobs should continue to grow, this is an opportunity for women to make inroads and claim a higher share of professional roles.

But these growing categories consider only jobs that exist today. Recent research by MGI notes that men are more heavily represented in "frontier" jobs involving the most cutting-edge technologies, which may position them for other jobs that have yet to emerge.[2] For example, women are heavily underrepresented in the technology sector. They hold only 26 percent of computing jobs in the United States.[3] Programs that encourage young women to pursue tech degrees and tech jobs are important to leveling the playing field. With digital skills in high demand, companies can benefit from tapping into historically underutilized pools of talent.

Female entrepreneurs in tech also need better access to funding. In 2018, all-male founding teams received 85 percent of total venture capital investment in the United States, while all-women teams received just 2 percent, and gender-neutral teams 13 percent.[4] Addressing this imbalance could help more women become job creators themselves.

Persistent gender concentration in occupations and sectors makes it more difficult for women (and men) to cross over into those where they currently are the minority of workers. One recent US study showed that women's sectoral and occupational choices accounted for more than 50 percent of the gender gap.[5] More work needs to be done to reduce stereotypes that entrench gender concentration in some occupations.

The automation age is layering new challenges onto long-existing ones. Millions of women, particularly those who work in office support and retail, will need to acquire new skills and perhaps change occupations. But many will have to juggle training with household responsibilities, and they tend to drop out of those programs at higher rates than men.[6] Paid childcare has become increasingly hard to secure—and one recent survey found that one-third of US families now spend 20 percent or more of their household income on it.[7] If displaced women find that low-wage, inflexible, or erratic jobs are their only alternative, some could drop out of the workforce altogether. Technology could offer some solutions for countering these issues by facilitating more flexible online training courses and remote telework, for example. However, such options are still not as broadly available as they need to be. A 2018 survey of employers found that only 23 percent of employers were offering flexible or remote working options.[8]

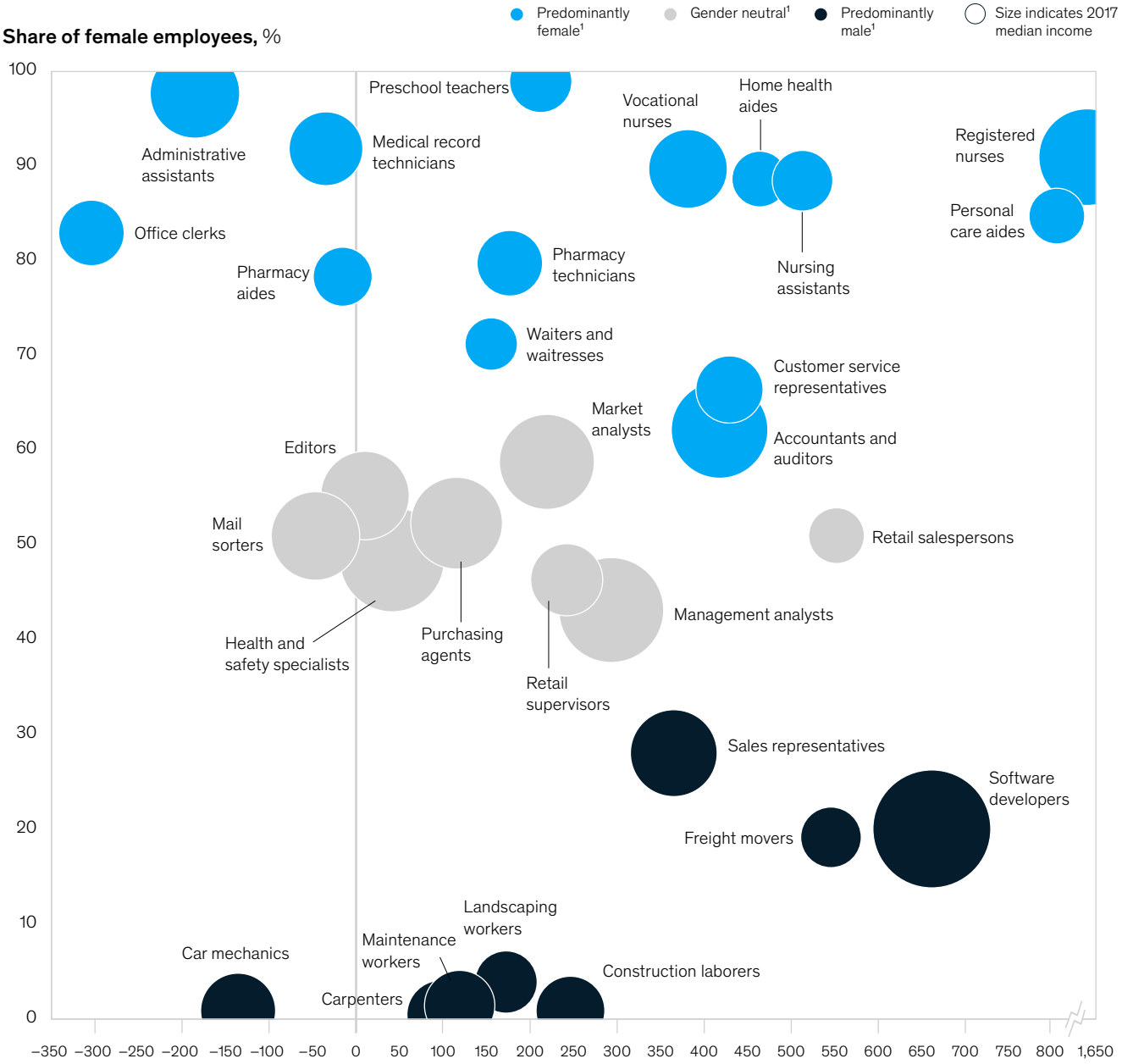
Women disproportionately work in some occupations that will be resistant to automation, including childcare, home healthcare, and teaching. But these professions are also largely low-paying. While women may benefit from the sheer numbers of care-related positions in the future, many of these roles lack economic security, legal protections, chances for advancement, and even physical security.[9] It may be time for the United States as a society to reappraise the value it places on the work of caring for and teaching others.

1 *The future of women and work: Transitions in the age of automation,* McKinsey Global Institute, June 2019.
2 Ibid.
3 Michael Conway, Kweilin Ellingrud, Tracy Nowski, and Renee Wittemyer, "Closing the tech gender gap through philanthropy and corporate social responsibility," September 2018, McKinsey.com.
4 Kate Clark, "Female founders have brought in just 2.2% of US VC this year (yes, again)," TechCrunch, December 2018, techcrunch.com.
5 Francine D. Blau and Lawrence M. Kahn, *The gender wage gap: Extent, trends, and explanations*, IZA discussion paper number 9656, January 2016.
6 Claire Cain Miller, "How society pays when women's work is unpaid," *New York Times,* February 22, 2016.
7 "This is how much child care costs in 2018," Care.com, July 17, 2018, care.com. See also Sara Mead, "Child care laggard," *US News & World Report,* February 23, 2017.
8 *2018 talent shortage survey: Solving the talent shortage,* Manpower Group, 2018.
9 *Work, Workers and Technology Blog,* "The future of work for women: Technology, automation, and the overlooked workforce," blog entry by Molly Kinder, February 25, 2019, newamerica.org/work-workers-technology/shiftlabs/blog/future-work-women.

Exhibit 30

Women are currently more heavily represented than men in some of the high-growth jobs of the future.

Female representation in the United States, illustrative set of occupations, 2017



[1] Occupations are considered "dominated" by one gender if 60 percent or more of employees are male or female; 2017 data.
Note: Based on 2017 gender concentrations within occupations. We assume these distributions hold constant through 2030 for the purposes of this analysis, although they can change over time. Net jobs gained factors in both jobs lost due to automation and expected job creation.

Source: US Bureau of Labor Statistics, McKinsey Global Institute analysis

As machines begin to handle a wider range of tasks, millions of Americans may need to move to new roles, new companies, new industries, or new geographies. At the same time, almost all jobs will evolve, with a different mix of tasks and heavier use of technology. Chapter 5 looks at the decisions facing employers, including how to incorporate these technologies, how to manage change, and how to think about the broader ramifications for their business models and the communities where they operate.

5 Mapping the impact on companies

The next wave of automation will have major implications for every aspect of what companies do, from strategy and innovation to operations and investment. Taking full advantage of the potential boost to productivity requires rethinking business processes, workflows, and especially talent needs.

The challenge is creating a road map to get from today's strategy, organization, and workforce to tomorrow's. Moving with speed and agility matters, since the adoption of AI is quickly becoming a competitive race across industries.[83] Although talent is at the core of corporate performance, not all companies have treated it as a real priority—and now they no longer have that luxury. Capturing the productivity potential of new technologies will require organizations to have a clear window into their current employees' skills, innate capabilities, and aspirations. They will need a detailed inventory of the tasks and skills associated with existing roles, plus a corresponding list of the tasks and skills that will be needed in the future.

As machines take over tasks, the time that is freed up can be reallocated to new and higher-value tasks. As jobs change, companies will need to decide if current workers whose tasks are automated can move to new roles within the organization, whether they will need training to make those moves, or whether to release some of them. More than 80 percent of executives from large companies responding to a 2017 McKinsey survey said retraining will have to be at least half of the answer to addressing their skills gap.[84] Even when employees do not need to move into wholly different roles, technology will change the way they work.

While the factors that go into each company's future of work decisions will be unique, some common frameworks can prove useful to shape their thinking. This chapter explores the coming challenges and how they vary for organizations with different geographic footprints and workforce characteristics.

Organizations will face cross-cutting challenges that require multidisciplinary solutions

Companies are at various stages of digital transformation, and automation represents a promising—albeit complicated—next stage of that journey. Every organization will need to understand what automation technologies can do and consider the full range of possibilities for using these new systems to create products and services, improve workflows, and boost productivity. While some will simply pursue labor cost reductions, those that deploy automation and AI technologies in pursuit of innovation and growth can accelerate profitability growth and even add jobs.[85]

[83] Jacques Bughin and Jeongmin Seong, "How competition is driving AI's rapid adoption," *Harvard Business Review,* October 17, 2018.
[84] Pablo Illanes, Susan Lund, Mona Mourshed, Scott Rutherford, and Magnus Tyreman, "Retraining and reskilling workers in the age of automation," January 2018, McKinsey.com.
[85] Jacques Bughin, "Why AI isn't the death of jobs," *MIT Sloan Business Review,* Fall 2018.

As many firms learned firsthand in the past decade, digital transformation is not easy. Implementing more sophisticated technologies will demand adept leadership. These are not only issues for human resources. They are cross-cutting issues that get to the heart of the business, and they demand focus from the CEO, the entire leadership team, and the midlevel managers charged with making high-level change into a practical daily reality. Three main focus areas will require attention:

— **Strategy.** Every organization will need to consider the full range of possibilities for using automation technologies to create new products and services, improve workflows, and boost productivity.[86] Leaders must set the strategic vision and determine the degree to which technological advancement is integral to gaining or maintaining a competitive advantage. They need to quantify the value potential at stake when weighing a large-scale workforce transformation. The divergence of local labor markets across the country will affect patterns of consumer purchasing power, and companies may need to adjust their offerings and geographic footprint in response. The trends described in this report should shape decisions regarding capital investment and real estate portfolios.

— **Operations and workforce transformation.** Integrating automation technologies into operations requires redesigning workflows and building the right workforce to support these changes. Workforce development will take on outsize importance. Companies need to identify current skills within the organization, then assess the skills they will need in the future and the extent of the gaps. Then they can determine the viability of moving current employees into new roles and what kind of training that will take; in some areas, they may need to opt for external hiring, particularly for more specialized digital talent. Speed and agility in undertaking these initiatives will be important, requiring adept change management.

— **Social responsibility.** Companies will also need to weigh the impact of their automation decisions on the communities in which they operate. Layoffs can have serious local implications, particularly if the organization is a major employer in a struggling place where people have fewer options for finding new jobs. Meeting goals of diversity and inclusion may become more challenging if certain roles are phased out. However, the social responsibility considerations are not all about mitigating tough circumstances; there is also an opportunity for companies to lead in positioning people and communities for success. Some organizations are already reaping the rewards of not only investing in their own workforces but also supporting broader external workforce development initiatives that extend beyond their own immediate needs (see Chapter 6 for a sampling of what some large employers are doing).

Transformation strategies depend on the unique characteristics of a company's workforce, operations, and geographic footprint

As employers design the workforce of the future, many company-specific factors will shape their decisions:

— **The stage of digital transformation initiatives under way.** The first consideration is where the company stands currently in its digital transformation journey.[87] Companies that are further along have typically already identified the highest-value digital initiatives

[86] As a large body of research by MGI and McKinsey has documented, the applications are remarkably broad across many industries. See, for example, *The age of analytics: Competing in a data-driven world,* McKinsey Global Institute, December 2016; *Notes from the AI frontier: Applications and value of deep learning,* McKinsey Global Institute, April 2018; Steven Begley, Bryan Hancock, Thomas Kilroy, and Sajal Kohli, "Automation in retail: An executive overview for getting ready," May 2019, McKinsey.com; Michael Chui, Katy George, James Manyika, and Mehdi Miremadi, "Human + machine: A new era of automation in manufacturing," September 2017, McKinsey.com; Jeff Berg and Julian Raabe, "Charting the future of customer care through a core optimization philosophy," March 2018, McKinsey.com; Alexander Edlich, Fanny Ip, and Rob Whiteman, "How bots, algorithms, and artificial intelligence are reshaping the future of corporate support functions," November 2018, McKinsey.com.

[87] Jacques Bughin and Nicolas van Zeebroeck, "Artificial intelligence: Why a digital base is critical," *McKinsey Quarterly,* July 2018.

as well as the talent and organizational structure required to bring those programs to life. Their experiences to date in digitizing their operations and customer experience have given them a track record in addressing the related workforce challenges and a foundation that readies them to adopt more advanced new technologies. In contrast, companies that are only in the early stages, or those sectors where digital technologies have not been widely adopted, will be in a very different place.

— **Density of automatable tasks.** The share of the company's work that machines can handle determines the extent to which its workflows are likely to change. In some cases, technology may substitute for labor, handling the bulk of tasks associated with certain occupations. In others, new jobs and new types of talent may need to be added. Technology may complement some workers and enhance their productivity; by automating some of their lower-value tasks, companies can redirect them into higher-value activities.

— **Shift in occupations.** As machines take over some types of tasks, an organization could redeploy workers within the same department; it could also move them to different departments and functions, or even to new physical locations. Firms with diverse sets of occupations tend to have more internal redeployment options for workers whose current jobs are being redefined or phased out. Large national retailers, for example, may reduce the number of cashiers, but they have substantial customer support and supply chain operations; they may also be adding offerings, such as delivery, that could support new roles. Companies with fewer roles have fewer options for moving workers internally when manual or routine work is automated.

— **Workforce skills.** The education level and skill sets of an organization's current workforce will color its decisions on retraining and redeploying workers. Companies with mainly college-educated workforces will have a different challenge than those that employ people who lack postsecondary credentials and skills. As operations and workflows evolve, company leaders will have to consider what new roles need to be added, looking at areas such as operating and maintaining technologies or enhancing the customer experience; then they can consider whether displaced workers can be retrained to fill those new roles. A key prerequisite is taking a skills inventory to understand which roles represent logical moves and which specific employees have either the innate qualities or the transferable skills to succeed in roles that are different from the jobs for which they were originally hired.

— **Geographic concentration.** A company's operational footprint will dictate the scope of its transformation and choices about which locations to prioritize for investment. Companies with a distributed national footprint must consider how the trends outlined in this report will affect patterns of labor supply and consumer purchasing across geographies, planning for areas to grow or shrink in the coming decade. Companies with more concentrated operations will have to understand the local talent and its projected growth; some may decide to move some of their operations out of the fastest-growing but highest-cost locations to tap into new talent pools and lower costs in other regions of the country.

— **Turnover.** Companies have to weigh the trade-offs between providing digital training to current employees versus hiring outside candidates who already have these skills, and the rate of turnover colors many of their decisions (see Box 5, "To train or to hire? Weighing the value of employee retraining programs").

Box 5

To train or to hire? Weighing the value of employee retraining programs

Many companies do not see a clear business case for investing in training workers who can take their newfound skills and leave—and this is especially true for those with many low-skill, high-turnover roles. But it is worth questioning these assumptions and taking a broader view.

When companies have new types of roles to fill, bringing in new external hires can be a faster way to meet those needs. But it is not always feasible when the talent pool is limited (as it often is for roles such as cybersecurity analysts or data visualization designers). Furthermore, recruiting and onboarding take time, and whether someone will be a good fit is never guaranteed until they are actually on the job.

Offering existing employees training and a clear path toward moving into new roles can be part of the company's value proposition, helping to reduce attrition and improve morale and performance. Even companies in sectors such as retail and food service can benefit from training and retaining employees, upgrading the quality of jobs to encourage worker engagement and performance. Creating more "human-centered" jobs with continuous learning and greater empowerment could provide a competitive advantage to retailers and restaurants, whose turnover rates in 2016 averaged 65 percent and 73 percent, respectively. Spanish grocery store chain Mercadona has emphasized training employees and soliciting their input in problem solving, and it has achieved dramatically lower turnover rates as a result.[1] Instead of viewing employee training as a burden, it can be an opportunity to create better jobs. At a time when traditional rewards systems and career ladders are disappearing, workers need new relationships with their companies—and a large body of research shows that they give their best effort and ideas when they feel they are part of something larger.[2]

Deciding to retrain employees leads to another set of questions about the most effective way to go about it. Organizations can develop their own tailored in-house training programs or partner with an education provider to create external instruction. They can also choose a variety of delivery mechanisms: traditional classroom courses, programs that combine classroom work and experiential learning, online modules using multimedia content and interaction, apps, boot camps, one-on-one coaching, or rotational stints.

Organizations—including unions, technical specialists, training providers, and educational institutions—can step into the gaps and provide workforce development services benefiting workers and companies alike. These organizations will need to track the skills of the future and how certain workers and talent profiles could be qualified for different career development options. They will also need to understand what kinds of training models actually produce results and to make strategic decisions about whether to partner with external providers.

In some cases, unions have been leading retraining efforts—and this can be a critical option for developing industry-wide talent pipelines over the longer term. The Service Employees International Union–United Healthcare Workers West (SEIU–UHW) has prioritized helping California workers prepare for in-demand medical coding jobs. In 2018, its Joint Employer Education Fund partnered with the California Community Colleges to create a new online community college dedicated to proving remote coursework in medical coding.[3] A subsequent partnership with Western Governors University formed the Medical Coding Career Accelerator Program, which provides working adults with online training to earn a Certified Professional Coder credential.[4]

Acquisition is another route for capability builders to gain the training programs required to support workers. In 2018, staffing firm Adecco Group bought digital retraining company General Assembly. General Assembly began as a consumer-facing company providing local coding instruction but later developed a service line offering training courses to enterprises.[5] It continues providing services through 20 campuses and the broader Adecco ecosystem. Microsoft recently announced a partnership with General Assembly to train 15,000 people around the world in AI-related skills; it is also joining General Assembly's AI Standards Board to help develop AI skills standards, assessments, career frameworks, and credentials for the field.[6]

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1 Zeynep Ton, *The Good Jobs Strategy: How the Smartest Companies Invest in Employees to Lower Costs and Boost Profits,* Boston, MA: Houghton Mifflin Harcourt, 2014; Zeynep Ton, "The case for good jobs," *Harvard Business Review,* November 2017.

2 Marcus Buckingham and Ashley Goodall, "The power of hidden teams," *Harvard Business Review,* March 2019; and Dan Cable and Freek Vermeulen, "Making work meaningful: A leader's guide," *McKinsey Quarterly,* October 2018.

3 "Leading healthcare union training fund announces partnership with new online community college," press release, California Community Colleges Chancellor's Office, April 24, 2018.

4 "WGU, SEIU-UHW, and healthcare employers partner to reinvent workforce education for tens of thousands of California students," press release, Western Governors University, April 16, 2019.

5 Shirin Ghaffary, "Lessons from a General Assembly investor: 'It turned out there were no moats at all in the coding school market,'" Vox, April 21, 2018.

6 Sarah Perez, "Microsoft aims to train and certify 15,000 workers on AI skills by 2022," TechCrunch, May 17, 2019.

The future of work will have many variations across organizations

Below we profile six types of employers with different workforce characteristics, geographic concentrations, and density of automatable activities (Exhibit 31). In reality, every company has unique challenges and will have to forge its own path. But these profiles, while not exhaustive, illustrate some of the opportunities and challenges companies will face.

White-collar workforces

Many of these organizations are in commercial and investment banking, asset management, insurance, law, and government. Many corporate headquarters also fit this profile. These organizations, often located in urban or suburban areas, typically have middle- to high-wage jobs with low turnover, including a significant number of jobs that pay wages above the median but do not require college degrees.

Exhibit 31

Employers' opportunities and challenges depend on company footprint and workforce characteristics.

Size of workforce | Share of workers with bachelor's degree | Automation displacement rate

Workforce characteristics	Examples[1]	Description	Key challenges
White-collar workforces 25M–30M · 35–45% · 20–25%	Insurance Banking HQ functions Gov't agencies	Concentrated footprint, middle- and high-skill workforce with low turnover. Process automation can enhance efficiency but may displace workers.	• Retraining and redeployment to new roles within the company, especially digital • Hiring required tech talent
Nationwide customer-facing 15M–20M · 15–25% · 25–30%	Retail Food service Hospitality	Nationally dispersed geographic footprint. Majority of workforce is in lower-skill jobs with high turnover.	• Economics of retraining may be challenging given high turnover • Reskilling and redeployment (into managers, delivery, other new customer experience roles)
Movers and builders 10M–15M · 5–15% · 20–25%	Parcel delivery Warehouses Construction	Mix of local and national footprint. Largely middle-skill workforce, some with specialized skills. High diversity of occupations and automation potential.	• Training employees to integrate, operate, and maintain technologies • Finding adjacent middle-skill occupations to redeploy workers
Specialized practitioners 5M–10M · 50–60% · 10–15%	Healthcare Education Professional services	Middle- to high-skill workforce. Automation complements labor and reduces routine tasks, allowing more time on highest-value-added work.	• Continuous learning to adopt new technology • Finding new business models that leverage technology, including remote service delivery
STEM-based workforce 5M–10M · 65–75% · 10–15%	Pharmaceutical Tech Software	Highly specialized, high-skill workforce with concentrated geographic footprint. High pace of sector technology change.	• Attracting and retaining top talent and continuous learning • Rethinking location strategy based on cost and access to talent
Makers and extractors 5M–10M · 5–15% · 25–30%	Manufacturing Oil and gas Mining	Geographically concentrated. Low- to middle-skill workforces performing physically intensive and repetitive tasks. Lower turnover.	• Building technical capabilities; attracting talent to remote areas or retraining existing employees • Potential for community disruption

[1] These are major sectors where these characteristics tend to be significant, but they are not universal or exhaustive.

Source: McKinsey Global Institute analysis

A commercial bank with various lending and investment products, for example, could see large-scale changes in its workforce needs, because automation and AI systems can handle many underwriting, accounting, and related back-office support tasks.[88] This opens up questions about creating redeployment paths and finding new ways for workers to add value. Retraining people to fill new digital roles or shifting workers into more customer-facing roles might be attractive options, especially given the relatively high skill and education profile of the workforces, but they will require designing effective and large-scale training programs and continuous learning opportunities. Furthermore, the bank must look at its retail footprint and the roles that are needed in each branch.

To facilitate retraining, JPMorgan Chase is developing a "skills passport" digital platform on which workers can take assessments and explore training and career options across the company. The bank's internal training programs include the JPMC Coding Academy, a 10- to 14-week immersive training program in software engineering, and the Bournemouth Technology Degree Apprenticeship, a four-year program that allows students to earn a degree while working in the firm's technology units.

Nationwide customer-facing workforces

Companies in industries such as retail, food service, and hospitality—including many well-known consumer names—have large customer-facing workforces spread across the country in every type of community segment. Many of their employees are entry-level workers, and a substantial share of their activities can be automated.

While machines can handle many back-of-house activities, automating public interactions will require thoughtful design and testing to ensure that the customer experience does not become frustrating or impersonal.[89] Automated ordering in restaurants, self-service checkout in stores, automated reception in hotels, and robot deliveries will boost productivity, but the need for a smiling human face and quick problem-solving at critical junctures will not disappear. Hospitality, after all, is warm and personal.

One key challenge for these employers will be deciding how current workers might fit into other roles, which ones have the potential to succeed, and whether they would need retraining to make those moves. Because the entry-level jobs most susceptible to automation typically have high turnover rates, the return on investment in retraining programs is not clear, although they may help to reduce attrition and the associated costs of recruiting and onboarding new employees. In addition, many companies fitting this profile have traditionally spotted location managers as they rise through the ranks and learn on the job, so new models for developing future leaders might be needed.

Walmart's training programs accommodate workers at different stages in a career journey. For new hires, an introductory program covers basics such as a customer-service-oriented approach and reliability. Employees who move up the career ladder go on to attend Walmart Academy, an off-site program to train associates and managers in store operations and leadership. Finally, associates and high school student employees can gain credentials in business, supply chain management, or technology through "dollar a day college," an online education program offered in collaboration with Guild Education and six universities.

To address a growing shortage of pharmacy technicians, CVS established an apprenticeship program combining classroom and online instruction with on-the-job training. The company has also built four regional learning centers, each with classrooms and a full mock pharmacy. These facilities act as hubs not only for developing a new pipeline of talent but also for training

[88] Federico Berruti, Emily Ross, and Allen Weinberg, "The transformative power of automation in banking," November 2017, McKinsey.com.

[89] Steven Begley, Bryan Hancock, Thomas Kilroy, and Sajal Kohli, "Automation in retail: An executive's guide for getting ready," May 2019, McKinsey.com.

thousands of current employees each year.[90] One of its mock stores is specially designed to help with hiring and training people with disabilities.[91]

The sharply different rates of net job growth across the country will change patterns of customer demand. Consumer-facing companies will need to understand these trends at a detailed level. These local variations may prompt the closing of some locations and expansion in other parts of the country. They could also inform new products and new offerings (such as delivery service) that could add jobs, although not the same mix of jobs as in the past.

As a group, these companies will be making decisions regarding staffing and footprint that will affect millions of low-wage workers, many of whom have limited educational attainment. These decisions will ripple through local communities, some of which could lose conveniences and important services in the event of store closures. The public-facing nature of these companies means that large-scale layoffs also carry reputational risks. Companies can demonstrate a commitment to communities and workers by investing in training for current and transitioning employees.

Movers and builders

In sectors such as logistics, construction, and warehousing, companies have a mix of footprints, including some with national networks and others focused on certain regions. Their workforces tend to be in low- to middle-wage roles, and some (but not all) tasks lend themselves to automation. These jobs tend to be physically intensive but unpredictable, so humans are still needed to utilize and work alongside technology.

In parcel delivery, for example, many aspects of logistics can be automated. Today, 65 percent of consumable goods reach US consumers on trucks, and e-commerce sales are soaring. Autonomous trucks will eventually disrupt this supply chain, although drivers may still be needed for the next decade at different stages of the journey.[92] Robots are not yet capable of loading packages of varying sizes, weights, and materials, but over time, technology is likely to alter new aspects of the delivery process, as self-driving vehicles, delivery robots, and self-service parcel lockers are introduced. Current pilots show that fully automated warehouses might reduce overall logistics costs by up to 40 percent.[93]

As automation spreads through logistics, companies will need to decide whether to retrain existing workers or whether natural attrition and retirement will allow the workforce to evolve organically. A key challenge will be either training or attracting the talent needed to install, maintain, and use technology systems—tasks that require a higher level of specialization and technical knowledge than many current physically intensive roles at these companies. This is an opportunity to create upward career trajectories, even if those journeys require moving across the company's geographic locations.

Amazon is a prime example of providing training for roles outside of current physically repetitive tasks. The company is setting up classrooms in some of its fulfillment centers and launching a 16-week certification program that will enable warehouse workers to train for roles as data technicians. If they successfully complete the course and are hired by one of the company's data centers, they can double their wages from $15 an hour to $30 an hour.[94] In addition, Amazon Career Choice offers employees tuition reimbursement to pursue postsecondary educational degrees at night, even if the course of study is not related to a future job at Amazon.

[90] See "A prescription for career success," CVS Health, cvshealth.com/about/diversity/a-prescription-for-career-success.
[91] Shaun Heasley, "CVS opening mock stores to train people with disabilities," Disability Scoop, November 13, 2017.
[92] Bernd Heid, Dago Diedrich, Matthias Kässer, Sebastian Küchler, and Friedrich Kley, "Route 2030: The fast track to the future of the commercial vehicle industry," September 2018, McKinsey.com.
[93] Ashutosh Dekhne, Greg Hastings, John Murnane, and Florian Neuhaus, "Automation in logistics: Big opportunity, bigger uncertainty," April 2019, McKinsey.com; and Aisha Chottani, Greg Hastings, John Murnane, and Florian Neuhaus, "Distraction or disruption? Autonomous trucks gain ground in US logistics," December 2018, McKinsey.com.
[94] Lauren Weber, "Why companies are failing at reskilling," *Wall Street Journal,* April 19, 2019.

Specialized practitioners

Some companies with educated and middle- to high-wage workers have national (or international) footprints, including many in healthcare and education as well as larger national firms in business services such as law, financial services, architecture, engineering, and consulting. In these fields, many technologies will augment labor, enabling specialized workers to focus on the tasks that add the highest value (although technology may reduce demand for administrative and office support roles).

Improved connectivity from anywhere is increasing the viability of remote work. This may enable some tasks to be unbundled and moved to new workers and locations. One big challenge will be deciding which technologies to adopt as well as which functions to keep centralized and which to convert to remote or outsourced positions. Pricing models may also need updating as service delivery evolves.

A healthcare provider with a distributed footprint is an example of how automation technology and remote work can expand the impact of specialists.[95] Automating redundant paperwork and patient record keeping can free up hours in the day for specialists to see more patients. Remote access to patients and scans can enable mental health counseling via telemedicine, as well as allowing radiologists to examine scans taken hundreds of miles away. This will require providers to decide which specialists to station in smaller markets compared to offering advanced diagnostics and other services only in larger cities, supplemented by remote technologies.

STEM-based workforces

Many firms fitting this profile are in web services, telecom, media, some advanced manufacturing, architecture, engineering, and design. They are disproportionately found in urban core cities, and they employ highly skilled and highly paid workforces with a relatively low share of activities that can be automated.

Technology is likely to complement what people do in these organizations, raising productivity and enabling new types of products and services rather than displacing workers.[96] Training or recruiting people who combine professional expertise with fluency in cutting-edge digital systems is a priority for these firms to innovate and stay competitive. One difficult issue is whether to provide digital training to current employees versus hiring outside candidates who already have these skills. As an example, for IT services firms providing contract services, removing technical talent from accounts to provide training can be cost prohibitive. External hiring can require paying third-party sourcing fees or forming partnerships with university systems to develop a longer-term talent pipeline. Both strategies are time-intensive and require investments that chip into near-term margins.

Additionally, firms will have to make decisions about where to locate technology centers. Traditional technology hotbeds in urban areas can have higher associated costs and competition for hiring eligible workers. Investing in growing areas can be advantageous, if the region has the necessary workforce skills.

SAP, headquartered in Europe but with many offices across the United States, quantified an expected skills gap and then mapped comprehensive end-to-end "learning journeys" for thousands of employees to help them transition into new roles. These involve a combination of in-house classroom training courses and boot camps, job shadowing, and on-the-job practice. These journeys may take six to 18 months, although shorter-term learning modules were also developed to meet immediate needs.[97]

[95] David Champagne, Sastry Chilukuri, Martha Imprialou, Saif Rathore, and Jordan VanLare, "Machine learning and therapeutics 2.0: Avoiding hype, realizing potential," December 2018, McKinsey.com.

[96] Yan Han, Evgeniya Makarova, Matthias Ringel, and Vanya Telpis, "Digitization, automation, and online testing: The future of pharma quality control," January 2019, McKinsey.com.

[97] "Building the workforce of tomorrow, today," *McKinsey Quarterly,* November 2018.

Makers and extractors

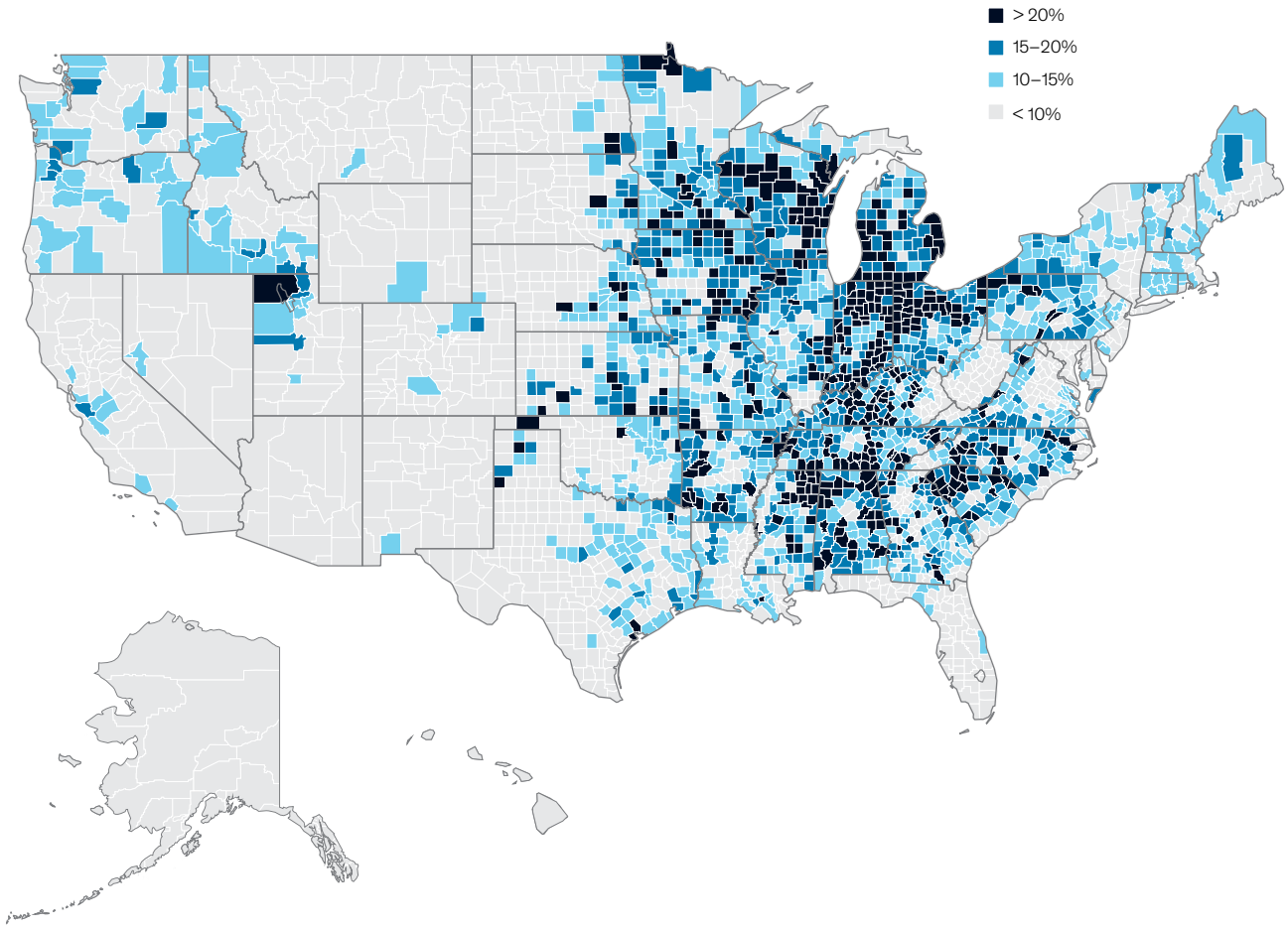
Companies in industries including manufacturing, food processing, mining, and energy tend to have large workforces and concentrated footprints that are often rural (Exhibit 32 shows the footprint for manufacturing). They are often major employers in these local economies, offering middle-wage jobs with relatively low turnover and a limited number of occupations. Many workers perform physical or repetitive tasks that machines are increasingly able to handle.

The core challenges for these companies will be acquiring digital capabilities while determining the optimal retraining, redeployment, or release options for workers whose skill sets no longer fit. While many workers have been displaced by automation, the jobs that remain are more interesting, require better skills, and often are better paid.[98] For example, an oil and gas company might need to hire engineers to operate new systems that can handle many of the extraction tasks that workers have long performed on rigs. But roustabouts and other rig workers with largely manual skill sets cannot transform into engineers overnight. With few logical paths open to redeploying them, large-scale displacement could follow. These challenges could be more acute in remote areas and places with a heavy industry concentration, such as the Gulf Coast.

Exhibit 32

Manufacturing accounts for 20 percent or more of employment in 460 counties.

Share of 2017 employment in manufacturing, %



Source: US Census American Community Survey; McKinsey Global Institute analysis

[98] "At these factories, robots are making jobs better for workers," March 2019, McKinsey.com.

When skills are in short supply, companies may take steps to build their own talent pipelines. In advanced manufacturing, multiple blue-chip companies have partnered with local community colleges to develop educational frameworks for in-demand roles. In South Carolina, BMW has partnered with four community and technical colleges to develop the BMW Scholars program, an apprenticeship initiative for full-time manufacturing degree students who also hold part-time jobs at BMW. General Dynamics' Electric Boat division in Connecticut partnered with Three Rivers Community College to develop six- to eight-week free training programs in manufacturing skills; the company has hired hundreds of these trainees.

This approach is not limited to the world of manufacturing. To staff its data centers located in rural and semirural areas, Microsoft has set up multiple Datacenter Academies.[99] The company collaborates with community colleges on the curriculum, creates job shadowing and internship opportunities, and offers fully funded scholarships for individuals from underrepresented populations in tech.

As individual organizations undergo profound workforce changes, the cumulative impact on local economies and the US labor market grows. Chapter 6 looks at the broader societal impacts and the solutions that can emerge from cooperation among businesses, government, education providers, nonprofits, and individuals.

[99] See https://azure.microsoft.com/en-us/global-infrastructure/community/

6 Building a brighter future of work

Automation is reshaping the future of work, with implications for individuals and incomes, the fortunes of local communities, and the footprint of companies and industries. Millions of Americans will need access to retraining and the ability to find new opportunities. Responding to a transition of this magnitude will require collaboration among multiple stakeholders, including federal, state, and local governments; businesses; community leaders and residents; philanthropic organizations; educational institutions; and unions and professional societies.

The trends outlined in this report point to further polarization—between high-growth cities and struggling rural areas, and between high-wage workers and everyone else. But policy choices and investment can still create a better outcome. Companies can make a difference, too, in recognizing that there is talent available across the country and investing alongside other entities to realize untapped potential. Broadening their own footprint can lower costs, create resilience, and have a major positive impact on revitalizing communities.

Stakeholders can draw on a large and varied tool kit of options to create better outcomes in their communities (Exhibit 33).[100] But as this research shows, segments across the United

Exhibit 33

While local communities have their own priorities, they can draw from a common tool kit when deciding which actions to take.

Examples of community interventions; not exhaustive

Connecting workers with new opportunities

- Use big data and digital platforms to track and match local and regional demand for occupations and specific skills
- Standardize employer and industry skills taxonomy
- Create nationally recognized workforce skills credentials
- Address transportation challenges, especially from low-employment areas to employment hubs
- Explore solutions to enable mobility, including incentives and affordable housing
- Reduce burdensome occupational licensing requirements

Building the workforce of the future

- Innovate and scale options for short-term training (including online learning)
- Consider incentives for companies to invest in worker training and expand co-funding for apprenticeships
- Create partnerships between educators and employers to design career-relevant curricula
- Expand vocational programs that create pathways from school to work, including apprenticeships
- Encourage educators to create programs for lifelong learning
- Strengthen K-12 education to build foundational skills

Undertaking economic development to spur job creation

- Create sector-specific development strategies to attract investment and build innovation clusters
- Promote entrepreneurship through incubators, mentorship, and capital access programs
- Increase secondary and postsecondary education and link it to local employers
- Invest in traditional and digital infrastructure
- Create specific plans to turn around distressed neighborhoods

Supporting workers in transition

- Offer financing options, including grants and subsidies, for people undertaking midcareer retraining
- Expand access to unemployment insurance and increase program flexibility
- Provide high-quality career counseling and skills assessment
- Pilot portable benefit systems
- Broaden benefits for independent workers to encourage entrepreneurship
- Investigate programs to raise incomes for low-wage workers

Source: McKinsey Global Institute analysis

[100] For a comprehensive discussion of potential policy interventions, see *The work ahead: Machines, skills, and US leadership in the twenty-first century*, Council on Foreign Relations, Independent Task Force Report number 76, 2018; *America at work: A national mosaic and roadmap for tomorrow*, Walmart, 2019; and Ethan Pollack, Alastair Fitzpayne, and Conor McKay, *Automation and a changing economy*, Aspen Institute Future of Work Initiative, April 2019.

States have different starting points and distinct challenges. Depending on their unique circumstances and the relative urgency of each issue, individual communities will need to establish their own priorities (Exhibit 34). Skills development will be near the top of the list for most places, but programs must address the local context. Federal resources and coordination may be needed, but no one-size-fits-all approach will work across the country. Local officials, educators, and employers know their own people and places best.

This chapter brings four of the most critical challenges into focus: connecting workers with new opportunities through improved job matching and mobility; scaling up retraining efforts; creating new local economic development approaches to boost job creation; and addressing incomes. We highlight examples of programs and pilots from across the country—and the good news is that there are many promising efforts under way. The crucial next step will be identifying what works, sharing those models, and expanding them across cities, counties, and wider regions.

Across the country, workers need to connect with new opportunities

A central challenge in the automation age will be connecting millions of displaced workers to new, growing jobs. Some may need to change jobs within the same company, and employers would provide the necessary training in these situations. But many workers may need to find work with new employers or make even bigger transitions to different occupations in

Exhibit 34

Communities face different future of work challenges.

		Key priorities
Urban core *Megacities* *High-growth hubs*		• Increase affordable housing near employment centers • Involve employers in creating high school and community college programs to develop key skills needed in growing fields • Target job training and placement to low-income and marginalized populations • Improve transportation links within city and with periphery
Urban periphery		• Attract investment in high-value businesses to diversify beyond local services • Link tertiary education programs to urban employers to create talent pipeline • Improve transportation links with city and within periphery
Niche cities *Small powerhouses* *Silver cities* *College-centric towns*		• Promote startup clusters and innovation (technology businesses in small powerhouses, healthcare in silver cities, university spin-offs in college-centric towns) • Adopt varying local strategies: silver cities need to attract young workers in growing industries; college-centric towns need to prevent brain drain and address poverty rates
Mixed middle *Stable cities* *Independent economies* *America's makers*		• Create a clear value proposition and economic development strategy to attract investment to create a thriving economic cluster • Facilitate entrepreneurship through incentives, access to capital, and streamlined regulation • Retrain and redeploy workers at scale to avoid unemployment and slow-growth downward spiral
Low-growth and rural areas *Trailing cities* *Americana* *Distressed Americana* *Rural outliers*		• Identify potential anchor industries that can be growth engines building on local advantages (e.g., low-cost land) • Improve / update skills through high school completion programs, apprenticeships, training boot camps • Expand digital infrastructure and teach digital skills to enable remote work

Source: McKinsey Global Institute analysis

new locations. A survey of US households found that more than half of workers displaced between 2005 and 2015 found their next job in a different industry.[101] For these workers, governments and other stakeholders can help to make local labor markets more fluid and easier to navigate.

Using data and digital platforms to improve job matching

Today the labor market provides relatively crude signals about the skills that are in demand. As we write this report, more than six million positions are open in the United States, yet employers say it is difficult to find workers with the requisite skills. Individuals apply guesswork as they try to map out an education, training, and career path.

In a technology-driven world, job-matching efforts should be underpinned by big data and run on easily accessible digital platforms.[102] Today online talent platforms are gathering rich troves of data on the positions that employers are filling, the skills required, and the avenues that lead to more fulfilling work. Harnessing this data could help individuals make more informed decisions about how to prepare for the jobs of the future. Education and training providers could be held to a new standard of accountability as the career outcomes associated with specific institutions and degree programs become more publicly transparent.[103] New online tools can assess individuals' skills, suggest appropriate career choices, and create more transparency on which jobs are in demand and the credentials needed to obtain them (see Box 6, "Charting new career pathways").

Some efforts are under way to try to apply big data analysis to the labor market and build marketplaces for matching. The Markle Foundation's Skillful initiative, for instance, was launched in 2016 as a partnership with Microsoft, LinkedIn, the state of Colorado, and local employers. Its coaches and online services show job seekers what skills are in demand and help them connect with training programs. The initiative also feeds this data to training programs to keep them relevant. Finally, Skillful works with employers to create job postings that emphasize the skills needed rather than the educational degree desired, boosting the number of applicants and improving their diversity. Launched in Colorado, the program recently expanded into Indiana.[104]

Major efforts are under way to create a consistent taxonomy of workforce skills and a standardized set of credentials. The US Chamber of Commerce Foundation and the Lumina Foundation have launched the T3 Innovation Network to create an open data ecosystem to centralize information on skills, credentialing, and the needs of the economy and to standardize how skills are defined across industries and employers. A nonprofit called Credential Engine is creating an online registry to make information about the thousands of varying credentials across the country more transparent and searchable.[105] The Manufacturing Institute has established a skills certification system to fill gaps and promote industry-specific education efforts.

Some job matching efforts targeted to specific populations illustrate what could be done for the general population. Many veterans need specialized support as they transition into civilian life, since employers may not be sure how their military experience translates into job skills. VetJobs is an online employment board with millions of postings. An organization called CASY (Corporate America Supports You) offers veterans résumé help, interview and job search tips, job training, and direct placement services in varied professions. Upwardly Global has developed professional licensing guides for regulated occupations in a bid to help college-educated immigrants work in the professions they trained for in their home countries. The

[101] *Addressing America's reskilling challenge*, US Council of Economic Advisers, July 2018.
[102] *A labor market that works: Connecting talent with opportunity in the digital age,* McKinsey Global Institute, June 2015.
[103] Michael Spence and James Manyika, "Job-saving technologies," Project Syndicate, October 15, 2015.
[104] See markle.org/rework-america/skillful.
[105] See also Sean R. Gallagher, *Educational credentials come of age: A survey on the use and value of educational credentials in hiring,* Northeastern University Center for the Future of Higher Education and Talent Strategy, December 2018.

Box 6

Charting new career pathways

Understanding potential career pathways with workers' current employers and elsewhere will be important for all stakeholders. Individuals need to know if their skills are compatible with less automatable roles at the same or a higher salary level. Employers need to know which employees can succeed in new internal roles. Even if they release some workers, employers can use information on skills adjacencies to help people find new opportunities outside the company.

We use data from Economic Modeling Specialists International that has calculated a compatibility index between occupations by applying a proprietary algorithm to the free online O*Net occupational information database. Using a combination of this index and our own analysis, we see many potential career pathways for people who want to move into adjacent occupations. Loan interviewers, for example, have a potential higher displacement rate (42 percent) than paralegals (37 percent), but they have more than five times the number of possible career pathways to jobs with equivalent or higher salaries and displacement rates below the national median.

Bookkeepers, accounting, and auditing clerks are another example (Exhibit 35). Those who remain in the occupation may be called upon to use more creativity, critical thinking, and digital skills as they work alongside new technologies and focus less on tasks that are automated. Others could use their existing skills to transition into other jobs in finance.

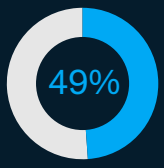
If this kind of analysis is done on a national scale, continuously updated, and made available to everyone, workers would be better able to see their way forward.

Exhibit 35

Bookkeeping, accounting, and auditing clerks have compatible pathways to higher-paying finance roles.

Bookkeeping, accounting, and auditing clerks

2017 national data



Displacement rate

$39,240

Annual median salary

1,727,980

Total employment

	Compatibility index, 0–100	**Displacement rate,** midpoint adoption scenario, 2030, %	**Median annual salary,** $ thousand
Insurance underwriters	95	21	69.8
Tax examiners, collectors, and revenue agents	94	20	53.1
Loan officers	93	14	64.7
Loan counselors	93	22	44.7
Eligibility interviewers, government programs	93	22	44.4
Accountants	92	9	69.4
Claims adjusters, examiners, and investigators	91	16	64.9
Credit analysts	91	13	71.3
Credit counselors	91	22	44.7
Energy brokers	90	20	52.5

Source: EMSI compatibility index; US Bureau of Labor Statistics; McKinsey Global Institute analysis

organization offers both coaching and online resources to help participants understand the cultural norms for job hunting in the United States.

Tackling geographic mobility and mismatches

Geography can be a barrier to job matching (see Box 2 in Chapter 1). Our research finds that job growth could be disproportionately concentrated in the nation's most thriving—and expensive—cities and their peripheries, while rural areas can expect higher displacement rates and larger potential labor surpluses in declining occupations.

It is often suggested that people should simply leave distressed places and move to where the jobs are. But this greatly oversimplifies the weight of this decision for individuals who may have deep personal ties to their homes as well as economic barriers to leaving. Not everyone can pack up and move—and moving itself entails risk and expense, particularly in an age when jobs do not last as long as they once did. Furthermore, older people may be less inclined to pull up roots, and dual-career couples might have to weigh giving up the certainty of one spouse's job to allow the other to pursue a new opportunity.

Stark differences in housing prices across the country also lock people into place. Many cannot sell their homes without losing money. Conversely, soaring home prices and rents can make it seem impossible for someone to move from a depressed region to one of the country's hottest job markets. Addressing the affordable housing shortage in the fastest-growing urban areas would enable people to move for higher-productivity jobs and create demand in the construction sector at the same time. Previous MGI research estimated that California alone has an affordable housing shortage of some two million units—a gap that may shave up to 6 percent off the state's GDP annually.[106]

The approaches to better job matching described above can help people gain insight into the opportunities available elsewhere and inform their choices. Policy makers can consider providing moving subsidies to help people who do want to leave distressed areas, particularly if they can fill labor shortages in other communities. Vermont, for example, now offers mobility payments to entice more workers to move there from out of state.[107] Portable benefits that are connected to an individual rather than a particular employer could create more equity between traditional and nontraditional workers and fuel a more dynamic labor market.[108]

The nation's transportation infrastructure is also sorely in need of investment. Building out more transit and mobility options, and even subsidizing their use, can help expand the radius of what constitutes a reasonable commute.

Rationalizing occupational licensing requirements is another way to improve mobility. One-quarter of occupations now require workers to obtain state-mandated licenses, up from about 5 percent in the 1950s, and the requirements often vary from state to state.[109] While some of these credentials provide important assurances of consumer safety, imposing licensing requirements on too many occupations, with standards that vary across states, creates unnecessary hurdles for workers who aspire to enter a new profession or to move. Dismantling excessive requirements and making other licenses portable would be a simple step toward improving worker mobility.

[106] *A tool kit to close California's housing gap: 3.5 million homes by 2025,* McKinsey Global Institute, October 2016.
[107] April McCullum, "Vermont may expand its pay-to-move program, would pay up to $7,500 to all eligible non-residents," *Burlington Free Press,* April 12, 2019.
[108] Libby Reder, Shelly Steward, and Natalie Foster, *Designing portable benefits: A resource guide for policymakers,* Aspen Institute, June 2019.
[109] Conor McKay, Ethan Pollack, and Alastair Fitzpayne, *Automation and a changing economy part II: Policies for shared prosperity*, Aspen Institute Future of Work Initiative, April 2019.

Retraining opportunities need to be widely accessible

Workforce skills have been a growing concern in the United States for many years.[110] Now technology demands new and higher-level skills, including more critical thinking and judgment, creativity, and socioemotional skills. The skills needed in fast-growing STEM roles, in particular, are continuously evolving.

Millions of midcareer workers will need new skills to remain in the workforce, and their prospects for moving into better jobs will often hinge on acquiring more technical and specialized skills. Making effective job training programs available to anyone who needs them will be a priority across the country. Employers will be the natural providers of training and continuous learning opportunities for many workers (see Chapter 5 for more on this topic, including multiple examples of how some large corporations are already moving on this front). Because the business case is not always clear for companies to undertake training programs, policy makers can consider creating new incentives for workforce training, just as they have done for R&D and capital investment and for co-funding for apprenticeships. Individuals who need to find positions with new companies or switch occupations will require opportunities outside the workplace. All levels of government, nonprofits, education providers, and industry groups will have a role to play (see Box 7, "Expanding postsecondary education opportunities").

This task is complicated by the fact that there are few successful large-scale models on which to draw. Over the years, a great deal of funding has gone into efforts that have failed to produce effective results.[111] A recent study by the Government Accountability Office found that there were 43 federal employment and training programs spanning multiple agencies and backed with $14 billion in funding; many of them have overlapping mandates. Agencies have taken steps to increase coordination, but these efforts have not been studied in a formal way.[112]

Using data to track real-world employment outcomes is critical for channeling funding and resources into what works as well as enabling individuals to make more informed choices about their own training and careers. The most effective programs will need to be expanded and replicated across cities, counties, similar community archetypes, and industries. Employer involvement, whether by individual companies or industry associations, is important to making programs relevant and successful.

Midcareer workers attempting to stay relevant in the workforce need to pay their bills and put food on the table while they are preparing for their next move. Short-term training programs, measured in weeks or months, are critical, because most adults will not have the luxury of returning to school for years at a time. Boot camps, online learning, and "nanodegrees" are all options, along with subsidies for individuals undertaking such training.

Many pilots in flight

Across the country, numerous industry-specific training programs delivered through local educational institutions have resulted in job placements. Georgia's QuickStart, for instance, is a state-funded initiative that provides customized workforce development training at no cost to qualified businesses; it includes training in industries such as advanced manufacturing and bioscience.[113] In Pennsylvania, the University of Pittsburgh's graduate business school has begun offering "micro-credentials" in fields such as accounting and data programming for business insights, while the Community College of Allegheny County has announced the

[110] See Dominic Barton, Diana Farrell, and Mona Mourshed, *Education to employment: Designing a system that works,* January 2013, McKinsey.com.

[111] See, for example, Jeffrey Selingo, "The false promises of worker retraining," *The Atlantic,* January 8, 2018; and Glenn Thrush, "$1.7 billion federal job training program is 'failing the students,'" *New York Times,* August 26, 2018.

[112] *Employment and training programs: Department of Labor should assess efforts to coordinate services across programs,* US Government Accountability Office, report to the Permanent Subcommittee on Homeland Security and Governmental Affairs, US Senate, March 2019.

[113] See https://www.georgiaquickstart.org/.

construction of a new high-tech collaborative workforce training facility focused on high-demand fields such as information technology and healthcare.

Some companies are underwriting programs as part of their corporate social responsibility efforts. The Grow with Google initiative, for example, is focused on expanding skills training and job opportunities across the United States through new partnerships and funding for existing programs. Some of the early grants have gone to establishing digital career accelerators in 126 Goodwill locations nationwide; providing IT training and career coaching to veterans; connecting military spouses with work-at-home opportunities; and piloting technology programs in 50 underserved middle schools. Walmart and the Walmart Foundation have provided grants to the California Community College system, Code for America, and edX.org to create flexible online microcourses for adults.[114]

A number of large employers have also begun to offer tuition reimbursement to help their employees further their education and prepare for better-paying opportunities. McDonald's, for example, created the Archways to Opportunity program to help its employees improve their English, earn a high school diploma, or work toward a college degree. Anthem Blue Cross and Blue Shield offers employees the chance to earn a free online degree from Southern New Hampshire University, while Starbucks does the same with Arizona State University. Walt Disney's Aspire program offers the company's hourly employees 100 percent of tuition plus reimbursement for books and fees. Its options include English language classes, high school equivalency courses, vocational training, and college curricula at partner institutions such as the University of Central Florida. Since the program launched in 2018, more than 6,000 employees have begun taking classes.[115] Other large employers offering tuition reimbursement include Dunkin' Brands, Home Depot, JetBlue, Lowe's, Publix, Taco Bell, and UPS.

But the scale of what is needed goes beyond what individual companies can do on their own. Other models are needed to help millions of individuals make career moves. Government, industry associations and employers, unions, and education providers can partner to create not only one-off programs but broader ecosystems of training and lifelong learning. The Rework America Business Network, for instance, is a coalition of large employers focused on developing more innovative hiring and training practices.[116] The nation's community college systems are natural delivery platforms, and employers can team up with local institutions to design career-relevant curricula. Online learning is another possibility for scaling up effective programs. Coursera, for example, offers an eight-month Google-designed IT support certificate program that has drawn tens of thousands of trainees.[117] Udacity, another online learning company, offers "nanodegrees" in areas including data science, programming, and cloud computing.

[114] "Walmart and the Walmart Foundation announce nearly $4 million in grants to create innovative pathways for lifelong learning and training," press release, Walmart, October 9, 2018.
[115] Jenni Fink, "Free college: More than 53,000 Disney employees can attend University of Central Florida," *Newsweek,* May 24, 2019.
[116] See https://www.markle.org/RABN.
[117] Sandra Upson, "Tech companies try to retrain the workers they're displacing," *Wired,* March 16, 2018.

Box 7

Expanding postsecondary education opportunities

Although education is not a perfect proxy for these skills, four-year college degrees still confer a wage premium on employees and offer a ticket to upward mobility in the United States. College attainment has been rising for all demographics, but not equally. From 2008 to 2018, the share of people aged 25 to 29 that had completed at least four years of college rose from 12.4 to 20.7 percent for Hispanics, 20.6 to 22.3 percent for African-Americans, 31.1 to 37.9 percent for whites, and 59.4 to 69.5 percent for Asian-Americans.[1]

For students not pursuing a college degree, some other type of postsecondary credential is becoming essential. The nation needs a much wider variety of well-established learning pathways, including technical schools, industry credentials, online nanodegrees, and apprenticeships.

Even before students reach the postsecondary stage, the nation's K-12 system needs to deliver stronger foundational skills. Once students reach high school, creative ways to begin layering in more vocational skills and exposure to new career paths are available. IBM saw a shortage of programmers in its New York offices and worked with the New York City Department of Education to create a new type of charter school called P-Tech. This six-year program offers students a high school diploma plus a two-year degree in a STEM field. It has now expanded to more than 100 schools in four countries and offers students from all backgrounds not only essential degrees but mentoring and internships with a local company, giving many program participants their first glimpse of a professional work environment. The Texas state legislature recently provided state funding to expand P-Tech schools across the state. Early College High Schools, with 280 locations, are a similar model, offering community college courses to high school students.

Apprenticeships offer another pathway to gaining critical technical skills. In Germany, for instance, nearly half a million students enter the workforce through apprenticeship programs, dividing time between high school and experiential learning in the workplace. Colorado modeled its CareerWise apprenticeship program on a Swiss system that sends 70 percent of students to an apprenticeship instead of directly to college. A recent report by the USDA Task Force on Agriculture and Rural Prosperity cited a particular need for apprenticeship programs to help rural counties develop more talent in healthcare and skilled trades.

Individual companies and industry associations can take the lead in developing similar programs in partnership with community colleges. Toyota's Advanced Manufacturing Technician program, for example, integrates a two-year technical degree program with paid part-time employment; it is offered at community colleges across multiple Midwestern and Southern states.[2]

A final part of the challenge will be getting Americans used to the idea of periodically reinventing themselves—that is, creating a mind-set of "lifelong employability." Education cannot only be front-loaded early in life: individuals will need to take it upon themselves to remain employable for as long as they want to stay in the workforce.[3] Governments and nonprofits can work with education providers to build new and easily accessible courses for lifelong learning.

1 Current Population Survey, US Census Bureau.
2 Laura Putre, "Building a better advanced manufacturing workforce," IndustryWeek, May 17, 2016.
3 Beth Davies, Connor Diemand-Yauman, and Nick van Dam, "Competitive advantage with a human dimension: From lifelong learning to lifelong employability," *McKinsey Quarterly,* February 2019; *Addressing America's reskilling challenge,* US Council of Economic Advisers, July 2018.

Programs tailored to specific demographics

Efforts by industry may not be enough to meet the nation's training needs. As this research shows, automation will have different effects on various demographic groups. A program designed to help young food service workers in Los Angeles gain new skills may not resonate with manufacturing workers over age 50 in Ohio. Amy Goldstein's *Janesville* recounts how laid-off GM workers in Wisconsin flocked to training opportunities at a technical college, but many dropped out when they discovered the course had an online component. Many had never learned to use a computer.[118] Local knowledge and real empathy are key; programs have to meet participants where they are. Some may need to include remedial reading, writing, and math as well as baseline digital usage.

4x

higher displacement risk for workers with high school diplomas or less

Some programs around the country are geared to specific demographic groups and their needs. The Greater Dubuque Development Corporation has begun providing free childcare to parents attending job training, for instance, while New York's LaGuardia Community College offers free English classes, job training, and career counseling to low-income immigrants.

The millions of Americans who did not complete high school will be hit hardest by automation—and they are shut out of many opportunities. The Michigan 23+ program aims to reach them with an online program offering high school diplomas, workforce credentials, guidance in juggling coursework and family demands, and job placement.

Some 11.5 million workers over age 50 are at risk of being displaced, and many need to continue working to bolster retirement savings. The AARP Foundation launched the Back to Work 50+ program to help older workers train for positions that are in demand and update their job-hunting techniques. The program is available through community colleges, workforce investment agencies, and nonprofits in 28 locations nationwide.

The American Association of Community Colleges has a Plus 50 initiative, supporting hundreds of individual institutions across the country with grants to create or expand workforce training programs that engage participants over age 50. Based on feedback from students, the association has realized that older learners value flexibility, the chance to ask questions, interaction, and clear outcomes that result in credentials. The programs include ongoing professional development for instructors to continuously improve effectiveness. The modules also include math and English refresher courses for those who need them and the ability for those who do not to place out of them.[119]

A nonprofit initiative founded by McKinsey and other organizations called Generation targets unemployed youth worldwide. In the United States, it operates in 11 cities, training young people for jobs such as hospitality worker, cloud support engineer, and IT help desk technician. The program works with employers to identify the essential skills new employees need, then distills those skills into short-term four- to 12-week technical training courses, accompanied by mentorship and placement services with partnering employers. A related program called ReGeneration targets midcareer workers, helping them earn industry certifications and providing placement services for jobs in healthcare and IT services.

The nonprofit Per Scholas offers free 15-week intensive training courses designed in collaboration with corporate partners. The group focuses on preparing underprivileged women and people of color for careers in tech; it screens participants to find people with innate drive and intelligence, helps them with job placement, and provides two years of follow-up support.[120]

[118] Amy Goldstein, *Janesville: An American Story,* New York, NY: Simon & Schuster, 2017.
[119] *Plus 50 programs in practice: How AACC's Plus 50 initiative is helping community colleges transform programs and services for adults age 50 and over,* American Association of Community Colleges, Lumina Foundation, and Learning for Action, January 2015.
[120] See perscholas.org.

Struggling places need reinvigorated economic development approaches

Every community, from the most dynamic to the most distressed, faces economic development issues that will need to be solved at the local and regional level. Even in thriving urban areas, automation could disproportionately hit disadvantaged populations, and local leaders cannot underestimate the work it will take to connect them to new opportunities. But in general, cities have resources, density, networks, and investment flows on which to draw. Their rates of new business formation are higher, and a more diverse mix of industries makes them more resilient. Their key challenges include not only creating opportunity for marginalized workers but also expanding public transportation and affordable housing.

Reinvention will be a harder task for trailing cities, some manufacturing towns, and rural counties that never bounced back from the Great Recession. Many of these areas lack an economic growth engine and the inflows of investment to create new jobs. No amount of workforce retraining can be effective if jobs do not exist to be filled. With shrinking populations and tax bases, these locations may find funding stretched for schools, hospitals, emergency services, and infrastructure. Rural areas and trailing cities may be hard pressed to attract some of the professionals they need, particularly healthcare and digital specialists. Individual companies can help to ease these strains by considering whether there is a business case for establishing operations in more affordable parts of the country that need the investment, provided they offer sufficient talent and infrastructure.

Turning around a local economy is a multiyear journey that requires a combination of local economic development efforts, private-sector involvement, and state and local funding. Revitalizing America's smaller towns and areas is important for relieving the pressures of congestion and soaring housing costs in high-growth cities, and cities themselves have a stake in sharing resources and participating in rural redevelopment coalitions where they can. While each community will need to forge a unique path, they can take some common actions (see Box 8, "Reborn in the USA").

Every rural community (and trailing city, for that matter) will have to take a realistic inventory of its assets, such as available industrial space, potential tourist attractions, educational institutions, and specialized workforce skills. That data can form the basis of a clear-eyed plan, built around a growth engine industry that can create jobs and spillover effects. Manufacturing is not the only option. Another idea would be attracting service centers, including those for basic IT support. Rising wages in emerging economies and high churn rates are making offshore service and call centers less attractive to companies, and lower-cost rural areas of the United States can be attractive alternatives.

Once a given community decides to build a future around certain industries, the next step is considering what kind of investment it will take—and the answer will vary by industry. Going after tourism may entail rebranding, hotel construction, and revitalization of key neighborhoods and attractions. Pursuing certain manufacturing industries may require developing new types of workforce skills, forming R&D and training partnerships with local educational institutions, and expanding logistics infrastructure.

Many local governments have relied on subsidies and tax breaks to attract new businesses. Such incentives have tripled as a share of GDP since 1990, even though they show little correlation to economic gains.[121] Subsidies may be part of the tool kit, but they need to be backed by a rigorous business case and used in support of a more holistic economic development plan. Most subsidies are geared to greenfield investment, but new construction is not the only answer. Incentives for brownfield investment could help legacy firms modernize and grow, making existing plants and facilities more productive.[122] It is also possible to attract core employers with compelling value propositions rather than tax incentives, perhaps based

[121] Timothy J. Bartik, "A new panel database on business incentives for economic development offered by state and local governments in the United States," Upjohn Institute, prepared for the Pew Charitable Trusts, 2017.
[122] *Making it in America: Revitalizing US manufacturing,* McKinsey Global Institute, November 2017.

Box 8
Reborn in the USA

The challenges of declining places are daunting—but not insurmountable. Some stories of successful reinvention from around the country offer models that other communities can follow. One clear lesson is that attracting a company in a growth industry can spark job creation and enable growth in services, enabling further diversification that makes the local economy more resilient. In all cases, the local mayor, government, businesses, and other community leaders worked together.

Akron, Ohio (stable city; pop. 703,000)
Once the center of a thriving rubber industry, the city watched that traditional employment base wither to just 5,000 workers in the 1990s. But it stabilized by taking a sector-specific approach to revitalization. The University of Akron, local government, and local employers joined forces to put Akron's rubber expertise to work in an industry of the future. Akron developed a new but related specialty in polymers, with positive spillover effects for the state as a whole.

Today Ohio has roughly 1,300 companies specializing in polymer and special chemistry; together they employ more than 88,000 people. Akron is one of three Ohio metro areas with positive population growth since 2000. It was relatively insulated during the Great Recession, losing just 1.5 percent of employment from 2007 to 2012.

The polymer industry grew out of research at the University of Akron and the university's commitment to driving economic development and innovation through spin-offs and startups. Anchor employers also played a role. Goodyear funded a polymer science center in 1990 and established its new world headquarters in Akron in 2013. Government efforts such as Ohio's Third Frontier provided funding to cultivate the materials science technology industry and seed a community of startups.[1]

Duluth, Minnesota (independent economy; pop. 236,000)
In the late 1990s, Duluth was experiencing the same kind of distress and decline that was afflicting the broader Rust Belt.[2] But the city's mayor led efforts to attract Cirrus Aircraft, an aviation company that employed hundreds of advanced manufacturing workers. It was a pivotal first step in Duluth's shift away from heavy industries such as steel, lumber, and concrete. That first anchor company soon produced spillover effects, attracting engineers, designers, and customers as well as other aviation businesses. United Healthcare set up a service center employing over a thousand people. Today the city's economy has diversified into advanced manufacturing, education, medicine, and outdoor recreation that revolves around the natural beauty of its setting on Lake Superior. Duluth's GDP per capita is just over $51,000, well above the segment average of $46,800.

Reno, Nevada (small powerhouse; pop. 449,000)
Home to both Reno and the less flamboyant city of Sparks, Washoe County flourished as a gambling hub until the 2008 recession crippled that economy. Caught in a housing collapse, Reno bled construction jobs, and the city government was forced to cut one-third of its workforce. By 2011, the city of Reno was on the brink of insolvency.

The tech industry was its lifeline. Washoe County positioned itself as a lower-cost alternative to Silicon Valley, touting lower housing and labor costs. Many tech companies were convinced, saying an additional reason for their relocation was Reno's relative proximity to Silicon Valley, which is about an hour away by plane. In 2012, Apple announced plans to invest $400 million in building a data center in neighboring Storey County; in 2014, Tesla announced plans to build a battery manufacturing plant there. The tech gamble has paid off handsomely. The county gained 11 tech companies and 15 corporate headquarters in 2018 alone. The Reno/Sparks economy added 2,000 jobs in 2018, and the average wage jumped 40 percent over 2016.

Since 2012, GDP has grown by 3 percent and employment by 4 percent. Today, Reno has an entrepreneurial culture—although population and wage growth have once again boosted housing prices. In a remarkable comeback story, Reno has become one of our small powerhouse economies.

1 Antoine Van Agtmael and Fred Bakker, "How cities can use local colleges to revive themselves," *The Atlantic*, March 29, 2016.
2 James Fallows and Deborah Fallows, *Our Towns: A 100,000-Mile Journey into the Heart of America,* New York, NY: Pantheon Books, 2018.

on land, zoning, or a talent pipeline coming out of a local community college. Getting local employers involved in strengthening their community's school systems and presenting career options to the next generation can be a win for everyone involved.

Another important area of focus is creating local startup ecosystems. Local governments and anchor companies can support entrepreneurs by establishing incubators that offer networking opportunities, coaching, exposure to new technologies, and access to seed funding.

Almost every city and county has pockets of poverty that need special attention.[123] It may take extra investment and targeted efforts (such as blight removal, home and infrastructure repair, and additional community services) to stabilize the most distressed neighborhoods. One potential tool for states is the creation of Opportunity Zones.[124] This community redevelopment program, a provision of 2017 tax reform legislation, is a mechanism for pooling capital from investors with unrealized capital gains. There have been concerns that the terms defining the 8,700 eligible zones nationwide are overly broad, which could allow funding to go to areas where the need is not acute.[125] Our own analysis indicates that only 5 percent of the 8,700 eligible zones nationwide are in trailing cities and 30 percent are in rural counties; the share in distressed Americana counties is actually lower than the share in somewhat better-performing Americana counties.

But for states that target their funding requests wisely and creatively, Opportunity Zones can unlock scarce capital and help to bring developers and private investors into long-neglected areas. To give just one example, Virginia designated the Southwood community near Charlottesville, where Habitat for Humanity had already purchased and stabilized a large mobile-home community, as an Opportunity Zone. The resulting funding is being used for additional community projects, including hundreds of new affordable housing units, as well as business development support for neighborhood entrepreneurs.[126]

The investment necessary to develop anchor industries and generate jobs does not have to come from within the United States. Many of the regions that have lost manufacturing jobs still have pools of highly experienced workers, long-lived small and midsize firms, advanced technical know-how, and industrial and research facilities. These make them attractive destinations for foreign direct investment. While cities and regions themselves can do more to attract this investment, the federal government can also facilitate matches.

The growing acceptance of remote working models (whether full-time work-at-home employee roles or contract work) could be a positive trend for creating jobs beyond major cities. But it will take a push to continue building out fast, affordable broadband in the regions that still need service. Providing backbone digital infrastructure could make remote working options feasible for more workers and make it possible for rural America to attract and retain more professionals. The Rural Innovation Initiative, recently launched in nine communities nationwide, is building outposts for workers in the downtowns of rural cities, aiming to educate and train local residents in digital skills, employ them in new economy jobs, and empower them to launch startups.[127]

[123] Raj Chetty, Nathaniel Hendren, and Lawrence F. Katz, The effects of exposure to better neighborhoods on children: New evidence from the Moving to Opportunity experiment, August 2015.
[124] JP Julien, Mike Kerlin, Ben Safran, and Rachel Schaff, "Making the most of US Opportunity Zones," April 2019, McKinsey.com.
[125] See Samantha Jacoby, *Potential flaws of Opportunity Zones loom, as do risks of large-scale tax avoidance,* Center on Budget and Policy Priorities, January 2019; and Hilary Gelfond and Adam Looney, *Learning from Opportunity Zones: How to improve place-based policies,* Brookings Institution, October 2018.
[126] Kathy Orton and Samantha Schmidt, "In an old mobile-home park in Virginia, the residents get a say in the redevelopment," *Washington Post,* June 6, 2019.
[127] See ruralinnovation.us/rural-innovation-initiative.

Workers need support to prepare for new opportunities

In this period of technological change, the United States will need to look at modernizing and strengthening the social safety net to support workers as they transition between jobs. Workers displaced from full-time roles experience an average 35 percent loss of earnings, due to gaps in employment or working fewer hours at a new job.[128] Some of the people most likely to be affected are already living paycheck-to-paycheck. For them, even a short period of disruption could provoke tremendous stress.[129]

Supporting them can take many forms: longer and more flexible income support programs during periods of unemployment, relocation assistance, training grants, and earned income tax credits. Currently, less than 30 percent of unemployed workers receive any type of benefits.[130] Because unemployment insurance is administered at the state level, this area is a particular opportunity for state governments to innovate and lead. Employer tax incentives to offer job retraining could help to head off some potential displacements before they occur.

Portable benefits—tied to the worker rather than the employer—could offer stability to people who need to move between opportunities and geographies. Benefits could be universal for full-time, part-time, and independent workers, and they could be prorated so that contributions are tied to hours worked for different employers. A broader system of portable benefits can offer more stability and free more Americans to strike out on their own and become entrepreneurs.

Wages and purchasing power are real concerns. Although a tighter labor market may increase wage growth in the short term, it will take sustained growth to counter the trend of wage stagnation, which dates to the 1980s.[131] In the decade ahead, if displacement leaves more uncredentialed workers competing for the jobs that remain, this surplus labor could flood the market and again drive down wages at the lower end of the pay scale. Policy makers and employers alike cannot ignore the implications if a large share of the population is falling behind.

The automation age threatens to deepen existing disparities in the United States. But it could also create better, more interesting jobs and boost productivity at the national level. Making the most of these technologies and making economic growth more inclusive do not have to be mutually exclusive goals. The United States will need a set of bold, holistic programs and a new commitment to investing in people and education. It will also need the combined energy and ingenuity of many local coalitions from coast to coast. There is a great deal at stake. Ensuring dignity and opportunity for workers during this period of technological disruption will have major implications for the social fabric that binds the nation together and for the health of democracy.

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[128] Henry Farber. "Employment, hours, and earnings consequences of job loss," *Journal of Labor Economics.* Volume 35, number S1, July 2017.

[129] Conor McKay, Ethan Pollack, and Alastair Fitzpayne, *Automation and a changing economy, Part I: The case for action,* Aspen Institute Future of Work Initiative, April 2019.

[130] The average recipiency rate—the share of unemployed workers receiving unemployment insurance benefits—was 28 percent in 2018 based on data through November. Employment and Training Administration. "Unemployment Insurance Chartbook." US Department of Labor. https://ows.doleta.gov/ unemploy/chartbook.asp.

[131] Jay Shambaugh et al., *Thirteen facts about wage growth,* The Hamilton Project, Brookings Institution, September 2017.

Technical appendix

This appendix provides additional detail on the methodologies and data sources employed in the report. Specifically, it includes the following topics:

1. Data and models
2. County and city segmentation
3. Additional analyses
4. Potential limitations

1. Data and models

Several data sources and models were critical to our analysis. Our report includes projections from a starting point in 2017, since much of the public data required was not yet available for 2018 or 2019. Some of our analysis used 2016 data, which we harmonized to 2017 based on historical trends.

County- and city-level data sources
We built extensive county- and city-level data sets, covering 3,113 counties and 315 cities.[132] We pulled more than 600 statistics from public and private data sources, grouping them into the following categories: development indicators, economic health, labor market, industry mix/business dynamism, innovation, and socioeconomic factors. Public data sources include the US Census Bureau's American Community Survey (ACS) and the US Bureau of Economic Analysis. Private data sources include Economic Modeling Specialists International (EMSI) and Moody's. Many of the statistics in these data sets became key variables used in our segmentation. (See below for more on the methodology used for our county and city segmentation.)

National occupational data
Every two years, the US Bureau of Labor Statistics publishes the National Employment Matrix (NEM), with current employment data by occupation as well as ten-year occupation projections that assess the impact of current trends on future employment. Unlike the BLS Occupational Employment Statistics (OES), the NEM includes self-employed workers, unpaid family workers, agriculture/fishing/forestry/hunting workers, and government employees. Because the most recent NEM data was published in 2016, we annualized the BLS projected growth rates between 2016 and 2026 to scale employment numbers to 2017. From this, we modeled total US jobs in 2017 to be 157 million.

County-level occupational data
For detailed 2017 county-level occupational data, we distributed national NEM numbers to the county level based on the share of an occupation's jobs in a county, calculated using a new McKinsey Global Institute asset, LaborCube. Using OES employment data for metropolitan and micropolitan areas from the BLS and county-level employment data by industry from Moody's, LaborCube distributes jobs to the county level via a statistical technique known as the RAS method. LaborCube includes additional county-level Integrated Public Use Microdata Series data (methodology explained under "National and county-level demographic data") on self-employment to mitigate differences between the

[132] Based on Moody's county FIPS codes, available for all 3,143 US census counties.

OES and NEM as well as other ACS data to highlight additional county-level variations in occupational composition.

County-level economic growth rates
County economic growth rates are central to our understanding of how individual locations fare in job creation. To arrive at its county-level employment forecasts, Moody's takes state GDP forecasts, county population trends, and county industry composition to arrive at county GDP forecasts. From there, it applies a regression to model the historical relationship between the county's GDP and employment. We use the Moody's forecasts by county to size the 2030 workforce, and then use our national employment models to identify the change in occupations over time. Because both of them consider the role of increased productivity on employment growth, it is possible that we overstate total employment growth.

National and county-level demographic data
For all demographic analysis on the US workforce, we used 2017 microdata from the US Census Bureau's five-year American Community Survey through the Integrated Public Use Microdata Series (IPUMS). At a national level, we mapped this data to the BLS NEM by mapping between US Census occupational codes (OCC codes) and BLS SOC codes. Because this mapping is not one-to-one, the share of 2017 jobs held by a demographic may vary slightly from what is reported elsewhere.

We used this microdata to derive county-level occupational demographic statistics. The most granular regional data reported is at the level of a Public Use Microdata Area (PUMA), a geographic unit used by the US Census Bureau that contains at least 100,000 people. We overlaid counties onto PUMA tracks using advanced geospatial analytics to determine what share of a PUMA's population was in each county. To derive county-level occupational demographic statistics, we then distributed survey responses to all counties within a PUMA, weighting responses based on the share of a PUMA's population in that county. To limit small sample sizes, we analyzed the demographic composition of the workforce at the level of 16 occupational categories for counties rather than individual occupations. In other words, we can understand the number of African-American workers in customer service and sales roles within a given county, for example, but not the number of African-American cashiers.

MGI's Automation Adoption Model
MGI has developed detailed models showing the automation potential of various work activities as well as different scenarios for rates of adoption. This report builds on these models and our prior research into automation, with a deeper focus on US trends.

Our 2017 report *A future that works: Automation, employment, and productivity* assessed the underlying work activities of each occupation, using databases published by institutions including the US Bureau of Labor Statistics and O*Net. Breaking down more than 800 occupations into more than 2,000 activities, we identified the capabilities required to perform these activities (for example, the activity of greeting customers requires natural language understanding, sensory perception, and social and emotional sensing).

We then compared these capabilities to those of demonstrated automation technologies, including robotics (machines that perform physical activities) and artificial intelligence (software algorithms that perform calculations and cognitive activities). The share of activities that can be performed by automation technologies defines each occupation's "technical automation potential." We then considered additional factors influencing the timing of automation and its impact on an occupation, including the technology's development timeline, economic feasibility, and end user adoption rate. The "displacement rate" cited in this report refers to the share of activities that are likely to be automated given these additional considerations.

We evaluated the displacement rate of an occupation in three scenarios: an early adoption scenario with an accelerated timeline, a late scenario in which end users are slow to incorporate automation technology into their business operations, and a midpoint scenario. All analyses in this report are based on the displacement rate in the midpoint scenario, which provides a moderate view of the automation timeline in the center of two extreme cases (Exhibit A1).

In addition to factors such as technical feasibility and social and regulatory acceptance, companies decide whether to adopt automation technologies based on the cost of these systems versus the cost of labor. Where wages are relatively low and systems are expensive, companies have fewer incentives to automate. But where wages are high, the incentive to automate is greater, particularly as the price of automation systems falls.[133] Previous MGI reports analyzed this dynamic at a national level only. For this report, we incorporated regional wage differences to offer a more granular view of how the impact will vary at the city and county level across the United States. Exhibit A2 shows the extent of differentials in average salary in 16 job categories across regions and in urban versus rural areas.

Because of this variation, we ran eight analyses of our automation and adoption research, using average annual occupational wage rates in urban and rural areas of the Midwestern, Northeastern, Southern, and Western regions of the United States.[134] We used our findings to size the number of jobs that could be automated by 2030. We assumed that each hour of work that could be automated will result in proportional job loss. For example, if 10 percent of current work hours in an occupation could be displaced, then 10 percent of jobs will be displaced, as fewer workers are needed to complete all required activities.

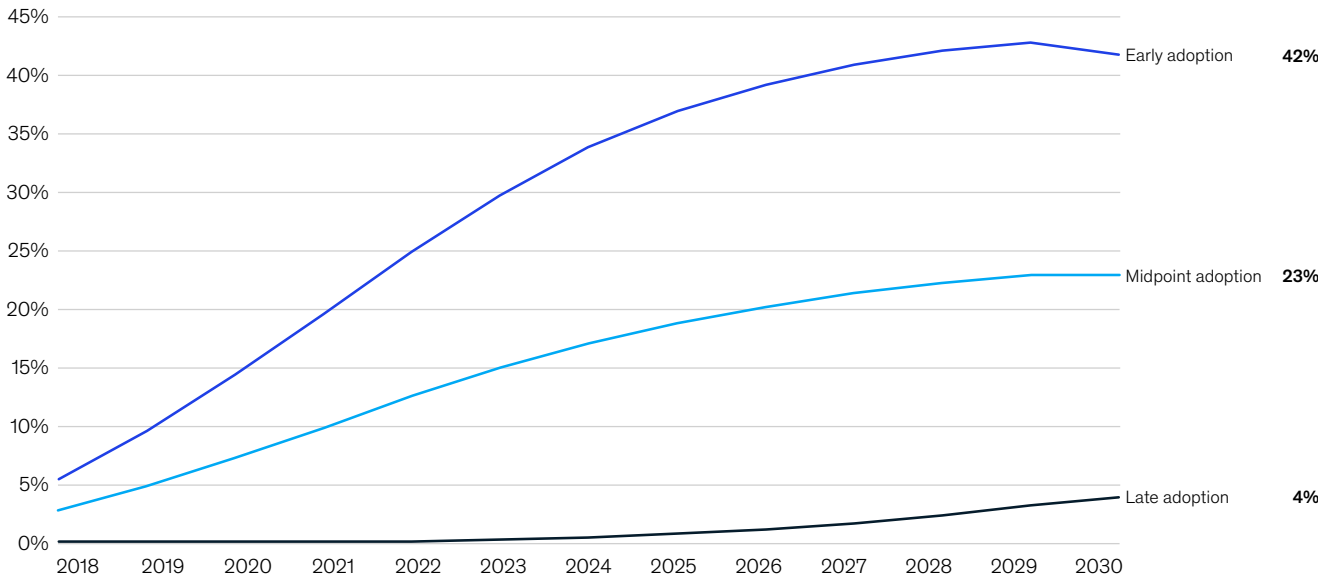
Because displacement from automation will happen over time to a growing and changing labor force, we first model the expected growth of an occupation to 2030 without the impact of automation, then apply the displacement rate to the outcome. Consequently, for a given

[133] Daron Acemoglu and Pascual Restrepo, *The race between machine and man: Implications of technology for growth, factor shares, and employment*, NBER working paper number 22252, May 2016, revised June 2017.
[134] Based on BLS OES 2017 wage data for metropolitan and micropolitan areas.

Exhibit A1

In our midpoint adoption scenario, 23 percent of work activities in the United States are automated by 2030.

Percent of time spent on existing work activities that could be automated, by automation adoption scenario, 2018–30



Source: McKinsey Global Institute analysis

Exhibit A2

Wages differ by region across occupational categories.

Average[1] annual salary, $ thousand

Min Max

	Northeast		West		Midwest		South	
Job category	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Builders	59.5	48.1	54.3	50.4	54.3	45.5	43.3	40.0
Business/legal professionals	85.4	71.9	80.5	62.7	73.2	59.7	75.5	58.3
Community services	49.9	47.9	51.5	46.7	45.1	41.6	43.8	38.6
Creatives and arts management	63.0	45.6	59.2	35.8	47.2	32.2	52.3	35.5
Customer service and sales	32.3	30.2	32.2	29.0	30.1	27.2	29.0	25.5
Education and workforce training	64.0	55.1	57.8	46.4	52.9	45.3	52.4	43.5
Food services	27.1	25.4	27.6	25.8	23.5	22.6	23.4	21.2
Health aides, technicians, and wellness	36.6	34.5	37.5	33.6	34.3	31.2	33.9	29.0
Health professionals	99.7	92.7	104.6	87.4	89.5	76.4	89.2	75.1
Managers	140.5	107.7	122.0	87.9	112.6	86.2	118.7	86.9
Mechanical installation and repair	50.6	47.3	50.4	48.4	47.2	44.2	45.3	41.5
Office support	43.3	39.1	42.5	36.0	39.0	33.4	39.0	31.9
Production work	38.2	38.1	37.0	40.0	36.5	35.7	35.6	33.0
Property maintenance and agriculture	32.7	30.3	30.2	29.6	28.2	27.2	25.8	24.6
STEM professionals	91.5	81.2	98.6	64.7	82.2	66.2	89.6	63.7
Transportation services	40.9	37.3	40.0	40.1	38.4	36.5	37.4	34.5

[1] Employment-weighted average.

Source: BLS Occupational Employment Survey 2017; McKinsey Global Institute analysis

occupation in a county, we multiply 2030 employment by one of eight different displacement rates, depending on what region the county is in and whether it is an urban or a rural county.[135]

In addition to the changes described above, we updated the displacement rates of nine occupations in our existing model to reflect recent developments in autonomous vehicle adoption.

MGI's Jobs Gained Model

To model job growth net of automation in the years through 2030, we continued to adapt the methodology and findings of MGI's December 2017 report *Jobs lost, jobs gained: Workforce transitions in a time of automation*. The work's full methodology is detailed in its technical appendix. We provide a summary of the seven key catalysts for growth below and detail additional updates.

MGI's prior research posited that labor demand between 2017 and 2030 is affected by seven main drivers:

— **New technology:** Digital and environmental innovation will drive demand for STEM professionals to work in technical areas (e.g., software developers, electrical engineers, aerospace engineers).

— **Energy transitions and efficiency:** Development of new energy sources may require STEM research and infrastructure, resulting in more jobs focused on sustainable

[135] To delineate urban versus rural counties, we relied on county-level USDA classifications.

energy (e.g., nuclear engineers, solar photovoltaic installers, environmental engineering technicians).

— **Healthcare:** An aging population, paired with increased healthcare investment, may result in increased need for health professionals (e.g., registered nurses, audiologists, surgeons).

— **Infrastructure investment:** As the country invests in repairing current assets and building out new infrastructure, it will need more workers laying this groundwork (e.g., insulation workers, materials engineers, iron and steel workers).

— **Residential and commercial buildings:** With a growing population comes the need for more living and working space, resulting in the need for more builders (e.g., roofers, fence erectors, construction laborers).

— **Rising incomes:** As technological developments increase productivity, the average American income will increase, allowing more to be spent on personal services and leisure (e.g., interior designers, entertainers and performers, animal caretakers).

— **Marketization of previously unpaid work:** Although we do not include this in our jobs gained estimates, new paid jobs, highlighted by the gig economy, may substitute for currently unpaid work, much of which is domestic work such as childcare and cooking.

In addition to the catalysts driving job growth described above, we adjusted job growth for 40 occupations based on other recent trends. The primary changes were based on the prevalence of e-commerce and new consumer delivery models as well as issues such as climate change, the shift toward alternative energy sources, and public health trends. We referenced the BLS national employment 2026 projections for guidance on how affected occupations are expected to grow.

We also manually adjusted the modeled growth rate down to zero for 35 occupations that have been declining over time and for which the BLS projects continue to decline. These include switchboard operators, locomotive operators, sewing machine operators, and others. Many of these have already declined because machines produce more output with the same amount of labor.

A core assumption of our modeling was that, just as has happened in all previous technological revolutions, there will be enough demand for labor for the United States to be at or near full employment (barring an economic downturn). Historical analysis suggests that we could expect 8 to 9 percent of 2030 labor to be in new jobs relative to today.[136] Because we cannot predict what specifically these new occupations are, we assumed these roles will have the same occupational mix as the 29 million jobs gained from our revised Jobs Gained model. Likely, several of these jobs would stem from current occupations but would split off and form new occupations in the future.

To localize job growth projections, we distributed our national estimates of jobs gained based on the share of an occupation in each county, determined by LaborCube. For example, if an occupation gains 100 jobs and a county had 2 percent of that occupational distribution in 2017, the county would gain two jobs in that occupation in the future.

When combined with the output from the Automation Adoption Model and the new worker estimates (calculated using county growth rates from Moody's), this exercise enabled us to calculate projected net job growth by county.

[136] *Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages,* McKinsey Global Institute, November 2017.

MGI's Skill Shift Model

To understand the evolving demand for certain types of workforce skills, we continued to adapt the methodology and findings from MGI's May 2018 report *Skill shift: Automation and the future of the workforce*. Its full methodology is detailed in that report's technical appendix. We focused on the United States as a whole, using 2017 employment and 2030 employment projections from the analysis on automation-related job displacement and job growth models described above.

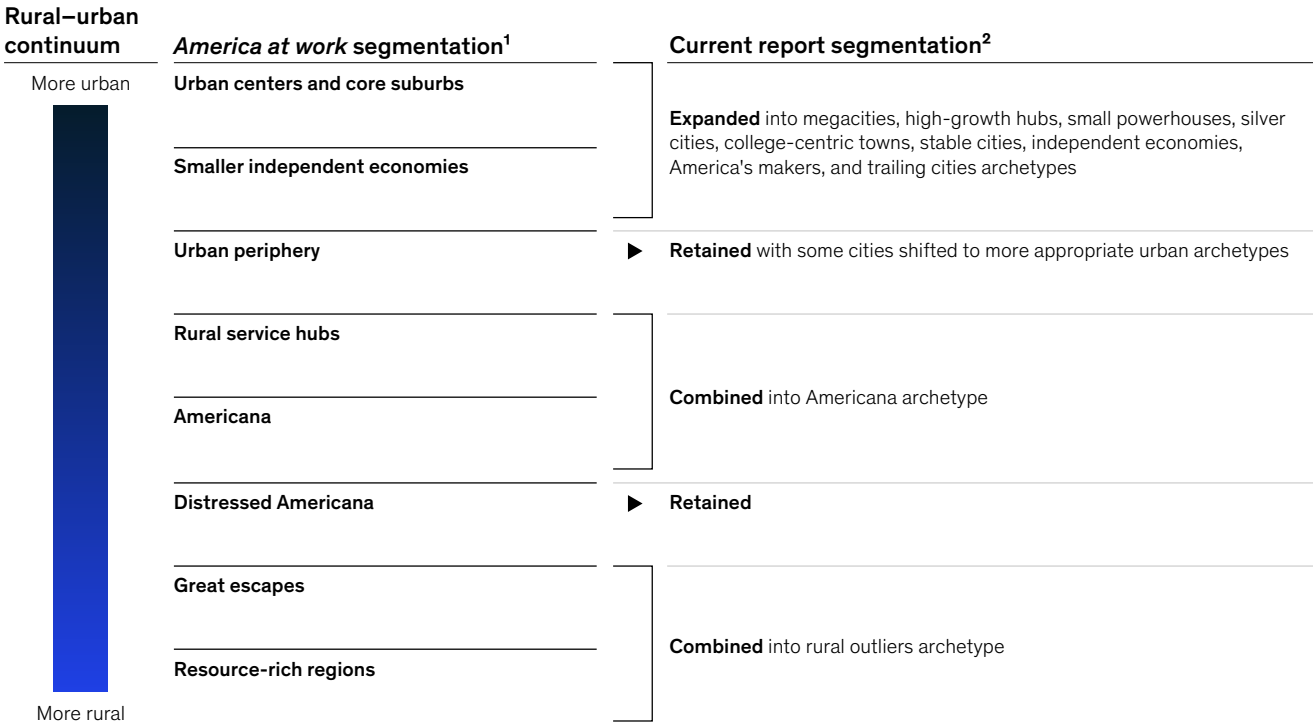
In addition, we made two key changes to the model. First, we considered displaced activities from automation both for jobs that are lost and for jobs that are gained.[137] Second, we localized the model to be able to show skills shifts at a county level. Using a methodology similar to those deployed in other parts of this research, we distributed changes in hours spent in 2030 based on the share of an occupation in a county in 2017, according to LaborCube.

2. County and city segmentation

Our segmentation of US cities and counties built on a recent McKinsey & Company research collaboration with Walmart and the resulting February 2019 report *America at work: A national mosaic and roadmap for tomorrow*. That report identified eight unique county segments, with a strong focus on the nuances in various rural communities. For this report, we sought to make greater distinctions between the three urban segments used in *America at work*. We conducted a secondary city segmentation of 315 core-based statistical areas (as defined by the US Office of Management and Budget). We also combined or retained other urban periphery and rural segments (Exhibit A3).

Exhibit A3

Segments from the "America at work" report were updated to provide a more granular view of urban areas.



[1] This report utilizes the county archetypes used in a recent McKinsey & Company research collaboration with Walmart, titled *America at work.*
[2] Some exceptions apply for one-off sorting in cases where counties aligned more directly with different archetype.

Source: McKinsey Global Institute analysis

[137] The original *Skill shift* report considered only displaced activities for calculating the impact of jobs lost on total hours spent using a skill, not for jobs gained.

Both the segmentation done for the *America at work* report and our additional segmentation of 315 cities used a statistical technique known as the Ward method for agglomerative hierarchical clustering analysis (HCA). An HCA model starts by putting each place into its own cluster. It then iteratively identifies pairs of clusters that are most similar and merges them, forming larger and larger clusters until all are combined into a single cluster. During this process, the difference between clusters is computed using the Ward's linkage function, which minimizes within-cluster variance. The results of an HCA are then interpreted using a dendrogram, showing the full hierarchical structure identified.

The key variables used to identify similar characteristics between places in HCA are shown in Exhibit A4. The variables used in the two segmentation methodologies overlapped. To segment all counties, the *America at work* methodology placed more emphasis on development indicators and socioeconomic factors, whereas the additional urban segmentation for this report added detail on historical growth trends, industry mix, and business dynamism of cities. Our segments were derived from the variables shown below. But it is important to note that this is a point-in-time analysis. If other variables were used or if different date ranges were selected for analysis, the resulting clusters might differ from the ones used in this report.

To define our final 13 community archetypes, clusters identified in the HCA output were reviewed by experts in economic development. We made select manual adjustments between segments if a city on the margin aligned more directly with the defining characteristics of another segment. To exclude county-specific segments from urban segment statistics, all

Exhibit A4

We used county- and city-level data on 40+ variables within six macro categories.

● Variables used in city segmentation ● Variables considered in county segmentation

		City	County
Development indicators	Drive time distance from major MSA		●
	Population		●
	Post-recession population growth, CAGR		●
	USDA metro categorization		●
	USDA urban-rural classification		●
Economic health	GDP per capita	●	
	GDP, total		●
	Post-recession employment growth, CAGR	●	
	Post-recession GDP growth, CAGR	●	●
	Post-recession income per capita growth	●	
	Post-recession household income growth, CAGR		●
	Post-recession unemployment change, CAGR		●
	Unemployment rate	●	●
Labor market	Automation potential		●
	Employment/population ratio	●	
	Labor force participation rate	●	●
	Net migration 2010–17, % of 2017 population	●	
	Share of population by age	●	●
	Share of population by education	●	●
	Post-recession growth in working-age population, CAGR		●
	Total jobs		●
Industry mix and business dynamism	Share of establishments with 500+ employees		●
	Share of employment in manufacturing	●	
	Share of GDP in hospitality and food services	●	
	Share of GDP in primary, secondary, tertiary, and quarternary industries		●
	Share of GDP in high-growth industries	●	
	Industry diversity score		●
	Post-recession change in number of establishments	●	
	Ratio of large to medium-size establishments	●	
	Rental vacancy rate	●	
Innovation	Carnegie R1, R2, R3 university count	●	●
	IPEDS number of academic schools, occupational schools, and both		●
	Number of patents		●
	Patent growth, 2005–15	●	
Socioeconomic factors	Share of households receiving food stamps/SNAP		●
	Share of population with health insurance		●
	Cost of living index score		●
	Gini coefficient	●	●
	Life expectancy		●
	Median household income		●
	Population by race and ethnicity		●
	Poverty rate	●	●

Source: McKinsey Global Institute analysis

data in this report used county-level data and rolled up urban statistics based on population, GDP, employment, or other relevant weightings. For this reason, city-specific statistics may differ slightly from those publicly reported at the core-based statistical area level.

Exhibit A5 shows the full list of 315 cities within each segment. The full segmentation, including more than 3,000 US counties, can be found online at www.mckinsey.com/futureofworkinamerica.

Exhibit A5

Cities by segment

Megacities	Atlanta, GA	**Small powerhouses**	Bend, OR	**College-centric towns**	Ames, IA
	Boston, MA		Boise, ID		Ann Arbor, MI
	Chicago, IL		Charleston, SC		Athens, GA
	Dallas, TX		Des Moines, IA		Blacksburg, VA
	Houston, TX		Fayetteville, AR		Boulder, CO
	Los Angeles, CA		Fort Collins, CO		Champaign, IL
	Miami, FL		Greeley, CO		Charlottesville, VA
	New York, NY		Midland, TX		College Station, TX
	Philadelphia, PA		Provo, UT		Columbia, MO
	Phoenix, AZ		Reno, NV		Corvallis, OR
	San Francisco, CA		Santa Rosa, CA		Durham, NC
	Washington, DC				Eugene, OR
					Gainesville, FL
High-growth hubs	Austin, TX	**Silver cities**	Asheville, NC		Iowa City, IA
	Charlotte, NC		Barnstable Town, MA		Ithaca, NY
	Denver, CO		Cape Coral, FL		Lansing, MI
	Las Vegas, NV		Daphne, AL		Lawrence, KS
	Minneapolis, MN		Deltona, FL		Lubbock, TX
	Nashville, TN		Hilton Head Island, SC		Manhattan, KS
	Orlando, FL		Lakeland, FL		Missoula, MT
	Portland, OR		Medford, OR		Morgantown, WV
	Raleigh, NC		Mount Vernon, VA		Santa Barbara, CA
	San Antonio, TX		Myrtle Beach, SC		Santa Cruz, CA
	San Jose, CA		Naples, FL		South Bend, IN
	Seattle, WA		North Port, FL		State College, PA
	Tampa, FL		Ocean City, NJ		Tallahassee, FL
			Palm Bay, FL		
			Port St. Lucie, FL		
			Prescott, AZ		
			Salisbury, MD		
			Sebastian, FL		
			The Villages, FL		

Exhibit A5 (cont.)

Cities by segment

Stable cities	Independent economies
Akron, OH	Abilene, TX
Albany, NY	Allentown, PA
Albuquerque, NM	Amarillo, TX
Baltimore, MD	Auburn, AL
Baton Rouge, LA	Augusta, GA
Birmingham, AL	
Buffalo, NY	
Cincinnati, OH	
Cleveland, OH	
Colorado Springs, CO	
Columbia, SC	
Columbus, OH	
Dayton, OH	
Detroit, MI	
Fresno, CA	
Honolulu, HI	
Indianapolis, IN	
Jacksonville, FL	
Kansas City, MO	
Louisville/Jefferson County, KY	
Memphis, TN	
Milwaukee, WI	
New Orleans, LA	
Oklahoma City, OK	
Omaha, NE	
Pittsburgh, PA	
Rochester, NY	
Sacramento, CA	
St. Louis, MO	
Salt Lake City, UT	
San Diego, CA	
Stockton, CA	
Syracuse, NY	
Tucson, AZ	
Tulsa, OK	
Virginia Beach, VA	

Independent economies (cont.)
Bellingham, WA
Billings, MT
Bismarck, ND
Bremerton, WA
Burlington, VT
California, MD
Carson City, NV
Cedar Rapids, IA
Chambersburg, PA
Chattanooga, TN
Cheyenne, WY
Chico, CA
Clarksville, TN
Coeur d'Alene, ID
Corpus Christi, TX
Crestview, FL
Dover, DE
Dubuque, IA
Duluth, MN
Eau Claire, WI
Fargo, ND
Flagstaff, AZ
Grand Forks, ND
Grand Junction, CO
Hagerstown, MD
Hammond, LA
Harrisburg, PA
Hattiesburg, MS
Huntsville, AL
Idaho Falls, ID
Jackson, MS
Kahului, HI
Kennewick, WA
Killeen, TX
Kingston, NY
Knoxville, TN
La Crosse, WI
Lake Charles, LA
Lancaster, PA
Lebanon, PA
Lexington, KY
Lincoln, NE
Little Rock, AR
Longview, WA
Lynchburg, VA

Independent economies (cont.)
Madison, WI
Manchester, NH
Mankato, MN
Merced, CA
Modesto, CA
Montgomery, AL
Napa, CA
Odessa, TX
Ogden, UT
Olympia, WA
Panama City, FL
Pensacola, FL
Pittsfield, MA
Portland, ME
Providence, RI
Rapid City, SD
Richmond, VA
Roanoke, VA
Rochester, MN
St. Cloud, MN
St. George, UT
Salem, OR
Salinas, CA
San Angelo, TX
San Luis Obispo, CA
Santa Fe, NM
Savannah, GA
Scranton, PA
Sherman, TX
Sioux Falls, SD
Spokane, WA
Springfield, IL
Springfield, MA
Springfield, MO
Trenton, NJ
Tyler, TX
Vallejo, CA
Walla Walla, WA
Wenatchee, WA
Wilmington, NC
Winchester, VA
Winston-Salem, NC
York, PA

Exhibit A5 (cont.)

Cities by segment

America's makers	Albany, OR
	Appleton, WI
	Beaumont, TX
	Canton, OH
	Columbus, IN
	Elkhart, IN
	Erie, PA
	Evansville, IN
	Fond du Lac, WI
	Fort Wayne, IN
	Gainesville, GA
	Gettysburg, PA
	Grand Island, NE
	Grand Rapids, MI
	Green Bay, WI
	Greensboro, NC
	Greenville, SC
	Harrisonburg, VA
	Hickory, NC
	Jackson, MI
	Janesville, WI
	Kalamazoo, MI
	Kankakee, IL
	Lafayette, IN
	Lewiston, ID
	Lima, OH
	Logan, UT
	Michigan City, IN
	Midland, MI
	Monroe, MI
	Niles, MI
	Oshkosh, WI
	Owensboro, KY
	Racine, WI
	Reading, PA
America's makers (cont.)	Rockford, IL
	Rome, GA
	St. Joseph, MO
	Sheboygan, WI
	Sioux City, IA
	Spartanburg, SC
	Springfield, OH
	Staunton, VA
	Terre Haute, IN
	Toledo, OH
	Tuscaloosa, AL
	Waco, TX
	Waterloo, IA
	Wausau, WI
	Wichita, KS
Trailing cities	Albany, GA
	Anchorage, AK
	Atlantic City, NJ
	Bakersfield, CA
	Bangor, ME
	Binghamton, NY
	Bloomington, IL
	Bloomsburg, PA
	Bridgeport, CT
	Cape Girardeau, MO
	Casper, WY
	Charleston, WV
	Columbus, GA
	Davenport, IA
	East Stroudsburg, PA
	El Centro, CA
	El Paso, TX
	Elizabethtown, KY
Trailing cities (cont.)	Elmira, NY
	Fairbanks, AK
	Farmington, NM
	Fayetteville, NC
	Flint, MI
	Florence, SC
	Glens Falls, NY
	Gulfport, MS
	Hanford, CA
	Hartford, CT
	Houma, LA
	Huntington, WV
	Jefferson City, MO
	Lafayette, LA
	Lawton, OH
	Lewiston, ME
	Macon, GA
	Madera, CA
	McAllen, TX
	Mobile, AL
	New Bern, NC
	New Haven, CT
	Norwich, CT
	Parkersburg, WV
	Peoria, IL
	Topeka, KS
	Utica, NY
	Victoria, TX
	Vineland, NJ
	Visalia, CA
	Warner Robins, GA
	Wichita Falls, TX
	Williamsport, PA
	Yakima, WA
	Youngstown, OH
	Yuba City, CA

3. Additional analyses

In this section, we review our analysis on other key topics in this report: the loss of middle-wage jobs, migration, shifts in the skills mentioned in job postings, the demographic impact of automation-related displacement, and occupational pathways.

The loss (or "hollowing out") of middle-wage jobs

To determine past losses of middle-wage jobs, we used data from the BLS OES from 1997, 2007, 2012, and 2017. We split occupations into terciles (with the bottom 30 percent designated low-wage jobs, the middle 40 percent as middle-wage jobs, and the top 30 percent as high-wage jobs). These designations were based on the 2017 median annual wages associated with each occupation, weighted by 2017 employment. Finally, we determined which occupations from 1997, 2007, and 2012 corresponded to each 2017 occupation despite changing SOC codes and occupation names.

For our forward-looking analysis on middle-wage jobs, we analyzed the growth trajectories of occupations based on their 2017 wage profiles. The methodology is similar to our historical

analysis, but it utilized BLE NEM data rather than BLS OES data, because the NEM data set was used for all other forward-looking analyses.

In reality, we would expect wages to adjust in response to automation and new labor demand. Wages could also respond to other economic effects, such as minimum wage legislation. Modeling the potential impact from these effects was beyond the scope of our analysis. While this leaves a significant amount of uncertainty about wage shifts and inequality, our approach allowed us to identify relative and directional shifts between high-, middle-, and low-wage occupations.

Population migration

For our migration analyses, we used American Community Survey County-to-County Migration Flows from 2012 to 2016 provided by the US Census Bureau, which records from which county a person moved and to where. Removing all migration flows leaving the United States as well as movement between counties within the same city in a given segment, we mapped each county pair to their respective community archetypes and then analyzed the overall inflows and outflows for each pair of archetypes.

Job posting analysis

We used EMSI's proprietary job posting data, which scrapes 72 million job postings from 80,000 job boards, to assess the frequency with which certain skills appear in postings for a given position. We pulled a month-by-month view of the skills requested in postings for 10 occupations of interest. We looked at the average rate of mentions in three-month periods to smooth seasonal irregularities in the data across a 31-month period from September 2016 to February 2019. We compared the ten most frequently requested skills in the first three months and last three months of this period and identified whether the original skills requested increased or decreased in frequency of mentions. We also flagged new skills that emerged in the data set over this period that were not among the ten most frequently requested.

Demographic impact of automation-related displacement

Using the mapping between the 2017 ACS data from IPUMS and the BLS described above, we were able to combine our national estimates with detail on the demographic breakdown of an occupation (gender, race, education level, and age). It is important to note that, because we consider part-time work as a job, we do not model the number of workers with a demographic feature affected. Rather, our analysis shows the share of jobs currently held by someone with this demographic feature.

For all forward-looking analysis, we assumed the same demographic composition of an occupation in the future as in 2017. We recognize the limitations of this assumption given trends such as increased female participation and aging. In addition, the demographic composition of occupations may shift over time in response to automation and new labor demand, but modeling this effect was beyond the scope of our analysis.

For our analysis of displacement by age and separation rate, we mapped our national jobs estimates to BLS NEM data on occupational separation rates, which uses a series of regression analyses to identify the characteristics of workers that make them likely to either exit the labor force or transfer occupations and applies these patterns to the current demographic distribution of employment in each occupation. With this data, we identified employment-weighted terciles to define which occupations had "high," "medium," and "low" separation rates.[138]

[138] For additional detail on the BLS methodology for calculating for occupational separations, see Michael G. Wolf and C. Brett Lockard, "Occupational separations: A new method for projecting workforce needs," *Bureau of Labor Statistics Monthly Labor Review*, May 2018, bls.gov.

Occupational pathways

To explore potential career pathways, EMSI created a compatibility index that identifies similarities across occupations. Assessing the knowledge, skills, and abilities levels of every occupation provided by O*Net, EMSI produces a numerical score indicating compatibility between pairs of occupations (on a scale of 1 to 100, with 100 being a perfect match). Our analysis looked at occupations at high risk of automation and presents only compatible occupations that have a displacement rate below the national median and a median annual salary greater than or equal to that of the displaced occupation.

4. Potential limitations

In addition to the many smaller caveats we have noted throughout the report and technical appendix, we acknowledge some larger limitations to our research. This report models only one of numerous potential scenarios for the net impact of automation and future labor demand on employment, skills, and wages. While we assume sufficient ongoing demand for labor to keep the economy at or near full employment, ensuring that displaced workers have the skills and support needed to obtain the new jobs will be critical. Furthermore, none of the models used in this report is dynamic. Therefore, they do not take into account how trends could accelerate or decelerate for a given location based on a host of other factors; nor do they consider the interconnectivity of factors (e.g., wages and employment). For these reasons, our conclusions could either overstate or understate the impact of changing labor demand and job growth.

The disruptions in the coming decade could be smaller for several reasons:

— Adopting automation requires significant investment and redesign of business processes, and companies have incorporated digital technologies at varying rates in the past. Delayed adoption of automation technologies would slow workforce evolution.

— Our modeling of future job growth does not consider dynamic effects within the economy and may represent only a partial list of labor demand drivers. For example, if automation adoption is rapid, future productivity could be higher, thereby raising incomes and leading to further growth of certain occupations as purchasing rises.

— We assume that every hour of work that is automatable translates into a certain share of a job displaced. In reality, companies can choose to redefine occupations or redeploy workers in ways that would not lead to displacement.

— Automation technologies could create new jobs that are currently unimaginable, and thus cannot be modeled accurately.

— The deployment of labor-saving technologies could cause downward pressure on wages, thereby creating less incentive for further automation and slowing overall proliferation of automation technologies.

Conversely, the disruptions in the coming decade could be larger for several reasons:

— The development of automation technologies, including AI, could compound and accelerate both innovation and workforce transformations. Some work might be automated more rapidly than originally estimated.

— While we anchor here on the role of wage rates in determining automation adoption, competitive pressures or other factors may compel companies to adopt at an accelerated pace.

— Rising geopolitical tensions, a new recession, or unforeseen national events could make our job creation scenarios—particularly assumptions we make regarding future consumption growth and infrastructure spending—too optimistic.

— Displaced workers might not find new work quickly because they lack the skills and educational requirements, or because they do not relocate in response to localized mismatches.

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