McKinsey Global Institute

The future of women at work

Transitions in the age of automation

June 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

Technological change, notably the adoption of automation technologies, is beginning to transform the way many of us work. Observers of this unfolding phenomenon have long asked how automation may affect the working lives of men and women differently, and new research from the McKinsey Global Institute attempts to answer that question.

The report is part of the McKinsey Global Institute's research program on the future of work, and it focuses on how the growing adoption and diffusion of automation and artificial intelligence technologies is likely to affect women in the workforce. This research was prepared for the Women Deliver 2019 conference as part of our knowledge partnership with Women Deliver. We used MGI's models on automation and the future of work to create scenarios for the future of work for women and men. We drew out differences in patterns of impact in the period to 2030 in ten countries (six mature economies and four emerging economies) that account for about half of the world's population and that are representative of a wide range of demographic profiles, stages of economic development, and progress toward gender parity. This research complements MGI's research on the "power of parity" that has, over the past four years, explored trends in gender inequality in work and society around the world and what can be done to advance women.

The research was led by Anu Madgavkar, MGI partner in Mumbai; Mekala Krishnan, MGI senior fellow in Boston; James Manyika, chairman and director of the McKinsey Global Institute and McKinsey senior partner based in San Francisco; Kweilin Ellingrud, McKinsey senior partner in Minneapolis; Lareina Yee, McKinsey senior partner and chief diversity and inclusion officer in San Francisco; Vivian Hunt, McKinsey senior partner and managing partner for the United Kingdom and Ireland office; Jonathan Woetzel, McKinsey senior partner and a director of MGI based in San Francisco, and Michael Chui, MGI partner in San Francisco. Sruti Balakrishnan, a consultant based in Chicago, led the project team, which comprised Rachel Garber, Emma Kemble, Natalie Borowski, and Rishi Arora. Gurneet Singh Dandona and Alok Singh, automation specialists with the McKinsey Global Institute, led the research and analytics to build the automation and job-growth models for the ten countries in our report. We thank MGI partner Susan Lund and Tera Allas, senior fellow at the McKinsey Center on Government, who contributed their expertise to this effort.

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Many external experts gave invaluable advice, including Amy Jerrett and Keiko Valente, associate program officers at the Bill & Melinda Gates Foundation; Irene Natividad, president of the Global Summit of Women and chair of Corporate Women Directors International; Jeni Klugman, managing director of the Georgetown Institute for Women, Peace and Security at Georgetown University; Andrew Dunckelman, head of economic opportunity, and Suzanna Bobadilla, strategy and operations, at Google.org; Henriette Kolb, head of the gender secretariat, and Alexa Roscoe, digital economy lead, at the International Finance Corporation; Kalpana Kochhar, director of the human resources department, and Era Dabla-Norris, division chief of fiscal affairs, at the International Monetary Fund; Amanda Lenhart, deputy director, and Brigid Schulte, director, at the Better Life Lab at New America, and Anne-Marie Slaughter, president and CEO of New America and Bert G. Kerstetter '66 University Professor Emerita of Politics and International Affairs at Princeton University; Umran Beba, senior vice president and chief diversity and engagement officer, PepsiCo; Nicole Bates, senior adviser,

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This report was edited and produced by MGI senior editor Janet Bush, editorial production manager Julie Philpot, and MGI graphic designers Laura Brown, Marisa Carder, Edgardo Salas, and Patrick White; Rebeca Robboy, MGI director of external communications, managed dissemination and publicity, while digital editor Lauren Meling provided support for online publication and social media. We thank Tim Beacom, Nura Funda, and Karen Jones, MGI research specialists, and Deadra Henderson, MGI's manager of personnel and administration, for their support.

This report contributes to MGI's mission to help business and policy leaders understand the forces transforming the global economy, identify strategic locations, and prepare for the next wave of growth. As with all MGI research, this work is independent and has not been commissioned or sponsored in any way by any business, government, or other institution.

While we are grateful for all the input we have received, the report and views expressed here are ours alone. We welcome your comments on this research at MGI@mckinsey.com.

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In brief

The future of women at work: Transitions in the age of automation

In the automation age, women face new challenges overlaid on long-established ones. Technology adoption could displace millions from their jobs; many others will need to change the way they work. 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 leaving the labor market. Men and women need to be skilled, mobile, and tech-savvy in the automation age, but women face pervasive barriers. Concerted and creative new solutions are needed to enable women to move forward.

- Men and women tend to cluster in different occupations in both mature and emerging economies, and this shapes how each is likely to be affected by automation. For instance, in many countries, women account for more than 70 percent of workers in healthcare and social assistance, but less than 25 percent of machine operators and craft workers.

- In a scenario where automation unfolds on the scale of past technological disruptions, women and men could face job displacement and potential job gains of a broadly similar magnitude. In the ten countries studied, an average of 20 percent of working women (107 million) could lose their jobs to automation versus 21 percent of men (163 million) by 2030. Rising demand for labor could imply 20 percent more jobs for women, compared with 19 percent for men, assuming their shares of sectors and occupations hold. Entirely new occupations will also be created, but approximately 60 percent of new US occupations have been in male-dominated fields.

- However, the composition of potential job losses and gains for men and women could be different. Service-oriented and clerical support occupations could account for 52 percent of women's job losses, but machine operation and craft work occupations could account for 40 percent of men's losses. Women are well represented in fast-growing healthcare, which could account for 25 percent of potential jobs gained for women, while manufacturing could account for 25 percent of jobs gained for men.

- Worldwide, 40 million to 160 million women—7 to 24 percent of those currently employed—may need to transition across occupations (the wide range reflects different paces of automation). For men, the range is comparable at 8 to 28 percent. If women take advantage of transition opportunities, they could maintain their current share of employment; if they cannot, gender inequality in work could worsen.

- To make these transitions, women will need new skills. In mature economies, only jobs requiring a college or advanced degree may experience net growth in demand. In emerging economies, the many women working in subsistence agriculture with little education may have difficulty securing work in other sectors. Even women remaining in their current jobs will need to refresh their skills; they could be more prone than men to partial automation of their jobs, and will need to learn to work alongside automated systems.

- More women work in lower-paid occupations than men. In mature economies, demand for high-wage labor is expected to grow, while demand for medium- and low-wage labor could shrink. Many emerging economies could experience stronger growth in demand for higher-wage jobs. Enabling women to move up the skills ladder could prepare them for higher-paying jobs and more economic opportunity. However, va potential glut of workers in lower-wage jobs—including men displaced from manufacturing—could put pressure on wages. Some women could leave the labor market entirely.

- Long-established barriers will make it harder for women to make transitions. They have less time to reskill or search for employment because they spend much more time than men on unpaid care work; are less mobile due to physical safety, infrastructure, and legal challenges; and have lower access to digital technology and participation in STEM fields than men. Policy makers and businesses need to step up interventions, some targeted at women, to overcome these barriers. High priorities include more investment in training and transitional support; more provision of childcare and safe and affordable transportation; addressing stereotypes about occupations; boosting women's access to mobile internet and digital skills in emerging economies; and supporting women in STEM professions and entrepreneurship.

The future of women at work

Navigating transitions could put women on a path to more productive, better-paid work; failing to do so could worsen existing challenges

The overall scale of job losses and gains could be similar for men and women[1]

Patterns of jobs lost and gained could differ for men and women

Biggest **job losses** (% of 2017 employment for each gender)

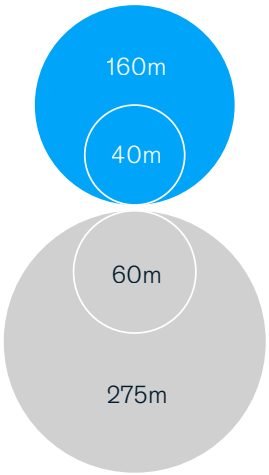
- Service workers **30%**
- Machine operators and craft workers **40%**

Biggest **job gains** (% of 2017 employment for each gender)

- Healthcare sector **25%**
- Manufacturing sector **25%**

To capture job opportunities, millions of women could need to make major work transitions by 2030

40 million–160 million women (7–24%) and 60 million–275 million men (8–28%) could need to switch occupations by 2030. If women can navigate these transitions, they could maintain their current share of employment; otherwise gender inequality in work could worsen.



Many women may need higher education attainment or reskilling to stay employed.

Mature markets

College/advanced degree
More

Associate
Less

Secondary education
Significantly less

Lower than secondary education
Less

Emerging markets

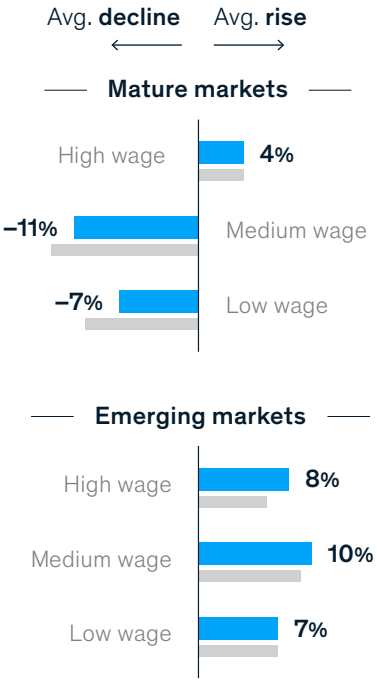
College/advanced degree
More

Associate
More

Secondary education
Significantly more

Lower than secondary education
Flat/similar

Navigating the transitions holds the promise of higher wages for women.



Concerted measures and creative new solutions by governments, companies, and individuals are needed in three areas to enable the necessary transitions and overcome long-established barriers

1. Invest in training programs and platforms to enable women to develop necessary skills.
2. Enable women to balance unpaid and paid work, and develop infrastructure and networks, to boost their labor mobility.
3. Raise women's access to technology, their skills to use it, and their share of tech jobs and leadership roles.

[1] Based on analyzing ten countries that account for about 60% of global GDP: Canada, China, France, Germany, Japan, Mexico, India, South Africa, the United Kingdom, and the United States.

Source: McKinsey Global Institute analysis

NOTE: All numbers described are based upon a trend-line scenario of job creation and a midpoint scenario of automation. The range of transitions estimate is based upon both an early and a midpoint scenario of automation. See technical appendix for more details.

Executive summary

40m–160m

women globally may need to transition between occupations by 2030

The world of work is undergoing a radical transformation as automation—and, on the near horizon, artificial intelligence (AI) technologies—begins to sweep through sectors and businesses search for productivity gains. Automation promises a new productivity revolution as robots and computers take over many routine physical tasks and are increasingly capable of accomplishing work that requires cognitive abilities.

Men and women could experience significant improvements in their working lives, spending less time on repetitive routine tasks such as data processing and physical manual labor, thus freeing up time to use social, emotional, and higher cognitive skills instead. In a partially automated emergency room, for instance, health workers could spend less time on paperwork and more time interacting with patients. Many more women (and men) will work alongside machines and will have more fulfilling and productive working lives as a result.

However, automation will undoubtedly be disruptive for many. This report builds on two bodies of MGI work: automation and the future of work, and the power of parity. In this research, many of our findings apply to men and women, but our focus is seeking to understand how automation could affect women, in particular, and what the future of work could look like for them. Our main findings are at the level of occupations, sectors, and economies, but the impact of automation can even vary within countries at the local level, as our work in the United States shows.[1]

The spread of automation could potentially displace millions of female workers from their current jobs, and many others will need to make radical changes in the way they work. At the same time, shifting population dynamics and growing incomes will drive increased demand for certain jobs. Globally, between 40 million and 160 million women may need to transition between occupations by 2030, often into higher-skilled roles. Navigating these transitions successfully could mean that many women would be well positioned for more productive, better-paid work, allowing them to maintain or even improve on their current share of employment.

However, this positive outcome could be challenging for many women to secure. To make these transitions successfully, women will need different skills and more education, mobility to switch jobs easily, and access to technological capabilities that will not only be in demand, but can also open up new ways of working and new sources of economic opportunity. Women face persistent challenges on these three dimensions that will be needed to thrive in the automation era; these challenges have already slowed women's progress toward gender equality in work.

In 2015, the 193 member nations of the United Nations agreed to the Sustainable Development Goals (SDGs). One of these, goal five, focuses on gender equality. In the four years since, women's progress toward equality in the workplace continues to lag behind societal measures of equality.[2] In 2015, MGI mapped 15 indicators of gender inequality in society (women's education levels and rate of child marriage, for instance) and gender

[1] MGI is publishing research on the future of work in the United States in summer 2019.

[2] A GPS score of zero represents no gender parity, while 1.0 represents full gender parity. For instance, a GPS score of 0.95 indicates that 5 percent further progress is needed before full gender parity is attained. See *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015. Since its original 2015 global research, MGI has looked at gender inequality in France and Western Europe, India, the United States, the United Kingdom, Canada, the Netherlands, and Asia Pacific. All reports can be downloaded at **https://www.mckinsey.com/mgi/our-research/productivity-competitiveness-and-growth**.

inequality in work (for example, female labor-force participation, and presence in leadership roles) and compiled them into a gender parity score, or GPS. Since that research in 2015, our score for gender equality in work has risen from 0.51 to 0.52; this score continues to trail our score for gender equality in society, which has risen from 0.66 to 0.67. Now that we are entering the automation era, the future of work for women will overlay new challenges on long-established ones.

Leaders in the private, public, and social sectors will need to be bold, putting in place concerted measures—many of them designed with women specifically in mind—to enable women to develop the skills, the flexibility and mobility, and the tech access and expertise that will be needed. The stakes are high. If women fail to make the necessary transitions, they could face a wider wage gap relative to men or even drop out of the workforce altogether, falling further behind in their share of employment.

MGI has extensively researched the future of work (see Box E1, "Modeling trends in the future of work"). This report builds on that research by looking specifically at the changing world of work for women. We used MGI's future of work models to analyze how women and men could fare in the employment market from now to 2030.[3] We evaluated several scenarios of "jobs lost" (jobs displaced by automation), "jobs gained" (job creation driven by economic growth, investment, demographic changes, and technological innovation), and "net jobs" (combining jobs lost and jobs gained) by 2030. The main scenario described in this report consists of a "midpoint" automation scenario in which the pace at which automation unfolds is on par with the scale of past major technological disruptions, and a "trend-line" scenario of job growth, in which job creation occurs based on current spending and investment trends observed across countries. We also evaluated how jobs may change as their underlying activities evolve due to automation. We assessed how women could be affected differently from men by the future of work by overlaying current female and male employment data on these scenarios, and assuming that the current representation of men and women in occupations and sectors remains unchanged from 2017 to 2030. Using this approach, we tested how well positioned women currently are to react to and benefit from future work trends, given their current occupational and sectoral representation in the labor market.

The research covers six mature economies (Canada, France, Germany, Japan, the United Kingdom, and the United States) and four emerging economies (China, India, Mexico, and South Africa). Together, these ten economies account for about half of the world's population and about 60 percent of global GDP. They have a wide range of demographic profiles, stages of economic development, and degrees of progress toward gender parity, as well as different patterns in how women are likely to be affected by automation and other trends (see Box E2, "Countries exhibit differences and similarities in patterns of women's future work" at the end of this executive summary).

This report is not meant to predict the future; our findings could shift depending on different modeling scenarios for jobs lost and jobs gained, as well as different assumptions of gender mix in sectors and occupations from 2017 to 2030. For instance, in an "early automation scenario" in which certain technologies (for instance, technology replacing predictable physical labor) are adopted more rapidly, the disparity of outcomes between men and women could be larger because the jobs that men typically hold are automated faster. Similarly, if women are able to improve their representation in the economy over time—which they may

[3] MGI's research on the future of work—for men and women—in the automation age found that around half of current work activities are technically automatable by adapting current technologies, that between 15 and 30 percent of workers around the world could potentially be displaced, and that 3 to 14 percent of workers may need to change their occupational category due to automation. MGI's models quantified the potential loss of 400 million jobs in a midpoint automation scenario across 46 countries, but the potential creation of between 500 million and 900 million jobs globally by 2030. Although MGI found that enough jobs could be created to maintain full employment in the period to 2030 in most scenarios, many workers will need to undertake challenging transitions. See *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017; and *Skill shift: Automation and the future of the workforce*, McKinsey Global Institute, May 2018.

do, especially in some emerging economies where their representation currently tends to be lower than in developed economies—the future could look brighter for women than in the scenario described in much of this report. That main scenario describes one potential outcome as the result of several trends that affect women, which we hope can be useful as a tool for discussion and decision making. We also use other scenarios at various points in the report to help highlight a range of possible outcomes.

This research breaks new ground, we believe, because it looks at a broad range of effects on women's employment in the future, including potential job displacement, opportunities for job creation, and the changing nature of jobs, and makes a quantitative assessment of the transitions that women will need to make to capture these new opportunities, including implications for wages and average education levels. We note that several important aspects of the discussion on how the future of work may unfold are beyond the scope of this research. Other digital technologies, such as independent work platforms and digital identification, may also have an impact on women's employment, but we do not quantify the effects of these technologies on employment. Nor do we discuss how patterns of the future of work could vary between men and women of different ages, or between part-time and full-time workers. We acknowledge that these aspects are all areas for useful study in the future.

In this report, first we look at how men and women are employed across different sectors and occupations, and then lay out potential scenarios for the world of work in 2030, looking at possible levels of job displacement and job growth in an era of automation. Next, we discuss the prospect of partial automation of women's jobs, and how women's work could change as a result. We explore the transitions millions of women (and men) will need to make across occupations, increasing demand for more educated workers and different skills, and prospects for gender wage disparity in light of a shift to higher-wage employment. Finally, we look at three areas where there is an imperative to address barriers women face—the need for skills development, enhanced mobility, and more access to technology and the capabilities to use it—and discuss the kind of measures that may be necessary to support women as they make transitions in their working lives.

Box E1

Modeling trends in the future of work

MGI's research on the future of work studies the effect on businesses, workers, and the workplace of the growing adoption and diffusion of automation and AI, including an examination of how work activities, occupations, and business processes will change and the shifting skill requirements for the workforce. The research has focused on several key metrics: jobs lost (jobs that will be displaced due to automation), jobs gained (jobs that will be added due to economic growth, investment, and demographic changes), net jobs (the net increase or decrease in jobs based on additions and losses), and jobs changed (jobs that will be altered but not lost as a result of the partial automation of tasks and the broader adoption of technology in the workplace).

In its first report on the future of work, in 2017, MGI found that about half of the activities that people are paid to do could theoretically be automated using currently demonstrated technologies.[1] The research found that less than 5 percent of occupations consisted of activities that could be fully automated, but that at least one-third of activities in 60 percent of occupations could be automated. MGI then estimated the potential extent of automation adoption in several countries using five factors: technical feasibility, the cost of developing and deploying solutions, labor market dynamics, the relative economic benefit of adoption, and the likelihood of regulatory and social acceptance.

In its examination of two scenarios of early and midpoint automation adoption, MGI estimated that between 400 million and 800 million individuals could be displaced by automation by 2030. Of the total workers displaced, up to 375 million may need to switch occupational categories and learn new skills.

Later in 2017, MGI returned to this analysis and looked in detail at jobs lost and jobs gained across occupations and sectors. This analysis covered 46 countries, accounting for almost 90 percent of global GDP, and focused in particular on six countries (China, Germany, India, Japan, Mexico, and the United States). For each, MGI modeled the potential net employment changes for more than 800 occupations based on different scenarios for the pace of automation adoption and for future labor demand. To translate automation adoption rates into jobs lost, MGI assumed that automation adoption rates directly translated into an estimate of jobs lost (for instance, if an occupation was found to have a 5 percent automation adoption rate by 2030, this would translate into 5 percent of jobs within that occupation category being lost). We found that, in a midpoint scenario, 400 million jobs could potentially be lost due to automation in the period to 2030.[2]

At the same time, trends in seven catalysts—rising incomes, healthcare spending due to an aging population, technology adoption, marketization of unpaid work, and spending on infrastructure, construction, and energy—could create between 555 million and 890 million jobs around the world.[3] The lower figure results from a "trend-line" scenario, while

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1 *A future that works: Automation, employment, and productivity,* McKinsey Global Institute, January 2017.

2 We use the term "jobs" as shorthand for full-time equivalent workers (FTEs), and we apply our analysis to both work displaced by automation and new work created by future labor demand. In reality, the number of people working is larger than the number of FTEs, because some people work part time. Our analysis of FTEs covers employees at firms as well as independent contractors and freelancers.

3 *Jobs lost, jobs gained: Workforce transitions in a time of automation,* McKinsey Global Institute, December 2017.

the higher figure is the result of a "step-up" scenario that assumes an additional governmental policy-driven boost to construction and infrastructure, as well as a push to marketize unpaid labor. While there are many scenarios and sources of potential labor demand that we have not included, the seven trends on which we focus in this report have the potential to create demand for hundreds of millions of workers globally through 2030, albeit with significant variations among countries. Our work also accounts for job growth in entirely new occupations; historical analysis suggests that we might expect up to 9 percent of the 2030 employed population in a given country to be employed in such new roles, potentially adding more than 160 million additional jobs.[4]

In 2018, MGI examined the shifts in skills that will be needed to ensure that men and women can remain employed in the automation age. We modeled skill shifts from automation and AI technologies in the period to 2030 and found that they would accelerate. Demand for technological skills has been growing since 2002 but will gather pace. Demand for social and emotional skills will also speed up. However, the need for basic cognitive skills and physical and manual skills will decline.[5]

For this report, we leverage the existing MGI research that we have described and extend it to cover ten countries.[6] We find that more than 300 million net jobs could be added to the global labor market in the ten countries studied by 2030.[7] Substantially more of this growth in jobs is likely to be in emerging economies, with the exception of South Africa. These estimates are based on a midpoint automation scenario and a trend-line scenario for job growth. We then apply a gender lens to identify the differential impact of these trends on men and women. We assume that the current representation of men and women in each sector and occupation remains the same between now and 2030 for two reasons. First, we find (as we detail later) that men and women tend to be concentrated in certain sectors and occupations, and that shifts in sectors and occupations between genders in recent years have been limited. Second, this approach allows us to assess how well positioned men and women are today to capture future job opportunities.

4 Based upon analysis conducted in Jeffrey Lin, "Technological adaptation, cities, and new work," *Review of Economics and Statistics*, May 2011, Volume 93, Number 2.
5 *Skill shift: Automation and the future of the workforce,* McKinsey Global Institute, May 2018.
6 All analyses are based upon MGI future of work models as of April 2019. These models are subject to change as we continue to refine and update underlying data.
7 See *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017; and *Skill shift: Automation and the future of the workforce,* McKinsey Global Institute, May 2018.

The future of work will look different for women and men due to entrenched gender differences in occupations and sectors

72%

of clerical support workers, on average, are female in mature economies

Across countries, there are distinct gender differences in employment across occupations and sectors, which shape women's prospects for jobs lost and gained differently from those of men. For instance, in mature economies women account for only 15 percent of machine operators on average.[4] However, women account for 72 percent, on average, of clerical support workers. In emerging economies, women make up 22 percent of machine operators on average, but 43 percent of clerical support workers. We see a similar trend across sectors. More than 70 percent of workers in healthcare and social assistance in nine of the ten countries studied (India is the exception) are women. Conversely, less than 15 percent of construction workers, and only about 30 percent of manufacturing workers, are female in many countries (Exhibits E1 and E2).

To some extent, the concentration of men or women in specific occupations and sectors reflects the degree to which women participate in the labor force, and is not correlated to level of economic development (Exhibit E3). For instance, gender concentration in specific occupations and sectors is more pronounced in India than in other countries studied, reflecting the facts that women's labor-market participation is relatively low and women's jobs are concentrated in agriculture. In countries like China and Canada where labor-force participation is relatively high among women, gender concentration in certain occupations and sectors is less marked. Nevertheless, even in mature economies with high female labor-force participation, gender differences exist within occupations and sectors, suggesting that deep social and cultural norms influence where women (and men) work. It remains unclear to what extent "innate" differences between men and women contribute to choices about the kind of work they do. We do not explore this topic in this report, and we acknowledge that, ultimately, where women and men work is a matter of personal choice that is likely shaped by preference as well as social and environmental factors.

These measures of gender concentration are entrenched and persistent, and they could be difficult to overcome. They matter because where men and women are employed today influences how they will be affected by automation, and this could also be indicative of their ability to tap into future growth opportunities across sectors and occupations.

[4] All average figures cited here refer to simple averages unless otherwise noted.

Women may be at slightly less risk of losing their jobs due to automation than men

~52%

of female jobs lost could be in clerical support and service worker roles

Despite lower shares in automation-prone manufacturing occupations, women could be only slightly less at risk than men of their jobs being displaced. On average, approximately 20 percent of women in our sample—107 million women—could be at risk of losing their jobs in a midpoint automation scenario. This compares with 21 percent or 163 million employed men (Exhibit E4).[5] Patterns of potential jobs lost vary enormously between men and women as well as within countries; this is driven by the mix of occupations in which women and men tend to work within each country in our analysis, and the activities that make up these occupations.

Some activities, and therefore occupations, are more automatable than others. For instance, routine physical tasks and routine cognitive work are both highly automatable, but those requiring more complex cognitive, social, and emotional skills are less so. Men have high representation in routine physical roles such as machine operators and craft workers, and nearly 40 percent of jobs held by men that could potentially be lost to automation are in these categories. Conversely, women have high representation in many occupations with high automation potential due to their high share of routine cognitive work, such as clerical support worker roles and service worker roles; we estimate that this is where 52 percent of female job losses could be (compared with 27 percent of male job losses).

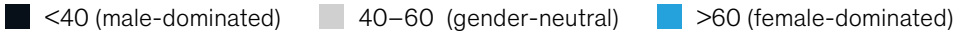
We also see differences among countries. In mature economies, men tend to lose machine operator jobs and women tend to lose clerical and service worker jobs. Emerging economies have a visible trend of jobs being lost in agriculture-related occupations for both men and women. Even here, however, patterns vary among emerging economies. For instance, in Mexico, agricultural work is one of the top three occupations driving job losses for men (21 percent of losses), but it is not in the top three for women. However, in India, where so many women work in subsistence agriculture, losses in this occupational category could account for 28 percent of jobs lost by women, compared with 16 percent of jobs lost by men. On the whole, our research shows that emerging economies could experience much lower levels of automation by 2030 relative to the size of their employed population than mature economies. This is because MGI's automation model takes into account the economic viability of implementing automation technology. Emerging economies tend to have lower labor costs (particularly in occupations with high levels of routine physical and cognitive work), suggesting that—at least over the next few years—the relative benefits of implementing automation technology will be less clear than they would be in higher-wage economies.

[5] All jobs lost and jobs gained percentage figures are represented as a share of 2017 male and female employment, respectively.

Exhibit E1

There are strong gender-based differences in employment within occupations and sectors in mature economies.

Occupation and sector gender mix, 2017
% of female workers out of total workers in sector and occupation category (weighted average across mature economies)[1]



	Elementary occupations	Clerical support workers	Agricultural and fishery workers	Service workers and shop and market sales workers	Machine operators and craft workers	Professionals, associate professionals, and technicians	Legislators, senior officials, and managers	**Simple average across countries**
	Wage increase →							
Accommodation and food services	59	66	21	60	30	50	45	**59**
Administrative and support and government	56	73	16	23	14	53	41	**42**
Agriculture, forestry, fishing, and hunting	51	86	30	50	12	42	21	**32**
Arts, entertainment, and recreation	47	63	28	51	17	45	39	**49**
Construction	7	80	0	21	2	20	12	**12**
Educational services	61	78	33	76	26	69	57	**66**
Finance and insurance	47	73	25	53	23	50	41	**54**
Healthcare and social assistance	72	87	4	84	27	76	66	**78**
Information	36	62	25	33	13	29	25	**35**
Manufacturing	33	56	34	42	25	25	20	**30**
Mining	11	63	8	16	4	19	16	**14**
Other services	62	82	22	51	17	50	49	**54**
Professional, scientific, and technical services	46	74	23	46	16	41	35	**44**
Real estate and rental and leasing	35	81	25	32	7	52	42	**44**
Retail and wholesale trade	36	62	51	54	20	49	31	**50**
Transportation and warehousing	24	48	33	46	10	27	22	**25**
Utilities	10	42	17	36	3	22	19	**20**
Simple average across countries	**45**	**72**	**24**	**60**	**15**	**52**	**31**	**47**
Median income[2] $ thousand, PPP	22.6	25.2	29.2	30.6	31.7	41.6	59.9	34.4

[1] Based on weighted average of Canada, France, Germany, Japan, the United Kingdom, and the United States.
[2] Determined by estimating the median income of each of the detailed occupations within each occupational category, and then calculating the median income across those detailed occupations.

Source: ILO, 2017; CPS IPUMs; ONS, 2017; Japan National Survey; EUROSTAT, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Exhibit E2

There are strong gender-based differences in employment within occupations and sectors in emerging economies.

Occupation and sector gender mix, 2017
% of female workers out of total workers in sector and occupation category (weighted average across emerging economies)[1]

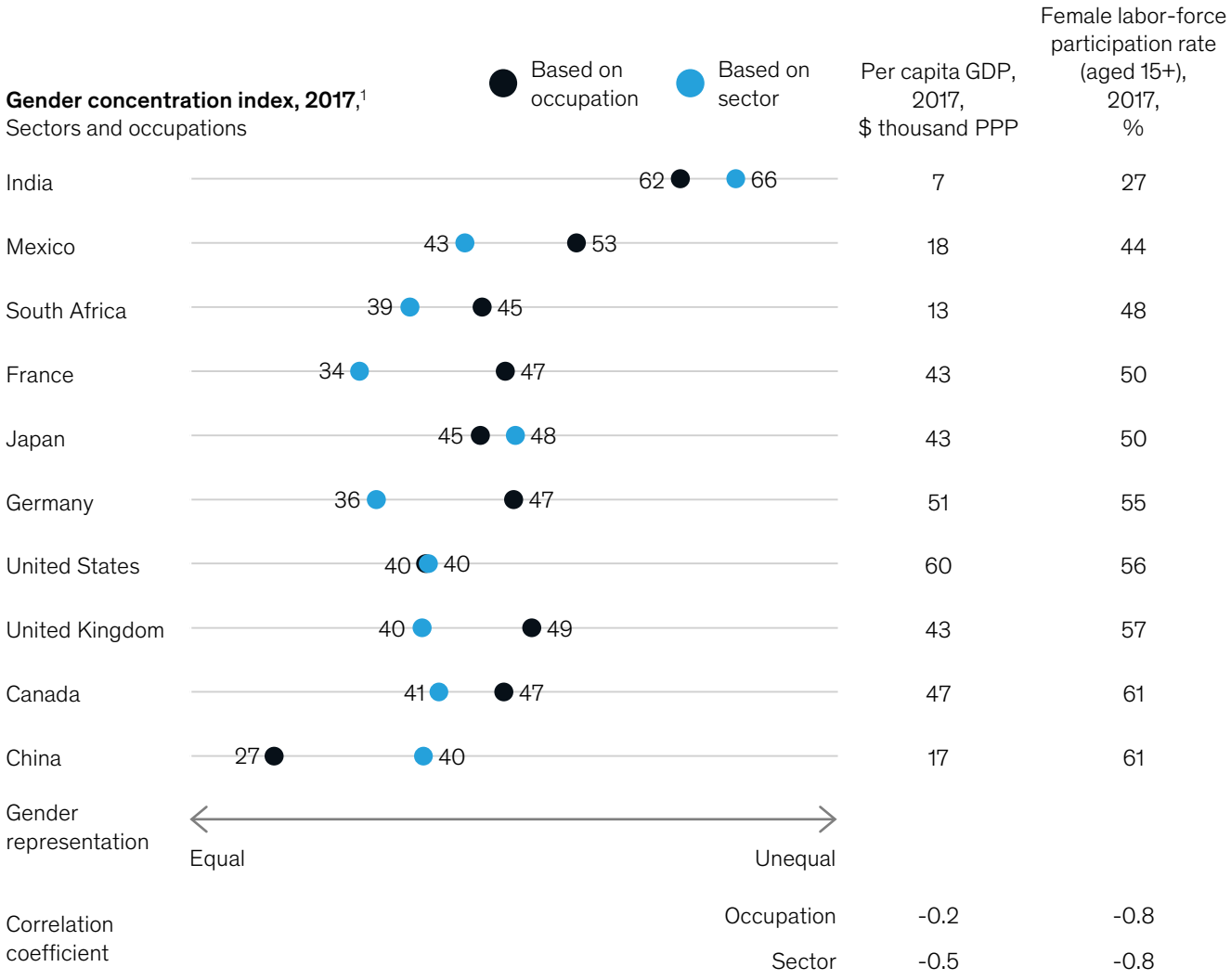
■ <40 (male-dominated) ■ 40–60 (gender-neutral)
■ >60 (female-dominated)

	Elementary occupations	Clerical support workers	Agricultural and fishery workers	Machine operators and craft workers	Service workers and shop and market sales workers	Professionals, associate professionals, and technicians	Legislators, senior officials, and managers	**Simple average across countries**[2]
	Wage increase →							
Accommodation and food services	10	32	4	35	28	18	20	**43**
Administrative and support and government	21	37	10	6	21	19	18	**25**
Agriculture, forestry, fishing, and hunting	37	15	34	12	25	32	15	**31**
Arts, entertainment, and recreation	2	30	3	5	18	18	56	**32**
Construction	18	53	4	13	14	15	4	**13**
Educational services	28	34	6	27	58	46	28	**53**
Finance and insurance	9	22	0	0	17	26	23	**41**
Healthcare and social assistance	40	46	2	20	67	49	34	**67**
Information	9	27	33	16	23	23	15	**31**
Manufacturing	24	28	29	30	28	16	25	**37**
Mining	21	41	1	10	27	4	6	**15**
Other services	70	25	28	5	63	14	21	**54**
Professional, scientific, and technical services	8	39	0	8	10	15	27	**33**
Real estate and rental and leasing	0	36	35	0	3	5	4	**35**
Retail and wholesale trade	14	25	2	5	14	11	14	**37**
Transportation and warehousing	2	17	2	1	41	19	3	**14**
Utilities	25	27	42	4	16	20	20	**21**
Simple average across countries	**35**	**43**	**29**	**22**	**43**	**41**	**25**	**39**
Median income[3] $ thousand, PPP	2.6	6.5	6.8	6.8	7.2	16.1	35.9	11.7

[1] Sector x occupation data are weighted average of India, Mexico, and South Africa. Data at the cross-tab level exclude China given limited data availability.
[2] Column and row averages include China data, and thus may appear higher than the cross-tab estimates (China is excluded from the cross-tab-level estimates due to data limitations).
[3] Determined by estimating the median income of each of the detailed occupations within each occupational category, and then calculating the median income across those detailed occupations.
Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; McKinsey Global Institute analysis

Exhibit E3

Occupations tend to be more differentiated by gender than sectors; concentration also tends to be correlated with female labor-force participation.



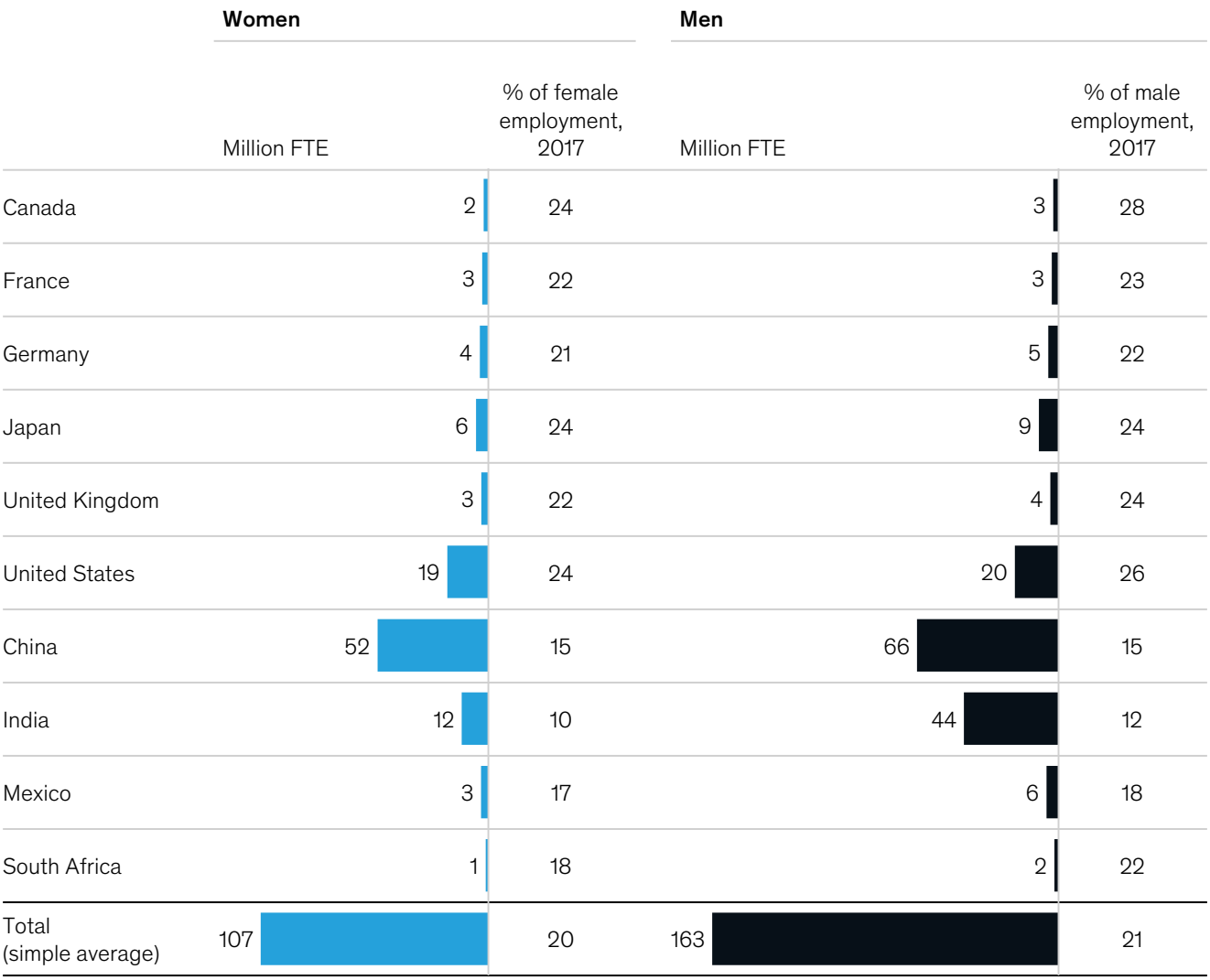
[1] The index measures the concentration of people of both genders in sectors and occupations. The index was created by calculating the sum of the squares of the distance from equal gender representation in each sector or occupation within a country, and then taking the square root. The index was then adjusted to fit a zero to 100 scale, with zero indicating equal representation and 100 indicating fully gendered occupations and sectors.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015; South Africa Quarterly Labour Force Survey, 2018; World Bank; McKinsey Global Institute analysis

Exhibit E4

Women may be slightly less at risk of being displaced by automation than men.

Jobs at risk of being displaced by automation by 2030[1]



[1] Based on a midpoint automation scenario.

Note: Countries ordered based on mature and emerging economies, and alphabetically within each group.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Women could also experience job gains, assuming they maintain their current share of employment within sectors and occupations

Even with automation, demand for work and workers could increase as economies grow, partly fueled by productivity growth enabled by technological progress. Rising incomes and consumption (especially in emerging countries), increasing healthcare for aging societies, investment in infrastructure and energy, and other trends will create demand for work that could offset the displacement of workers. Women could be marginally better placed to capture these potential job gains relative to men because of expected robust growth in sectors where they are well represented. Before factoring in jobs displaced, by 2030 women could gain, on average, 20 percent more jobs compared with present levels (171 million jobs gained) versus 19 percent for men (250 million jobs gained) (Exhibit E5).[6]

~20%

more jobs could be gained by women vs ~19% for men by 2030

Women's slight advantage compared with men in their positioning to gain jobs reflects the fact that so many more women than men work in healthcare. Particularly in mature economies, demand for, and employment in, healthcare could grow significantly by 2030 as the population ages and the cost of care continues to rise. We estimate that, on average, 25 percent of jobs gained for women across our sample of ten countries will be in this sector, and 30 percent for our sample of mature economies.

We note that the main driver of potential job gains is sectoral, rather than occupational, representation. This reflects the fact that GDP growth—and therefore job creation—tends to be driven by consumption and investment, which then affects employment in sectors experiencing demand (and in the various occupations within each sector). However, it is important to note that women will be able to achieve these gains only if they are able to maintain their current share of employment within sectors and occupations in the labor market; if not, women could risk falling behind.

In the ten countries in our sample, on average 58 percent of potential gross job gains by women are driven by three sectors: healthcare and social assistance, manufacturing, and retail and wholesale trade. On average, 53 percent of men's potential gross job gains are in the manufacturing, retail and wholesale trade, and professional, scientific, and technical services (PST) sectors.[7] It may seem surprising that so many women could find employment in manufacturing given it is highly automatable, but there is significant scope for new jobs to be added in this sector as automation boosts productivity, fueling expansion. In emerging economies, manufacturing continues to be a major driver of job growth in the period to 2030.

[6] While the overall percentages for job displacement and incremental demand are roughly similar at 20 percent in each case for women, the millions of jobs to which they correspond is different—107 million potential jobs displaced for women, compared with 171 million incremental jobs demanded). This is because the overall percentages represent simple averages across countries, while the millions of jobs are a sum across countries.

[7] Professional, scientific, and technical services is a broadly-defined sector, which includes occupations in a variety of industries including legal, accounting, architectural, engineering, design, computer, consulting, research, advertising, photographic, translation, and veterinary services. This sector is broader than "tech" or "STEM," which refer to a narrower range of occupations.

Exhibit E5

Before factoring in potential job losses, women could expand their current employment by 20 percent by 2030, compared with a gain of 19 percent for men.

Demand for jobs in 2030, assuming constant female land male share of employment in sectors and occupations[1]

	Women		Men	
	Million FTE	% of female employment, 2017	Million FTE	% of male employment, 2017
Canada	2	24	2	23
France	2	15	2	16
Germany	4	23	5	24
Japan	2	8	3	6
United Kingdom	3	17	3	17
United States	15	19	14	18
China	112	33	120	28
India	23	19	91	24
Mexico	6	29	8	25
South Africa	1	13	1	9
Total (simple average)	171	20	250	19

[1] Figures represent a trend-line scenario of job creation that is based upon current spending trends, and excludes demand for entirely new occupations. In a forthcoming 2019 MGI report on the future of work in the United States, we will explore another scenario.

Note: Countries ordered based on mature and emerging economies, and alphabetically within each group. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

More than 150 million net jobs could be added in existing occupations and sectors by 2030

In our scenario to 2030 across the ten countries analyzed, approximately 150 million net jobs (factoring in both jobs displaced by automation and job creation) could be added in existing occupations and sectors, the vast majority of which could be in emerging economies. Mature economies could experience minimal net job growth or even a net decline as any gains in employment are counteracted by higher rates of automation adoption. Across the ten economies, 42 percent of net jobs gained (64 million jobs) could go to women and 58 percent (87 million) to men, if current employment trends in occupations and sectors hold and if both men and women can make the transitions required into available jobs.

Up to 9%

of employed people could work in entirely new occupations by 2030

In mature economies, positive net job growth could be concentrated in only two sectors: PST and healthcare. Today, women are well represented in the second but underrepresented in the first in many countries; in Canada, Japan, the United Kingdom, and the United States, women have lower representation in the PST sector compared with their average share in the economy.

In emerging economies, net job growth could occur in a broader range of sectors including manufacturing, accommodation and food services, retail and wholesale trade, and construction (on average, 57 percent of positive net jobs gained in India, China, and Mexico). We find that in China, Mexico, and South Africa women tend to outnumber men in accommodation and food services relative to their overall share of employment and tend to be underrepresented in manufacturing and construction. In India, women are slightly underrepresented relative to economy-wide participation in manufacturing and strongly underrepresented in construction and in accommodation and food services.

Many people could move into entirely new occupations, but women may face more challenges making this move

Waves of technological innovation displace or change the nature of many jobs, but they also create new ones, as was the case when economies shifted away from agriculture in the past. Historical trends in the United States suggest that up to 9 percent of the employed population could be working in entirely new occupations by 2030.[8] Examples from the past decade range from recently created jobs in machine learning and AI to ride-hailing drivers and roles in sustainability and resource management. If we extrapolate from trends in the United States across our sample of ten countries—recognizing that the United States is an imperfect comparison for many of these countries—this translates into more than 160 million additional jobs in entirely new occupations by 2030. This would be comparable to the *entire* net growth in labor demand for existing occupations (after accounting for jobs lost due to automation) in the sample of ten countries. Tapping into these jobs is therefore a major source of opportunity for women.

However, employment in new occupations may be more challenging for women than for men. MGI analysis of 135 recently created US occupations defined by O*NET in 2009 found that approximately 60 percent of jobs were in occupation categories that are male dominated, and only 16 percent female dominated. Other studies have also found that men are more likely to work in highly paid "frontier" jobs, a category of new occupations that involves the deployment of next-generation technology (for instance, AI specialists and roboticists).[9]

[8] Based on analysis conducted in Jeffrey Lin, "Technological adaptation, cities, and new work," *Review of Economics and Statistics*, May 2011, Volume 93, Number 2.

[9] David H. Autor, Frank Levy, Richard J. Murnane, "The skill content of recent technological change: An empirical exploration," *Quarterly Journal of Economics*, 118 (4), February 2003.

More women than men may experience partial automation of their work

Even if women and men remain in their current jobs, the ways in which they work are likely to change significantly as some of the component activities of their occupations are automated, creating "partial automation" of their work. As an illustration, the typical auto mechanic working in 2019 engages in a very different set of activities than the average mechanic in 1950. These workers now use hydraulic lifts and diagnostic computers rather than jacks and manual methods of diagnosis. However, the average number of auto mechanics has not declined in most countries; instead, mechanics have experienced a major transformation in the way they work because of partial automation.

55%

more time could be spent using technical skills in Europe and the United States by 2030

Some evidence suggests that women could be more likely to face partial automation than men. Using the United States as an example, we find that approximately half of occupations that are mainly held by women are less than 50 percent technically automatable by 2030, compared with about 20 percent of occupations largely performed by men.[10] If this pattern holds across countries, women could be at less risk than men of seeing their jobs replaced in their entirety by machines, but could be more likely to experience a fundamental change in their jobs (Exhibit E6).

As partial automation becomes more common and other technologies, including digital platforms that enable independent work, for instance, become more prominent, women's working lives (and men's) could change in three ways:

- **Work activities may shift in importance and could increasingly involve collaborating with automated systems.** As machines increasingly handle routine physical and cognitive tasks, women could spend more time managing people, applying expertise, and interacting with stakeholders. In an emergency room in 2030, for instance, health workers could spend less time doing clerical work (due to the adoption of preregistration by mobile phone, computerized checkout and billing, and AI-led diagnostic tools), and physical work, but more time interacting with patients.

- **Certain skills could become more important.** By 2030, jobs in Europe and the United States could require up to 55 percent more time using technical skills and 24 percent more hours using social and emotional skills.[11] Time spent using physical and manual skills and basic cognitive skills could decrease as those activities are automated.

- **More women could work flexibly.** Co-location with colleagues is an important part of working lives today, but technology could reduce the need to co-locate as telecommuting becomes more widely adopted, for instance. The rise of these new, more flexible ways of working is particularly helpful to women because they disproportionately carry the "double burden" of working for pay and working unpaid in the home in both mature and emerging economies.

Roughly 40 million to 160 million women globally may need to transition between occupations and skill levels

As jobs are lost and gained, women (and men) will need to transition across occupations and skill levels in order to achieve the 2030 scenario we have simulated. Our analysis suggests that across the ten countries studied, between 20 million and 100 million women may need to make transitions across occupations to ensure that they are positioned for shifts in labor demand. For men, we estimated that 35 million to 170 million men need to make these

[10] "Technical automatability" refers to a job's ability to be automated given technology that currently exists. This differs from our previous estimates of automation *adoption*, since it refers only to *technical* automation potential, whereas our automation adoption estimates accounted for economic and social factors that affected broader adoption rates across countries.

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

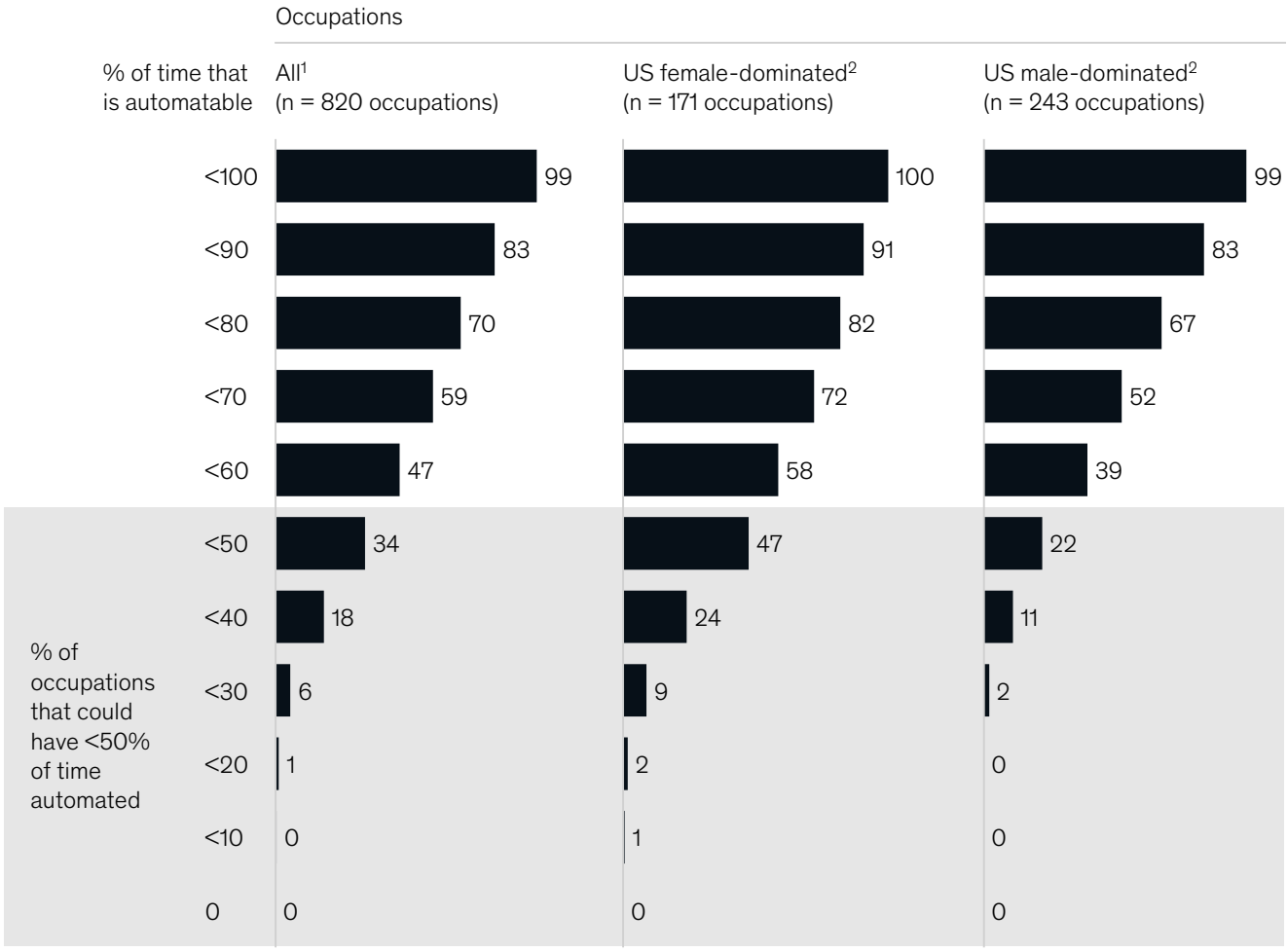
transitions. These wide ranges reflect different potential paces of diffusion of automation technologies, which is difficult to anticipate. The ranges are based on a midpoint automation adoption and an early automation—or rapid— adoption scenario. Extrapolating these findings globally, between around 40 million and 160 million women may need to transition across occupations—between 7 and 24 percent of women—compared with about 60 million to 275 million men, or 8 to 28 percent (Exhibit E7).

If women are able to navigate the necessary transitions, they may be able to maintain, or in some cases slightly increase, their current share of employment. However, if women are not able to make these transitions effectively, their share of employment could decline. To provide a sense of the impact this could have, we looked at how female share of employment would change if the 40 million to 160 million women dropped out of the labor force entirely rather than making job transitions. We acknowledge that this is an extreme outcome, but note it to help illustrate the imperative for successful transitions. In this hypothetical case, we found that the female share of employment could drop by one to seven percentage points, on average, across the ten countries studied between 2017 and 2030.

Exhibit E6

Nearly half of female-dominated occupations in the United States are less than 50 percent automatable, suggesting women could be more likely than men to experience partial automation of their jobs.

Partial automation within occupations,
% of occupations that could have time automated in 2030 based on midpoint technical automation potential



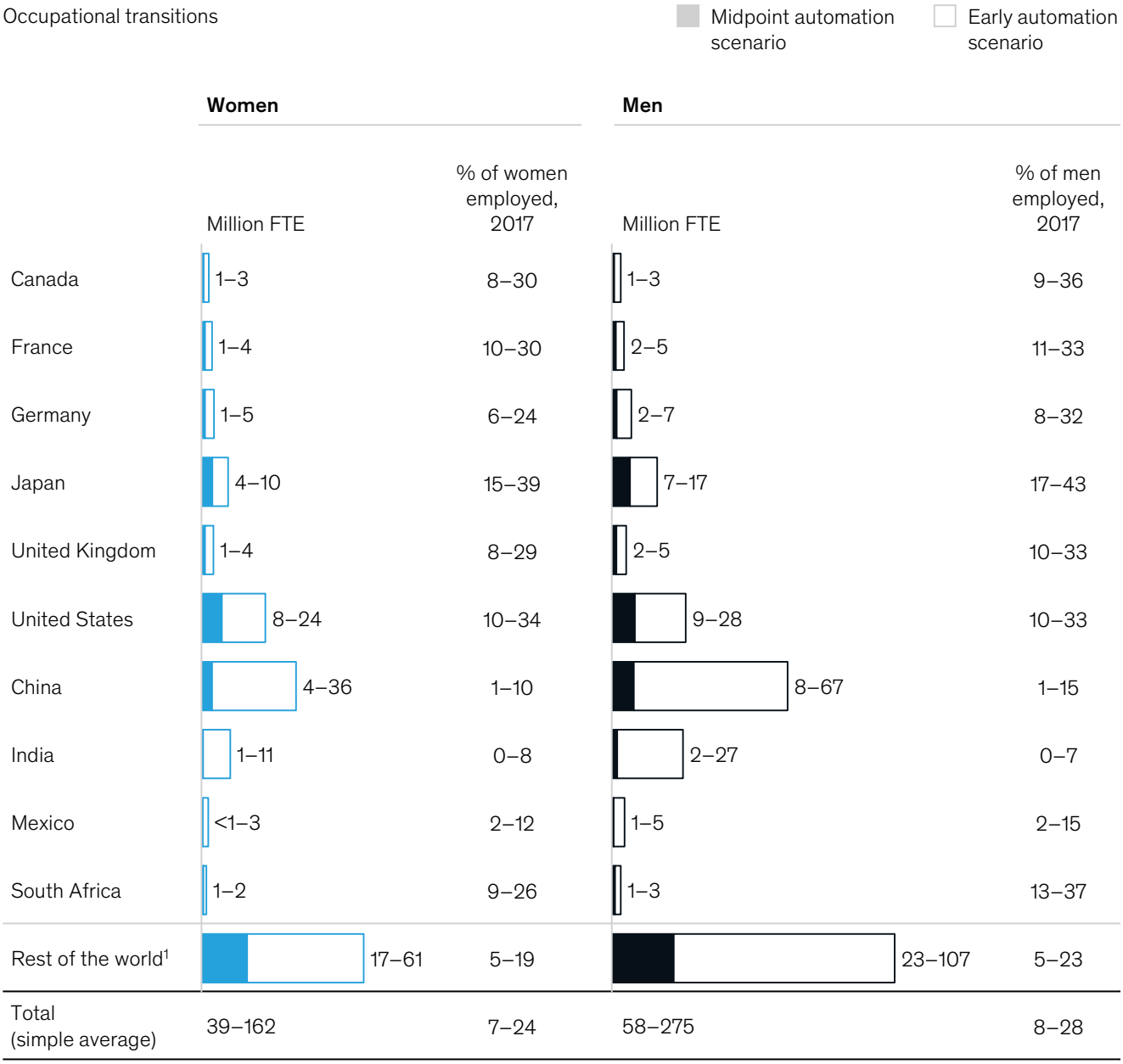
[1] Includes 820 occupations in United States Bureau of Labor Statistics (BLS) data that are female-dominated, male-dominated, and gender-neutral, as well as occupations that do not include gender splits.
[2] Female- and male-dominated means occupations with 60% or more female/male employee representation, respectively.

Source: US BLS; McKinsey Global Institute analysis

Exhibit E7

Roughly 40 million to 160 million women may face a need to transition across occupations and skill sets by 2030 to remain employed.

Occupational transitions



[1] Extrapolated by mapping countries in the world to the most similar of the 10 countries studied in this report (53 countries in total) by applying rates of transition by gender to employment for each country.

Note: Countries ordered based on mature and emerging economies, and alphabetically within each group. Analysis excludes jobs created in new occupations and unsized labor demand. Figures represent a trend-line scenario of job creation. In a forthcoming MGI report on the future of work in the United States, we will explore another scenario.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Women will need higher educational attainment and skills to make successful transitions, thrive in existing jobs, and capture new opportunities

In mature economies, most women (and men) are likely to have to transition into occupations with higher educational requirements. In the six mature economies we include in our sample, net labor demand for jobs requiring a secondary education or an associate degree are likely to decline across the board.[12] In five of the six mature economies in our sample, net labor

[12] An associate degree is an undergraduate academic degree awarded by colleges and universities upon completion of a course of study intended to usually last two years or more. It is considered to be a higher level of education than a high-school diploma. This analysis excludes jobs in entirely new occupations.

demand is only seen growing for jobs with a college or advanced degree (Exhibit E8). In three of the four emerging economies in our sample—China, India, and Mexico—net labor demand is seen rising strongly for occupations requiring a secondary education for both men and women (Exhibit E9). In India, in particular, low-skill women in the agriculture sector could face a significant need to reskill as labor demand for jobs requiring less than a secondary education decline.

However, having the right education and skills is not enough to ensure that women successfully navigate the transitions needed for the workforce of the future. Women still face many barriers in the labor market, including the need to juggle paid employment with unpaid family responsibilities, as well as cultural barriers (this is the case in both emerging and mature economies).

These transitions are also characterized by job growth in higher-wage occupations that offers both opportunities and challenges

In the period to 2030, the adoption of automation technologies and the areas where jobs are created could drive a shift in labor demand toward higher-paid jobs. The situation carries both opportunity and risk for women. If they manage to transition between occupations and retrain themselves to meet demand for jobs that are higher-paying and associated with different skills, they could be looking at a future of more productive and more lucrative employment. However, if they cannot make the necessary transitions, many women could face an intensifying wage gap relative to men.

In all the mature economies studied, demand for low- and middle-wage jobs may contract by 2030. Workers in middle-wage jobs in mature economies could be the most vulnerable. In general, although demand for low-wage labor could also decline, low-wage workers could be somewhat less at risk of job loss than middle-wage workers since their wages are often too low to justify the cost of implementing automation technology. Meanwhile, middle-wage workers in mature economies are often in jobs with a high degree of automation potential, such as plant and machine operation, with significant enough earnings to make automation cost-effective.

In four out of the six mature economies studied, men in middle-wage jobs could face a higher risk of job loss than women as a share of their current employment in that income category. Low- and middle-wage men in mature economies are likely to bear the brunt of labor-market displacement from automation, due to their high representation in machine operation and craft worker occupations. However, there may be crucial second-order effects upon women. A reduction in demand for low- and middle-wage workers could cause displaced men increasingly to compete for jobs with women, exerting downward pressure on wages. Evidence suggests that the labor supply of women is typically more responsive to wage pressure than that of men. For instance, one meta-analysis found that the wage elasticity of labor supply for women may be as much as five times that of men in mature economies.[13] Women may, therefore, leave the labor market more readily than men when facing downward pressure on wages. Moreover, in many countries, cultural attitudes favor the man being the primary earner; if women's wages come under significant pressure, the cost-benefit of working versus not working may not make sense for many women.[14] Structural challenges are associated with dual-earner households (for instance, higher tax rates and additional childcare costs) that could encourage women in those households to leave the labor force if the costs associated with employment become too high. The imperative is high for women to reskill in order to weather these potential disruptions from shifting labor demand.

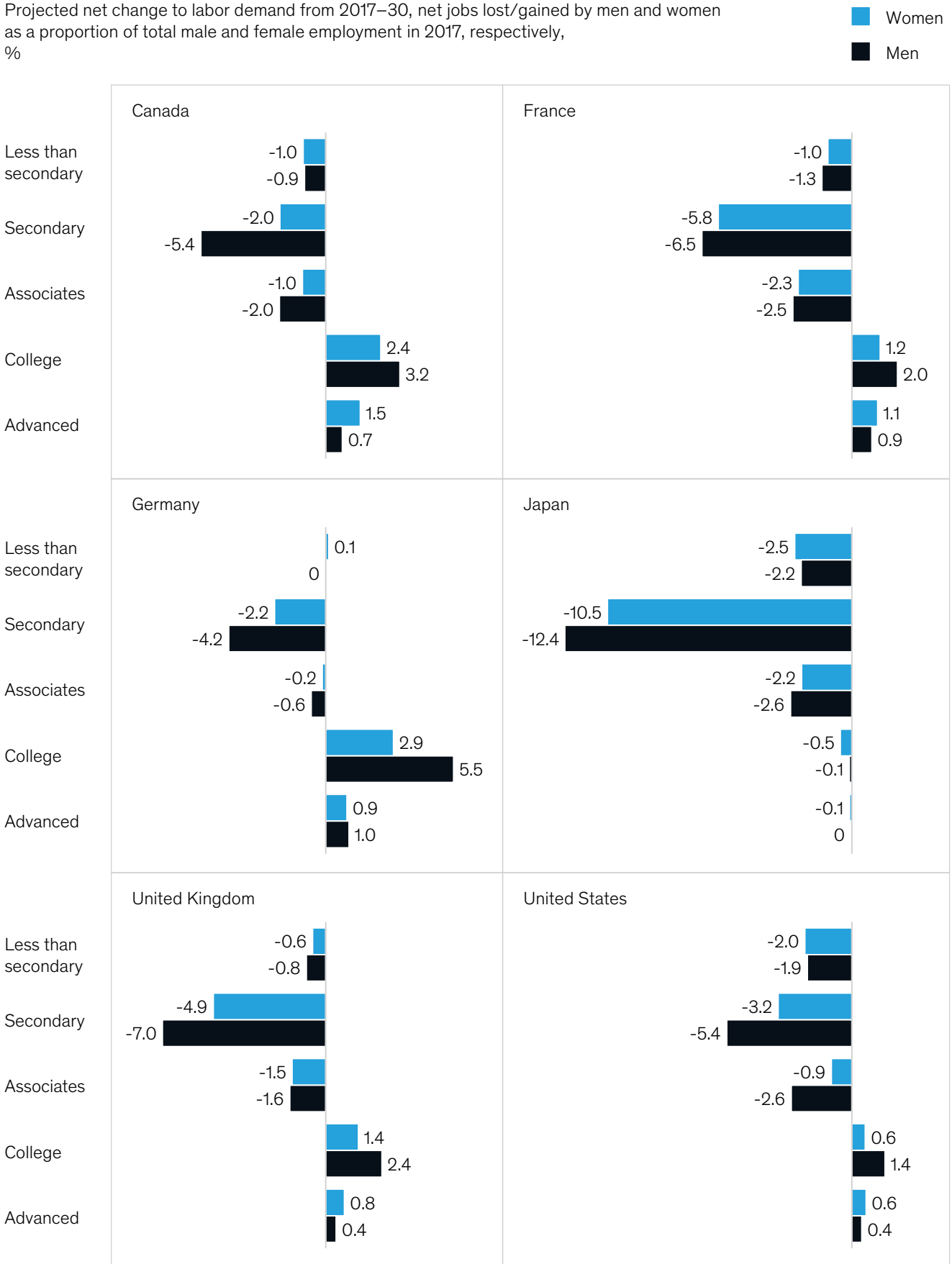
[13] Michiel Evers, Ruud De Mooij, and Danial Van Vuuren, "The wage elasticity of labour supply: A synthesis of empirical estimates," *De Economist*, March 2008, Volume 156, Issue 1.

[14] We have analyzed the World Values Survey and Organisation for Economic Co-operation and Development (OECD) data and found a strong link between societal attitudes that limit women's potential and gender-equality outcomes in a given region. Globally, 60 percent of respondents agreed with the statement that men have more right to a job than women when jobs are scarce. See *WVS Wave 6 (2010–2014),* worldvaluessurvey.org/WVSDocumentationWV6.jsp.

Exhibit E8

In mature economies, men and women could only experience net growth in labor demand in jobs with higher educational requirements.

Projected net change to labor demand from 2017–30, net jobs lost/gained by men and women as a proportion of total male and female employment in 2017, respectively, %



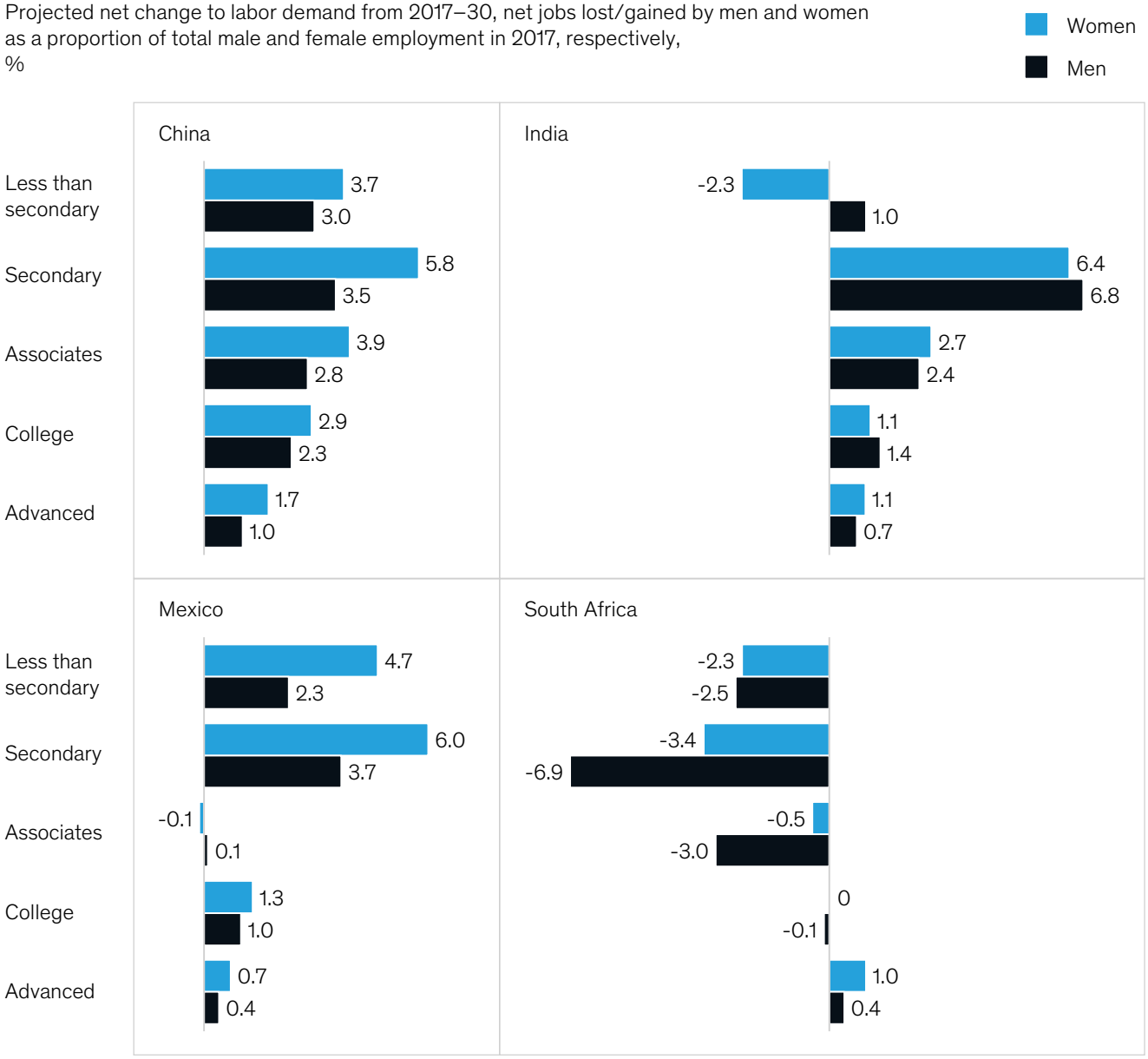
Note: These data are based upon a midpoint scenario of automation and a trend-line scenario of job creation. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: CPS IPUMs; ONS; 2017; ILO, 2017 ; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Exhibit E9

In most emerging economies, men and women could experience growth in labor demand across all education levels, with the largest gains at the secondary education level.

Projected net change to labor demand from 2017–30, net jobs lost/gained by men and women as a proportion of total male and female employment in 2017, respectively, %



Note: These data are based upon a midpoint scenario of automation and a trend-line scenario of job creation. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; McKinsey Global Institute analysis

In emerging economies, demand from employers for jobs in the low-, medium-, and high-wage categories could grow in the period to 2030 for most countries. This reflects robust economic growth and the fact that relatively lower wages overall mean that the incentive for automation is somewhat weaker—for now. However, in India and China, labor demand for medium- and high-wage jobs is growing rapidly, outpacing that of low-wage jobs. This presents a challenge for low-wage women (and men) to eventually develop the skills needed to take up medium- and high-wage jobs. This will be particularly true of India, where the agriculture sector, which today employs about 60 percent of the female working population, is poised to contract.

The gender wage gap could narrow in some countries if women make the necessary transitions but could widen if they don't

Gender wage disparity is also a feature of both mature and emerging economies. Currently, more men tend to be employed in the highest-paying occupations compared with women. In our sample of mature economies, for example, 5 percent of women are in the highest-paying legislator, senior official, and manager occupations, compared with 8 percent of men. At the same time, a higher percentage of employed women work in the two lowest-paying occupational categories—elementary occupations and clerical support work. Twenty-five percent of women are employed in these roles, compared with 15 percent of men. In emerging economies, women and men hold a comparable number of jobs in the professional, associate professional, and technician occupational category, but more men work in the legislator, senior official, and manager occupational category. Twenty-eight percent of women are employed in the lowest-paying category (elementary occupations), compared with 22 percent of men.

5%

of women in mature economies work in the highest-paying legislator, senior official, and manager occupations vs 8% of men

Looking ahead to 2030, our scenario suggests that gender wage disparity may lessen slightly in certain mature economies if women are able to gain the necessary skills and successfully navigate the occupational transitions we have discussed. Women could make inroads in the relatively high-paying professional and associate professional occupation category (for example, 38 percent of women in mature economies could be in this group by 2030, compared with 34 percent in 2017), and the bulk of women's job losses could occur in relatively low-paying occupational categories such as clerical services (for example, 14 percent of women in mature economies could be in this group by 2030, a decline from 17 percent in 2017). However, it is important to note that men could still outnumber women in the highest-paying occupation category: legislators, senior officials, and managers. For instance, in our scenario, 9 percent of men in mature economies could be employed in these high-paying leadership roles, compared with only 6 percent of employed women.

If women are not able to make effective transitions into higher-wage occupations such as the professional category, the gender gap may worsen, or women could become unemployed or drop out of the labor force entirely. In emerging economies on average, both men and women face an imperative to transition away from lower-wage occupations like agriculture into higher-wage occupations such as professional and service worker roles.

Women will need to be skilled, flexible and mobile, and tech-savvy, and will need measures to overcome challenges in all three areas

Women and men face a period of disruption and change. It will be vital for both to develop (1) the skills that will be in demand; (2) the flexibility and mobility needed to negotiate labor-market transitions successfully; and (3) the access to and knowledge of technology necessary to work with automated systems, including participating in its creation. Unfortunately, women face long-established and pervasive structural and societal barriers that could hinder them in all three of these areas, a situation that has made progress toward gender equality in work slow.

The good news is that the forces of technology and innovation that characterize the automation age can also pave the way for more gender equality in the workforce. Digital and internet technologies offer women a way to break down barriers by making reskilling more

accessible and enabling flexible working, for instance. Moreover, private- and public-sector leaders have a huge opportunity to support women as they navigate impending transitions. We describe three priority areas for targeted interventions, some of which apply to both men and women and some of which are geared toward addressing the specific challenges women face (Exhibit E10).

Women need a range of measures to help them develop the skills they will need to make successful labor-market transitions

Women around the world have made significant strides in educational attainment, but there is room for more progress, and for targeted reskilling to enable them to develop the capabilities that will be in demand.

Women in mature economies are generally graduating at rates on a par with, or even higher than, men. In developed economies, more women than men graduate with at least a secondary degree, according to the World Economic Forum (WEF) and UNESCO. For instance, in Western Europe, on average 90.9 percent of women attain a secondary degree, compared with 90.5 percent of men, and on average 79.8 percent of women hold a tertiary qualification, compared with 66.7 percent of men.[15] However, they still need to match their skills as closely as possible to where the most job opportunities will be. There is some concern that women are not acquiring skills needed for high-growth fields such as PST. For instance, in the United Kingdom, of first-year full-time students gaining a higher education, only 37 percent of women studied science subjects in 2016–17, compared with 48 percent of men.[16] Women already in the workforce also need to reskill to meet the needs of the jobs of the future.

~60%

of employed women in India are in agriculture with a narrow set of skills

In emerging economies, education of girls and women has improved markedly in recent years, suggesting that women should be better positioned now than in the past to take advantage of shifts in labor demand. However, large gender gaps persist in education, and even more so in the skills that women will need. In low- and lower-middle-income countries such as India, where about 60 percent of employed women are in agriculture and tend to have a narrow set of skills that may be hard to adapt, transitioning into new occupations and sectors is likely to be highly challenging. More than ever, women must embrace lifelong learning from school to employment and throughout their working lives.

To address these needs, the private sector can invest more in training and reskilling employees within companies or in partnership with academic and other institutions. In China, for instance, the All-China Women's Federation has forged partnerships with private-sector companies including Alibaba to provide training and networking for women, especially in e-commerce and technology sectors.[17] Increasingly, midcareer workers will need to refresh or develop new skills; in 2018, 54 percent of employers were providing additional training and development opportunities to their existing workforce in order to fill skills gaps, compared with only 20 percent in 2014.[18] Governments can contribute by providing women with subsidies and financial support to finance training and reskilling. Singapore's SkillsFuture Credit provides all Singaporeans aged 25 and over a credit of approximately S$500 (approximately $360) to use for approved work-related skills programs.[19] Public and private investment in digital learning platforms would open up another avenue for women. One example of this is Goldman Sachs' 10,000 Women initiative, which has an online education partnership with Coursera that provides female entrepreneurs with access to a free digitized

[15] Note that net secondary education is the percentage of girls and boys in the official age range for secondary education who are enrolled in secondary education. Gross tertiary education is the total enrollment in tertiary education, regardless of age, expressed as a percentage of the most recent five-year age cohort that has left secondary school. See *The global gender gap report*, World Economic Forum, 2018.

[16] *Higher education student statistics: UK 2016/17 – qualifications achieved*, Statistical First Release SFR247, HESA, January 11, 2018.

[17] *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.

[18] *Solving the talent shortage*, 2018 Talent Shortage Survey, Manpower Group, 2018, **manpowergroup.co.uk/wp-content/uploads/2018/07/MG_TalentShortage2018.pdf.**

[19] *About SkillsFuture,* SkillsFuture Singapore, **skillsfuture.sg/AboutSkillsFuture.**

Exhibit E10

Government, industry, education, and NGO leaders will all play a role in supporting job transitions for women.

			Key actors		
	Interventions	Examples of potential initiatives	Govern-ment	Private sector	NGOs
Support skill-building efforts	Invest in training and reskilling	• Training and apprenticeship programs for women • Reskilling opportunities for midcareer women or women returning to workforce	●	●	●
	Subsidize transition costs	• Government or corporate reskilling subsidies for targeted occupations and sectors • Childcare subsidies for parents undergoing reskilling or pursuing higher education	●	●	
	Invest in digital platforms	• Industry partnerships with massive open online courses (MOOCs)		●	●
	Increase transparency on labor demand trends	• Technical school or university curriculums co-created with industry • Informational campaigns targeting women		●	●
Address labor mobility constraints	Help women balance paid and unpaid care work	• Public or corporate policy interventions to provide universal or accessible childcare • Corporate policy changes to promote flexible or telecommuting work options	●	●	
	Invest in transportation infrastructure and public safety	• Investment in more efficient public infrastructure • Campaigns to increase bystander awareness of harassment	●		
	Foster more dynamic career paths and enable women's access to networks	• Intrafirm and cross-sector networks and mentorship opportunities for women • Sponsorship of network-building organizations for women • Increased unconscious bias training in performance reviews and hiring practices • Digital talent platforms to help women find opportunities		●	
	Reduce stereotypes about gendered occupations	• Increased pubic visibility of female role models in male-dominated industries (eg, through diverse panels at speaking engagements)		●	
	Enhance social protections and safety nets for workers	• Labor agencies equipped to support and reskill the unemployed • Unemployment insurance or universal basic income policies	●		
Increase women's representation in and access to technology	Create pathways for women in STEM	• Partnerships to increase exposure to STEM opportunities for girls and women from primary school to university • Internship, apprenticeship, and mentoring programs for women in STEM • Sponsorship of women pursuing advanced education in STEM	●	●	●
	Increase access to basic technology for women in emerging markets	• Investment in internet and mobile infrastructure	●	●	
	Provide more support for women to develop digital skills	• Digital and mobile literacy programming targeting women in emerging economies	●		●
	Ease path for women to work in gig economy	• Increased worker protections for independent workers	●	●	
	Address funding gap for women entrepreneurs	• Strengthened entrepreneurship ecosystem for female founders • Increased diversity within venture capital firms • Increased microfunding and access to credit to female entrepreneurs in emerging markets		●	

Source: McKinsey Global Institute analysis

curriculum tailored to meet the needs of female business owners in emerging markets.[20] Finally, as labor demand shifts, it is important to ensure that skills development matches market demand; doing so will require employers to provide clear and transparent signals to women (for example, through online targeting of women and information campaigns).

Interventions are needed to help women improve their flexibility and mobility

Labor mobility and flexibility help women and men move between employers, occupations, sectors, and geographies as needed in order to respond to the needs of an evolving labor market. However, women tend to face more structural challenges in this area than men.

Women are less mobile and flexible because they spend much more time than men on unpaid care work—more than 1.1 trillion hours a year, compared with less than 400 billion hours for men.[21] Governments can help give women the flexibility to ease their double burden through subsidized maternity and parental leave and childcare. Companies can offer flexible workplace policies, but one 2018 survey of employers found that only 23 percent were doing so.[22] Globally, nearly 40 percent of women in wage employment do not have access to social protection such as pensions, unemployment benefits, or maternity protection.[23]

Another factor limiting women's mobility is that women—in both mature and emerging economies—face dangers to their physical security when traveling, potentially limiting where they can find employment. Several countries have attempted to improve women's mobility by introducing women-only train cars and other gender-segregated travel options. In emerging economies, limited access to—and poor safety on—transportation systems is regarded as the greatest obstacle to women's participation in the labor market, especially in the formal economy. One study estimated that this issue reduced the probability of women in low-income economies participating in the labor market by 16.5 percentage points.[24]

1.1t

hours of unpaid work each year by women vs 400b for men (OECD)

Women also don't have access to the same extent as men to networks that help them to develop their skills, achieve career progression, and transition into new jobs. Some companies are moving ahead on this front. US-based hotel company Hilton has created networking groups for women and other underrepresented groups of employees.[25]

Persistent gender concentration within occupations and sectors also makes it more difficult for women (and men) to cross over into roles where they currently are the minority of workers. More effort is needed to combat stereotypes that entrench gender concentration in some occupations. For instance, companies and other organizations can actively seek to increase the number and visibility of role models to counteract gender-biased representation of men or women in the media.

As they transition into different occupations or sectors, women (and men) may need financial support, including social safety nets like unemployment benefits and insurance. Labor agencies can focus on providing benefits and assistance to the unemployed: serving as job counselors, offering career guidance, and enabling access to potential training and job opportunities for those temporarily out of the workforce. In Germany, caseworkers are assigned to every unemployed individual and offered incentives to find their clients work. This policy, among others, helped to reduce Germany's unemployment from 10 percent in 2003 to below 5 percent by 2015.[26]

[20] *Goldman Sachs 10,000 Women launches online education partnership with Coursera,* Goldman Sachs, May 21, 2018.
[21] OECD Gender, Institutions and Development Database 2018, United Nations Department of Economic and Social Affairs, Population Division (2017 revision).
[22] *Solving the talent shortage*, 2018 Talent Shortage Survey, Manpower Group, 2018.
[23] "Gender differences and why they matter," Chapter 5 in *World Development Report 2012,* World Bank, September 2011. http://siteresources.worldbank.org/INTWDR2012/Resources/7778105-1299699968583/7786210-1315936222006/chapter-5.pdf
[24] *World employment social outlook: Trends for women,* International Labour Organization (ILO), 2017.
[25] *Women in the workplace 2018,* McKinsey & Company and Lean In, October 2018.
[26] Niklas Engbom, Enrica Detragiache, and Faezeh Raei, *The German labor market reforms and post-unemployment earnings,* IMF working paper number 15/162, July 2015.

Women must be more engaged in technology—more access, more skills, and more participation in its creation—to thrive

Technology can break down many of the barriers facing women, opening up new economic opportunities, helping them to participate in the workforce, and, in the automation age, enabling the navigation of transitions. For example, women are now employed independently in what is popularly known as the gig economy, taking advantage of technology that enables new and more flexible ways of working.[27] In middle-income emerging economies, increased connectivity, the low cost of labor, and a rise in e-commerce have propelled an increase in gig work as an alternative to traditional self-employment. Additionally, the flexibility of using technology platforms, often from home, helps to explain why so many women have become e-commerce entrepreneurs. For example, a McKinsey survey in Indonesia found that women-owned micro, small, and medium-size enterprises (MSMEs) generate 35 percent of e-commerce revenue, compared with only 15 percent of offline MSME revenue.[28]

<20%

of tech workers are female in many mature economies

However, women continue to lag behind men in their access to technology, the skills to use it, and employment in tech sectors. It is also vital that women participate in the creation of technology, not only because diverse teams have distinct benefits, but also because their contribution can help provide a diverse set of inputs as AI algorithms are created, thereby helping to tackle concerns about inbuilt gender bias in such algorithms.[29]

Globally, men are 33 percent more likely than women to have access to the internet; that gap worsens when focusing on women in poor, urban communities.[30] Women also lag behind men in developing tech skills. Around the world, women account for only 35 percent of science, technology, engineering, and math (STEM) students in higher education.[31] Women are significantly underrepresented in tech jobs—less than 20 percent of tech workers are female in many mature economies.[32] Only 1.4 percent of female workers in OECD countries have jobs developing, maintaining, or operating information and communications (ICT) systems, compared with 5.5 percent of male workers.[33]

A number of interventions are needed to address these challenges. First, there is a need to create pathways for women in STEM fields. The Canadian government's Science campaign aims to encourage young women to pursue careers in the sciences.[34] Nonprofits across the world, from Afghanistan to the United States, are focused on developing girls' coding skills.[35] Companies in STEM fields can invest in and partner with nonprofits and colleges to develop a broader pipeline of women in tech. Via partnerships, companies can, for instance, support women's communities and clubs by offering networking or early internship opportunities.[36] Second, women's access to basic enabling technology needs to expand. In emerging economies in particular, improving women's access to the internet and mobile technologies

[27] Independent work, also known as the gig economy, is defined by three characteristics: a high degree of worker autonomy, payment by task, and a short-term relationship between worker and client. For a broad discussion of the gig economy, see *Independent work: Choice, necessity, and the gig economy*, McKinsey Global Institute, October 2016.

[28] McKinsey survey of Indonesian e-commerce merchants, 2017. N = 700.

[29] On the benefits of diversity, McKinsey research has found that companies in the top quartile for gender diversity in their executive teams were 21 percent more likely to experience above-average profitability than companies in the fourth quartile. See *Delivering through diversity*, McKinsey & Company, January 2018. On the risk of bias in AI, see, for instance, Moritz Hardt, *How big data is unfair*, Medium, September 26, 2014; Tom Simonite, "Machines taught by photos learn a sexist view of women," *Wired*, August 21, 2017; Eva Noble, *Without data equality, there will be no gender equality*, Women Deliver, June 11, 2018; and Hope Reese, *Bias in machine learning and how to stop it*, TechRepublic, November 18, 2016.

[30] *The case for the web,* The Web Foundation, 2018.

[31] *Taking stock: Data and evidence on gender equality in digital access, skills and leadership,* EQUALS Global Partnership, 2018.

[32] The share of women in tech is different from the share of women in the PST sector, which encompasses a variety of industries including legal, accounting, architectural, engineering, design, computer, consulting, research, advertising, photographic, translation, and veterinary services. A forthcoming McKinsey research report, *The diversity opportunity in tech,* will provide further detail.

[33] *Taking stock: Data and evidence on gender equality in digital access, skills and leadership, EQUALS Global Partnership, 2018.*

[34] *Government of Canada launches interactive campaign to build network of mentors for young women in science,* Innovation, Science, and Economic Development Canada, February 2018.

[35] *Cracking the code: Girls' and women's' education in science, technology, engineering, and mathematics (STEM),* United Nations Educational, Scientific and Cultural Organization, 2017.

[36] *Rebooting representation: Using CSR and philanthropy to close the gender gap in tech,* McKinsey & Company and Pivotal Ventures, 2018.

can provide them with gateways to online learning and independent work platforms. GSMA estimates that there are 433 million unconnected women in emerging economies.[37]

Third, women need more help to develop their digital skills. In India, Google and Tata Trust fund the Internet Saathi program to increase digital literacy among rural women.[38] However, more needs to be done. In a 2015 study, GSMA said that it had found few examples of large-scale initiatives specifically focused on teaching women mobile literacy and digital skills, but, on a positive note, said that a number of mobile network operators had begun to address the gap in developing countries.[39]

~433m

unconnected women in emerging economies (GSMA)

Fourth, barriers to women working in the gig economy must be addressed. This includes concerns about physical security (in food delivery or ride-sharing, for instance), lower access to internet and mobile devices among women, and less social protection than for formally employed workers. Finally, more can be done to address the funding gap faced by women entrepreneurs as part of a broad effort to actively encourage women to create technology and work in new ways. Consider that, 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 just 13 percent.[40] The numbers in Europe are even lower, with 93 percent of 2018 capital raised going to all-male founding teams.[41] There is an imperative for investors to step up efforts to promote gender diversity and eliminate gender bias in funding. The World Bank's Women Entrepreneurs Finance Initiative funds efforts to tackle both financial and nonfinancial constraints faced by women entrepreneurs in emerging markets. In its first round of approved projects, it expects to mobilize more than $800 million in new financing to women-owned and -led small and medium-size enterprises.[42]

The world of work is undergoing a radical transformation as automation technologies spread. Automation could displace many women, affect their earnings, and require millions to seek work in other occupations or sectors. New opportunities will emerge, too, given that many women work in fast-growing sectors such as healthcare. However, in order to thrive and advance in the automation era, many millions of women will need to make challenging transitions between occupations and develop new skills. Women are likely to face unique difficulties in making these transitions effectively—and therefore positioning themselves for the automation era and preserving their job prospects—because of stubborn structural barriers in the labor market.

Times of significant technological change undoubtedly bring challenges, but digital, internet, mobile, and AI can also open new doors to women to gain skills, to secure higher-paying jobs, and to become entrepreneurs. It is vital that everything possible is done to help women overcome the challenges and seize the opportunities of the automation age. There are concrete, practical ways that leaders in the public, private, and social sectors can—and should—support women in these areas. If they offer active measures to help lower barriers to women's ability to respond to the disruption of automation dynamically and effectively, women could maintain or even slightly improve their relative position in the labor market in certain economies—benefiting not only women but also the global economy. If they do not take necessary measures, women could fall further behind in the world of work.

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[37] *Connected women, The mobile gender gap report 2019,* GSMA, 2019.
[38] "Google, Tata Trusts to expand Internet Saathi programme," Hindu Business Line, January 2018.
[39] *Accelerating digital literacy: Empowering women to use the mobile internet*, GSMA, 2015.
[40] Kate Clark, *Female founders have brought in just 2.2% of US VC this year (yes, again)*, TechCrunch, December 2018.
[41] *Diversity & inclusion in tech: A practical guidebook for entrepreneurs*, Atomico, 2018.
[42] *Women Entrepreneurs Finance Initiative allocates first round funding: Expected to mobilize twice the original target,* World Bank, April 19, 2018.

Box E2

Countries exhibit differences and similarities in patterns of women's future work

Some dynamics and patterns in the future of work are similar whether we are looking at mature or emerging economies, but differences exist between the two groups, for countries within in each group, as well as between men and women within these countries (Exhibit E11).

Gendered work. In mature and emerging economies alike, men and women cluster in certain occupations and sectors. However, an inverse relationship exists between gender concentration and women's labor-force participation—when more women participate, gender concentration diminishes as women cross gender lines. China stands out, with both high female participation and less gender concentration in occupations. In India, by contrast, participation is relatively low, as is diversity within occupations and sectors.

Jobs lost. The risk of automation for both men and women tends to be higher in countries with higher per capita GDP where wages tend to be higher and where, therefore, the incentive is greater to replace labor with automated processes and systems. Looking at gender differences, we find that, on average, the share of jobs lost for women is slightly lower than the share of jobs lost for men across the ten countries in our sample. This trend generally holds for both mature and emerging economies; however, in Japan and China, the difference in share of jobs lost between men and women is negligible. While the overall automation risk is roughly similar for men and women, sector and occupation patterns of jobs lost for men and women look different, driven by variations in the occupations in which men and women tend to work. A combination of clerical support occupations and service and sales occupations make up the bulk of job losses for women in mature economies (on average 58 percent), while service and sales occupations and machine operators and craft occupations drive the majority of losses for women in emerging economies (on average 55 percent). It is important to note that, in India, agricultural occupations account for close to 30 percent of losses for women.

Jobs gained. Factors such as rising consumption and infrastructure investment play a key role in potential job creation. The relative level of jobs gained in healthcare relates closely to the changing proportion of the population aged over 65, especially in mature economies. This is due to the fact that as populations age, healthcare spending increases, and that sector is a major driver of job creation in mature economies. Given women's relatively high representation today in healthcare, we find that women could be somewhat better positioned than men to capture opportunities from jobs gained—the share of jobs gained could be higher for women than men in most countries and is concentrated especially in healthcare. One exception to this pattern could be in Germany, where job growth could be concentrated in manufacturing (a sector in which men significantly outnumber women). Another exception could be in India, where about 60 percent of women are concentrated in agriculture, a sector that is not expected to gain jobs, versus only 37 percent of men.

Net jobs. In mature economies, net job growth could be concentrated in only two sectors: PST and healthcare. Women are well represented in the second but less well represented in the first; women currently account for about 44 percent of all workers in PST in mature economies, which is lower than their 47 percent average share of overall

Exhibit E11

Summary of key measures: Overview of results (1/2).

	Per capita GDP, 2017, $ thousand PPP	% of population 65+		Female labor-force participation rate, %	Gender Concentration Index,[1] occupations, 0–100	Change in female share of employment, 2017–30, percentage points
		2017	2030			
Canada	47	17	23	61	47	1–2
France	43	20	24	50	47	0–1
Germany	51	21	27	55	47	-1–0
Japan	43	27	30	50	45	0–1
United Kingdom	43	19	22	57	49	0–1
United States	60	15	20	56	40	0–1
China	17	11	17	61	27	0–1
India	7	6	8	27	62	-1–0
Mexico	18	7	10	44	53	0–1
South Africa	13	5	7	48	45	1–2

[1] The index measures the concentration of people of both genders in sectors and occupations. The index was created by calculating the sum of the squares of the distance from equal gender representation in each sector or occupation within a country, and then taking the square root. The index was then adjusted to fit a zero-to-100 scale, with zero indicating equal representation and 100 indicating fully gendered occupations and sectors.

Note: Countries ordered based on mature and emerging economies, and alphabetically within each group.

Source: McKinsey Global Institute analysis

employment. In emerging economies, positive net job growth could occur in a broader range of sectors including manufacturing, accommodation and food services, retail and wholesale, and construction (for example, 74 percent of net jobs gained by women in India, 22 percent in China, and 75 percent in Mexico). We find that women tend to be more present than men in accommodation and food services and healthcare relative to their overall share of employment, and underrepresented in manufacturing.[1]

Transitions. On average, women face a comparable need to transition occupations relative to men. Globally, in a midpoint automation scenario, an average of 7 percent of women (40 million) could face a need to transition, compared with 8 percent of men (60 million). Men may face slightly higher rates of transition, particularly in mature economies, given larger displacement in sectors such as manufacturing. In India and Mexico, rates of transition are comparable. Under an early automation scenario, an average of 24 percent of women (160 million) and 28 percent of men (275 million) could face a need to transition globally. The gap between women and men widens in an early automation scenario due to a shift in occupational mix that is weighted more heavily toward occupations involving routine physical work where men are more highly represented, such as grounds maintenance workers, heavy-truck drivers, and farm laborers.[2]

[1] This analysis does not include wholly new occupations that do not exist today. Past research in the United States suggest that up to 9 percent of the employed population in 2030 could be working in entirely new occupations that could add 160 million or more jobs. Based upon analysis conducted in Jeffrey Lin, "Technological adaptation, cities, and new work," *Review of Economics and Statistics*, May 2011, Volume 93, Number 2.

[2] Occupations that have a high concentration of routine physical work activities exhibit the fastest acceleration in automation adoption rates between a midpoint and an early automation adoption scenario.

Exhibit E11 (Continued)

Summary of key measures: Overview of results (2/2).

Women Men

	Potential jobs displaced by 2030		Potential jobs demanded in 2030		Job transitions	
	Million FTE	% of 2017 employment	Million FTE	% of 2017 employment	Million FTE	% of 2017 employment
Canada	2	24	2	24	1-3	8–30
	3	28	2	23	1-3	9–36
France	3	22	2	15	1-4	10–30
	3	23	2	16	2-5	11–33
Germany	4	21	4	23	1-5	6–24
	5	22	5	24	2-7	8–32
Japan	6	24	2	8	4-10	15–39
	9	24	3	6	7-17	17–43
United Kingdom	3	22	3	17	1-4	8–29
	4	24	3	17	2-5	10–33
United States	19	24	15	19	8-24	10–34
	20	26	14	18	9-28	10–33
China	52	15	112	33	4-36	1–10
	66	15	120	28	8-67	1–15
India	12	10	23	19	1-11	0–8
	44	12	91	24	2-27	0–7
Mexico	3	17	6	29	<1-3	2–12
	6	18	8	25	1-5	2–15
South Africa	1	18	1	13	1-2	9–26
	2	22	1	9	1-3	13–37

Note: These data are based upon a midpoint scenario of automation and a trend-line scenario of job creation.

Source: McKinsey Global Institute analysis

1 Jobs lost, jobs gained

Technological change is transforming the world of work. Automation promises a new productivity revolution as robots and computers take over many routine physical tasks and are increasingly capable of accomplishing work that requires cognitive abilities; at the same time, adoption of automation technologies could put millions of women and men at risk of their jobs being displaced. However, even with automation, net demand for work and workers could increase as economies grow, partly fueled by productivity growth enabled by technological progress. Rising incomes and consumption, especially in emerging economies, increasing demand for healthcare in societies that are aging, growing investment in infrastructure and energy, and other trends could create demand for work that could help offset the displacement of workers.

During the transition to a more automated world of work, disruption to current ways of working could be challenging for women, whose progress toward gender equality in work has already been slow (see Box 1, "An update on progress toward gender parity"). In 2015, the 193 member nations of the United Nations agreed to the Sustainable Development Goals (SDGs). One of these, goal five, focuses on measuring gender equality. In the four years since, little progress has been made in the world of work, and gender parity in work continues to be lower than gender parity in society. In its previous work to track progress toward gender parity, MGI mapped 15 indicators of gender inequality in society and work and compiled them into a gender parity score, or GPS.[43] Since that research in 2015, MGI has updated the GPS, and found that GPS for gender equality in work has risen only marginally. As we enter the automation era, the future of work for women could overlay new challenges on long-established ones.

We find that the impact of automation on women and men varies and is, overall, a nuanced story. Women could experience job displacements and potential gains from new labor demand on a broadly similar scale as men. In fact, our simulation suggests that, on average, women could be slightly less likely to lose their jobs to automation than men, and slightly more likely to capture demand for new jobs given where they are employed today.[44] In contrast, however, our research suggests that women may not be as well positioned as men to gain employment in entirely new occupations that could be created by technological change. Taking into account job displacement and demand for new jobs (excluding additional jobs in brand-new occupations), we find that the relative shares of women and men in the workforce may remain roughly stable in the period to 2030—assuming that women and men are able to capture the job opportunities that open up—but that patterns and composition of jobs lost and gained could be quite different for men and women.[45]

[43] A GPS score of zero represents no gender parity, while 1.0 represents full gender parity. For instance, a GPS score of 0.95 indicates that 5 percent further progress is needed before full gender parity is attained. See *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015. Since its original 2015 global research, MGI has looked at gender inequality in France and Western Europe, India, the United States, the United Kingdom, Canada, the Netherlands, and Asia Pacific. All reports can be downloaded at https://www.mckinsey.com/mgi/our-research/productivity-competitiveness-and-growth.

[44] Throughout this report, all average figures are simple averages across the ten countries studied unless otherwise indicated.

[45] We use the term "jobs" as shorthand for full-time equivalent workers (FTEs), and we apply our analysis to both work displaced by automation and new work created by future labor demand. In reality, the number of people working is larger than the number of FTEs, because some people work part time. Our analysis of FTEs covers employees at firms as well as independent contractors and freelancers.

Box 1

An update on progress toward gender parity

In 2015, MGI found that countries could add $12 trillion to global GDP by 2025 by advancing women's equality.[1] This figure was based on a realistic scenario in which all countries were to match the progress toward parity of the country in each region that had scored the most success in narrowing gender gaps: a best-in-region scenario. In this previous research, MGI mapped 15 indicators of gender equality in society and in work for 95 countries that were home to 93 percent of the world's female population and generated 97 percent of global GDP. Using the 15 indicators, we compiled a gender parity score or GPS for each country.[2]

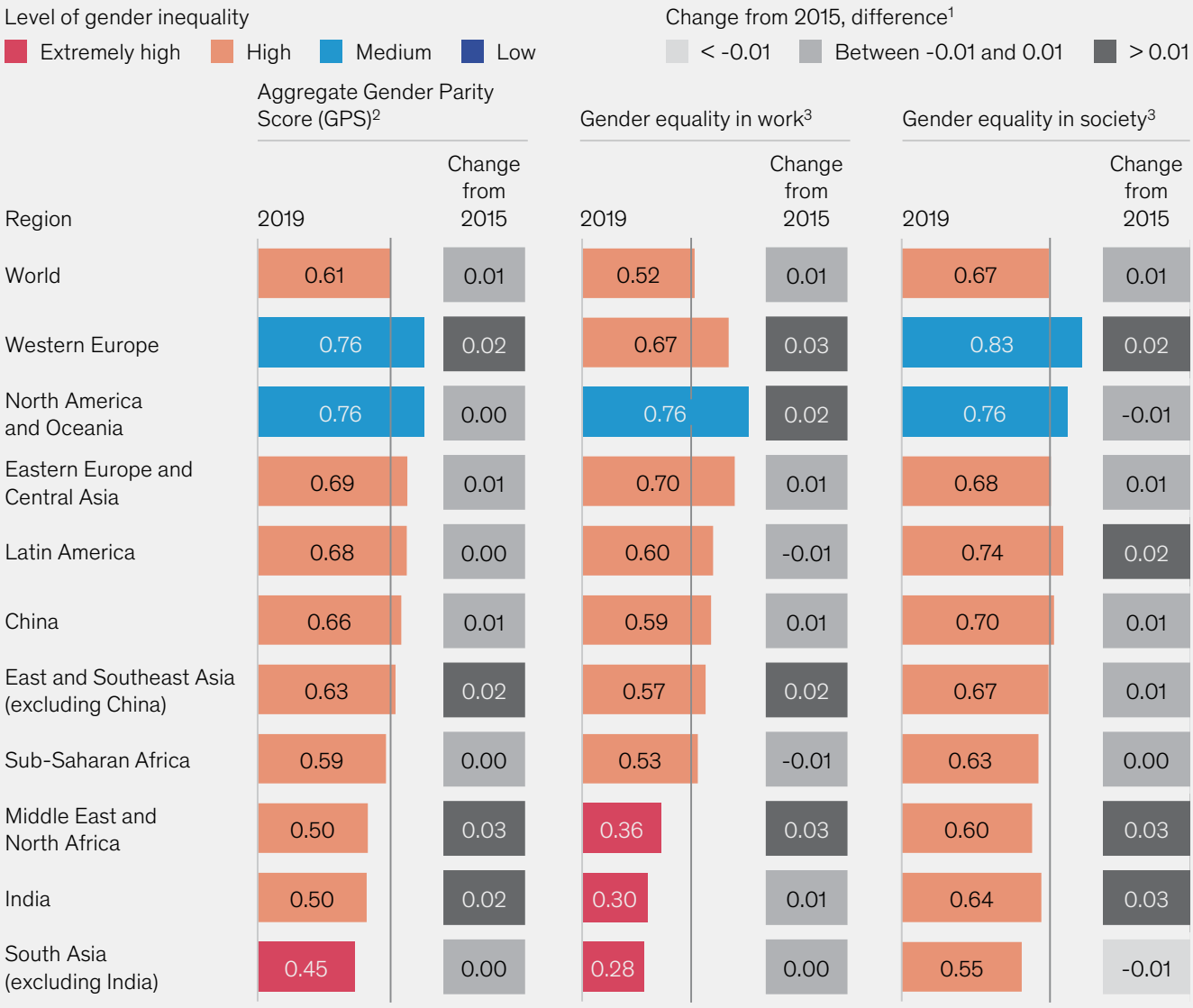
Four years later, we have created an updated view of GPS in 2015 and GPS in 2019. In this update, we look at 125 countries. We find that progress toward gender equality at work and in society has been marginal. In 2015, the global GPS score was 0.60; today, it is 0.61 (Exhibit 1). Gender equality in work lags behind gender equality in society with a GPS of 0.52 versus 0.67, respectively.

1 *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015.

2 In MGI's research, gender equality in society has three dimensions: essential services and enablers of economic opportunity, legal protection and political voice, and physical security and autonomy. Gender equality in work includes the ability of women to engage in paid work and to share unpaid work more equitably with men, to have the skills and opportunity to perform higher-productivity and formal jobs, and to occupy leading positions in the economy. On the GPS, for most indicators, low inequality is defined as being within 5 percent of parity, medium between 5 percent and 25 percent, high inequality between 25 percent and 50 percent, and extremely high inequality as greater than 50 percent from parity. For physical security and autonomy indicators, we defined extremely high inequality as greater than 33 percent distance from no prevalence (of child marriage or violence against women). For sex ratio at birth and maternal mortality, given the different range of values for these two indicators, slightly different thresholds were used. Please see the technical appendix for more details.

Exhibit 1

There has only been slight progress toward gender parity globally, both in gender equality at work and in society.



1 Color coding and thresholds for difference between 2015 and 2019 are illustrative to visually show different levels of progress.

2 All GPS calculations are conducted using a sum-of-squares method with equal weighting across indicators. Numbers are rounded to two decimal places. Color coding is based on actual, not rounded, values. For details about the color coding, see technical appendix.

3 The formal employment indicator within gender equality in work, along with the violence against women indicator and a portion of the financial inclusion indicator within gender equality in society, are unchanged between 2015 and 2019 due to a lack of time-series data.

Source: McKinsey Global Institute analysis

Across countries, distinct and entrenched gender differences characterize sectors and occupations

The world of work is characterized by distinct gender differences both in sectors and occupations. Men and women exhibit strong tendencies to cluster within selected occupations and sectors (for additional details on the occupations and sectors reviewed, together with a glossary of terms, please see the technical appendix). For example, in all of the countries studied, we find that women are strongly concentrated within the healthcare sector, whereas men are strongly concentrated within manufacturing.[46] These gender differences matter because where men and women are employed today influences how they will be affected by automation, and this could also be indicative of their ability to tap into future growth opportunities across sectors and occupations. It is notable that these gender differences hold whether we are looking at mature or emerging economies.

To assess gender differences in employment, we developed a gender concentration index that measures how "gendered" different sectors and occupations are across the ten countries studied (Exhibit 2).[47] The higher the score, the more unequal gender representation is within sectors or occupations in a country. We find that across all countries, concentration tends to be relatively high, with no country at zero (that is, completely balanced representation across all roles).

In general, across our sample of countries, we find that concentration tends to be higher across occupations than across sectors, suggesting that men and women tend to gravitate strongly toward certain types of work, and that this pattern is stronger when selecting for role rather than industry. We also find a limited relationship between the level of concentration and the stage of economic development, with mature economies (which have high levels of economic development) still experiencing relatively high levels of concentration. Interestingly, we do find an inverse relationship between women's participation in the labor force and the level of concentration, suggesting that as more women enter the labor force, an opportunity exists for crossing traditional gender lines and for women to participate in a broader array of sectors and occupations.

China in particular stands out for a relatively low concentration score. In line with our observation that gender concentration declines when participation rises, we note that China's 2018 rate of female labor-market participation for ages 15 and above was 61 percent.[48] When Mao Zedong's government took power in China, women entered the workforce in large numbers. Certain studies have suggested that government encouragement of women to work may have contributed to high female labor-force participation.[49] However, even in China, we see a gender concentration index of nearly 30, which suggests that there is still some degree of gender concentration in sectors and occupations.

The prevalence of differences in sector and occupation choices across all countries suggests that social norms and preferences shape the occupational choices men and women make. We do not explore this topic in this report, and we acknowledge that, ultimately, where women and men work is a matter of personal choice that is shaped by preference as well as social and environmental factors.

[46] Globally, MGI's analysis of gender inequality in 125 countries found extremely high, high, or medium gender inequality across professional and technical occupations between men and women in over 50 percent of countries studied. For further details, see *The power of parity: How advancing gender equality could add $12 trillion to global growth*, McKinsey Global Institute, September 2015.

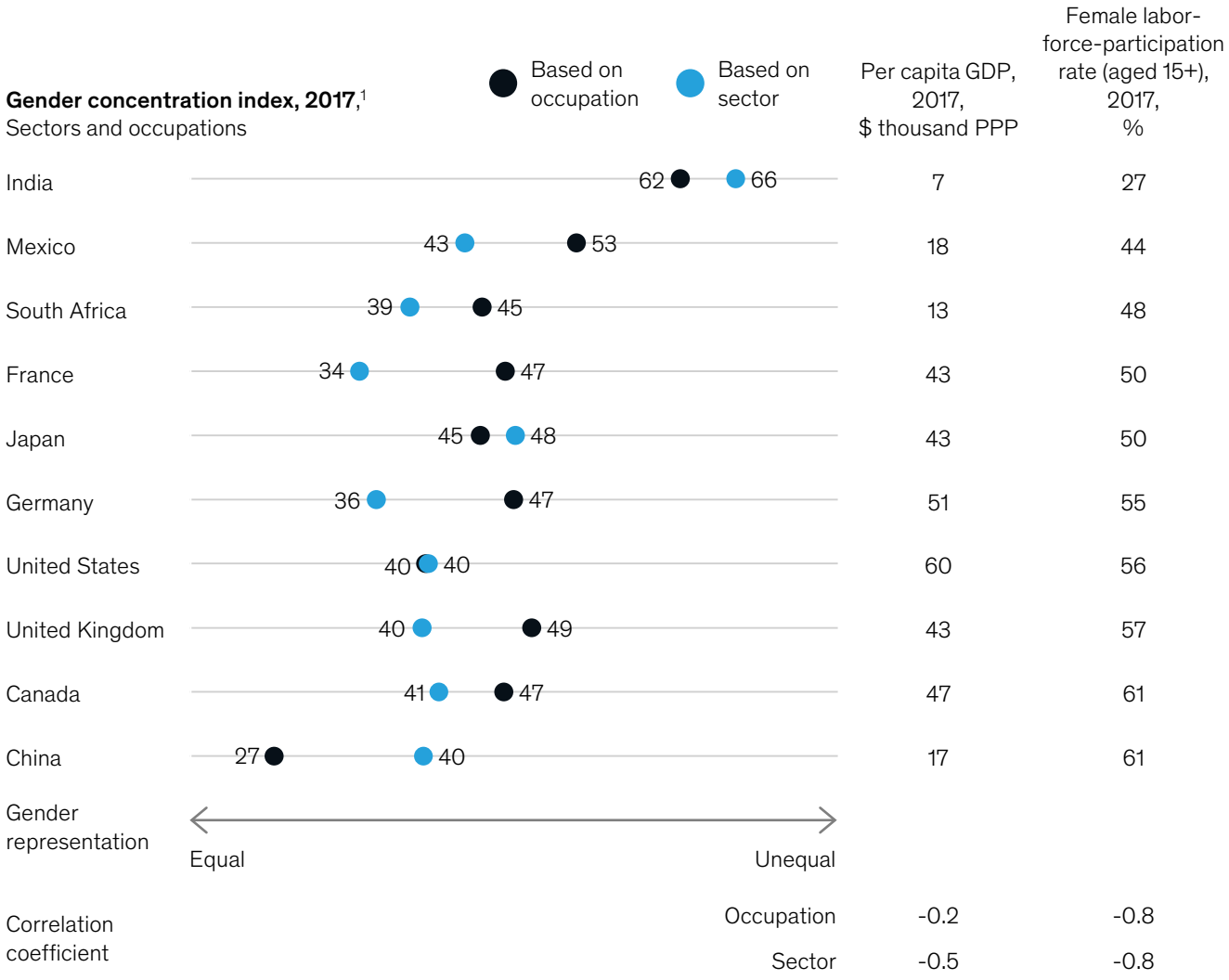
[47] This index was calculated by applying a sum-of-squares calculation across sectors and occupations within each country to measure how much each country deviated from equal representation within each sector or occupation. See the technical appendix for more detail.

[48] Data come from the International Labour Organization.

[49] See Wang Zheng, *Finding Women in the State: A Socialist Feminist Revolution in the People's Republic of China*, *1949–1964,* Oakland, CA: University of California Press, 2016.

Exhibit 2

Occupations tend to be more differentiated by gender than sectors; concentration also tends to be correlated with female labor-force participation.



[1] The index measures the concentration of people of the two genders in sectors and occupations. The index was created by calculating the sum of the squares of the distance from equal gender representation in each sector or occupation within a country, and then taking the square root. The index was then adjusted to fit a zero to 100 scale, with zero indicating equal representation and 100 indicating fully gendered occupations and sectors.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015; South Africa Quarterly Labour Force Survey, 2018; World Bank; McKinsey Global Institute analysis

~15%

of plant and machine operators in mature economies are female

To study these trends in more detail, we reviewed the percentage of jobs women hold in each sector and occupation (for example, the percentage of women in finance relative to total male and female workers in finance in that economy).[50] Once again, we find that the workforce is extremely gendered, and that this trend holds for both mature and emerging economies (Exhibits 3 and 4). Looking broadly across mature economies, we find that women tend to be disproportionately represented in clerical support occupations such as administrative assistants (on average, 72 percent of roles are held by women), and in services occupations such as retail salespersons, waiters, and cashiers (60 percent). In contrast, women make up only 15 percent of plant and machine operators, on average.[51] Across sectors, women tend to be strongly represented in healthcare (78 percent) and education (66 percent). Similarly, in emerging economies, women tend to have higher representation in services occupations than in production, making up 22 percent of machine operator roles on average but 43 percent of services and sales workers.[52] It is important to note that female labor-force participation rates overall are somewhat lower in many of the emerging economies in our sample (China being the notable exception). For instance, the rate is 27 percent in India and 44 percent in Mexico, compared with rates at, or above, 50 percent in all the mature economies studied.[53]

Looking at each of the ten countries, we see strong evidence of gender concentration across sectors. In all ten, women represent no more than 16 percent of workers in construction. In the United States and Japan, women represent 11 and 12 percent of construction workers, respectively, while in India and China, women account for 14 and 16 percent of construction workers, respectively. Men also dominate mining. Of the ten countries, women in Canada hold the highest share of jobs in mining (22 percent of jobs in the industry), followed by China at 19 percent, South Africa at 17 percent, and the United Kingdom at 16 percent.

We find that gender differences are even starker in occupations in most countries. The exceptions to this general pattern are China, Japan, and India, where gender differences are more obvious at the sector level than at the occupational level. Across all mature and emerging economies, women represent no more than 32 percent of plant and machine operators in a given country. In contrast, women represent a majority of clerical support workers across most countries in our sample. India is one notable exception (21 percent of clerical support workers are female), which is likely due to India's low rate of female labor-force participation. Women also account for more than 50 percent of workers in services occupations in eight of the ten countries (the exceptions are India and Japan). At the same time, women make up less than 40 percent of more senior-level roles (such as legislators, senior officials, and managers) in nine of the ten countries studied (the United States is the exception at 43 percent); in India, Japan, and China, this figure is less than 30 percent.

Looking ahead, technological change may break down gender-based occupational barriers, but there is little doubt that gender norms and stereotypes are challenging to overturn (see Box 2, "The gendered nature of occupations and sectors").

[50] These data are based on national sources in each of the ten countries studied, aggregated across sectors and occupations to enable us to compare across countries. For most of our analysis, we aggregate the data into seven occupational categories and 17 sectoral categories. For details, see the technical appendix.

[51] All averages referenced in this chapter are simple averages across the ten countries studied, unless otherwise noted.

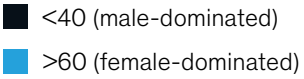
[52] This simple average calculation includes the four emerging economies studied. Note that Exhibit 4 excludes China at the cell level because of data limitations: no data for China are available for female employment at the intersection of occupations and sectors.

[53] Based on World Bank data for the 2018 female labor-force participation rate (percentage of female population aged 15 plus, modeled ILO estimate).

Exhibit 3

There are strong gender-based differences in employment within occupations and sectors in mature economies.

Occupation and sector gender mix, 2017
% of female workers out of total workers in sector and occupation category (weighted average across mature economies)[1]



	Elementary occupations	Clerical support workers	Agricultural and fishery workers	Service workers and shop and market sales workers	Machine operators and craft workers	Professionals, associate professionals, and technicians	Legislators, senior officials, and managers	**Simple average across countries**
	Wage increase →							
Accommodation and food services	59	66	21	60	30	50	45	**59**
Administrative and support and government	56	73	16	23	14	53	41	**42**
Agriculture, forestry, fishing, and hunting	51	86	30	50	12	42	21	**32**
Arts, entertainment, and recreation	47	63	28	51	17	45	39	**49**
Construction	7	80	0	21	2	20	12	**12**
Educational services	61	78	33	76	26	69	57	**66**
Finance and insurance	47	73	25	53	23	50	41	**54**
Healthcare and social assistance	72	87	4	84	27	76	66	**78**
Information	36	62	25	33	13	29	25	**35**
Manufacturing	33	56	34	42	25	25	20	**30**
Mining	11	63	8	16	4	19	16	**14**
Other services	62	82	22	51	17	50	49	**54**
Professional, scientific, and technical services	46	74	23	46	16	41	35	**44**
Real estate and rental and leasing	35	81	25	32	7	52	42	**44**
Retail and wholesale trade	36	62	51	54	20	49	31	**50**
Transportation and warehousing	24	48	33	46	10	27	22	**25**
Utilities	10	42	17	36	3	22	19	**20**
Simple average across countries	**45**	**72**	**24**	**60**	**15**	**52**	**31**	**47**
Median income[2] $ thousand, PPP	22.6	25.2	29.2	30.6	31.7	41.6	59.9	34.4

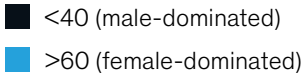
[1] Based on weighted average of Canada, France, Germany, Japan, the United Kingdom, and the United States.
[2] Determined by estimating the median income of each of the detailed occupations within each occupational category, and then calculating the median income across those detailed occupations.

Source: ILO, 2017; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015, Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Exhibit 4

There are strong gender-based differences in employment within occupations and sectors in emerging economies.

Occupation and sector gender mix, 2017
% of female workers out of total workers in sector and occupation category (weighted average across emerging economies)[1]



	Elementary occupations	Clerical support workers	Agricultural and fishery workers	Machine operators and craft workers	Service workers and shop and market sales workers	Professionals, associate professionals, and technicians	Legislators, senior officials, and managers	**Simple average across countries**[2]
	Wage increase →							
Accommodation and food services	10	32	4	35	28	18	20	**43**
Administrative and support and government	21	37	10	6	21	19	18	**25**
Agriculture, forestry, fishing, and hunting	37	15	34	12	25	32	15	**31**
Arts, entertainment, and recreation	2	30	3	5	18	18	56	**32**
Construction	18	53	4	13	14	15	4	**13**
Educational services	28	34	6	27	58	46	28	**53**
Finance and insurance	9	22	0	0	17	26	23	**41**
Healthcare and social assistance	40	46	2	20	67	49	34	**67**
Information	9	27	33	16	23	23	15	**31**
Manufacturing	24	28	29	30	28	16	25	**37**
Mining	21	41	1	10	27	4	6	**15**
Other services	70	25	28	5	63	14	21	**54**
Professional, scientific, and technical services	8	39	0	8	10	15	27	**33**
Real estate and rental and leasing	0	36	35	0	3	5	4	**35**
Retail and wholesale trade	14	25	2	5	14	11	14	**37**
Transportation and warehousing	2	17	2	1	41	19	3	**14**
Utilities	25	27	42	4	16	20	20	**21**
Simple average across countries	**35**	**43**	**29**	**22**	**43**	**41**	**25**	**39**
Median income[3] $ thousand, PPP	2.6	6.5	6.8	6.8	7.2	16.1	35.9	11.7

[1] Sector x occupation data are weighted average of India, Mexico, South Africa. Data at the cross-tab level exclude China given limited data availability.
[2] Column and row averages include China data, and thus may appear higher than the cross-tab estimates (China is excluded from the cross-tab-level estimates due to data limitations).
[3] Determined by estimating the median income of each of the detailed occupations within each occupational category, and then calculating the median income across those detailed occupations.
Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; McKinsey Global Institute analysis

Box 2

The gendered nature of occupations and sectors

Experience suggests that increased labor-force participation rates, attractive wages, and employer demand somewhat encourage women and men to cross gender lines into relatively concentrated occupations, but that these effects may be outweighed by cultural attitudes. The careers that men and women select are ultimately a matter of choice. However, both need to have equal ability to access growing jobs.

In the United States, for instance, some evidence indicates that gender concentration in occupations has diminished, but progress appears to have slowed in recent years.[1] Between 1960 and 1990, the female labor-force participation rate increased sharply, from 38 to 58 percent, while the male rate declined somewhat from 83 to 76 percent.[2] Women moved into both female-dominated and male-dominated professions. In some instances, jobs that used to be held primarily by men became primarily held by women; human resources and veterinarian occupations are examples. Since 1990, the female participation rate has stabilized, and so has the rate of women and men crossing gender lines in search of employment. While women can still be observed entering certain male-dominated occupations—including, for instance, doctors, lawyers, and dentists—their representation in engineering, construction, and power plant occupations has not risen much recently. Women's share of jobs in computer science has plateaued, as has male representation in nursing. Overall, eliminating occupational gender concentration entirely would require about half of the US workforce to switch occupations.[3] Evidence from countries like Canada, France, Germany, and the United Kingdom points to similar trends demonstrating that occupations and sectors are highly gendered.[4]

Two examples from the United States help illustrate the gendered nature of the workplace:

Computer science. Computer and information occupations feminized rapidly in the 1970s as these occupations expanded. By the 1980s and 1990s, women accounted for more than 40 percent of workers.[5] However, women's share then dropped, falling to only 32 percent in 2000, and then, from 2013 to 2018, stalled at around 25 percent despite attractive wages and high demand from employers.[6] Three barriers appear to be at work, as they are in STEM fields more broadly. The first is gender stereotyping. One 2009 study found that when girls are aware of the stereotype that boys are better at math than girls, the girls underperform boys; when girls are not aware of this stereotype, performance is equal.[7] Math is a critical skill for computer scientists, and if girls are deterred because of this stereotype, the risk increases that women will have a low share of computer science occupations in the future.[8] One 2013 study found that computer science is often perceived as not compatible with

1 *Women's labor force participation,* Status of Women in the United States, statusofwomendata.org/earnings-and-thegender-wage-gap/womens-labor-force-participation/.

2 ILO United States Current Population Survey for total aggregate age bands by gender. Note that labor-force participation numbers can vary depending on the source. For instance, ILO United States Population Census data for total aggregate age bands by gender have the 1960 female labor-force participation rate at 25 percent and the male rate at 54 percent.

3 "Men still pick "blue" jobs and women "pink" jobs: Does it matter that the labour market is so segregated?" *Economist,* February 16, 2019.

4 In these countries, looking at sectors, women make up the majority of healthcare and education workers. Looking at occupations, women make up the majority of clerical support workers.

5 American Community Survey by 1990 occupation codes.

6 US 2013–2018 BLS by detailed occupation.

7 G. M. Walton and S. J. Spencer, "Latent ability: Grades and test scores systematically underestimate the intellectual ability of negatively stereotyped students," *Psychological Science,* September 2019, Volume 20, Issue 9; H. H.Nguyen and A. M. Ryan, "Does stereotype threat affect test performance of minorities and women? A meta-analysis of experimental evidence," Journal of Applied Psychology, November 2008, Volume 93, Issue 6; and Generation STEM, What girls say about science, technology, engineering, and math, Girl Scout Research Institute, 2012.

8 *Math needed for computer science,* Master's Program in Computer Science, The University of Chicago, masters.cs.uchicago.edu/page/math-needed-computer-science.

female gender roles.[9] It is also notable that men are twice as likely as women to play characters with STEM skills in the media.[10] Second, girls and women feel isolated in these occupations because of a lack of female peers, role models, and mentors. In the United States, on average, only 17.5 percent of tenured or tenure-track faculty in computer science engineering schools were women in 2017.[11] When selecting a major, undergraduate students often compare themselves to those currently in the field.[12] Third, unconscious bias appears to be preventing girls from pursuing STEM subjects. Implicit association tests often show that a majority of the population has slight to strong automatic associations of science with men.[13] Numerous studies have found that teachers and parents are likely to attribute girls' success in math to effort while boys' success is viewed as an indication of ability.[14] Again, the difference in perception of math and other STEM topics at an early age could diminish the likelihood that women will choose to work in computer science.

Nursing. Male representation in US nursing increased starting in the 1970s as demand increased, but the rate at which men entered the occupation then slowed. In 1970, about 3 percent of nurses were male.[15] By 2000, that figure had risen to 11 percent. [16] But then male representation in nursing appeared to plateau; by 2018, 12 percent of US nurses were male, only a marginal rise.[17] This is despite the fact that employment and wages have both grown, making nursing an attractive occupation.[18] The total number of nurses in the United States increased from about 3.6 million to 4.1 million between 2013 and 2018, but the male and female shares of employment did not dramatically change.[19] Again, social attitudes and stereotyping appear to be factors deterring men from choosing the profession. A 2006 study found that male nursing students reported feelings of discrimination more often than female nursing students.[20] It has been reported that 70 percent of male nurses think stereotypes are their biggest challenge.[21] Male nurses also tend to feel isolated due to being in a predominantly female environment.[22] Again, a lack of male mentors could be a deterrent. In 2015, less than 10 percent of nursing educators were men.[23]

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9 Sapna Cheryan et al., "The stereotypical computer scientist: Gendered media representations as a barrier to inclusion for women," *Sex Roles*, July 2013, Volume 69, Issue 1–2.

10 *Representations of women STEM characters in media*, Geena Davis Institute on Gender in Media, 2018.

11 Brian L. Yoder, *Engineering by the numbers*, 2017, asee.org/documents/papers-and-publications/publications/college-profiles/2017-Engineering-by-Numbers-Engineering-Statistics.pdf. This issue was even more pronounced in the past. At Stanford University in the 1990s, 17 percent of computer science bachelor's degrees went to women, but women accounted for only 9 percent of the computer science faculty. See Women face unique barriers to academic success in computer science, Stanford University News Service, July 3, 1995.

12 Sapna Cheryan et al., "The stereotypical computer scientist: Gendered media representations as a barrier to inclusion for women," *Sex Roles*, July 2013, Volume 69, Issue 1–2.

13 *Interrupting bias in academic settings*, National Center for Women & Information Technology, ncwit.org/biasacademic; Gender-science implicit association test, Project Implicit, Harvard University.

14 Elizabeth K. Lawner and Harriet S. Mosatche, *From obstacles to opportunities: How to transform girls participation in computer science*, Code Like A girl, July 5, 2017.

15 American Community Survey by 1990 occupation codes.

16 National Center for Biotechnology Information, National Institutes of Health, ncbi.nlm.nih.gov/pmc/articles/PMC2756047/. Note that according to the American Community Survey by 1990 occupation codes, 8 percent of nurses were male by 2010. Numbers slightly vary by source and definition.

17 US 2013–2018 BLS by detailed occupation. Nurses include registered nurses, nurse anesthetists, nurse midwives, nurse practitioners, and licensed practical and licensed vocational nurses, as defined by the US Bureau of Labor Statistics.

18 Beth Greenwood, "How have salaries changed for nurses," *Houston Chronicle*, work.chron.com/salarieschanged-nurses-23316.html. According to the US BLS, median weekly earnings for full-time wage and salary nurse practitioners increased by 4 percent a year from 2011 to 2018.

19 US 2013–2018 BLS by detailed occupation. The BLS definition of nurse includes registered nurses, nurse anesthetists, nurse midwives, nurse practitioners, and licensed practical and licensed vocational nurses.

20 Stephen Kermode, "Is nurse education sexist? An exploratory study," *Contemporary Nurse*, July 2006, Volume 22, Issue 1.

21 *Men in nursing*, Online Nursing. onlinenursingms.com/resources/general/men-in-nursing/; and Nursebuff, nursebuff.com/.

22 Amanda Stott, "Exploring factors affecting attrition of male students from an undergraduate nursing course: A qualitative study," *Nurse Education Today*, May 2007, Volume 27, Issue 4.

23 *Men in nursing*, Online Nursing, onlinenursingms.com/resources/general/men-in-nursing/.

Women may be at slightly less risk of losing their jobs due to automation than men

We use our analysis of the gendered workforce as a starting point to assess how women and men could be affected by automation, reflecting where they are currently employed across sectors and occupations. As previously noted, we have modeled job displacement due to automation on a full-time equivalent basis and do not consider differences in job eligibility based on part-time versus full-time status. Our analysis suggests that women could potentially face slightly less risk of their job being displaced by automation than men, but that the difference is minimal. Using a simple average across the ten countries in our sample, we find that, on average, about 20 percent of women employed—107 million women—could lose their jobs by 2030 in a midpoint automation scenario, compared with, on average, 21 percent, or 163 million, men (Exhibit 5).[54]

~40%

of male job losses could be in machine operation and craft work roles

Behind these average figures, however, are very large differences among countries, largely reflecting varying rates of automation adoption (driven by average wages and per capita GDP). MGI's model of automation shows that emerging economies could have lower levels of adoption than mature economies. The model takes the economic viability of implementing automation technology into account when modeling adoption. On the whole, emerging economies tend to have lower labor costs (particularly in occupations with high levels of predictable physical and cognitive work), which suggests that, at least in the period to 2030, the potential productivity gains are unlikely to justify investment in development and implementation of automation technology. In India, for instance, which has relatively low automation adoption potential given relatively low wages, we estimate that 10 percent of female employment could be at risk. In contrast, in mature economies where digital and automation technologies are more pervasive and potential automation adoption is higher (given higher wages), the share of women's jobs that could be at risk is more than 20 percent. We observe slightly higher levels of risk for men. In India, we estimate that 12 percent of men's jobs could be at risk, relative to 22 percent in Germany, 24 percent in Japan, and 26 percent in the United States.

While we find that both men and women work in a significant number of jobs that are vulnerable to automation, and face broadly similar levels of risk overall, the underlying patterns of job displacement for men and women look very different, reflecting differences in the occupations in which they tend to work. Men and women diverge in which types of work they tend to do and the ways in which that work is vulnerable to automation. For instance, men are far more likely to work as plant or machine operators and craft workers (for instance, welders, carpenters, and maintenance workers), which have high levels of predictable physical activity. In contrast, women are more likely to work in clerical support (for example, administrative assistants) and services work (such as retail salespeople), which also involve a high share of routine, automatable cognitive work, such as data processing (we estimate that over 30 percent of activities within clerical support roles involve basic data processing, which could be automated). Both men and women who work in predictable, routine jobs are vulnerable—but a major driver of risk for men is the automation of predictable physical work, whereas women are more likely to be vulnerable to the automation of routine data processing. Our assessment of the pace of automation finds slightly faster rates of automation adoption of tasks involving routine physical activity, which, in part, explains why men could experience higher rates of job displacement in our scenario.

We estimate that 52 percent of potential job losses among women could be in services, sales, and clerical support occupations, and 40 percent of potential job losses among men could be in machine operation and craft work. These patterns hold across mature and emerging economies (Exhibits 6 and 7). For instance, services (including shop and sales workers) and clerical support occupations could account for 57 percent of women's jobs lost in France and

[54] All jobs lost and jobs gained percentage figures are represented as a share of 2017 male and female employment, respectively.

64 percent of women's jobs lost in Mexico; machine operation and craft work could account for 43 percent of jobs lost by men in Canada and 42 percent of jobs lost by men in India.

There are also diverging patterns among men and women across emerging economies. Emerging economies could experience different patterns of potential job displacements within agricultural work among men and women. For instance, agricultural work could be one of the top three occupations driving job losses for men in Mexico (21 percent of all job losses for men), but it is not in the top three for women (driving only 4 percent of jobs lost). In contrast, in India, agricultural work is a top driver of job loss for both men and women. Indeed, its effect is more pronounced on women; it could account for 28 percent of their job losses compared with 16 percent of jobs lost among men. This is likely because women in India continue to lag behind men in education and in labor-force participation, and therefore many women are currently employed in low-skill agricultural roles, often in the informal economy.

Exhibit 5

Women may be slightly less at risk of being displaced by automation than men.

Jobs at risk of being displaced by automation by 2030[1]

	Women		Men	
	Million FTE	% of female employment, 2017	Million FTE	% of male employment, 2017
Canada	2	24	3	28
France	3	22	3	23
Germany	4	21	5	22
Japan	6	24	9	24
United Kingdom	3	22	4	24
United States	19	24	20	26
China	52	15	66	15
India	12	10	44	12
Mexico	3	17	6	18
South Africa	1	18	2	22
Total (simple average)	107	20	163	21

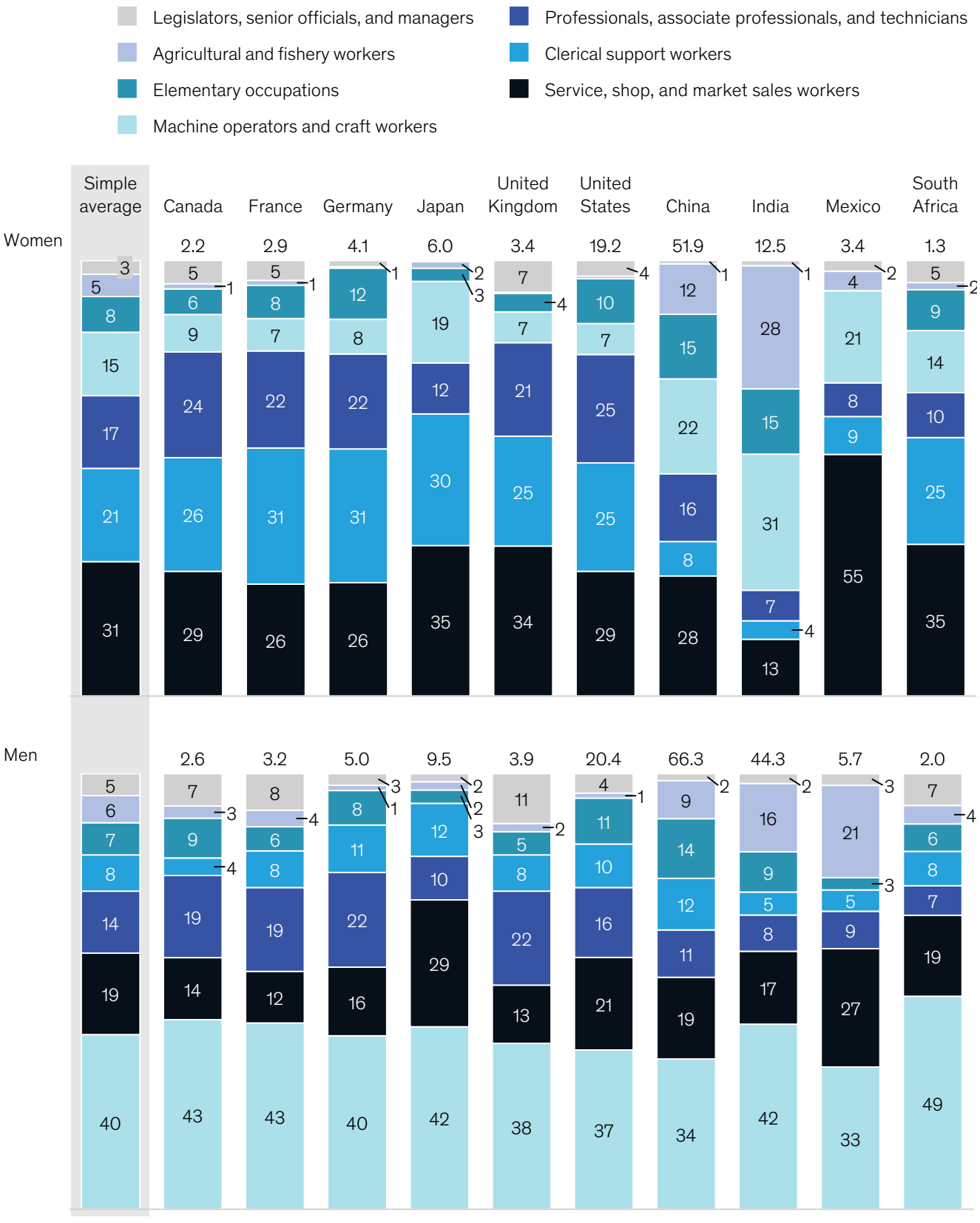
[1] Based on a midpoint automation scenario.
Note: Countries ordered based on mature and emerging economies, and alphabetically within each group.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Exhibit 6

Job displacement from automation could be concentrated in clerical support roles for women, machine operators and craft workers roles for men, and service roles for both genders.

Share of potential job displacement by 2030 across occupations, %
(Total= million FTE)

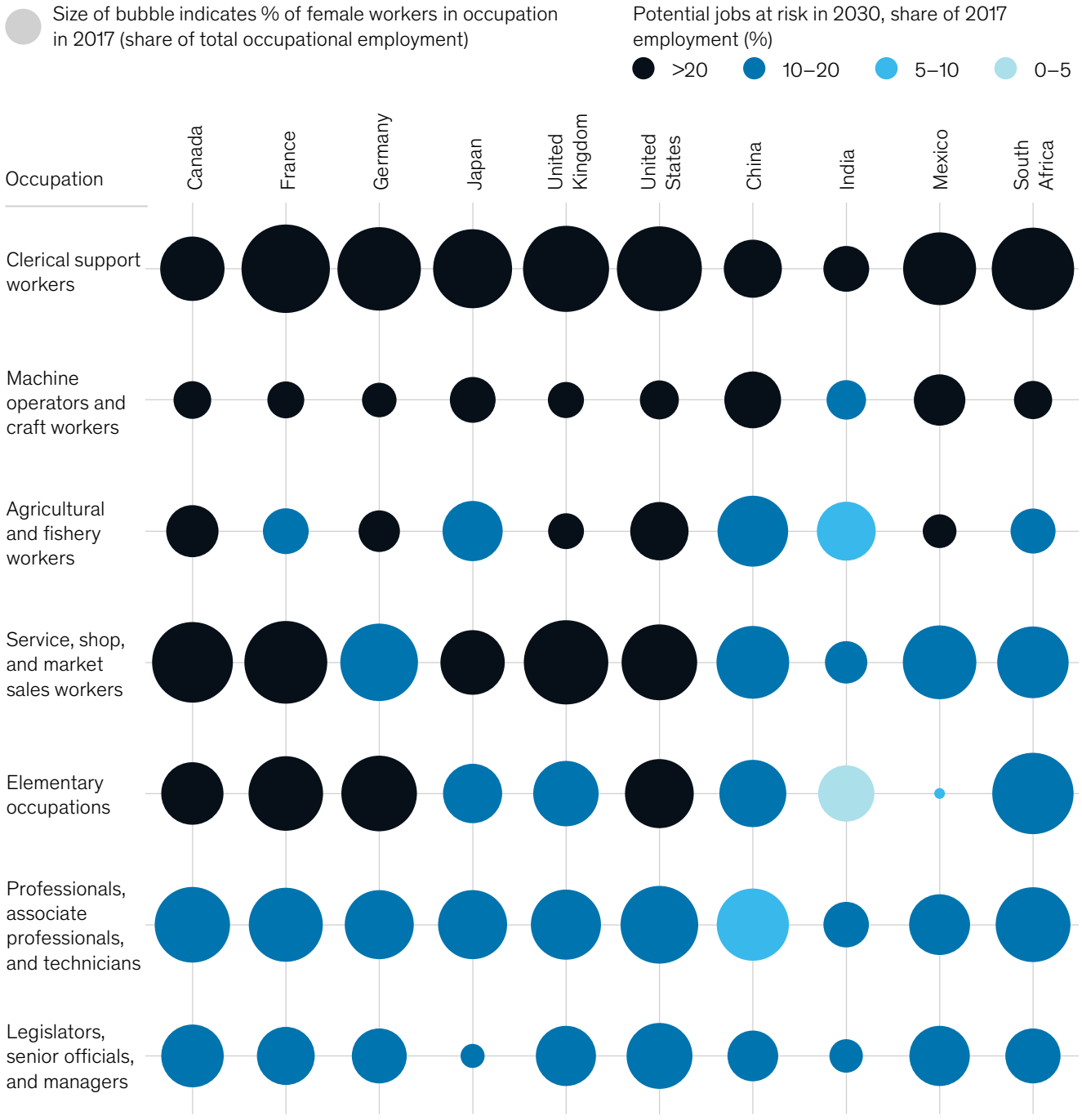


Note: Figures may not sum to 100% because of rounding. Data labels <1 not shown. These data are based upon a midpoint scenario of automation.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015; South Africa Quarterly Labour Force Survey, 2018; ONS, 2017, Statistics Canada, 2016 Census; China Population Census; McKinsey Global Institute analysis

Exhibit 7

Women make up a high share of clerical support and service roles, which could be subject to significant job displacement from automation.



Note: These data are based upon a midpoint scenario of automation.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015, South Africa Quarterly Labour Force Survey, 2018; ONS, 2017, Statistics Canada, 2016 Census; China Population Census; McKinsey Global Institute analysis

In mature economies, job displacements for women are likely to be primarily in the retail and administrative support sectors, largely driven by automation risk in clerical support and services occupations, as we have discussed. The healthcare sector could account for some displacements, largely driven by automation of healthcare support services–related roles such as medical billing. Meanwhile, the bulk of men's job displacements may be in manufacturing, retail, and administrative and government sectors.

Women could also experience job gains if they are able to maintain their current share of employment in sectors and occupations

Automation could fully or partially displace millions of workers, but history tells us that waves of technological change and shifting population dynamics can also create many new jobs. Our analysis suggests that women could be marginally better placed to take advantage of new job opportunities than men in most countries if they are able to maintain their current levels of employment in sectors and occupations. Their potential to gain jobs reflects the fact that they could account for a somewhat larger share of employment in growing sectors, notably healthcare, particularly in mature economies.

As we have discussed, underlying economic trends in a given country, including those related to consumption growth, healthcare spending, and infrastructure investment, influence the potential for job creation across countries. Gender-based concentration in different sectors and occupations influences the different outcomes we model for men and women in these potential jobs gained across countries. A country's GDP growth tends to be driven largely by consumption and investment. This in turn tends to affect employment at the sector level. For instance, investment in real estate will tend to boost construction sector employment. The specific impact on men and women depends on their choice of occupations within these sectors.

If current female shares of employment across sectors and occupations persist, our analysis finds that there could be—again using a simple average for the ten countries studied—a gross (before factoring in job losses from automation) 20 percent increase in the number of women employed, or 171 million, and an increase of 19 percent, or 250 million, in the number of men employed (Exhibit 8). In countries such as China, this trend is even more pronounced; women's gross employment could increase by 33 percent, compared with 28 percent for men. This reflects the fact that the top two sectors fueling growth, other services and healthcare, have equal and majority female representation, respectively.[55]

Once again, behind these average figures are differences among countries, reflecting varying per capita GDP growth rates, sector composition, and female labor-market participation rates. Emerging economies could experience higher rates of job gains overall because they are forecast to have high growth in per capita GDP, fueling job creation. In contrast, mature economies are expected to achieve lower rates of job creation, reflecting more moderate growth in per capita GDP. A notable exception is South Africa, which is expected to experience lower per capita GDP growth than other emerging economies, and therefore lower rates of job creation. Some patterns emerge that appear to be independent of the stage of economic development. In France, Germany, and India, for instance, men could experience slightly higher relative employment gains because economic growth is more concentrated in male-dominated sectors and occupations such as manufacturing and PST.[56]

[55] Increased labor demand in other services in China is driven by arts, entertainment, and recreation, which we categorize under other services due to data limitations.

[56] In Germany, the top two sectors experiencing demand for labor are manufacturing and PST, both of which are male-dominated). In India, the top two sectors are manufacturing and construction, also dominated by male workers. In France, the picture is more complex. The top two sectors experiencing increased demand for labor are healthcare and PST, the first female-dominated and the second male-dominated. However, France could also experience significant growth in demand for labor in manufacturing and construction, which would weigh the balance in favor of work done by men.

It is important to note that women will be able to step into jobs being created by increased demand only if they are able to maintain their current employment shares in sectors and occupations, which would require significant career transitions (as we discuss in chapter 3).

Patterns in potential jobs gained for men and women could vary by sector. Across the ten countries in our sample, on average, healthcare accounts for 25 percent of gross job gains for women, but only 7 percent of gross job gains for men. At the same time, manufacturing and PST could account for 37 percent of gross job gains for men, but 26 percent for women. On average, 58 percent of gross job gains by women come from three sectors: healthcare and social assistance, manufacturing, and retail and wholesale trade. 53 percent of men's gross job gains come from manufacturing, retail and wholesale trade, and professional, scientific, and technical services (Exhibit 9). Although manufacturing will likely account

Exhibit 8

Before factoring in potential job losses, women could expand their current employment by 20 percent by 2030, compared with a gain of 19 percent for men.

Demand for jobs in 2030, assuming constant female and male share of employment in sectors and occupations[1]

	Women		Men	
	Million FTE	% of female employment, 2017	Million FTE	% of male employment, 2017
Canada	2	24	2	23
France	2	15	2	16
Germany	4	23	5	24
Japan	2	8	3	6
United Kingdom	3	17	3	17
United States	15	19	14	18
China	112	33	120	28
India	23	19	91	24
Mexico	6	29	8	25
South Africa	1	13	1	9
Total (simple average)	171	20	250	19

[1] Figures represent a trend-line scenario of job creation that is based upon current spending trends, and excludes demand for entirely new occupations. In a forthcoming 2019 MGI report on the future of work in the United States, we will explore another scenario.

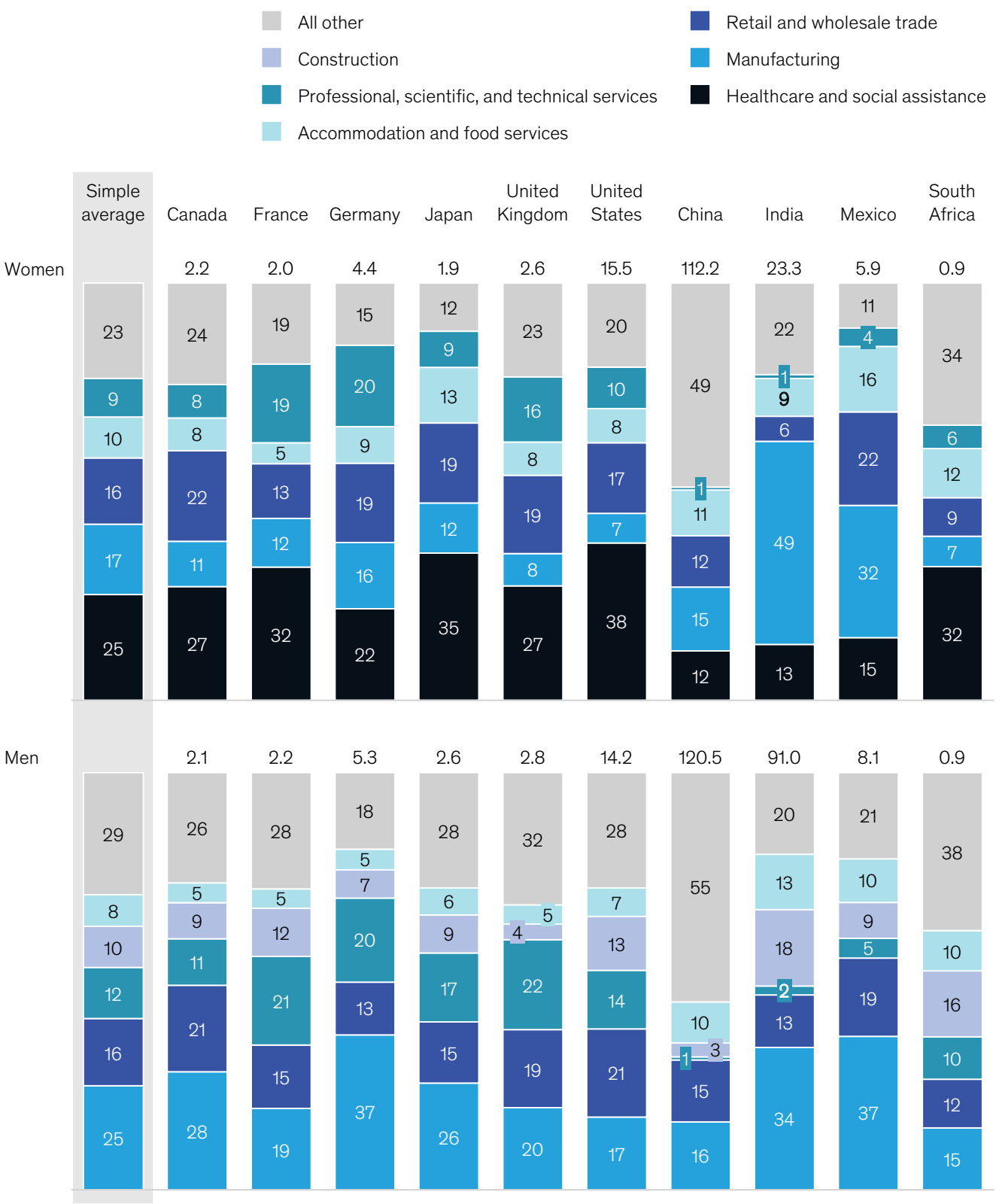
Note: Countries ordered based on mature and emerging economies, and alphabetically within each group. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Exhibit 9

Women could gain significant jobs in healthcare and professional services in mature economies, and manufacturing in emerging economies.

% of jobs gained by 2030, top five sectors by gender[1]



[1] Top 5 sectors based upon simple average by gender across all countries. Construction is not among top 5 sectors of jobs gained for women; healthcare and social assistance is not among top 5 sectors of jobs gained for men.

[2] For China, arts, entertainment, and recreation are included in other services (based on the availability of gender-specific data); other services in China is growing significantly due to increases in per capita GDP and spending on leisure.

Note: Figures may not sum to 100% because of rounding. These data are based upon a midpoint scenario of automation. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015, South Africa Quarterly Labour Force Survey, 2018; ONS, 2017, Statistics Canada, 2016 Census; China Population Census; McKinsey Global Institute analysis

for fewer job gains for women than for men, a significant number of women could find new jobs in manufacturing as demand grows. This may seem surprising, but women tend to be more present in manufacturing in emerging economies. Remember, too, that although the manufacturing industry is highly automatable and many jobs could be displaced in mature economies, the industry has significant scope for new jobs to be created, particularly in emerging economies, as new industries expand and higher productivity leads to lower prices, increased quality, and more demand.[57]

30%

of jobs gained by women in mature economies could be in healthcare

Healthcare demand is growing. A combination of aging populations, a rise in contagious diseases, and demand for more and higher-quality healthcare from the world's expanding middle classes means that global healthcare spending is likely to soar—and with it the need for healthcare professionals. Given that an average of 73 percent of workers in this sector are female, it could represent a significant opportunity. In most countries, female representation in healthcare occurs across a diverse set of occupations. Women make up the majority of professionals, senior officials and managers, services workers, and clerical support workers in healthcare in Canada, France, Germany, Mexico, South Africa, the United Kingdom, and the United States.

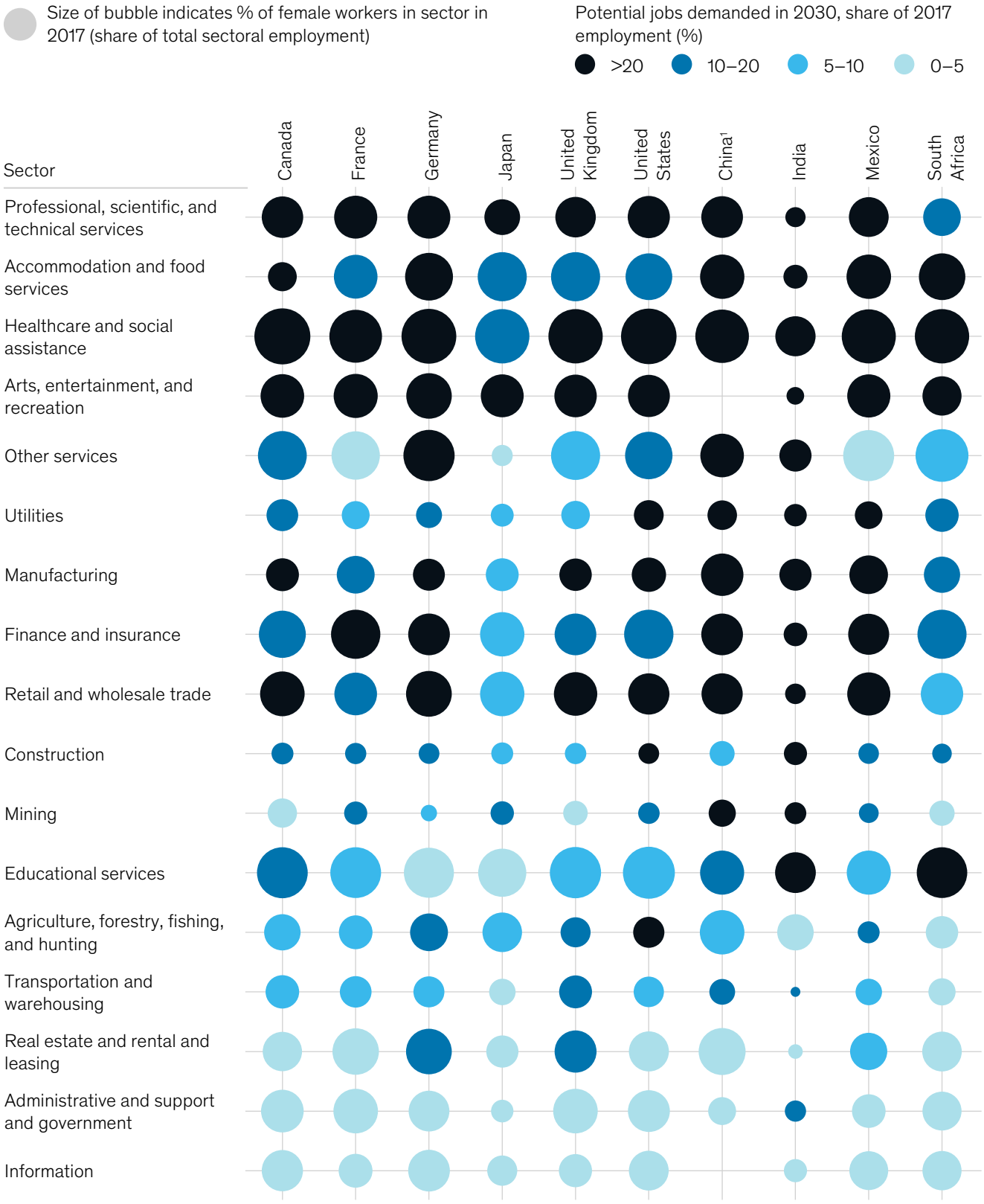
The pattern of potential job gains is relatively consistent across mature economies, where healthcare accounts for an average of 30 percent of jobs gained for women, but it is less consistent in emerging economies, where healthcare represents an average of only 18 percent of jobs gained (Exhibit 10). In China, India, and Mexico, healthcare accounts for no more than 15 percent of women's jobs gained, and manufacturing and other services sectors supply the majority of job growth for both women and men.

From an occupational perspective, across the ten countries studied, on average, 66 percent of job gains by women could come from professional and services-related roles. For example, professionals like accountants, nurses, and educators could continue to experience robust demand for their labor, as could workers in services-oriented occupations like daycare workers (for more detail, see the technical appendix). For men, 76 percent of gross job gains could come from roles in machine operation and craft work, and from services and professional work. For example, in mature economies in particular, professional, associate professional, and technician roles account for, on average, more than one-third of gross job gains for both men and women. In Japan, China, and Mexico, the largest job gains for both men and women could occur in services roles, as well as in machine operations and craft worker roles for men in Mexico. In India, machine operation and craft worker roles will likely account for the largest percentage of job growth for men and women.

[57] One example of this dynamic from the United States was the Model T produced by Ford. Automation of the assembly line led to far higher productivity—over a six-year period, the number of Model Ts produced by each worker nearly tripled. This allowed Ford to reduce the price, the number of cars sold soared 30-fold, and employment rose from about 1,600 to nearly 19,000. See David A. Hounshell, *From the American System to Mass Production 1800–1932: The Development of Manufacturing Technology in the United States*, Baltimore, MD: The Johns Hopkins University Press, 1985.

Exhibit 10

Healthcare and accommodation stand out as sectors where women could make significant gains relative to men.



[1] For China, arts, entertainment, and recreation are included in "other services." Information sector is not separately sized, and is included within other sectors, due to data availability restrictions.

Note: These data are based upon trend-line scenario of job creation. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015, South Africa Quarterly Labour Force Survey, 2018; ONS, 2017, Statistics Canada, 2016 Census; China Population Census; McKinsey Global Institute analysis

In our scenario to 2030, the share of employed women could remain stable or improve slightly

~150m

net new jobs within existing sectors and occupations could be added in our ten-country sample by 2030

Taking estimated jobs lost and jobs gained in our scenario to 2030, we find that approximately 150 million net new jobs could be added in the ten countries in our sample (before accounting for job creation in new occupations, which we discuss in the next section). Of these, 64 million jobs—42 percent—may be taken by women, and 87 million (58 percent) taken by men, assuming unchanged trends in the gender mix in occupations and sectors. The vast majority of net job growth will go to men and women in emerging economies. China alone accounts for 75 percent of net job growth for men and women across the ten countries studied. Mature economies could experience minimal growth in net jobs or even a contraction as the displacement of jobs by automation modestly outstrips new jobs created. It is important to note that this scenario would hold only if current employment trends in occupations and sectors continue, and if both men and women are able to make the transitions required into open jobs.

We note two broad trends within advanced and emerging economies:

- In mature economies, net job growth is likely to be concentrated in two sectors: healthcare and PST. In mature economies apart from the United States and Canada, the PST sector is by far the largest driver of net job growth—double the expected net job growth in healthcare. Today, women are well represented in healthcare but underrepresented in PST. Women could account for, on average, 44 percent of workers in this sector in 2030, compared with their 47 percent overall share of employment across mature economies.

- In emerging economies, net job growth could occur in a broader range of sectors including manufacturing, accommodation and food services, retail and wholesale trade, and construction, which together account for, on average, 57 percent of net positive jobs gained. In India, about 60 percent of women who work are employed in agriculture, a sector positioned to lose significant jobs, and women have much lower representation in sectors that show potential for net job growth, such as manufacturing and construction. In Mexico, women are well positioned in some sectors such as retail but may face challenges capturing jobs in other high-growth sectors in which they have limited representation, such as manufacturing.

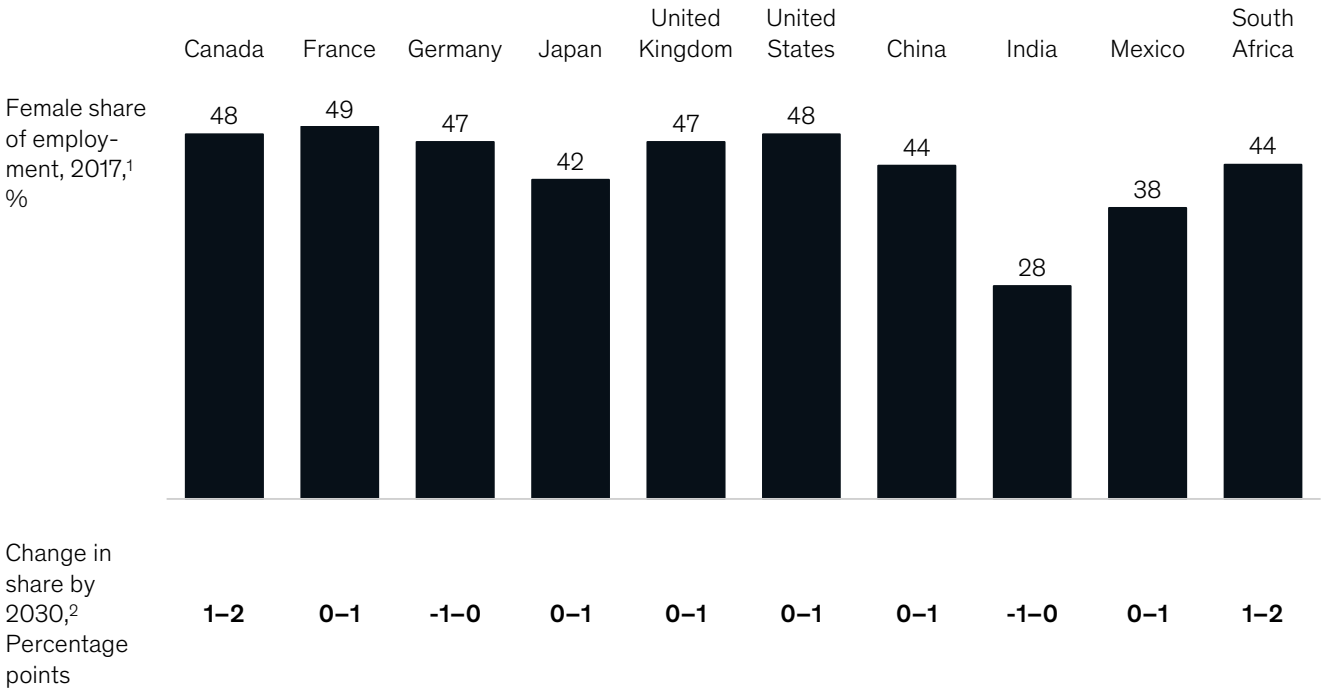
Overall, these net effects produce a roughly stable share of employment for men and women in both a trend-line 2030 scenario for job growth and a step-up scenario that assumes additional government investment in construction and infrastructure (Exhibit 11). This makes sense given that our results show that women and men could experience roughly similar magnitudes of job losses and gains. Most countries are positioned for women to maintain their share of employment or increase it by one percentage point. Increases in share are driven by women gaining jobs relative to their base employment at a faster rate, buoyed by growth in the healthcare sector across economies. India and Germany stand out as countries that could see a decrease in female share of employment. In India, this is driven by the high female concentration in the agriculture sector, which accounts for 45 percent of all female-held job displacements and employs about 60 percent of female workers in the country.[58] While men could experience large job losses in agriculture as well, their higher representation in sectors such as manufacturing, accommodation, construction, and retail offsets some of these losses. In Germany, the largest net job growth is driven by the PST sector and manufacturing, in which men hold the majority of jobs.

The results we have discussed describe one set of scenarios for how the future of work could affect women. However, it's important to note that these outcomes could look quite different

[58] Note that the agriculture sector employs workers in the "agriculture and fishery workers" occupation and other occupations.

Exhibit 11

Assuming frictionless transitions, women's share of employment could remain relatively stable.



[1] Share of employment incorporates part-time and full-time employment.
[2] Range is based on a trend-line and step-up scenario; in all countries except France and Germany, the female share of the labor force is larger in a trend-line scenario. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute

based on how rapidly countries adopt automation, trends in job growth, and how men and women capture future job opportunities. For instance, if we assumed a more aggressive automation adoption scenario, men could be even more at risk of job loss than women. To take another example, if we assume that governments react to threatened job loss with stimulus spending to create jobs (for instance, by launching infrastructure improvement projects), then men could disproportionately benefit from these additional jobs (see Box 3, "Alternative scenarios for how the future of work could affect men and women"). However, this broad expectation that the status quo may hold rests on the assumption that many millions of women will be able to negotiate significant transitions in the years ahead between occupations and sectors—without undue friction. This is a big if (as we discuss in chapter 2).

Box 3

Alternative scenarios for how the future of work could affect men and women

Overall, we find that men are slightly more at risk of job loss due to automation, that women are slightly better positioned to take advantage of growth in the labor market, and that, despite slightly benefiting women, these trends produce minimal increases in the female share of labor. Our analysis also finds that men and women will need to transition successfully between occupations.

We also note that these findings are not predictive and could shift depending on different modeling scenarios for jobs lost and jobs gained, as well as different treatments of gender mix in sectors and occupations from 2017 to 2030.[1] Here we detail how key assumptions affect jobs lost, jobs gained, and the gender mix, and discuss how these may change with different assumptions:

Jobs lost. MGI's model evaluates the number of displacements in three different automation scenarios: early, midpoint, and late adoption, which represent varying rates of automation adoption in the economy. The work in this report reflects results in a midpoint automation adoption scenario, which is on a par with the scale of the great employment shifts of the past, such as those out of agriculture and manufacturing. Selecting an early or late automation adoption scenario would have yielded slightly a different picture.

In an early adoption scenario, automation of elementary, machine operator, and craft- and trade-related occupations, which all involve a high level of routine physical tasks, tends to accelerate at a faster rate (relative to midpoint) than does automation of occupations involving clerical work. The former occupational category is male-dominated, while the latter is female-dominated. Thus, under an early automation adoption scenario, men would lose a greater number of jobs relative to women than in the midpoint scenario. In a late adoption scenario, very few occupations would be automated, and thus men and women could stand to lose a comparable number of jobs.

In chapter 3, we describe the implications of the future of work on the transitions that men and women need to make across jobs. For that analysis, we also include results based on an early adoption scenario to help estimate how large the transitions could be.

Jobs gained. MGI's jobs gained model looks at job additions driven by factors such as increased consumption and investment and the growing healthcare needs of an aging global population. In the trend-line scenario described in this report, women across economies could experience significant growth in healthcare jobs demanded. This scenario assumes limited government investment to spur additional growth. Under a "step-up" scenario where governments intervened to create additional growth to offset job losses, investment would likely be focused on infrastructure development. This type of intervention could drive higher job growth rates (and smaller net losses in mature economies) for men, given higher-than-average male representation in manufacturing and construction sectors. Overall, a step-up in government spending intended to combat job losses might skew slightly toward benefiting men.

Female and male representation over time. To evaluate how well positioned women are to adapt to the labor market of the future, our analysis examined a scenario in which the female share of jobs in current occupations and sectors remained constant. This scenario is also in line with recent historical trends observed in several mature economies, which have not displayed significant shifts in gender representation across sectors and industries since women entered the labor market in large numbers. Looking at selected occupations in US Bureau of Labor Statistics (BLS) data, we note that female representation grew rapidly across many occupations in the period from 1960 to 1990 but has slowed considerably in recent years. In Canada, a review of the past ten years suggested that female representation across sectors has been relatively flat.[2]

Although our analysis suggests that it is likely that female and male shares of labor-force participation may remain static, we also considered different ways in which shifts in those shares could unfold in mature economies. For instance, several of the occupations poised to see large growth in the United States (for example, nursing and computer and information) are those with high gender differentiation dominated by either male or female workers. In an alternative scenario, women could increase their labor share in traditionally male-dominated fields such as computer science. More men could enter female-dominated occupations such as nursing, which might result in men outpacing women in jobs gained.

In emerging economies, female representation across sectors has also remained relatively flat over the past two decades. On average in the four emerging economies studied, women's representation has increased by only two percentage points in the past 20 years.[3] For these economies, we have also considered how the results might shift with gender mix changes. This change could take the form of a more even gender split in various occupations, or a situation in which roles become increasingly dominated by one gender or the other—as observed in many mature economies. Both outcomes could increase women's overall share of jobs gained in emerging economies, since job growth is relatively broadly spread across sectors and occupations.

1 In a forthcoming 2019 MGI report on the future of work in the United States, we will explore another scenario of job creation.
2 Statistics Canada 2016 Census.
3 The analysis uses ILO sector-level employment estimates for 2000 and 2019 to calculate female representation over time. By country, we established the overall average change in female representation in sectors weighted by sector-level female employment, and then calculated a simple average across countries.

Many people could move into entirely new occupations, but women may face more challenges making this move

Thus far, our analysis has focused on jobs in existing occupation groups and sectors. However, it's important to note that as waves of technological change displace or alter the nature of many occupations, they also create new ones. This occurred in economies that were shifting away from agriculture toward manufacturing in the 19th and early 20th centuries, for instance, as a new group of factory worker jobs was created. These trends have also characterized changing labor markets as they digitized, creating a brand-new set of jobs in the digital economy (for example, machine learning specialists, programmers, social media managers, and many more). To meet the demands of entirely new occupations, women will need the right skills—and the labor mobility and networks—to go after these jobs in competition with men.

~60%

of recently-created US occupations were in male-dominated fields

These new jobs could be a key source of employment for both men and women in the future. For instance, historical trends in the United States suggest that up to 9 percent of the population could be employed in entirely new and emerging occupations by 2030. If we extrapolate this metric across the ten countries studied—recognizing that the comparison is imperfect—this translates into over 160 million jobs in entirely new occupations by 2030,[59] which is more than the *entire* net growth in labor demand within existing occupations (after accounting for jobs lost due to automation). Tapping into these jobs is therefore a major source of opportunity for women. Evidence suggests that these jobs could be focused on the services sector, since about 60 percent of recently created occupations were in services sectors and about 25 percent in manufacturing.[60] In services, examples of new jobs in recent history include patient representatives, spa managers, and loss prevention specialists. In manufacturing, new occupations may well be related to the adoption of new technologies in the production process and a push toward improved materials management for better efficiency.[61]

However, becoming employed in new occupations may be more challenging for women than for men, based on a historical analysis of how women have been able to capture previous opportunities. MGI analysis of 135 recently created US occupations as defined by O*NET in 2009 found that approximately 60 percent of these occupations were in jobs that were male-dominated and only 16 percent in jobs that were female-dominated.[62] The latter are primarily in healthcare support, education, customer care, and personal service, and include, for instance, roles such as genetic counselors, distance learning coordinators, and adaptive physical education specialists. Male-dominated new occupations are largely in engineering, computer science, environmental science, and construction, and include roles such as environmental restoration planners, human factors engineers, and geographic information systems technicians. Therefore, although it is impossible to predict exactly what new occupations will be created and what gender representation they may have, it is possible that without significant intervention, women will continue to be underrepresented in new occupation categories (see Box 4, "Opportunities for women to capture jobs in entirely new occupations").

[59] Based upon analysis conducted in Jeffrey Lin, "Technological adaptation, cities, and new work," *Review of Economics and Statistics*, May 2011, Volume 93, Number 2.

[60] Jerome Pikulinski, "New and emerging occupations," *Monthly Labor Review*, December 2004, Volume 127, Number 12.

[61] Ibid.; *New and emerging occupations of the 21st century: Updating the O*NET-SOC taxonomy*, O*NET Resource Center, March 2009, onetcenter.org/reports/UpdatingTaxonomy2009.html.

[62] We define occupations "dominated" by women (or men) as occupations in which women (or men) are 60 percent or more of the employed population.

Box 4

Opportunities for women to capture jobs in entirely new occupations

Research by David Autor finds that new and emerging occupations in the United States typically fall into three categories that have been consistent throughout the historical creation of occupations (although jobs that fell into each category have differed in previous periods). These include (1) "frontier jobs" that are highly paid and tend to be male-dominated, (2) "wealth jobs" that have average wages and tend to be female-dominated, and (3) "last-mile jobs" that offer lower pay and tend to be relatively gender-neutral.[1]

It appears particularly important to equip women with the education and training they need to perform frontier jobs. Today, frontier jobs involve producing, installing, maintaining, and deploying new-generation technologies, in occupations like AI specialists, robotic machine operators, and chief information officers. These roles typically demand technical skills and are disproportionately carried out by college-educated men: only 28 percent of frontier job hours are currently worked by women. Wealth work typically involves providing labor-intensive, in-person services to affluent consumers; women supply 62 percent of hours in wealth jobs. Broadly, these roles do not demand technical skills, but they are increasing in importance as incomes rise, particularly in urban areas. Occupations include baristas, yoga instructors, sommeliers, pet care workers, and exercise physiologists. About 41 percent of wealth work hours come from college graduates or people with higher education, compared with 50 percent of hours for frontier jobs. Finally, last-mile workers carry out tasks that have largely been automated but have a residual human component. They do not typically require face-to-face contact with customers. Examples include call-center operators, order fulfillment workers, data entry clerks, and underground utility cable locators. People with a college degree or higher account for only 15 percent of hours, and 43 percent of hours are supplied by women.

Three examples of recently created occupations illustrate how women could capture new opportunities and how entirely new jobs could affect them:

Ride-share drivers. Technological advances led to the rapid development of an entirely new industry in recent years: ride-sharing services. This industry is expected to increase from $36 billion in gross market revenue today to $285 billion in 2030.[2] Early evidence suggests that entry barriers to women are lower in this industry than in driving traditional taxis. In the United States and Canada, 20 percent of Uber drivers are female, compared with 16 percent of taxi drivers. Female drivers in these countries experience an average 13 percent increase over their previous salary when they enter the industry, compared with a 7 percent boost on average for men. Seventy-four percent of women say flexibility is the top reason for driving a ride-sharing vehicle. However, 26 percent say that security concerns stop them from driving more, and 14 percent of female drivers believe riders have canceled on them because of their gender, indicating some challenges for women, too.[3] Further, given that ride-sharing is part of the gig economy, it is possible that these jobs do not come with the same security (for example, benefits and protections) as jobs in the more formal economy do.

1 David H. Autor, Frank Levy, Richard J. Murnane, "The skill content of recent technological change: An empirical exploration," *Quarterly Journal of Economics*, 118 (4), February 2003.
2 *Rethinking mobility*, Goldman Sachs, May 23, 2017.
3 *Driving toward equality: Women, ride-hailing, and the sharing economy*, International Finance Corporation, March 1, 2018; and *Taxi drivers & chauffeurs*, Data USA, datausa.io/profile/soc/533041/.

Sustainability-related workers. Sustainability has increasingly become a key issue for businesses, and sustainability-related occupations have been on the rise since the 1990s. These roles originally focused on companies' effort to comply with environmental policies, but sustainability jobs have since become more strategic.[3] About 44 percent of publicly traded US companies have Chief Sustainability Officers (CSOs).[4] Energy sustainability has tended to be a male-dominated sector, but opportunities are increasing for women.[5] According to one report, at the end of December 2018, 45 percent of US CSOs were women, compared with 28 percent in 2011.[6] This contrasts with the overall energy industry, which is traditionally dominated by gas, mining, and oil, in which men fill the majority of executive positions; in 2018, women held only 24 percent of these roles.[7] The number of sustainability-related occupations is likely to grow as environmental issues rise and influence societal and corporate agendas.[8] As an illustration, McKinsey estimates that the clean-tech product market will reach $1.6 trillion by 2020, up from $670 billion in 2010.[9]

Machine learning engineers. Machine learning engineering roles are likely to increase as AI technology adoption spreads; these engineers are programmers who use large data sets to train models that are then used for speech recognition and language translation.[10] Between 2012 and 2017, the number of machine learning engineers increased tenfold. The number of job postings for the roles increased 344 percent from 2015 to 2018.[11] And this is only the start.[12] The machine learning market is expected to grow from $1.4 billion today to $8.8 billion in 2022.[13] The risk is that these new jobs will replicate the gender split of the broader tech industry. Only about 14 percent of machine learning and AI professionals are women, compared with about 20 percent female representation in the tech industry overall.[14] Women fill 18 percent of C-suite positions in AI and machine learning companies, and only 12 percent of leading machine learning researchers are women.[15] This could prove to be a challenge as men and women seek to take advantage of these emerging opportunities.

3 Andy Cartland, *The emergence of the chief sustainability officer*, Acre Resources, March 2, 2011.
4 *Weinreb Group presents its CSO findings for 2018*, Weinreb Group, December 2018, weinrebgroup.com/cso-update-december-2018/.
5 Lucie Frideling, "Women in energy and sustainability," *Professional Woman's Magazine*, hub.resourceadviser.com/latest-perspectives/pwm-women-in-energy-susty-article.
6 *Weinreb Group presents its CSO findings for 2018*, Weinreb Group, December 2018, weinrebgroup.com/cso-update-december-2018/.
7 *Quick take: Women in energy-gas, mining, and oil,* Catalyst, March 29, 2019.[9] American Community Survey by 1990 occupation codes.
8 Andy Cartland, *The emergence of the chief sustainability officer*, Acre Resources, March 2, 2011.
9 *The business of sustainability*, McKinsey & Company survey, October 2011.
10 *Springboard Blog,* "Machine learning engineer vs. data scientist," blog entry by Andrew Zola, January 3, 2019, springboard.com/blog/machine-learning-engineer-vs-data-scientist/.
11 Louis Columbus, "Machine learning engineer is the best job in the U.S. according to Indeed," *Forbes*, March 17, 2019.
12 Louis Columbus, "LinkedIn's fastest-growing jobs today are in data science and machine learning," *Forbes*, December 11, 2017.
13 *The diversity opportunity in tech,* McKinsey & Company, forthcoming.
14 Stephen Zafarino, *The outlook for machine learning in tech: ML and AI skills in high demand*, IT & Tech Hiring Insights, CIO, July 27, 2018.
15 *Women in artificial intelligence – a visual study of leadership across industries,* emerj.com/ai-market-research/women-in-artificial-intelligence-visual-study-leaderships-across-industries/; and Yoan Mantha, *Estimating the gender ratio of AI researchers around the world*, Element AI Lab, August 17, 2018.

As automation spreads, working men and women will both be vulnerable to disruption. Broadly, automation may affect women and men on a similar scale, but the picture is nuanced. Because of the occupations in which women tend to work, their risk of having their jobs displaced by automation could be similar to or slightly less than men's. Moreover, women could be similarly or slightly better positioned than men to gain jobs because of the sectors in which they tend to work. However, women appear not to be positioned as well as men to capture entirely new occupations. In summary, the current share of women in the labor markets of the ten countries studied could hold steady. However, this outcome by 2030 hinges on millions of women making occupational transitions in order to tap into changing demand for different types of labor. In the next chapter, we will explore how jobs might change for women as a result of automation and how that could affect the ways in which women work.

2 Jobs changed

A major part of the automation story is not simply about jobs being replaced or created, but about how the character and constituent parts of occupations are likely to change as people increasingly work alongside machines. Our scenario, based on data for the United States, suggests that more women than men could find their jobs partly automated rather than displaced. MGI's previous research found that in 60 percent of occupations, at least 30 percent of constituent work activities could be automated, indicating that many occupations could be transformed by the partial automation of activities within jobs.[63] That means the way many women work—even if they remain in their current jobs—will change. Even now, digital technologies have transformed the lives of women from secretaries to teachers, with computers taking over routine manual tasks such as basic data collection and processing.

Predicting specific ways in which automation could transform occupations by 2030 is extremely challenging, and we do not seek to predict the future. Indeed, societal choices as much as technological advances will determine how jobs will be lost, gained, and changed. In this chapter, we explore how women may be affected differently from men by partial automation and new workplace technology over the next several years. We share case studies of three sectors in which partial automation could impact women—healthcare, education, and financial services—and discuss how jobs requirements may change. These case studies are not intended to be predictive, but they are illustrative of how automation and new waves of technology may create pervasive changes within occupations.

More women than men may experience partial automation of their work

Our analysis of jobs lost and gained in chapter 1 illustrates the scale of work that could be automated in the future by measuring how FTEs could be affected. In this chapter, we go one step further and think through how jobs could *change* rather than being displaced. For instance, if half of all activities within an occupation category are automatable, it is possible that instead of 50 percent of all jobs within that occupation being lost, the nature of the work performed could simply change—automated systems and processes could replace 50 percent of activities formerly carried out by humans, but people doing those jobs may spend the 50 percent of time freed up by automation in other ways while learning to work alongside these new systems. Note that the 50 percent is illustrative—there is no set threshold that determines whether the automatability of a job leads to partial automation or full job displacement since many factors could influence whether automation leads to jobs being displaced or jobs changing within a particular field.

Many examples already exist of jobs changing rather than being lost. For instance, the typical auto mechanic working in 2019 engages in a very different set of activities from the average mechanic in 1950. These workers now use hydraulic lifts and diagnostic computers rather than jacks and manual methods of diagnosis. However, the average number of auto mechanics has not declined in most countries; instead, mechanics have experienced a transformation in the way they work because of partial automation.

[63] *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.

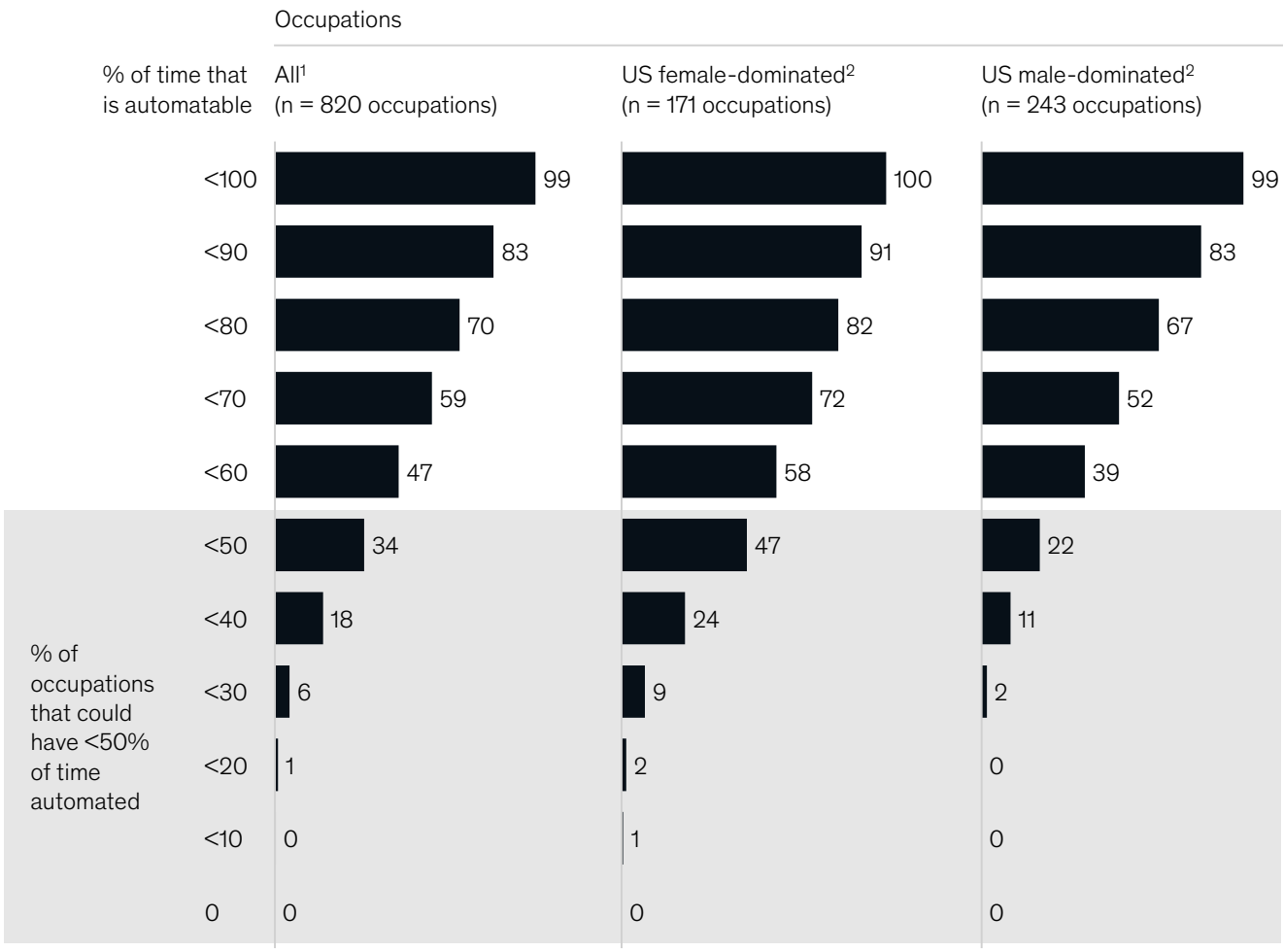
Some evidence suggests that women could be more likely to face partial automation than men. For example, in the United States—on which we base our analysis as an illustration—approximately half of occupations that are mainly held by women are less than 50 percent technically automatable by 2030, compared with about 20 percent of occupations predominantly held by men (Exhibit 12).[64] In short, jobs typically held by women may have less "automatable time" than jobs typically held by men; therefore, women in those jobs may need to prepare to experience a *change* in the nature of their jobs, rather than full job displacement, over the next several years.

[64] This analysis looks at female-dominated occupations and male-dominated occupations. It is important to note that there are female workers in male-dominated occupations, and male workers in female-dominated occupations. We define occupations "predominantly held" by women (or men) as occupations in which women (or men) are 60 percent or more of the employed population. For further details, see the technical appendix. Technical automatability refers to a job's ability to be automated given technology that currently exists. This differs from our previous estimates of automation adoption, since it refers only to technical automation potential, whereas our automation adoption estimates account for other economic and social factors that affect broader adoption rates across countries. As we discuss later in this chapter, social and economic factors can play a large role in determining to what extent technically automatable activities will result in job displacement or job change over the next decade.

Exhibit 12

Nearly half of female-dominated occupations in the United States are less than 50 percent automatable, suggesting women could be more likely than men to experience partial automation of their jobs.

Partial automation within occupations,
% of occupations that could have time automated in 2030 based on midpoint technical automation potential



[1] Includes 820 occupations in United States Bureau of Labor Statistics (BLS) data that are female-dominated, male-dominated, and gender-neutral, as well as occupations that do not include gender splits.
[2] Female- and male-dominated means occupations with 60% or more female/male employee representation, respectively.

Source: US BLS; McKinsey Global Institute analysis

Our observation that women may experience partial automation of their jobs more than men largely reflects the sectors and occupations in which women tend to be most concentrated. For instance, many women work in the education sector, which involves a large proportion of less automatable activities such as applying expertise and people management (Exhibit 13). Given similar patterns of gendered occupations in the United States and other mature economies, this could imply that—at least in some mature economies—women could be at less risk than men of having their job displaced entirely by automation. Many women may instead find their work partially automated.

MGI's previous research on automation has made it clear that very few occupations are 100 percent automatable based on currently available technology, but that almost every occupation has the potential to be partly automated.[65] Technology is not the only barrier to automation. The first step toward automation at work is for an activity to be technically automatable using existing technology; we have focused on this technical automation potential in our analysis of jobs changed. However, many other factors, including economic feasibility, influence automation adoption and the degree to which automation results in job displacement. We highlight three other considerations, which could result in partial automation rather than full job displacement:

- **Organizational considerations.** Companies in many sectors have been slow to adopt automation and AI technology across their organizations. In 2018, only 12 percent of companies appeared to have invested in AI in every functional domain where the business case for deploying AI seemed to be very strong.[66] The share appeared to range from a low of 7 percent among healthcare companies to a high of 18 percent in high tech. Three reasons may account for this reluctance to adopt automation technology: (1) the large up-front investment needed to implement these technologies and to retrain employees; (2) the organizational challenges and switching costs associated with redesigning workflows; and (3) the lack of, or limited access to, expertise on how to apply these technologies.[67] In the near term, the adoption of automation technologies may proceed slowly and be applied only to specific functions and workflows, implying that many people will continue to work alongside machines rather than be replaced by them.

- **Preferences for human contact.** In many work activities such as retirement planning in financial services, emergency room visits in healthcare, and childhood learning in education, interacting with qualified humans can bring a great amount of comfort to clients, patients, students, and their families. People often want human contact in these contexts, and many professionals in such fields may not trust or accept automated systems to replace their judgment. These attitudes are one factor in why many jobs may be partially rather than fully automated. Human beings will increasingly need to apply critical social and emotional skills, but they may also need to learn how to collaborate with—and trust—machines to perform other tasks and to instruct and guide stakeholders in the use of supporting technology.

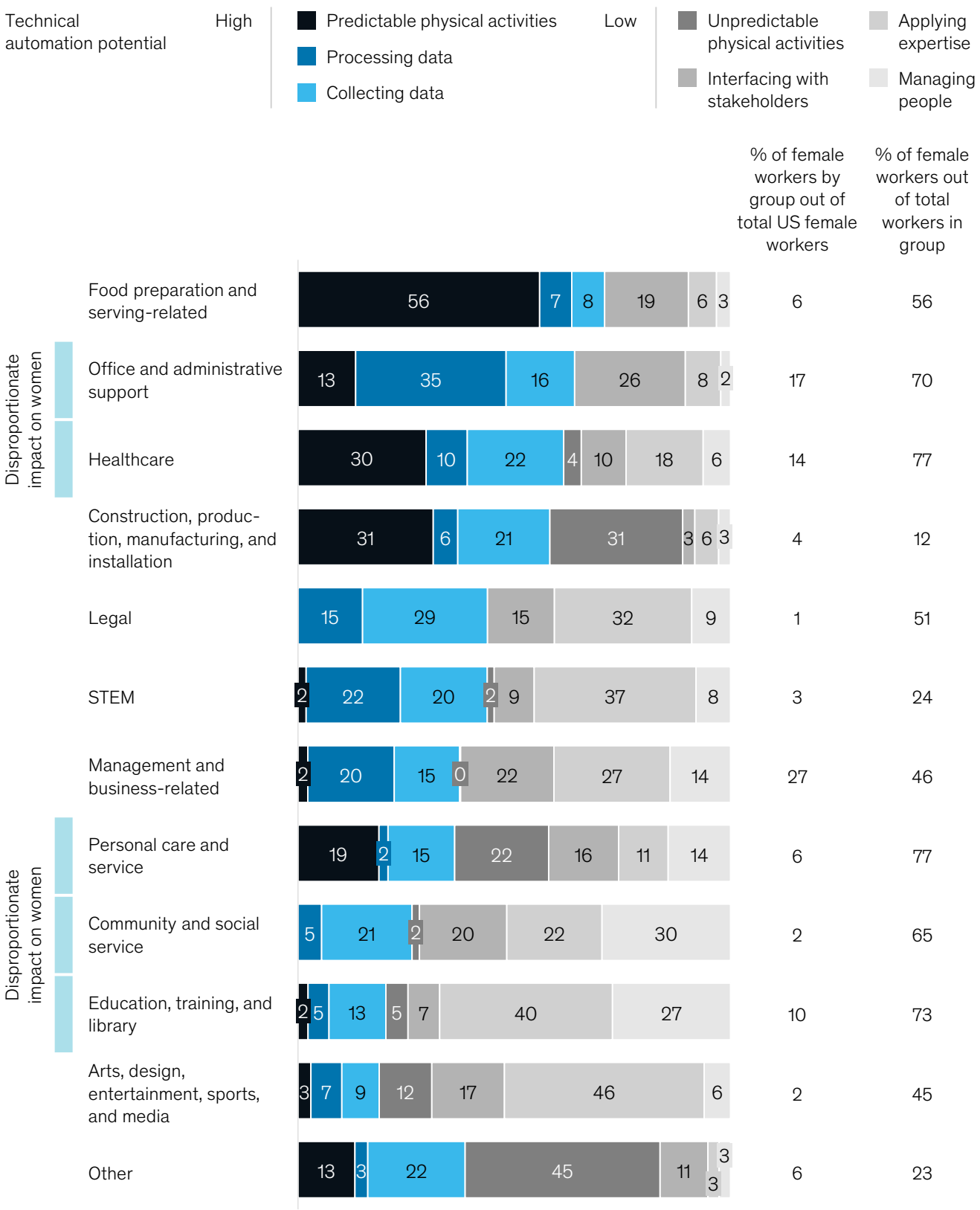
- **Liability and privacy concerns.** Suspicion and worry about machines taking over working activities are widespread, and policy makers may stand in the way of the full potential of automation in light of public concern. For instance, AI companies operating in the healthcare landscape face serious liability concerns if a patient is misdiagnosed. Data privacy is a crucial concern in many contexts. In healthcare, for instance, protected health information is likely to be needed for AI to process patient data and support clinical decisions in a seamless manner, but many people are often concerned about the security of such personal information. These kinds of concerns require human remedy and could

[65] *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; and *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.
[66] *Twenty-five years of digitization: Ten insights into how to play it right*, McKinsey Global Institute, May 2019.
[67] *A winning operating model for digital strategy*, McKinsey Digital, January 2019.

Exhibit 13

In nearly all types of occupations in the United States, including some dominated by women, workers could experience different degrees of partial automation.

US occupation groups by activity,
% of activity hours for each occupation group[1]



[1] Aggregations of individual occupations based on BLS 22 occupation family classification; does not include all BLS detailed occupations (excludes many "all other" categories).

Note: Figures may not sum to 100% because of rounding. Occupations ordered by decreasing levels of "high" technical automation potential.

Source: US BLS; McKinsey Global Institute analysis

potentially increase the likelihood of jobs changing rather than being completely lost due to automation in the near term.

Partial automation could change women's working lives in two key ways: (1) the types of activities performed during the working day, and (2) the skills required. We also discuss how broader technological change within jobs will affect ways of working.

Types of activities performed during the working day

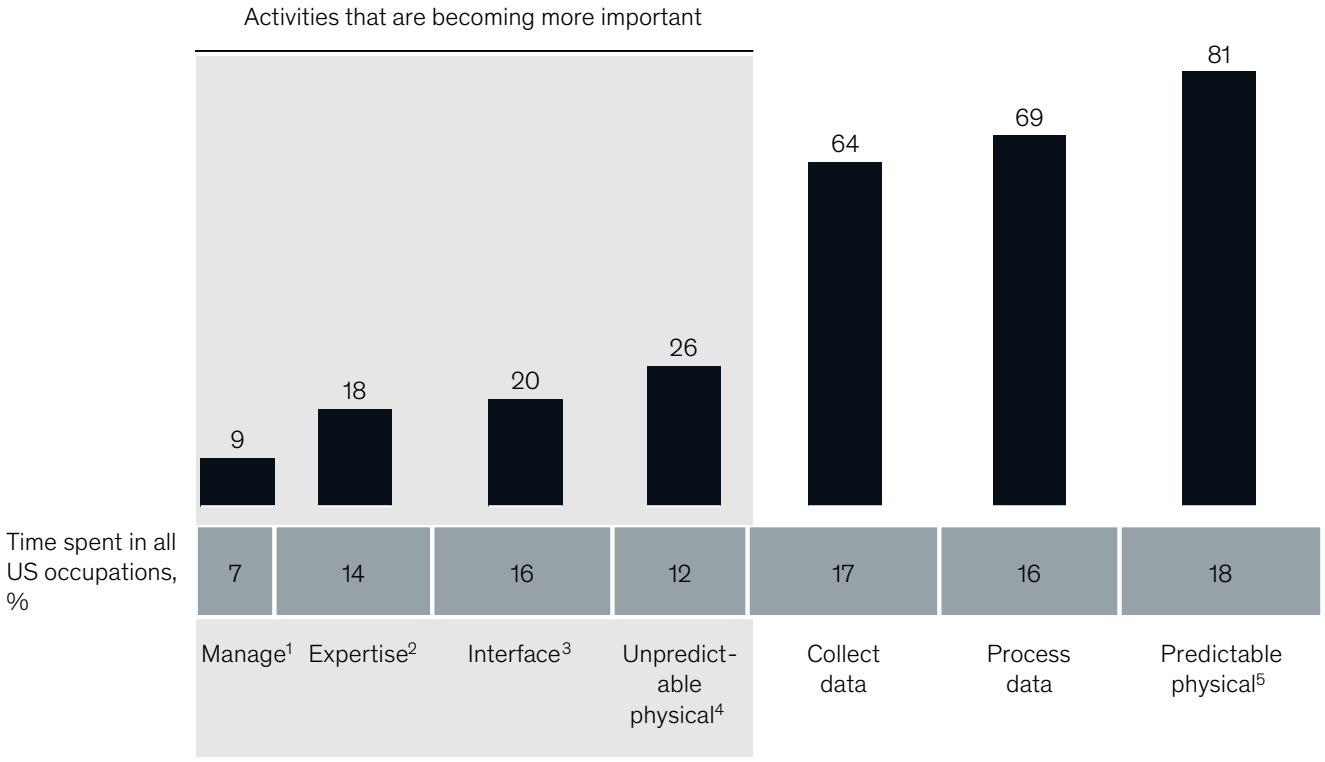
In response to automation, people will spend more time on certain activities compared with others (Exhibit 14). Managing people, applying expertise, interacting with stakeholders, and engaging in unpredictable physical activities are expected to be more in demand, while predictable physical activities and processing and collecting data will be less in demand. For example, approximately 80 percent of time spent on predictable physical activities can be automated by adapting currently demonstrated technology, while only 10 percent of time spent on managing people can be technically automated.

These shifts in demand for specific activities may affect women and men differently. Through automation, workers could spend more time focused on management. For instance, financial managers may be able to dedicate more capacity to coaching their teams and improving performance management across the organization. Both women and men who are currently managers or have managerial skills could benefit from the increased importance

Exhibit 14

By 2030, US workers may spend more time on managing people, applying expertise, interfacing with stakeholders, and unpredictable physical activities.

Time spent on activities that can be automated by adapting currently demonstrated technology, %



[1] Managing and developing people.
[2] Applying expertise to decision making, planning, and creative tasks.
[3] Interfacing with stakeholders.
[4] Performing physical activities and operating machinery in unpredictable environments.
[5] Performing physical activities and operating machinery in predictable environments.

Note: Figures may not sum to 100% because of rounding.

Source: US BLS; McKinsey Global Institute analysis

of management activities. However, on average, fewer women than men currently hold leadership positions in many countries; it is therefore possible that men, in aggregate, may have more experience with management skills.

The future of work could also lower physical activity requirements for jobs, which could potentially benefit women. In the United States, 31 percent of male work hours are currently spent on physical activities compared with 21 percent of female work hours. Indeed, workplace discrimination against women doing jobs requiring physical labor may be prevalent. Research has found that perceived differences between female and male workers influence job assignments, taking priority over the reality of job-worker interactions.[68] Many jobs that require physical strength reflect a bias toward a specific type of strength that is often associated with men, frequently leading to discrimination against women in hiring.[69] Automation can take over some physical jobs, potentially removing a barrier for women. For instance, in healthcare, autonomous tugs and wheelchairs could guide patients and move equipment, reducing the need for physical labor in nursing and orderly jobs.

It is important to note that one of the positive roles automation can play is to take over routine, repetitive, menial, and even dangerous tasks performed by men and women, freeing up their time to focus on activities that involve interaction with others and could be more fulfilling.

Skills required

As automation pervades the workforce, certain skills will be more in demand, and others less so. This is due to the activities within jobs changing as well as a demand for technical skills to implement and use technology. In 2018, MGI highlighted impending shifts in demand for workforce skills, quantifying the time spent on 25 workplace skills today and in the future in the United States and five European countries. The research focused in particular on banking and insurance, energy and mining, healthcare, manufacturing, and retail.[70] According to these findings, automation could accelerate the shift in required workforce skills observed over the past 15 years. In Europe and the United States, the strongest growth in demand will likely be for technological skills (55 percent growth in demand), social and emotional skills (24 percent), and higher cognitive skills (8 percent). In contrast, demand for basic cognitive skills, as well as physical and manual skills, will decline (Exhibit 15).[71]

In the United States, for example, workers are expected to spend 11 percent less time using physical and manual skills such as operating equipment, and 14 percent less time using basic cognitive skills such as data inputting between 2016 and 2030 (Exhibit 16).

The importance of technical skills such as programming will rise. In the United States, we estimate that the time spent on such skills could increase by 60 percent from 2016 to 2030. This may pose a challenge for women, who account for only 35 percent of STEM students globally and just 3 percent of information and communications technology students in higher education.[72] The rise in AI-supported work may put a premium on some types of technical know-how. For example, advanced investment algorithms may become more common in financial services, and this could require financial advisers to have sufficient education and skills, notably technical skills, to be able to feed data into algorithms, monitor calculations, and verify, organize, and interpret output. If women who currently work in finance are not equipped with the technical skills to use these algorithms effectively, they may not be in a good position

[68] Karen Messing et al., "Equality and difference in the workplace: Physical jobs demands, occupational illnesses, and sex differences," *The Science and Politics of the Search for Sex Differences*, 2000, Volume 12, Number 3; J. S. Ward, "Women at work—ergonomic considerations," *Ergonomics*, May 1984; Åsa Kilbom, Karen Messing, and Carina Bildt Thorbjörnsson, eds, *Women's health at work*, National Institute for Working Life, 1998.

[69] Karen Messing et al., "Equality and difference in the workplace: Physical jobs demands, occupational illnesses, and sex differences," *The Science and Politics of the Search for Sex Differences*, Vol. 12, No. 3, 2000.

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

[71] Ibid.

[72] *Girls' and women's education in science, technology, engineering and mathematics (STEM)*, UNESCO, en.unesco.org/themes/education-and-gender-equality/stem.

Exhibit 15

By 2030, workers are likely to spend more time using social and emotional, higher cognitive, and technical skills, and less time on physical and manual, and basic cognitive skills.

United States and 14 European countries

Skills that are becoming more important

Skills	Physical and manual	Basic cognitive	Higher cognitive	Social and emotional	Technological
Hours spent in 2016, Billion	203	115	140	119	73
Change in hours spent by 2030, %	-14	-15	8	24	55
Skills with the biggest shift in demand	▼ General equipment operation and navigation ▼ Inspecting and monitoring	▼ Basic data input and processing ▼ Basic literacy, numeracy, and communication	▲ Creativity ▲ Complex information processing and interpretation	▲ Entrepreneur-ship and initiative taking ▲ Leadership and managing others	▲ Advanced IT skills and programming ▲ Basic digital skills

Source: *Skill shift: Automation and the future of the workforce*, McKinsey Global Institute, May 2018; McKinsey Global Institute analysis

to adjust to intra-occupational shifts. In education, as another example, tech-enabled grading systems are likely to increase in prevalence, and teachers will need the skills to use these new technologies effectively.

Time spent using social and emotional skills, such as managing others, is also expected to rise by an estimated 26 percent more hours in the United States. Women working in occupations that use such skills to a significant extent may therefore be well positioned to take advantage of the jobs of the future. For instance, healthcare and education tend to be female-dominated, and these fields often require social and emotional skills. Nurses need to constantly interact with patients, families, and other healthcare workers, and nurse-patient interaction is considered to be at the heart of the nursing profession. This interaction is complex, requiring social perception, an understanding of emotions, and the use of these skills to manage sensitive situations and deliver high-quality patient care.[73]

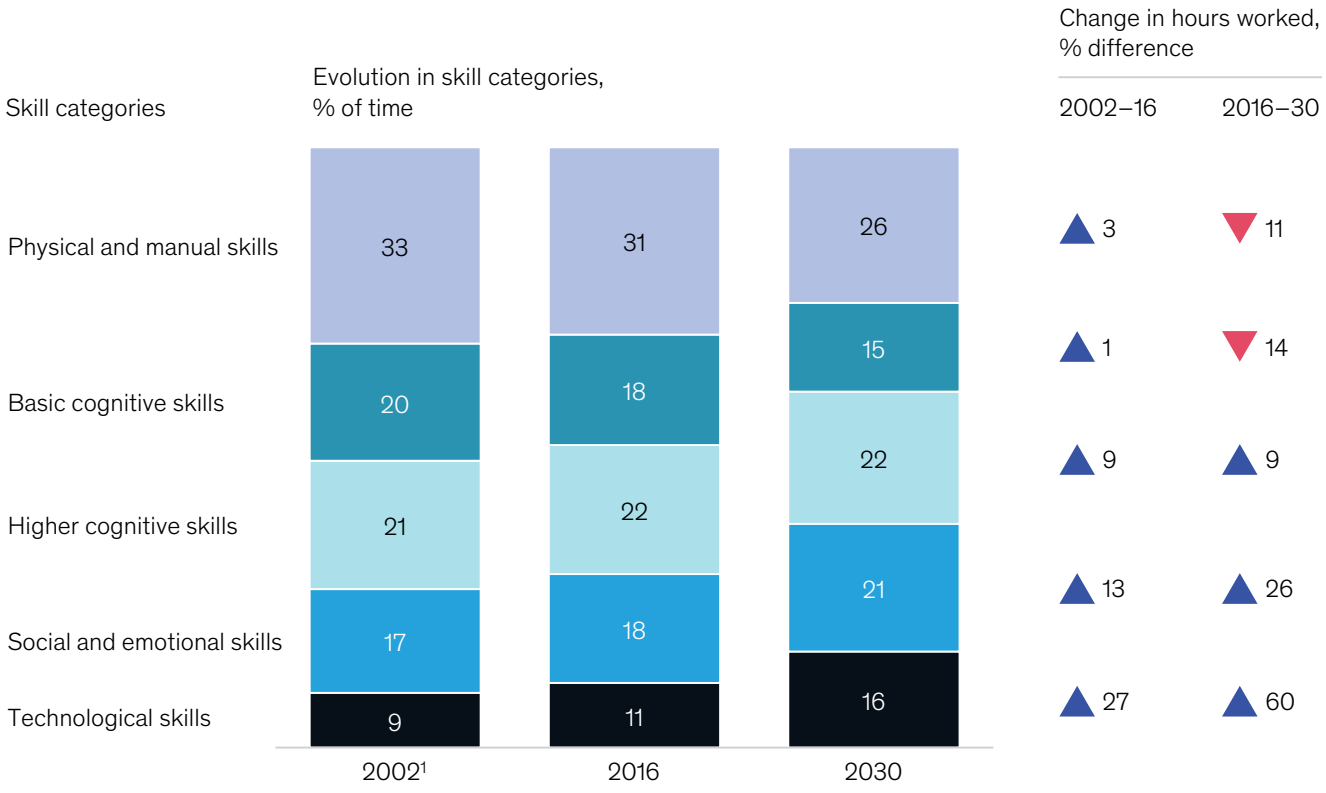
Time spent using higher cognitive skills—implying more creative roles—is also expected to increase in the United States by an estimated 9 percent. Similar trends and skill shifts are being observed and anticipated in other countries, too, including many in Europe.

[73] "Emotional intelligence in the nursing profession," *The Journal of Nursing,* asrn.org/journal-nursing/202-emotional-intelligence-in-the-nursing-profession.html.

Exhibit 16

Automation and AI will accelerate skill shifts.

United States, all sectors, 2002–30



[1] Calculated using the 2004–16 compound annual growth rate extrapolated to a 14-year period.
Note: Based on difference between hours worked per skill in 2016 and modeled hours worked in 2030. Figures may not sum to 100% because of rounding.
Source: US BLS; McKinsey Global Institute workforce skills model; *Skills shift: Automation and the future of the workforce*, McKinsey Global Institute, May 2018; McKinsey Global Institute analysis

Automation and other technologies are changing ways of working

Being physically co-located with fellow workers is an important part of most work cultures today. However, the adoption of new technologies, especially those associated with automation and improved communication, is likely to reduce the need to co-locate for two reasons. First, the adoption of digital and internet technologies broadly makes it easier to work remotely, independently, and with more flexible hours.[74] Second, as jobs become partially automated, workers may spend less time doing activities that require their physical presence in the workplace. For instance, if robotic financial advisers can take over simple client follow-ups, that may reduce the need for the human financial adviser to be available in the office for ad hoc client meetings. Similarly, in education, online courses and distance learning can enable teachers to work from home while reaching students worldwide. Further, the popularity of working remotely may increase as telecommunication becomes more reliable and mainstream.

Automation, along with the diffusion of a range of other technologies, can enable remote working even in the most skilled activities. For instance, robotic and AI-enabled surgeries could allow surgeons to operate from hundreds of miles away, increasing location flexibility for surgeons. Telemedicine enables doctors to consult with patients using digital voice or video links, helping them to see more patients and ease clinical shortages in remote areas.[75] The rise

[74] For a general discussion of how digital technologies are transforming the way we work, see *Independent work: Choice, necessity, and the gig economy*, McKinsey Global Institute, October 2016.
[75] Recent MGI research found that if telemedicine replaced 30 to 40 percent of in-person outpatient consultations, India could save up to $10 billion and improve care for the poor and those living in remote areas. *Digital India: Technology to transform a connected nation*, McKinsey Global Institute, March 2019.

of these new, more flexible ways of working is particularly helpful to women because women disproportionately carry the double burden of working for pay and working unpaid in the home—not only in emerging economies but across the world.

In the United States, for instance, 40 percent of women do most or all of the household work. Even women in senior leadership positions who have male partners are five times more likely than their partners to do all or most of the household work. One survey showed that 42 percent of senior-level US women say that they do not want to be top executives because it would require too much of their families, compared with 35 percent of men.[76] Therefore, allowing for flexible work locations may disproportionately benefit women, as it could reduce commute times and potentially help women better balance work and caregiving responsibilities. In China, one study found that flexible work policies increased job satisfaction and reduced the likelihood of an employee leaving a company—and more so in the case of women than men.[77] In Indonesia, many women find it hard to travel for work because the infrastructure is so deficient, but digital technologies enable them to work from home.[78]

Additionally, some evidence suggests that automation could help reduce workloads, enhance outcomes, and increase worker satisfaction (see Box 5, "Automation and other technologies could help enhance the quality of output and satisfaction in the workplace").

Three qualitative case studies illustrate how women's jobs may change

We developed three qualitative case studies that illustrate how jobs for women could potentially change through partial automation in diverse occupations within healthcare, education, and financial services (see infographics at the end of this chapter). These case studies showcase the impact of different levels and types of partial automation. They focus, in particular, on what a partially automated emergency room, classroom, and wealth-management firm might look like in the automation era.

In healthcare, many occupations may experience partial automation, including a large number of female-dominated professions. Licensed practical and vocational nurses could experience the automation of activities taking up about 30 percent of their time. This could have a disproportionate impact upon women, as the majority of nursing professionals are women. Such activities could include maintaining medical facility records, ordering medical equipment, and testing biological specimens (tasks that fall under the processing and collecting data categories). Even managing the preparation of special meals and maintaining inventory of medical supplies (within the task category of applying expertise) can technically be automated. However, activities such as explaining medical procedures to patients and collaborating with other healthcare professionals to plan or provide treatment are less likely to be technically automatable. Activities that are less likely to be automated require social and emotional skills along with management talent, as discussed above, and this could be an advantage for women given the current nature of many female-dominated occupations. Healthcare workers may be able to fill the time freed up by automation by further building deep, trust-based relationships with patients and spending more time on maintaining interactions with patients throughout their care life cycle to ensure treatment adherence. As automation grows, healthcare professionals may be able to spend significantly more time with patients, improving patient care and increasing employee productivity.

In education, many teaching occupations may be partially automated, leading to a shift in the nature of day-to-day work and the requirements of the job. Elementary school teachers could experience the automation of activities that currently take up about 40 percent of their time. This could affect women, who make up the majority of teaching professionals.

[76] *Women in the workplace 2018,* McKinsey & Company and Lean In, 2018.
[77] Wansi Chen et al., "Family-friendly work practices and their outcomes in China: The mediating role of work-to-family enrichment and the moderating role of gender," *The International Journal of Human Resource Management*, June 2016.
[78] Ibid.

It is important to note that technology is very unlikely to fully displace teachers—indeed, it is possible that the need for teachers will increase as automation and technology enter the classroom. According to the Programme for International Student Assessment (PISA), providing students with e-book readers, tablet computers, and laptops could have a negative impact on test scores, indicating that effective teacher direction is critical.[79] Amid debate about how much technology classrooms should have, schools will need to be thoughtful about the decisions they make.

Within education, activities such as maintaining student records (under collecting data), ordering instructional materials (under processing data), and documenting lesson plans (under applying expertise) could be technically automated. However, encouraging students, advising students on academic matters, discussing students' progress with parents or guardians, assisting students with special needs (under managing people), and developing instructional objectives (under applying expertise) are less likely to automated. A hypothetical partially automated classroom may allow teachers to spend more time on engaging with students through technology to augment the classroom experience, personalizing lessons for different student groups based on interest level or skill level, improving student learning journeys, and increasing teacher productivity. With that, teachers can increase time on coaching and advising students based on individual academic needs; for instance, teachers can rotate between small groups of students during class, as the students learn from their digital content and interactive experiments.[80] Women who use social and emotional skills at work due to their current occupations may be at an advantage, as these activities will likely require such skills.

Finally, in finance, personal financial advisers could experience the automation of activities that currently take up about 40 percent of their time. Activities such as assessing the financial status of clients (under applying expertise), computing debt repayment schedules (under collecting data), and analyzing market conditions or trends (under processing data) could be technically automatable. Activities such as developing business relationships (under interfacing with stakeholders) and advising clients on financial matters (under applying expertise) are less likely to be automated away by 2030. Financial professionals may be able to spend more time coaching their teams and ensuring full stakeholder alignment on investment decisions. As the use of automation increases in financial services, building client relationships and managing complex financial algorithms may increase in importance. Deepening client relationships requires social and emotional skills, and women who use these skills in their professions today may be poised to take advantage of this shift. However, developing and using complex algorithms may require technical skills, which could be a challenge for certain women because, on average, women currently lag behind men in technical education.

Working women—and men—are facing a time of radical change in their working lives. Many women will lose their jobs; others will tap into new employment opportunities. Many others may stay in their existing jobs, but the way they work will change significantly as some of the activities they perform are automated. Job lost, gained, and changed imply that many millions of women may need not only to transition between occupations and sectors, but also to make substantial changes in the way they work in their existing jobs. In chapter 3, we discuss these transitions in more detail.

[79] *How to improve student education outcomes: New insights from data analysis*, McKinsey & Company, September 2017.
[80] Amanda M. Fairbanks, "Digital content shifts educators into coaching, guiding modes," *Education Week*, May 20, 2013.

Box 5

Automation and other technologies could help enhance the quality of output and satisfaction in the workplace

Two female-dominated occupations in which automation and other technologies could lead to better outcomes, reduced workloads, and increased satisfaction are nursing and teaching:

Nurses. Research indicates that heavy nursing workloads can have an adverse impact on patient safety and job satisfaction among nurses, and therefore are associated with high turnover among nurses.[1] If automation and other technologies can decrease nursing workloads, this could improve patient outcomes as well as nurse satisfaction and retention. One study of 36 units in four Finnish hospitals showed that the rise of nursing workloads above a defined optimal level was associated with an 8 to 34 percent higher probability of an incident and 43 percent higher probability of patient mortality, compared with nursing workloads at the defined optimal level.[2] Correspondingly, if nursing workloads were below the defined optimal level, the odds of an incident and patient mortality were approximately 25 percent lower. As a result, if automation can reduce workloads, this could increase productivity and satisfaction for nurses, along with safety for patients.

Teachers. In the United States, about one in five early tenured teachers works more than 60 hours every week, and about 15 percent of teachers with more than seven years of experience work over 60 hours per week.[3] In the United Kingdom and Singapore, approximately 20 percent of early tenured teachers also work 60-plus hours every week. During this time, administrative responsibilities take up 15 percent of working hours for teachers in Singapore and about 7 percent for teachers in the United States. A survey of 4,450 respondents showed that 82 percent of teachers in the United Kingdom viewed their workload as unmanageable, and 20 percent of teachers stated that they plan to leave the occupation due to feeling overworked.[4] In 2016, more than 70 percent of teachers said they were worried that "a shortage of good teachers was severely affecting children." Many routine administrative tasks can be automated, potentially decreasing workloads and enabling teachers to spend more time on problem solving with, and coaching, students, which could lead to better learning outcomes and increased teacher satisfaction.

1 Pascale Carayon and Ayse P. Gurses, "Nursing workload and patient safety—a human factors engineering perspective," in R. G. Hughes, ed., *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*, Rockville, MD: Agency for Healthcare Research and Quality, US Department of Health and Human Services, April 2008; Thomas A. Lang et al., "Nurse-patient ratios: A systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes," *The Journal of Nursing Administration*, July/August 2004, Volume 34, Issue 7; Christine Duffield and Linda O'Brien-Pallas, "The causes and consequences of nursing shortages: A helicopter view of the research," *Australian Health Review*, 2003, Volume 26, Number 1.

2 Lisbeth Fagerström, Marina Kinnunen, and Jan Saarela, *Nursing workload patient safety incidents and mortality: an observational study from Finland*, BMJ Open, 2018.

3 McKinsey Global Teacher and Student Survey (n= 1,028 teachers).

4 Rachel Banning-Lover, "60-hour weeks and unrealistic targets: teachers' working lives uncovered," *Guardian*, March 22, 2016.

Case study: Healthcare

Partial automation may affect selected healthcare occupations

Selected healthcare occupations
% of time that could be automated in 2030[1]

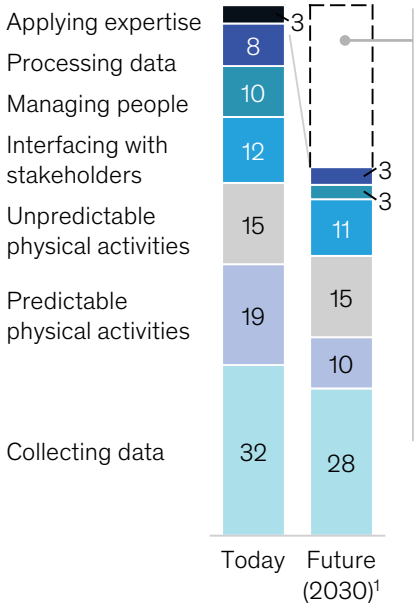
Female-dominated[2] Male-dominated[2] Gender-neutral

		% of women in occupation[3]
Massage therapists	21	83
Psychiatrists	23	40
Licensed practical and vocational nurses	31	88
Pediatricians	40	40
Surgeons	41	40
Nurse practitioners	42	87
Physical therapists	42	70
Physician assistants	47	72
Emergency medical technicians and paramedics	50	34
Orderlies	50	89

How selected jobs could change by 2030

% of time spent by activity group

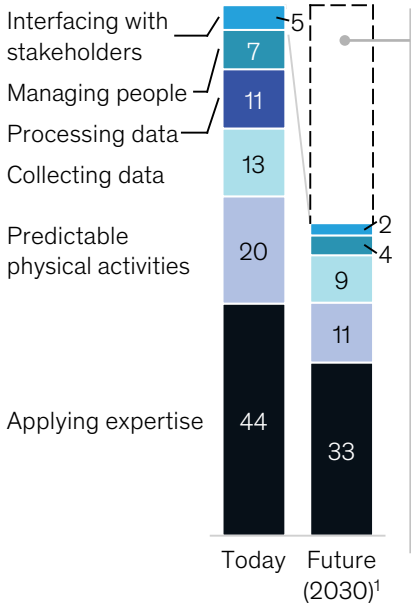
Nurses[4]



~30% of time available to

- Deepen patient relationships
- Increase personalization of care plans
- Further explain treatment plans
- Train other hospital staff

Surgeons[5]



~40% of time available to

- Collaborate on diagnoses using technology
- Use robots in surgery and remote care[6]
- Develop innovative techniques alongside technology
- Deepen relationships with patients, staff, and students

[1] Based on a midpoint automation scenario. See technical appendix for details.
[2] Female-dominated occupations are US occupations with 60% or more female employee representation. Male-dominated occupations are US occupations with 60% or more male employee representation.
[3] Based upon 2018 US BLS occupation categories and female employment data by detailed occupation (500-level). See technical appendix for details.
[4] As defined by BLS, licensed practical nurses and licensed vocational nurses provide basic nursing care. They work under the direction of registered nurses and doctors.
[5] As defined by BLS, surgeons are physicians who treat diseases, injuries, and deformities by invasive, minimally invasive, or noninvasive surgical methods, such as using instruments or appliances, or by manual manipulation. Excludes oral and maxillofacial surgeons.
[6] In 2015, Florida Hospital Nicholson Center successfully tested lag time created by the internet for a simulated robotic surgery in Fort Worth, Texas, more than 1,200 miles away from the surgeon who was at the virtual controls. In 2019, a surgeon in China reportedly performed the world's first remote animal operation using 5G technology to control robotic arms in a remote location 30 miles away, according to local reports.

Source: BLS; press search; McKinsey Global Institute analysis

Example: How a future emergency room (ER) could look

Automation potential by 2030[1] High Partial Limited

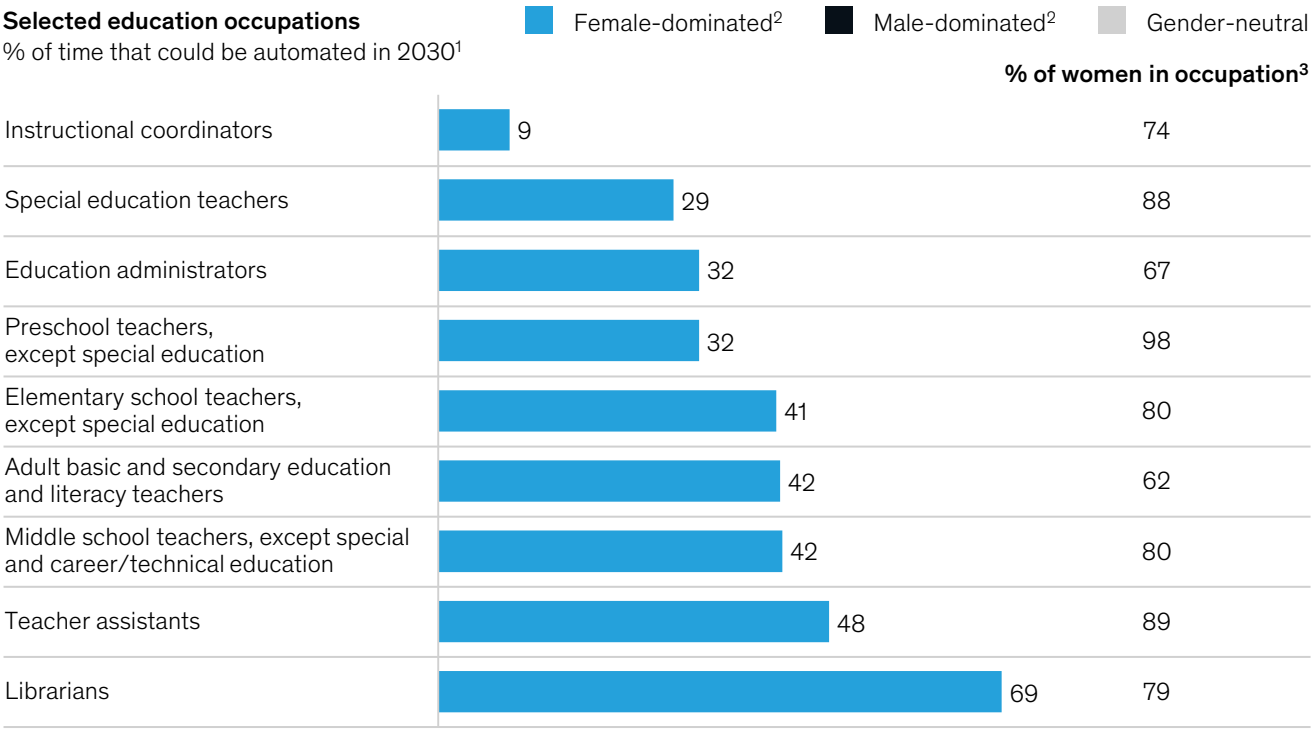
	Examples of automation	Implications for workers
Patient opts to go to ER	Telehealth[2] enables remote patient-clinician interaction, potentially avoiding ER visits in low-acuity cases	Decreases ER visits, helping reduce hospital employees' workload
Registration	Preregistration completed using mobile phone on way to hospital Wearable monitoring devices issued on arrival collect vital information	May increase demand for social and emotional skills, due to decreased clerical work and heightened focus on patient needs
Triage	Autonomous tugs and wheelchairs, substituting for staff, guide and move patients and equipment	Lower physical labor demand may reduce need for physical skills and increase value of cognitive and other skills
Lab testing	Advanced diagnostic tools reduce time required for diagnosis and expedite lab results	May require technical skills (eg, programming ability) to effectively use tools
MD consultation	AI-supported diagnosis quickly generates potential treatment options and prescription suggestions, but likely continues to require MD guidance and expertise	May require technical skills to effectively interface with AI
Checkout/ discharge	AI checkout issues reports and informs patient about medicine and bills	Enables focus on social and emotional skills to improve patient experience due to decreased clerical work
Follow-ups for patient	Remote monitoring sensors measure patient vitals and medication adherence with immediate feedback[3]	Increases flexibility for healthcare workers and may decrease ER overcrowding

1 Based on a midpoint automation scenario. See technical appendix for details.
2 The growth of telehealth will likely improve continuity of care in rural communities (in Mississippi, there are just 186 physicians for every 100,000 people, and telehealth helps connect doctors with patients). Additionally, both providers and patients save money on transportation costs.
3 People sometimes feel more comfortable revealing sensitive issues (PTSD, depression) to a virtual human compared with a real human through remote monitoring and virtual follow-ups.

Source: Expert interviews; press search; McKinsey Global Institute analysis

Case study: Education

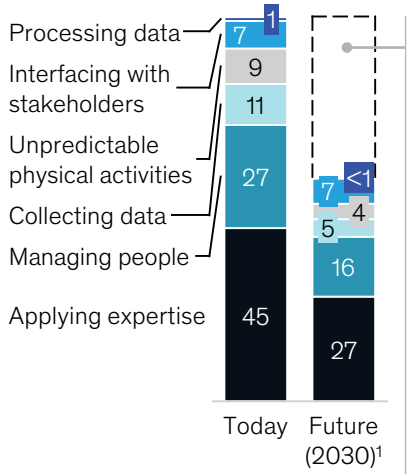
Partial automation may affect selected education occupations



How selected jobs could change by 2030

% of time spent by activity group

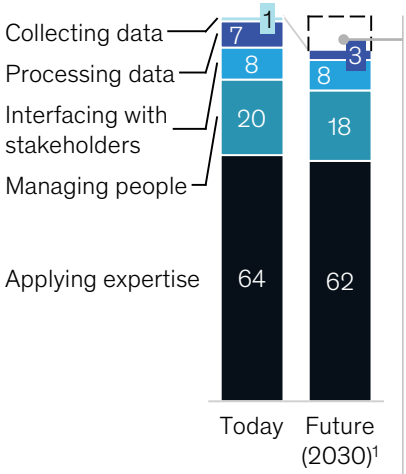
Elementary school teachers[4]



~40% of time available to

- Increase student coaching and focus on instruction and engagement[5]
- Develop personalized content[6]
- Use digital tools to teach concepts[7]
- Build new skills through professional development

Instructional coordinators[8]



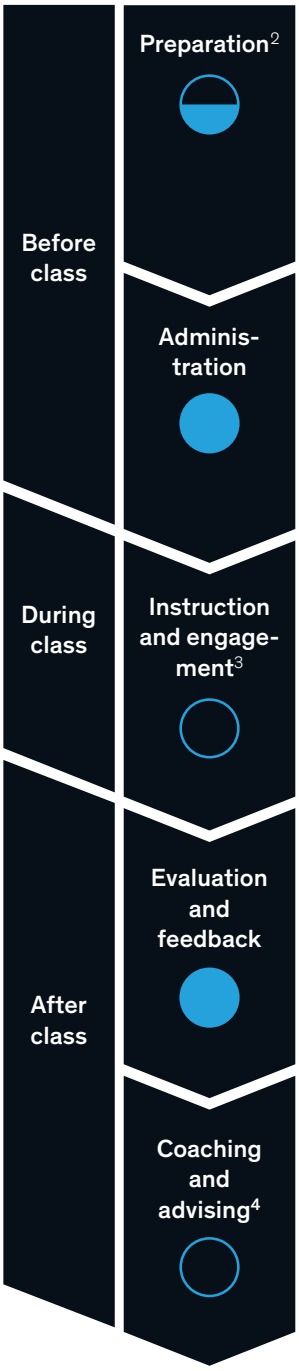
~10% of time available to

- Deepen relationships with administrators
- Solidify alignment on curriculum choices
- Collaborate using digital tools to create innovative curricula
- Increase teacher training and coaching

1 Based on a midpoint automation scenario. See technical appendix for details.
2 Female-dominated occupations are US occupations with 60% or more female employee representation. Male-dominated occupations are US occupations with 60% or more male employee representation.
3 Based upon 2018 US BLS occupation categories and female employment data by detailed occupation (500-level). See technical appendix for details.
4 As defined by BLS, elementary school teachers teach students basic academic, social, and other formative skills in public or private schools at the elementary level. Excludes special education teachers and substitute teachers.
5 Currently, about ~50% of teachers would like to spend more time on instruction and engagement and around ~30-50% of teachers would like to spend less time on administrative responsibilities.
6 Currently, two-thirds of teachers in the United States believe instruction and materials should be personalized for each learner, but 70% of teachers do not have enough time or flexible time to support personalization.
7 Across all the regions that undertook the PISA student ICT survey, providing students with e-book readers, tablet computers, and laptops had a negative impact on test scores, so schools will need to be conscious of the use of technology.
8 As defined by BLS, instructional coordinators oversee school curricula and teaching standards. They develop instructional material, coordinate its implementation with teachers and principals, and assess its effectiveness.

Source: BLS; McKinsey Global Teacher and Student Survey (n= 1,028 teachers); expert interviews; PISA; OECD; press search; McKinsey Global Institute analysis

Example: How a future classroom could look



1 Based on a midpoint automation scenario. See technical appendix for details.
2 According to the OECD, on average across countries, teachers spend half of their working time in nonteaching activities including planning lessons, marking, and collaborating with other teachers.
3 According to the OECD, the annual number of teaching hours of teachers differs greatly from one country to another and tends to decrease as the level of education increases. Teachers currently spend the most time on instruction and engagement (average of ~20–45% of time, based on averages for Canada, Singapore, the United Kingdom, and the United States).
4 Teachers may spend the most time on coaching and advising is in the future.
5 Note that AI will likely not replace teachers (it may support teachers), as students who receive a blend of teacher-directed and inquiry-based instruction achieve the best outcomes, showing that teacher-based learning remains valuable.

Source: McKinsey Global Teacher and Student Survey (n = 1,028 teachers); Program for International Student Assessment; OECD; press search; expert interviews; McKinsey Global Institute analysis

Case study: Finance

Partial automation may affect selected finance occupations

Selected finance occupations
% of time that could be automated in 2030[1]

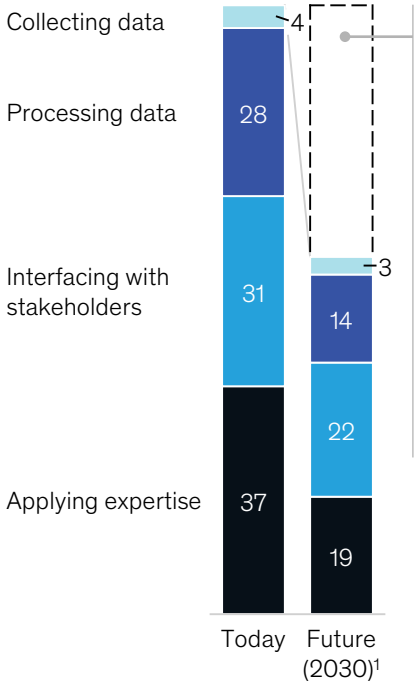
Female-dominated[2] Male-dominated[2] Gender-neutral

		% of women in occupation[3]
Budget analysts	24	62
Financial analysts	32	41
Personal financial advisers	41	34
Accountants and auditors	42	61
Loan officers	50	54
Financial managers	52	55
Receptionists and information clerks[4]	74	91

How selected jobs could change by 2030

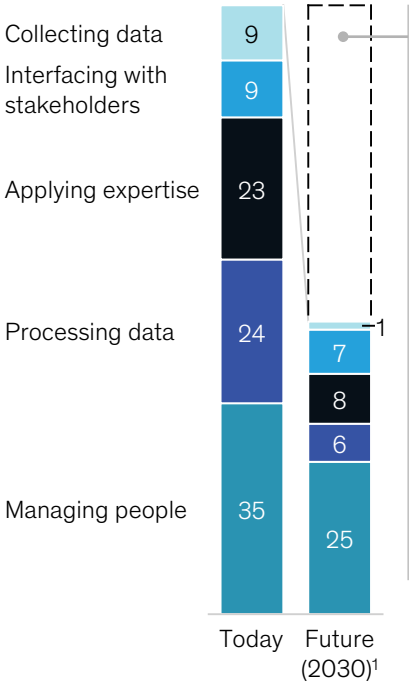
% of time spent by activity group

Personal financial advisers[5]



~40% of time available to
- Deepen client relationships
- Further personalize investment offerings
- Focus on professional development
- Build and use investment algorithms

Financial managers[6]



~50% of time available to
- Increase coaching and mentoring
- Improve organizational performance management
- Further focus on long-term financial strategies
- Deepen stakeholder relationships across organization

[1] Based on a midpoint automation scenario. See technical appendix for details.
[2] Female-dominated occupations are US occupations with 60% or more female employee representation. Male-dominated occupations are US occupations with 60% or more male employee representation.
[3] Based upon 2018 US BLS occupation categories and female employment data by detailed occupation (500-level). See technical appendix for details.
[4] Except legal, medical, and executive.
[5] As defined by BLS, personal financial advisers provide advice on investments, insurance, mortgages, college savings, estate planning, taxes, and retirement to help individuals manage their finances.
[6] As defined by BLS, financial managers are responsible for the financial health of an organization. They produce financial reports, direct investment activities, and develop strategies and plans for the long-term financial goals of their organization.

Source: BLS; McKinsey Global Institute analysis

Example: How a future wealth management firm could look

Automation potential by 2030[1] High Partial Limited

	Examples of automation	Implications for workers
Client acquisition	Social networks enable clients to choose financial advisers using peer-to-peer reviews	May increase demand for social and emotional skills to help improve client relationship building
Information gathering	Automated systems develop a detailed view of client's financial health, linking different accounts	May increase demand for social and emotional skills as routine tasks are automated away and clients look for more interaction
Recom-mendation	Investment algorithms deliver clear and simple asset-allocation advice	May require advanced technical skills to interact with and use algorithms
Execution	Advanced tools in portfolio replication and trading streamline the execution process	May require technical skills (eg, programming ability) for effective use of new tools
Reporting and monitoring	AI-supported portfolio monitoring with real-time updates eases client portfolio management Advanced analytics and visualization tools create easy-to-read dashboard	May require technical skills to use tools
Client follow-ups	Teleworking enables client and adviser to follow up remotely Robo-advisers deliver standardized, algorithm-based follow-up recommendations	May enable flexibility and remote working, as well as free up time for other tasks

[1] Based on a midpoint automation scenario. See technical appendix for details.

Source: Expert interviews; press search; McKinsey Global Institute analysis

3 Transitions

In the scenarios developed for this report, women's share of employment relative to men could remain roughly stable or even improve in 2030. However, this will hold only if many millions of women (and men) successfully negotiate significant transitions between occupations and sectors—and likely often into higher-skilled roles—to remain employed.

If women navigate these transitions successfully, they could potentially be on a path to more productive and better-paid work. Enabling women to raise their skills could position them for jobs that pay more, are associated with less drudgery and routine, and offer more scope to use social, emotional, and higher cognitive skills. However, if women face more difficulty than men in navigating these transitions, they could face significant declines in share of employment and an intensifying pay gap with men in both mature and emerging economies. In an era where growth in demand for higher-wage labor will likely be stronger than for lower-wage labor in many countries, many women may face a need to reskill. During this period of transition, the market for lower-wage jobs could see a surplus of female and male workers (the latter being particularly vulnerable to the automation of manufacturing). This could lead to pressure on wages at the lower end of the income scale, which could cause women to drop out of the labor market entirely and to do so more readily than men, given that women's labor supply tends to be more responsive to changes in wages.

In this chapter, we explore the transitions that could lie ahead for women if they are to thrive in the workforce of the near future, the implication on wages, and the skills and educational transitions that workers will likely need to make.

Millions of women and men could need to make transitions in how and where they work

7–24%

of women employed may need to transition between occupations by 2030 vs 8-28% of men

MGI's previous research on prospects for jobs lost and gained for both men and women found that as many as 375 million workers, or 14 percent of the global workforce, could face a need to change occupational categories and learn new skills in order to remain employed.[81] That analysis focused on six countries—China, Germany, India, Japan, Mexico, and the United States—and estimated transitions by calculating the number of workers at risk of net job loss who would likely not be able to find jobs within the same occupation or at the same skill level. These estimates were then extrapolated to 40 countries. We focus this analysis on transitions that need to take place between occupational categories and skill levels, as these are likely to be more challenging than sector transitions (see technical appendix for more details). MGI has since refined and expanded this analysis to 53 countries representing more than 90 percent of the global population (for details, see the technical appendix), which we use here to globally extrapolate the transitions that women would need to make by 2030 in order to remain employed.

In this analysis, we find that globally, between 40 million and 160 million women, or an average of 7 to 24 percent of those currently employed, could need to make transitions across occupations to ensure that they keep pace with shifts in demand for different types of labor. This compares with the potential for an estimated 60 million to 275 million men to make transitions, or on average 8 to 28 percent of men currently employed (Exhibit 17).

[81] *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.

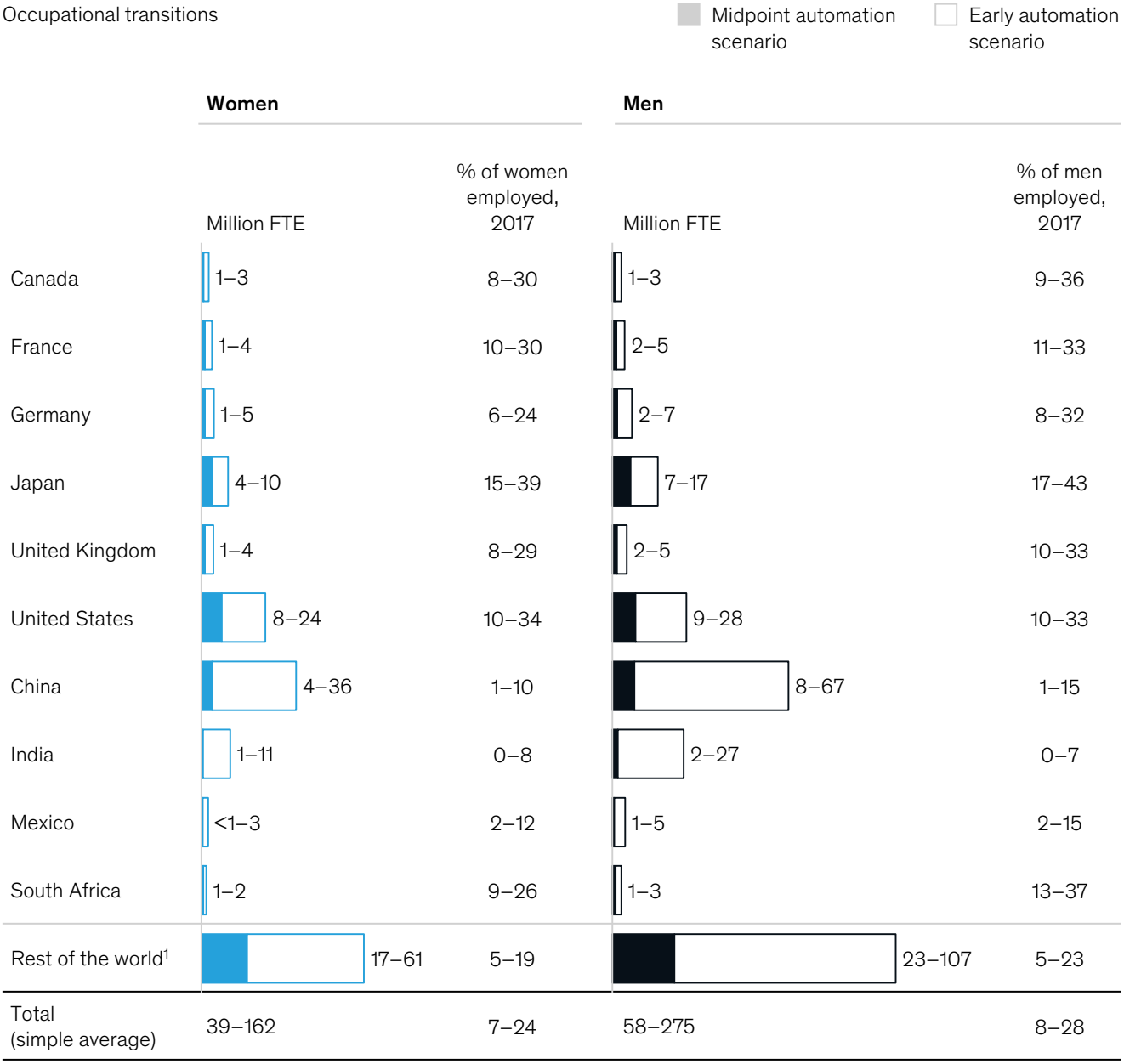
These ranges are based on a midpoint automation adoption scenario and an early automation adoption scenario developed by MGI; in the latter scenario, job losses would be higher, and therefore the number of people needing to transition between occupations would also be larger.

In chapter 1, we noted that if women are able to navigate the necessary transitions, they may be able to maintain, or in some cases slightly increase, their current share of employment. In most of the ten countries studied, women's employment share could hold or rise by one to two percentage points. Germany and India are exceptions; each could see the female share

Exhibit 17

Roughly 40 million to 160 million women may face a need to transition across occupations and skill sets by 2030 to remain employed.

Occupational transitions



[1] Extrapolated by mapping countries in the world to the most similar of the 10 countries studied in this report (53 countries in total) by applying rates of transition by gender to employment for each country.

Note: Countries ordered based on mature and emerging economies, and alphabetically within each group. Analysis excludes jobs created in new occupations and unsized labor demand. Figures represent a trend-line scenario of job creation. In a forthcoming MGI report on the future of work in the United States, we will explore another scenario.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; CPS IPUMs; ONS, 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

of employment fall by up to one percentage point. But what would the situation be if the 7 to 24 percent of women we highlighted fail to make the transitions that are necessary to stay employed? To provide a sense of the impact this could have, we looked at how the female share of employment would change if the 40 million to 160 million women dropped out of the labor force rather than transitioning to different jobs. We acknowledge that this is an extreme scenario, but one that helps illustrate the importance of these transitions. We found that if this were to occur, female share of employment could drop by one to seven percentage points, on average, across the ten countries studied between 2017 and 2030.

1–7pp

drop in female employment share possible if women do not make transitions

Across the countries studied, in a midpoint automation adoption scenario, women could face comparable or slightly fewer transitions as a percentage of their current employment as men. Net job losses across occupational categories and skill levels fuel transition rates. On average, women face slightly smaller net job losses and therefore the prospect of somewhat fewer transitions than men (as a share of their overall employment). In an early automation adoption scenario, in which automation adoption accelerates rapidly within the next few years, this trend is more pronounced. This is driven by more rapid automation of occupations involving routine physical tasks, which tend to be male-dominated. The development and adoption of technologies that automate routine physical tasks have been—and could continue to be—faster than for technologies that automate routine cognitive tasks.[82] Of the ten occupations for which automation rates accelerate fastest in an early automation scenario, eight are male-dominated and are concentrated in agriculture and plant and machine operation roles. For example, in Canada, the number of mechanic and repair roles that are automated could grow significantly (relative to the midpoint scenario) in an early adoption scenario. In contrast, the number of office support worker roles (which tend to be female-dominated) that are automated could have a smaller increase in an early adoption scenario. In Canada, these occupational categories have 83 and 15 percent male representation, respectively. We note, however, that in an early automation adoption scenario in India, women could experience a higher rate of transition than men, given rapid acceleration of automation of roles in agriculture, a sector that employs about 60 percent of women in India, compared with 37 percent of men.

Across mature and emerging economies, we notice different patterns. In mature economies, a higher percentage of both men and women could face a need to transition to new occupations, compared with emerging economies. On average, in a midpoint scenario, 10 percent of women in the the mature economies studied could face a need to transition, compared with 3 percent of women in the the emerging economies studied. Similarly, 11 percent of men in mature economies versus 5 percent of men in emerging economies could face a need to transition to new occupations. This is not surprising given that transitions are based on certain occupations contracting in size, requiring the workers in those occupations to switch to other roles. In emerging economies, lower incentives to automate (given lower labor costs) drive lower rates of job losses compared with mature economies. In addition, emerging economies are projected to see higher income growth going forward, fueling larger potential job gains. Therefore, industries in emerging economies are likely to experience net job growth across the board, reducing the need even for workers at risk of job loss to transition into entirely new occupation categories.

Could these transitions be different from the large-scale transitions of the past?

The 40 million to 160 million women figure implied by the automation age is significant, but if we put this into historical context, how large would this transition be? We explore two ways in which this transition compares to and potentially diverges from previous transitions: (1) the size, breadth, and pace of change; and (2) the skill and education imperative created by the transition. Ultimately, our analysis suggests that the impending transition could be significant,

[82] *A future that works: Automation, employment and productivity*, McKinsey Global Institute, January 2017.

comparable in size to major economic revolutions in the past. What's more, the impending transition could, on average, place a premium on skilled work, which would create additional pressure on workers to reskill.

The size, breadth, and pace of transitions in the age of automation could be comparable with those of major disruptions in the past

The potential need for 40 million to 160 million women to switch occupations could create major disruption in the global labor market. This is a nontrivial number of women. Consider, for instance, that in the United States between 1948 and 2016, approximately 60 million women entered the workforce in a period of nearly 70 years, but that almost half of that number may be expected to transition to new jobs in only the next ten years.[83] However, it is important to note that the global economy has successfully navigated technological disruptions of similar and even greater magnitudes in the past. For instance, the share of agricultural employment in China fell from 55 percent in 1991 to only 16 percent in 2018, a shift of roughly 240 million people. This corresponds to about 9 million workers transitioning per year historically in China, compared with 8 million transitions per year in our scenario for China.[84]

Some might argue that transitions in the age of automation could affect a higher proportion of women than past transitions. Previous waves of technological disruptions focused largely on routine physical work, which tends to be performed more by men than by women, whereas today's transitions could disrupt not only routine physical tasks but also routine cognitive tasks, which are more prevalent in female-dominated occupations. However, historians note that women were not insulated from transitions of the past, such as the Industrial Revolution. For instance, during the period from 1837 to 1870 in Massachusetts in the United States, as women transitioned out of agricultural roles the number of women employed in domestic service nearly tripled, and the number of women working in garment manufacturing increased by nearly sixfold. A similar trend played out across the United States. Although female employment increased minimally in absolute terms, the type of work women performed underwent a radical transformation.[85]

Automation will likely affect a broad range of industries simultaneously, from finance to retail to manufacturing to transportation.[86] Once again, however, technological advancements in history—such as the development of the steam engine, electricity, and computers— have similarly transformed multiple sectors. The steam engine drove the Industrial Revolution, affecting numerous sectors (for example, weaving and printing). Electrification transformed households, stores, and factories and gave rise to mass production. Computers transformed business services, finance, and retail and gave birth to the internet and mobile computing.[87]

When comparing the pace of change between these transitions and prior transitions, some have argued that the rate of technological innovation and adoption has sped up, dwarfing the pace of change experienced in the past. Advocates of this perspective point to technical advances ranging from machine learning models to cloud-based computing as evidence that today's innovation represents a break from the past. However, we note that even if technological innovations were to exceed historical rates, the impact on workers will be different only if the diffusion and adoption of new technologies also accelerates (rather than purely the pace of technology creation). A review of the past 60 years by MGI suggests that the rate at which this technology has been adopted has not increased: historical rates of adoption of 25 technologies (developed prior to automation) have fallen into a relatively constant range of about eight to 28 years.[88]

[83] *Facts over time – women in the labor force*, United States Department of Labor, dol.gov/wb/stats/NEWSTATS/facts/women_lf.htm#CivilianLFSex.
[84] ILO employment in agriculture estimates and ILO employment totals.
[85] Thomas Dublin, *Transforming Women's Work: New England Lives in the Industrial Revolution*, Ithaca, NY: Cornell University Press, 1994.
[86] Rudina Seseri, *The AI disruption wave*, TechCrunch, October 13, 2016.
[87] *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.
[88] Ibid. We define rate of adoption as the time from commercial availability to 80 percent saturation in the market.

In short, this transition represents a significant shift in the global economy. However, it is worth noting that the economy has weathered transitions of similar scale, breadth, and pace in the past.

The impending transition could introduce a premium on higher-skilled work, although demand for some low-skill jobs could continue

Some economists have made the case that today's wave of technological innovation is increasingly leading to skill-biased technological change, which would favor high-skill workers over lower-skill workers as more routine, less skill-intensive tasks are automated—a trend not seen in certain past transitions.[89] During the Industrial Revolution, for instance, technology increased the productivity of low-skill workers, enabling them to undertake tasks previously carried out by high-skill workers, including artisans such as hand-loom weavers.[90] In the academic literature, some have considered past technological change biased toward enabling low-skill workers at the expense of high-skill ones.[91]

Today, especially in mature markets, there is a trend toward increasing demand for high-skill jobs that require higher education, because automation technology often complements high-skill work and increases its productivity while substituting low-skill work. Therefore, as we discuss later in this chapter, women (and men) affected by automation will likely need to transition to work requiring higher average educational attainment and skill levels. Further, entirely new occupations are increasingly requiring higher education. In the United States in the 1980s, new work was evenly distributed among all educational attainment groups; however, in 2000, college graduates were more than twice as likely to be hired for new work as high school graduates.[92] Within these entirely new occupations, the jobs that are rapidly growing and highest paid are disproportionately held by college graduates and demand technical skills.[93] Therefore, the skill bias present in this wave of automation may pose a new challenge to workers—one potentially unseen in past waves of technological transformation.

However, we need to acknowledge several caveats regarding this potential skill bias. First, although today's automation may increasingly complement high-skill work, many technological innovations have "deskilled" jobs and will continue to do so. For example, pharmacists of the past were expected to formulate, compound, and dispense medicines. Technological advances have replaced the need to do so, arguably deskilling the profession in some ways.[94] Second, demand for lower-skilled work will continue, though it may be hidden when analyzing net demand aggregated by sectors and occupations. For instance, demand for jobs such as elderly care aides—an occupation that does not require a four-year degree—is likely to continue to grow as populations age. Finally, this analysis uses skills as a proxy for educational attainment; however, in future, the skills-education map we use may evolve. Although currently a college degree is the only pathway to qualify for certain jobs, this may change in the future. Demand for on-the-job training may mean that vocational and certificate-based instruction could eventually disrupt the existing infrastructure of education systems.

Women are likely to need higher education and skills levels to transition, thrive in existing jobs, and capture new opportunities

One effect of the automation age may be to favor the creation of jobs with higher educational requirements. In this analysis, we primarily focus on education levels, given the data that are

[89] David H. Autor, Frank Levy, Richard J. Murnane, "The skill content of recent technological change: An empirical exploration," *Quarterly Journal of Economics*, 118 (4), February 2003.
[90] *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.
[91] Ibid.
[92] Jeffrey Lin, *Technological adaptation, cities, and new work*, Federal Reserve Bank of Philadelphia working paper number 09-17, July 28, 2009.
[93] David Autor, *Work of the past, work of the future,* NBER working paper number 25588, February 2019;
[94] Jon Waterfield, "Is pharmacy a knowledge-based profession?" *American Journal of Pharmaceutical Education*, April 12, 2010.

available, but recognize that educational qualifications alone may be a flawed measure of underlying skill levels. We find that many of the 40 million to 160 million women needing to transition to new jobs will likely need significant training (both on the job and academic) and reskilling to successfully make the leap into a new occupation and remain employed. In mature economies, the magnitude of this reskilling burden is particularly heavy.

In mature economies, most women transitioning between occupations and sectors may need to acquire more advanced skills

Many of the 40 million to 160 million women transitioning jobs will need to achieve a higher level of education or develop more advanced skills. Requirements are different in mature and emerging economies.

In mature economies, most women (and men) are likely to have to transition into occupations that will require higher educational attainment or more advanced skill sets (Exhibit 18). In the six mature economies we include in our sample, net demand for jobs requiring lower than secondary education or an associate degree declines across the board. In five of the six mature economies in our sample, net demand grows only for jobs with a college or advanced degree. Japan is the outlier—according to our analysis, labor demand is flat even for those with a college or advanced degree. Despite an increased need for certain occupations that require digital talent, net job growth for Japan could be low. This is largely driven by low GDP growth and a declining population, which is forecast to continue into 2030; these factors drive reduced consumption and demand for investment that, in turn, drive down net growth in our scenario even in high-wage jobs in professional services and healthcare, for instance.

It is important to note that growth in net demand for high-skill jobs in mature economies could have a significant impact both on new graduates and on those currently in the workforce; the latter group will likely face a need to reskill or raise skills levels whether or not workers elect to return to education. For many, on-the-job training may become an increasingly prevalent reality.

Although the education imperative is high for both men and women in mature economies, healthcare, a field that fuels much of the potential net job growth opportunity for women, tends to require slightly higher education attainment, on average, than the PST sector, a field that drives the most net job growth for men (of course, there could be variations within occupations in each of these occupational categories). For instance, in Canada, the average education level required of a professional in the PST sector is a college degree, whereas the average education level required of a professional in the healthcare sector is an advanced degree.[95] For women to step into roles that are subject to strong demand for labor, they will need to develop the required knowledge base and skill sets. In addition, we note that women may face more challenges in raising their skill levels given unequal care burdens and mobility constraints, as we discuss in chapter 4.

In three out of four emerging economies, growth in labor demand could occur for jobs requiring secondary education, among others

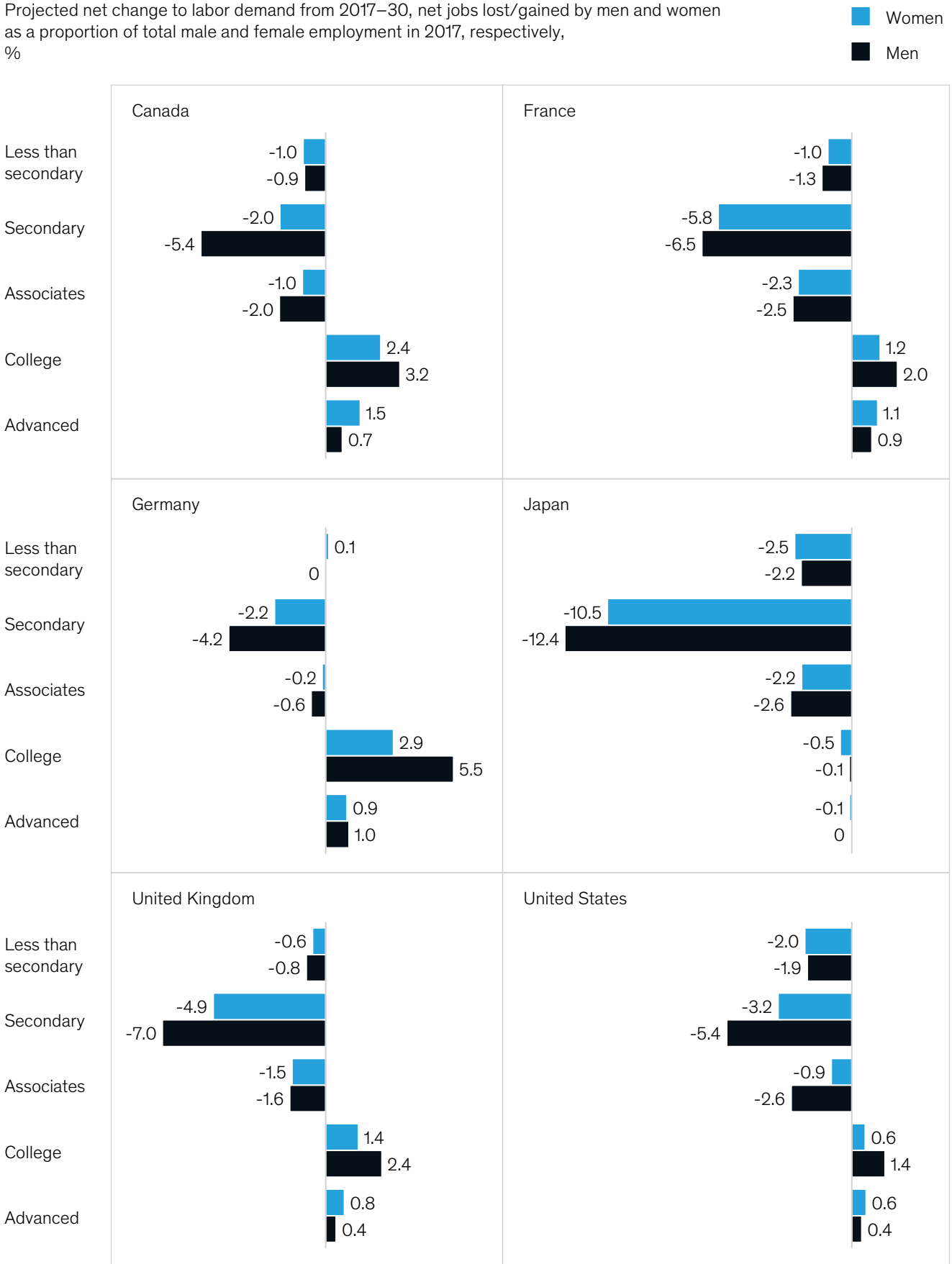
In three of the four emerging economies in our sample—China, India, and Mexico—net labor demand is seen rising strongly for occupations requiring a secondary education for both men and women (Exhibit 19). In China and India, net demand for jobs requiring associate, bachelor's, and advanced degrees is also expected to grow. The situation in South Africa is different, with net demand for labor falling across educational categories; this reflects lower forecasts for growth in per capita GDP. Shifting demand for jobs by education level in South Africa could be largely similar to what we expect in mature economies, namely that demand for jobs requiring a college degree may remain relatively stable, while demand for roles requiring an advanced degree may increase slightly, in contrast with declining demand for jobs requiring less than a college degree.

[95] Note that this refers to the professionals occupational category.

Exhibit 18

In mature economies, men and women could only experience net growth in labor demand in jobs with higher educational requirements.

Projected net change to labor demand from 2017–30, net jobs lost/gained by men and women as a proportion of total male and female employment in 2017, respectively, %



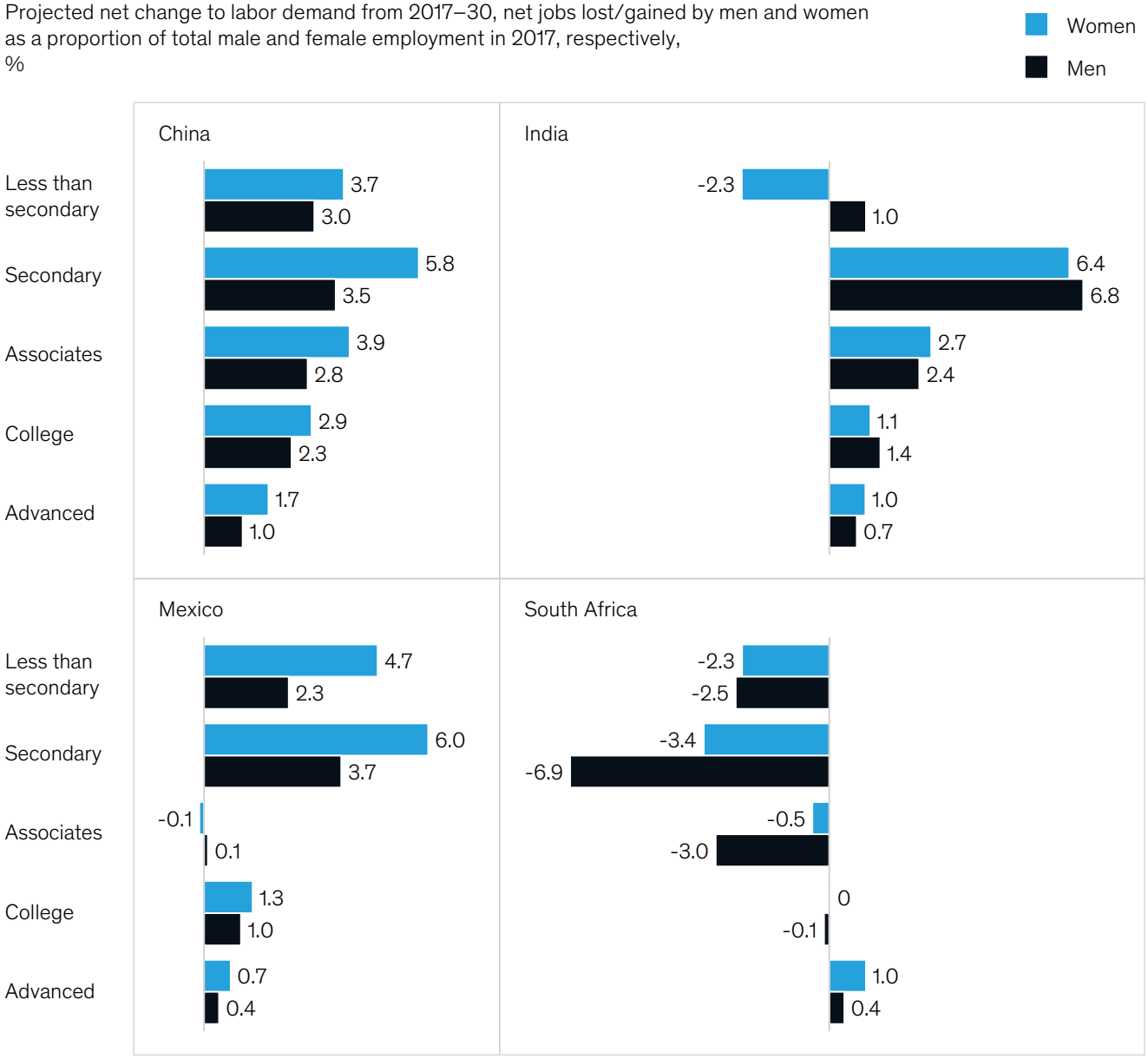
Note: These data are based upon a midpoint scenario of automation and a trend-line scenario of job creation. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: CPS IPUMs; ONS, 2017; ILO 2017; Japan National Survey; Eurostat, 2015; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

Exhibit 19

In most emerging economies, men and women could experience growth in labor demand across all education levels, with the largest gains at the secondary education level.

Projected net change to labor demand from 2017–30, net jobs lost/gained by men and women as a proportion of total male and female employment in 2017, respectively, %



Note: These data are based upon a midpoint scenario of automation and a trend-line scenario of job creation. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: ILO, 2017; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; McKinsey Global Institute analysis

Women will also need to reskill within their current jobs and for entirely new occupations
Even within existing jobs, women will need to learn new skills. As we have discussed, parts of their work, particularly tasks involving basic cognitive and physical skills, could be automated. At the same time, demand for higher cognitive, technical, and social and emotional skills could rise. In the future, it would be useful to break down skill shifts by the specific requirements in each sector and occupation, but that is beyond the scope of this report.

Taking up entirely new occupations (for instance, machine learning specialists) could also require a significant educational and skilling push by both women and men. One report found that, in the United States, college graduates were twice as likely to be hired for entirely new occupations as high school graduates in 2000.[96] Unless women effectively develop their skills further, they will find stepping into the new, in-demand jobs of the future highly challenging.

Transitions are characterized by a shift toward higher-wage occupations, intensifying the need for women to raise their skills

In the future of work, growth in labor demand for higher-wage jobs could outpace that for lower-wage jobs. These higher-wage jobs often, but not always, require a higher level of educational attainment. In the aggregate, this shift in labor demand could be a force for good if women are able to find their way into higher-wage jobs via reskilling. However, if workers struggle to meet employer demand, this could lead to even more income inequality. Challenges could therefore lie ahead for lower-paid women and men if they struggle to make the transition into higher-paid, higher-skilled occupations (see Box 6, "Automation could have an impact on wages").

To test the impact of the future of work on demand for jobs in different wage tiers, we segmented detailed occupations into three wage terciles—low, medium, and high—to create country-specific income brackets.[97] In all economies in our sample, the occupational categories most heavily represented in the low-wage income bracket are craft and related trades, elementary occupations, and service work; in the medium-wage income bracket, the most prevalent occupations are clerical support work and plant and machine operation; in the high-wage bracket, the occupational categories that predominate are professional, associate professional, and technician, and legislator, senior official, and manager roles.

In mature economies, increased demand for high-wage jobs will likely be accompanied by declining demand for lower-wage jobs
In all the mature economies studied, demand for low- and middle-wage jobs may contract, affecting both women and men—men somewhat more in certain cases. We observe a potential "hollowing out" of the middle class in which middle-wage workers could be hit the hardest (Exhibit 20). In general, low-wage workers in mature economies could be less at risk of losing their job than middle-wage workers since their wages are often too low to justify the cost of implementing and running automation technology. Meanwhile, middle-wage workers are often engaged in jobs with a high degree of automation potential (for example, plant and machine operators) that command high enough salaries to make the economic case for automation viable. In our analysis, high-wage jobs are the only ones set to experience net growth.

In all mature economies studied, net demand for low-wage jobs held by men could contract; this is true for women in five out of six of the mature economies studied. In Germany, low-wage jobs held by women today could remain roughly stable. This is driven by growth in service and

[96] Jeffrey Lin, *Technological adaptation, cities, and new work*, Federal Reserve Bank of Philadelphia working paper number 09-17, July 28, 2009.
[97] We acknowledge that this analysis has some limitations. Since the categories we discuss include a variety of occupations with diverse wages, a given occupational category could typically be represented in two if not three of a country's income terciles. Nevertheless, certain occupational clusters emerge across income brackets.

Box 6

Automation could have an impact on wages

Our research does not explicitly model shifts in relative wages across occupations. However, the economics of labor supply and demand suggests that wages may be under pressure in occupations for which demand declines. Since 1980, most mature economies have experienced an overall decline in the share of national income captured by labor rather than capital, and recent academic work suggests that technological change is one reason for this decline.[1]

A considerable body of evidence suggests that automation could reduce wages, particularly for those in lower wage tiers. One paper estimated that the introduction of industrial robots in Germany was responsible for the elimination of roughly 275,000 jobs between 1994 and 2014, but that the creation of additional jobs in service sectors fully compensated for these losses. However, there was an overall negative effect on the wages of low- and medium-skill workers. In addition, the study found that workers in occupations at higher risk of automation did not experience increased risk of displacement, but instead were likely to remain in their original workplace while performing different tasks. However, earnings for low- and medium-skilled workers (particularly medium-skill machine operators) declined due to the introduction of robots, while high-skill managers earned more.[2] This suggests that the impact on low- and high-wage, high-skill labor could be unequal.

[1] See Lawrence H. Summers, "Economic possibilities for our children," The 2013 Martin Feldstein Lecture, NBER Reporter Online, number 4, 2013; Laura Tyson and Michael Spence, "Exploring the effects of technology on income and wealth inequality," in *After Piketty: The Agenda for Economics and Inequality*, Heather Boushey, J. Bradford DeLong, and Marshall Steinbaum, eds, Cambridge, MA: Harvard University Press, May 2017; Loukas Karabarbounis and Brent Neiman. "The global decline of the labor share," *The Quarterly Journal of Economics*, February 2014, Volume 129, Number 1; and Wolfgang Dauth et al., *German robots—the impact of industrial robots on workers*, Centre for Economic Policy Research discussion paper DP12306, September 20, 2017.

[2] Wolfgang Dauth et al., *German robots— the impact of industrial robots on workers*, Centre for Economic Policy Research discussion paper DP12306, September 20, 2017.

sales roles, where women account for 59 percent of employment.[98] In almost all the mature economies we studied, men are hit hardest. In Canada, for instance, low-wage men stand to lose 7 percent of the jobs they hold today, but for low-wage women, this figure is 3 percent. Japan is the exception; in this case, women could lose slightly more jobs than men, as a share of their employment, in this wage bracket, reflecting the fact that clerical support roles—an occupational category that is 61 percent female—account for the largest job losses in the low-wage income bracket. In contrast to other mature economies where clerical support roles often earn middle-income wages, the average wage for a range of clerical occupations including word processors and library assistants in Japan tends to be in the bottom 30th percentile of wages.

In most of the mature economies in our sample, middle-wage jobs could contract the most, even more than in the case of low-wage jobs. Men in middle-wage jobs could face a higher risk of job loss than women, largely because of their high representation in middle-wage occupations that are often most vulnerable to automation, such as plant and machine operation.

Finally, in the mature economies we studied, with the exception of Japan, men and women could experience modest growth in labor demand in the high-wage segment. In Canada, France, and the United States, women could gain a proportionally higher number of jobs in

[98] Although German industry has adopted technology at a similar pace compared with other mature economies, this has typically not led to a reduction in the size of the workforce. Therefore, looking ahead to 2030, the scenario we modeled for Germany suggests fewer job losses, particularly in manufacturing, than in other mature economies, and therefore higher net job growth. As a result, growth in consumption in Germany could remain relatively strong, leading to growth in the retail sector and a commensurate increase in service and sales occupations (where women predominate) within that sector.

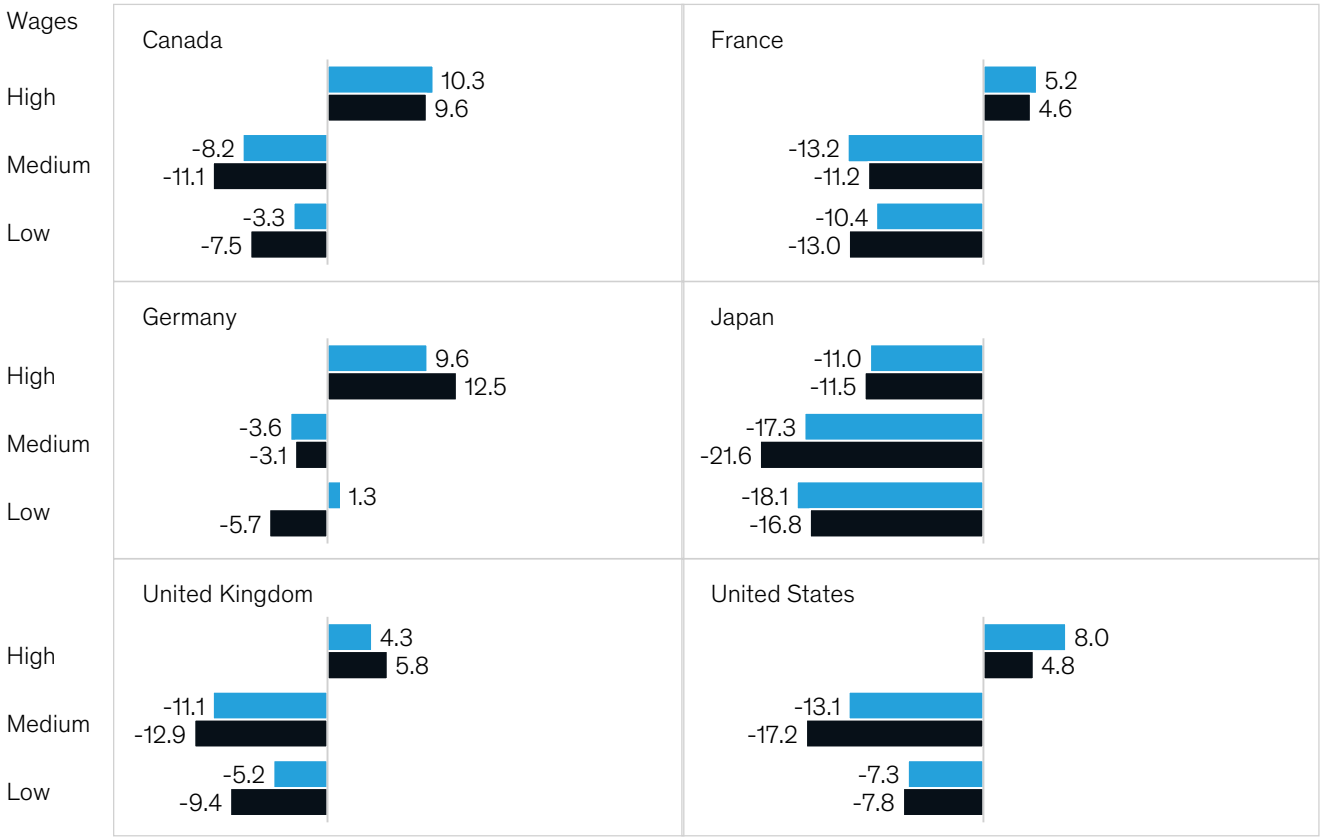
Exhibit 20

Automation may lead to a shift in labor demand toward higher-wage jobs.

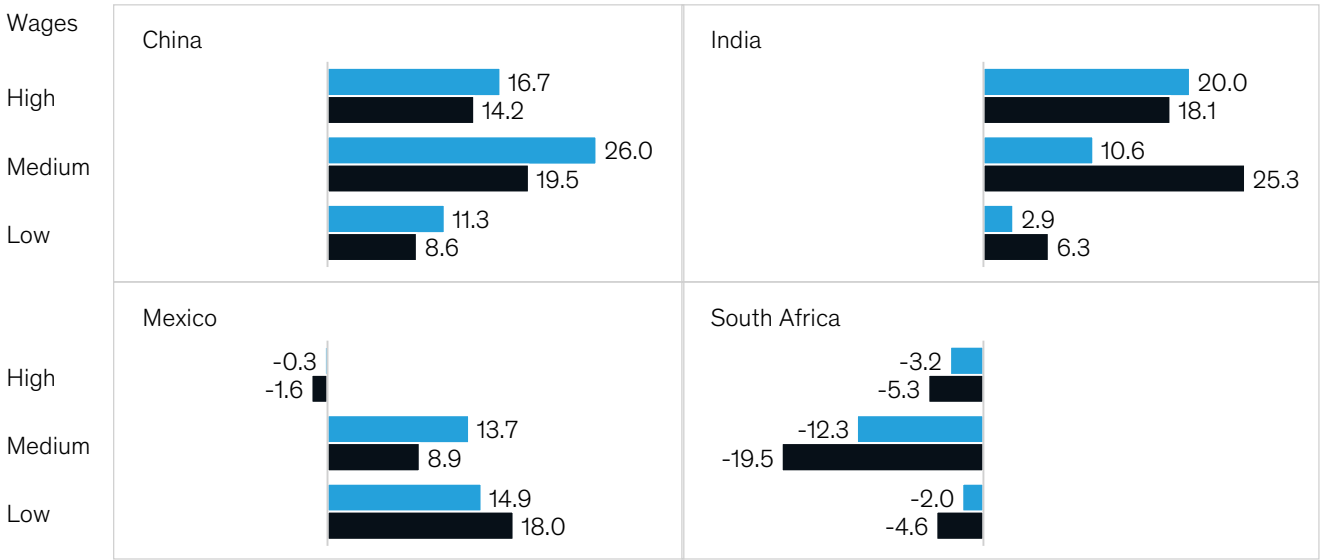
Projected net change to labor demand by wage level,[1]
Net jobs lost or gained by men and women as a proportion of total male and female employment by tercile, respectively,
%

Women
Men

In mature economies, workers in low and middle -wage jobs (particularly men) are likely to be most negatively affected by shifts in labor demand



In several emerging economies, growth in labor demand is highest in middle- and high-wage jobs



[1] Low wage is the 0–30th percentile, medium wage is the 30th–70th percentile, and high rage is the 70th–99th percentile. Applied occupation category gender splits to estimate percent of job growth in each wage bracket for women and men; assumption based on fact that occupation categories (rather than sectors) are strongest drivers of gender mix across jobs.

NOTE: Analysis reflects a trend-line scenario of job creation and a midpoint automation scenario. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: CPS IPUMs; ONS; ILO, 2017; Japan National Survey; Eurostat, 2015; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; McKinsey Global Institute analysis

this wage tercile than men. However, these gains are likely to be driven largely by jobs in the professional, associate professional, and technician occupation category (distinct from the PST sectoral category), which, in turn, is driven by increased demand for jobs in the healthcare sector. Our analysis suggests that men could continue to outpace women in job growth in legislator, senior official, and manager roles—the highest-paying occupations within this income bracket. For instance, in France, 40 percent of net positive job growth for men could occur in legislator, senior official, and manager roles, compared with 18 percent for women.

40%

of net positive job growth for men in France could be in legislator, senior official, and manager roles, compared with 18% for women

As previously noted, this story could have a positive side: the prospect of low-paying jobs declining and being replaced with a growing number of higher-paying jobs could improve quality of life for many people. Even if, as the scenario described here suggests, enough high-paying jobs are available to absorb all of those who have been displaced by automation (once jobs in entirely new occupations that do not exist today have been taken into account), the available pool of workers may not be sufficiently skilled to fill these roles. Growth in brand-new occupation categories could also help absorb workers displaced by automation, but as we have noted, many of these jobs are likely to require high levels of education that may prove difficult to attain for low-wage, low-skill workers. In summary, without effective management of the transitions that need to be made—and, notably, a significant push to develop the skills required—displacement of lower-wage workers, downward wage pressure affecting lower-wage workers, and rising income inequality may result.

Although men in low- and medium-wage jobs may experience the largest immediate challenges of job displacement due to automation, significant second-order effects on women may ensue. As low- and medium-wage jobs become scarcer due to reduced demand from employers, wages could come under pressure. Evidence suggests that women's labor supply is typically more responsive to wage shifts than that of men. One study found that the wage elasticity of labor supply for women in mature economies might be five times that of men.[99] This is likely due to a higher opportunity cost for women of being in the labor force—when wages fall, families face a trade-off between work and unpaid care, a burden that falls disproportionately on women. Women may, therefore, leave the labor market more readily than men when facing downward pressure on wages.

In Australia, for instance, many women are deterred from being the second earner in the family because of high childcare costs and restrictive tax systems. Australia's Productivity Commission estimated that secondary earners drawing an average wage would devote more than 50 percent of earnings to childcare if they worked two days a week, and more than 90 percent if they worked four days a week.[100] This means that, from a purely financial perspective, it often makes more sense for mothers rather than fathers to leave paid employment to look after children, because fathers tend to earn more (in Australia, men working full time on average earn 16 percent more than women).[101] If women's wages come under pressure, the incentive to remain employed weakens further.

Moreover, cultural attitudes are at play. In many countries, society favors men being primary household earners.[102] Scarcity could lead to preferential job allocation to men. Regardless of underlying biases, limited job opportunities may prompt displaced men to move into lower-wage jobs that have traditionally been held by women, such as sales workers and home-care assistants. It is not possible to fully anticipate how these dynamics may play out.

[99] Michiel Evers, Ruud De Mooij, and Daniel Van Vuuren, "The wage elasticity of labour supply: a synthesis of empirical estimates," *De Economist,* March 2008, Volume 156, Issue 1.

[100] *Childcare and early childhood learning, Overview and recommendations*, Productivity Commission Inquiry Report, Australian Government Productivity Commission, Number 73, October 31, 2014; and Miranda Stewart, ed., *Tax, Social Policy and Gender: Rethinking Equality and Efficiency*, Acton, Australia: Australian National University Press, 2017. Also see *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.

[101] *Gender equity insights 2017: Inside Australia's gender pay gap,* Bankwest Curtin Economics Centre and Workplace Gender Equality Agency, 2017

[102] We analyzed the World Values Survey and OECD data and found a strong link between societal attitudes that limit women's potential and gender-equality outcomes in a given region. Globally, 60 percent of respondents agreed with the statement that men have more right to a job than women when jobs are scarce. See *WVS Wave 6 (2010–2014), worldvaluessurvey.org/WVSDocumentationWV6.jsp.*

In most emerging economies, net job growth could occur across all wage profiles, with the greatest growth in demand generally in medium- and high-wage jobs

The picture in emerging economies is likely to be quite different from that in mature ones (see Exhibit 20 and the infographics at the end of chapter 4). In all three earnings categories, demand for jobs held by both men and women could grow in the period to 2030, with some exceptions. Several factors lie behind this expected growth in demand. First, in our scenario, emerging economies could see higher demand for jobs driven by relatively strong GDP growth. China enjoyed double-digit annual GDP growth until the early 2010s, and most forecasters anticipate that, while slowing, GDP growth could continue to top 5 percent per year in the period to 2030. Second, MGI's automation model accounts for the economic viability of automation while assessing automation adoption. In emerging economies, average wages tend to be lower, which reduces the incentive to automate, potentially limiting the automation potential in the period to 2030. Taking these factors together, net job demand across emerging economies is likely to be stronger than in mature economies.

In China and India, medium- and high-wage jobs could experience larger growth in demand than low-wage jobs. In China, demand for medium-wage jobs in particular could expand most for both men and women, although women could enjoy higher growth in labor demand in this category, driven by gains in services and sales occupations. In all three wage brackets, women in China appear positioned to experience proportionally higher rates of net growth in labor demand than men. In India, women could experience slower rates of growth in labor demand in the low-wage bracket, reflecting large declines in demand for jobs that women tend to do in agriculture that are not offset by representation in other low-wage occupational categories such as construction (as is the case for men). The largest growth in job demand for men could be in the medium-wage bracket, while the most growth for women could occur in the high-wage category, because women are relatively well represented in the expanding healthcare sector today. Although the stronger growth in higher-wage occupations could potentially help certain women, the benefits will be captured only if women negotiate a steep learning curve, which may prove particularly challenging for the many women working in low-skill informal agricultural jobs.

In Mexico, our analysis suggests that most growth in labor demand could be in the low-wage bracket for both men and women, but that men are likely to see higher growth than women in this category, driven by growth in machine operator and craft worker roles that are male dominated today. In the medium-wage bracket, women stand to gain proportionately more jobs than men, which is due to strong growth in the accommodation and food services sector, and retail and wholesale trade. Men could be vulnerable to job losses (as a share of current employment) in the high-wage bracket, reflecting a loss of high-paying jobs in agricultural employment. The patterns we observe in Mexico diverge from China and India primarily because of a high concentration of higher-paying agriculture jobs in Mexico, which could face a decline in demand. Therefore, while demand for agriculture jobs is likely to decline in all three economies, this affects different wage tiers in the three countries.

In contrast to China, India, and Mexico, South Africa exhibits patterns that are much more in line with mature economies. The country is expected to experience a decline in net employment demand across all three income brackets, reflecting lower per capita GDP growth, which is expected to continue. Job gains are not expected to be sufficient to offset those lost to automation. Medium-wage jobs could contract the most, particularly for men.

Women's ability to navigate transitions could affect the gender wage gap

Many studies have pointed to a wage gap between men and women. Recent WEF estimates suggest that only 50 percent of the global earned income gap has been closed.[103] The persistent wage gap between men and women appears at least in part to reflect the fact that

[103] *The global gender gap report 2018*, World Economic Forum, 2018. The "earned income gap" measures the amount of income that women and men in a country receive in the aggregate.

they are concentrated in different occupations and sectors.[104] One study estimated that these occupational and sectoral differences account for 51 percent of the gender pay gap in the United States (occupational differences account for one-third of the gender gap, and sector differences for 18 percent).[105] It is likely that the wage gap is also driven in part by differences in full-time and part-time work—the latter pays significantly lower wages, and women are disproportionately represented in this work (in the United States, women account for close to 65 percent of part-time employees).[106]

39%

of jobs in the two highest-paying occupational categories in mature economies are held by women vs 34% by men

Our analysis here also finds evidence of a current wage gap between men and women. Looking ahead to 2030, we find that even if men and women successfully navigate transitions, the gender gap could persist to a certain degree, driven by sectoral and occupational differences in where men and women tend to be employed. However, the future size of this gap is highly dependent on the degree to which women are able to effectively navigate job transitions by 2030.

In mature economies, women appear to be well represented in relatively high-paying occupations, at least at first glance (Exhibit 21). They hold 39 percent of jobs in the top two highest-paying occupational categories, while men hold 34 percent. However, these numbers disguise deeper inequalities. First, a larger percentage of employed men (8 percent of all men, compared with 5 percent of all women) work in the highest-paying occupational category—legislator, senior official, and manager occupations—which pays an average wage premium of more than 40 percent compared with the next-highest-paying occupation category of professionals, associate professionals, and technicians. Within the next category, women are more heavily concentrated in lower-paying roles. In Germany, for instance, women represent 52 percent of associate professionals and technicians, but 42 percent of professionals—and the latter earn, on average, more than 20 percent higher wages than the former. Finally, more women work in the two lowest-paying occupational categories, elementary occupations and clerical support work. In mature economies, 25 percent of women are employed in these roles, compared with 15 percent of men.

Looking ahead to 2030, we anticipate that women could make inroads into higher-wage jobs. While wage dynamics are influenced by various factors and hard to clearly anticipate, our scenario suggests that gender wage disparity could lessen slightly in certain mature economies if women are able to successfully transition into occupations in demand. The bulk of women's job displacements could occur in relatively low-paying occupation categories such as clerical services (14 percent of women could be in this group by 2030, down from 17 percent in 2017). Simultaneously, women could see demand rise and thus make inroads in the relatively high-paying professional and associate professional occupation category (38 percent of women could be in this group by 2030, compared with 34 percent in 2017). This could be a positive outcome if women are able to effectively navigate the job transitions required to achieve this picture by 2030. However, men could still outnumber women in the highest-paying occupations within this category. For instance, in our scenario, 9 percent of men could be employed in top-paying occupations, compared with 6 percent of employed women. Examples of these occupations are roles like sales directors, chief technology officers, and comptrollers. However, if women are not able to make the transitions required, or if they lag behind men in making these transitions, the pay gap could widen.

[104] Other factors that could contribute to a wage gap beyond occupation and sector differences include hours worked, experience in the labor force, education level, and union status. According to US Census Bureau data, in 2015 women in the United States earned 79 cents to every dollar earned by men. A study published in 2007 shows that such factors are taken into account, the gap declines to only eight cents. See Francine D. Blau and Lawrence M. Kahn, *The gender pay gap: Have women gone as far as they can?* The Academy of Management Perspectives, February 2007. In MGI's 2015 global research on gender inequality, we found that a perceived wage gap between men and women was a significant issue, and it remains so today. Although the gender earnings gap is difficult to prove conclusively, surveys of business leaders conducted by the World Economic Forum found a widespread perception that women earn less than men for equivalent work in all 87 countries we analyzed. See *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015.

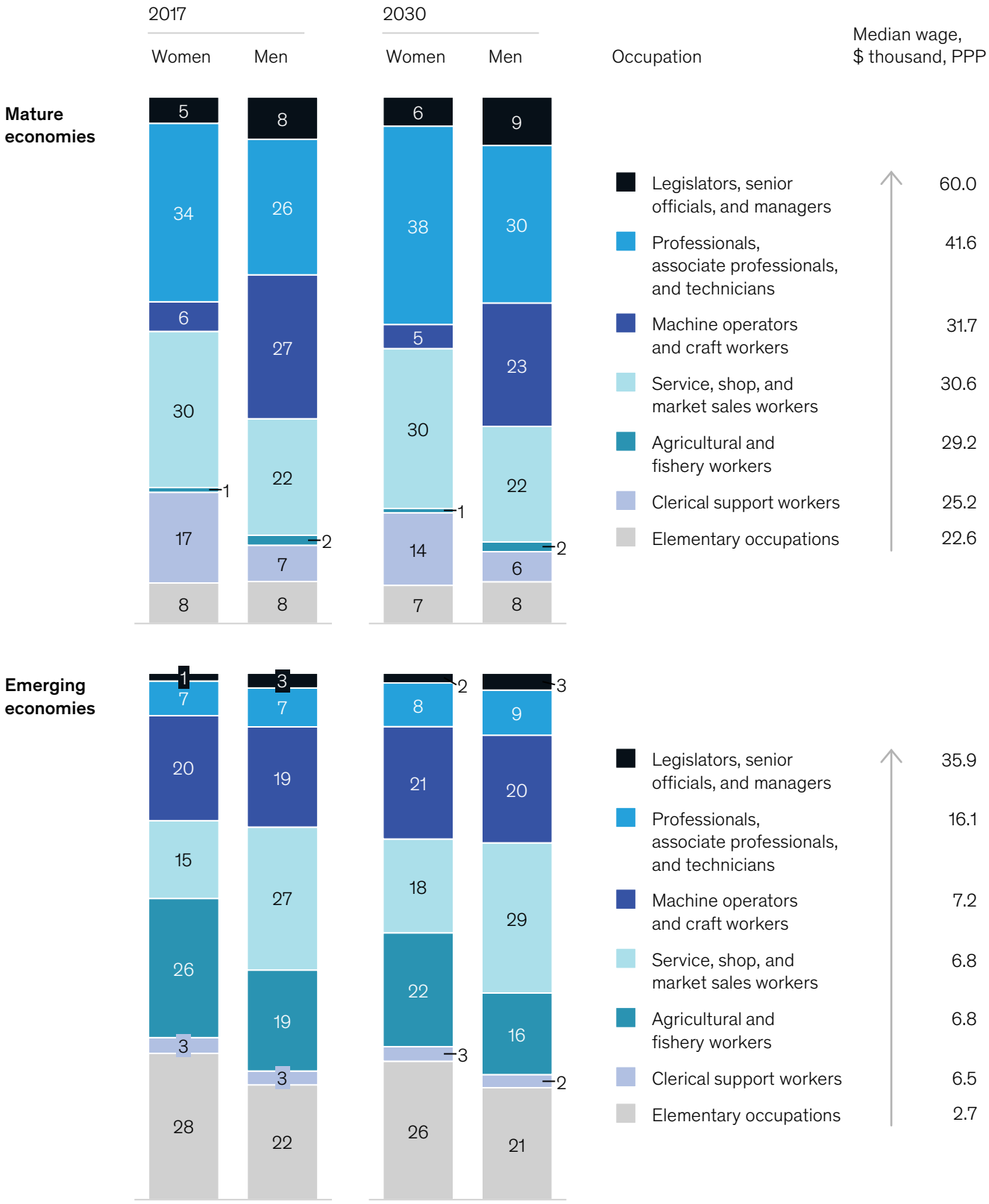
[105] Francine D. Blau and Lawrence M. Kahn, "The gender pay gap," *The Economists' Voice*, June 2007, Volume 4, Issue 4.

[106] *On pay gap, millennial women near parity—for now,* Pew Research Center, December 11, 2013; and Barry T. Hirsch, "Why do part-time workers earn less? The role of worker and job skills," *ILR Review,* July 1, 2005, Volume 58, Issue 4.

Exhibit 21

In both mature and emerging economies, more men are employed in occupations with higher median wages.

Employment distribution across occupation categories,
Weighted average across mature and emerging economies,
%



Note: Figures may not sum to 100% because of rounding. Analysis reflects a trend-line scenario of job creation and a midpoint automation scenario. Analysis excludes jobs created in new occupations and unsized labor demand.

Source: CPS IPUMs; ONS, 2017; ILO, 2017; Japan National Survey; Eurostat, 2015; NSS; INEGI; China Population Census; South Africa Quarterly Labour Force Survey, 2018; Statistics Canada, 2016 Census; McKinsey Global Institute analysis

In addition, as we noted in chapter 1, women may be less likely than men to enter entirely new occupations created. This phenomenon may perpetuate the gender wage gap, since many new jobs pay higher wages than established occupations: in 1990 and 2000, the wage premium was 30 percent or more for new occupations compared with existing ones.[107] Among possible reasons that these new occupations pay more are that many of them require workers with higher educational attainment, that they are largely emerging in high-paid sectors and occupations, that workers are more productive in these roles, and that these occupations are riskier, given lower stability associated with newer roles and businesses.

30%

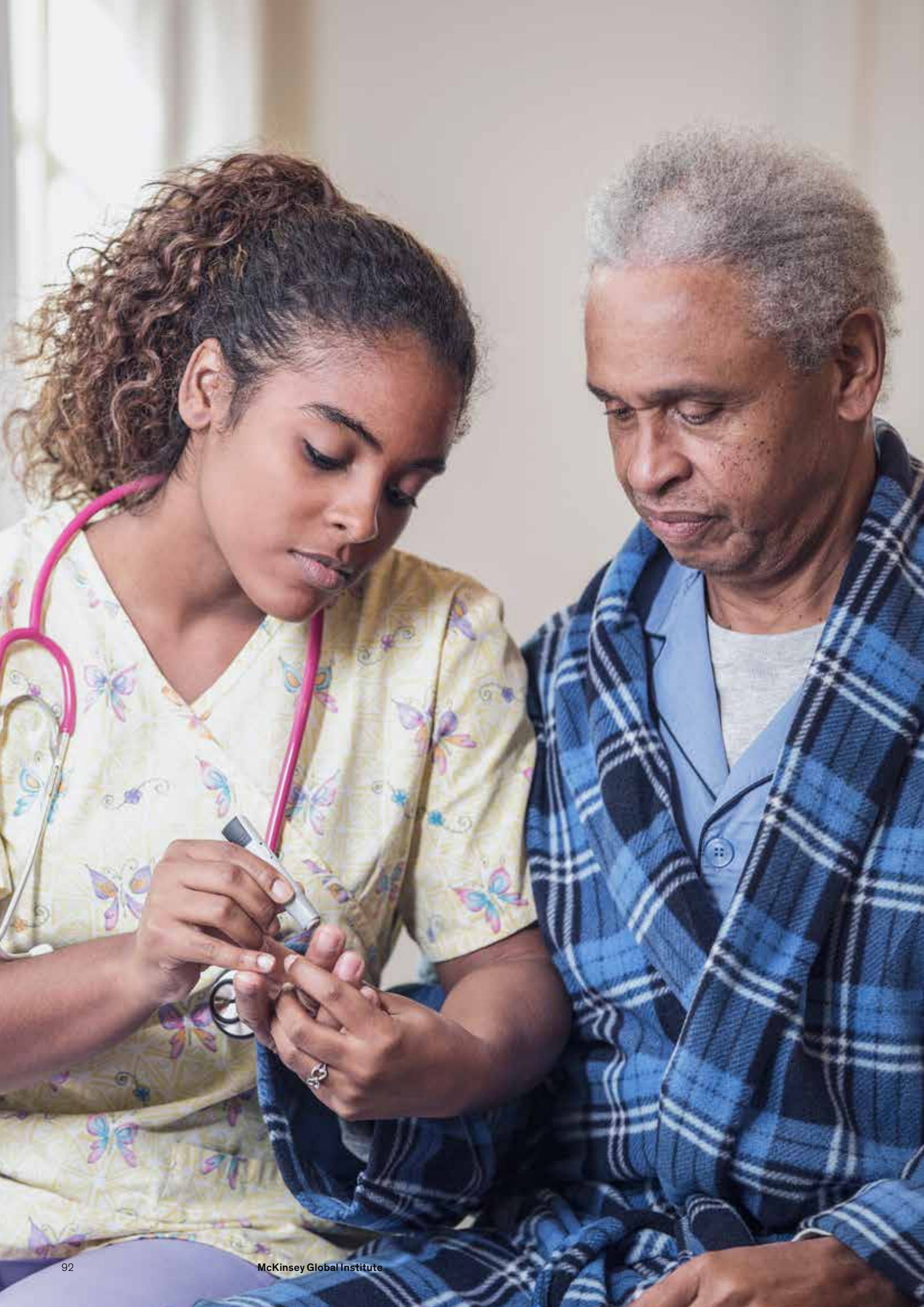
wage premium for jobs in brand new occupations over existing ones from 1900 to 2000 (study)

We observe a similar pattern in emerging economies (see Exhibit 21 and the infographics at the end of chapter 4). More men work in the top-paying category of legislators, senior officials, and managers (although this category accounts for less than 5 percent of both male and female employment). These top-paying occupations command twice the wage, on average, of those in the next-highest-paid occupational category. In the professional, associate professional, and technician category, women and men hold comparable numbers of jobs, but due to data limitations we are unable to determine definitively how they are placed within this group—a factor that would influence the gender wage gap. In the professionals subcategory, for example, average wages are twice those of associate professionals and technicians, and therefore a lower share of women in professional roles (and a higher share of women in associate professional roles) would lead to a gender wage gap even if the aggregate share was comparable. Finally, more women (28 percent of those employed) are employed in the lowest-paying category of elementary occupations, compared with men (22 percent). The median income in this occupational category is 60 percent lower than in the next-highest-paying category.

Looking ahead to 2030, both men and women in emerging economies could, on average, shift away from lower-paid occupations in agriculture, for instance, into higher-wage occupations such as service worker roles and, on the higher end, professional occupations. Mexico, where low-wage positions may post the highest relative net growth of any jobs, could be the exception. These changes suggest that, in aggregate, the gender gap may narrow in some of the emerging economies studied if women are able to make the necessary job transitions. However, there are variations in this story within countries. In China, for instance, as women potentially outpace men in gaining medium- and high-paying jobs (based on increased demand for jobs that are held by women today), the wage gap could narrow. At the same time, however, women in China could simultaneously experience a proportionally larger rise in demand for the low-wage jobs they hold today than men, which could somewhat counteract the effect of increased demand for female-held higher-wage jobs. In India, the wage gap could narrow as women, on average, shift from low- to high-paying occupations, while men shift from low- to both medium- and high-paying occupations. In Mexico, the wage gap could also narrow as men confront reduced demand for the high-paying occupations and increased demand for the low-paying occupations they hold today, at the same time as women experience increased demand for medium-paying occupations. However, to determine more definitively the impact of the wage gap of shifts in labor demand would require a deeper look at trends within the individual occupations that make up each occupation category. It is clear that if women in emerging economies do not navigate the transition to higher-wage jobs, the gender wage gap could widen.

[107] Jeffrey Lin, *Technological adaptation, cities, and new work*, Federal Reserve Bank of Philadelphia working paper 09-17, July 28, 2009.

To thrive in the automation age and potentially make headway in the labor market, millions of women will need to navigate transitions between occupations and to higher educational and skill levels. If they meet these challenges successfully, they could maintain their current labor share globally and potentially make a shift into higher-wage, higher-skilled jobs. This is a big if. In the final chapter of this report, we discuss the persistent structural barriers women face in the world of work. Those barriers have ensured that progress toward gender parity in work has been slow, and they may now make it harder for women than men to make the necessary occupational and skills transitions.



4 Supporting women's transitions

The prospect of transformational technology-led changes to the labor market will have a profound impact on men and women. Many millions of workers of both genders will need to be flexible, reinvent themselves, and reskill to be prepared to change as the labor market does. However, women have long faced barriers in their working lives that have contributed to slow progress toward gender equality in work and that may now make it even more difficult for women than men to make the transitions they need to thrive in the automation age. Women face a difficult reality that old barriers will now be overlaid with new challenges as they set out to transition between occupations and sectors and to develop higher levels of, and new, skills.

This argues for concerted action by leaders in the private, public, and social sectors to implement measures that enable women to break through these barriers. Women must attain the skills, including technological skills, and the mobility and flexibility that the future of work demands—giving them equality of opportunity to step into careers of their choosing. The prospect that women will be disadvantaged in the transitions they need to make is not inevitable. Indeed, the same forces of technology and innovation that will drive the automation age can also pave the way for more gender equality in the workforce. Digital and internet technologies offer women a way to break down barriers by making reskilling more accessible and enabling flexible working, for instance, but first women need more access to technology, more capabilities to use it, and more influence on its creation and implementation.

Leaders in the private, public, and social sectors have the ability to shape the future of work and women's inclusion in it, and they need to do so to enable women's opportunity and benefit women as well as economies as a whole (Exhibit 22). In this chapter, we focus our attention on interventions that can empower women to make the labor-market transitions they need. Individual women will need to prepare themselves for a rapidly evolving future of work as well. They will have to be aware of the new skills likely to be in demand, reexamine traditional notions of where they work, how they work, and what talents and capabilities they bring to that work, and be proactive to seize the opportunities that may become available.

0.8–1.4%

of annual additional productivity growth possible from automation

Beyond the interventions discussed here in this chapter that focus on transitions in the context of the future of work, there are also many other programs and initiatives that aim to reduce gender inequality and increase women's labor-market participation more broadly, which MGI has discussed in previous research.[108]

Making effective interventions requires a robust labor market that is creating jobs, alongside unencumbered creation of new businesses. Previous MGI research found that, even with spreading automation, demand for workers could increase as economies grow, not least because, once initial costs are absorbed, automation could deliver an additional 0.8 to 1.4 percent of productivity growth annually on average for the world economy.[109] This and other factors could, in turn, result in rising incomes and consumption, particularly in emerging economies, which would then drive job creation. Other drivers of economic growth and job creation include increasing demand for healthcare as societies age (we have noted that women could tap into many new employment opportunities in this sector) and investment

[108] See MGI reports on the power of parity at **mckinsey.com/mgi/our-research/productivity-competitiveness-and-growth** and the foundational global report *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015.

[109] *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; and *Jobs lost, jobs gained: Workforce transitions in a time of automation*, McKinsey Global Institute, December 2017.

Exhibit 22

Government, industry, education, and NGO leaders will all play a role in supporting job transitions for women.

			Key actors		
	Interventions	Examples of potential initiatives	Govern-ment	Private sector	NGOs
Support skill-building efforts	Invest in training and reskilling	• Training and apprenticeship programs for women • Reskilling opportunities for midcareer women or women returning to workforce	●	●	●
	Subsidize transition costs	• Government or corporate reskilling subsidies for targeted occupations and sectors • Childcare subsidies for parents undergoing reskilling or pursuing higher education	●	●	
	Invest in digital platforms	• Industry partnerships with massive open online courses (MOOCs)		●	●
	Increase transparency on labor demand trends	• Technical school or university curriculums co-created with industry • Informational campaigns targeting women		●	●
Address labor mobility constraints	Help women balance paid and unpaid care work	• Public or corporate policy interventions to provide universal or accessible childcare • Corporate policy changes to promote flexible or telecommuting work options	●	●	
	Invest in transportation infrastructure and public safety	• Investment in more efficient public infrastructure • Campaigns to increase bystander awareness of harassment	●		
	Foster more dynamic career paths and enable women's access to networks	• Intrafirm and cross-sector networks and mentorship opportunities for women • Sponsorship of network-building organizations for women • Increased unconscious bias training in performance reviews and hiring practices • Digital talent platforms to help women find opportunities		●	
	Reduce stereotypes about gendered occupations	• Increased pubic visibility of female role models in male-dominated industries (eg, through diverse panels at speaking engagements)		●	
	Enhance social protections and safety nets for workers	• Labor agencies equipped to support and reskill the unemployed • Unemployment insurance or universal basic income policies	●		
Increase women's represen-tation in and access to technology	Create pathways for women in STEM	• Partnerships to increase exposure to STEM opportunities for girls and women from primary school to university • Internship, apprenticeship, and mentoring programs for women in STEM • Sponsorship of women pursuing advanced education in STEM	●	●	●
	Increase access to basic technology for women in emerging markets	• Investment in internet and mobile infrastructure	●	●	
	Provide more support for women to develop digital skills	• Digital and mobile literacy programming targeting women in emerging economies	●		●
	Ease path for women to work in gig economy	• Increased worker protections for independent workers	●	●	
	Address funding gap for women entrepreneurs	• Strengthened entrepreneurship ecosystem for female founders • Increased diversity within venture capital firms • Increased microfunding and access to credit to female entrepreneurs in emerging markets		●	

Source: McKinsey Global Institute analysis

in infrastructure and energy. To ensure that demand is as robust as possible, it is vital to pull every lever, including fiscal and monetary policy levers. Governments also need to ensure that support for business investment and new business formation is strong. Men and women need to be flexible and mobile in order to navigate large shifts in demand for labor and skills, and labor markets must be as flexible as possible. This includes removing barriers to geographic mobility such as the cost and availability of housing. For example, evidence shows that geographic mobility in the United States has declined since the 1980s (both within and between states), reversing the increased mobility that was a characteristic of the US labor market earlier in the 20th century.[110] Other advanced economies exhibit similar trends.

Stakeholders also need to follow established best practices. They should take a life-cycle view rather than focusing on one-off interventions if they are to achieve sustainable impact. For example, ensuring women's participation in tech will require interventions to encourage tech skill building in schools, encouraging interest in tech-oriented degrees in college, and then successful transitions from college to the tech workforce. Partnerships are a proven, powerful way to achieve progress on enabling women's advancement.[111] Stakeholders must measure progress of interventions against key short- and long-term indicators, evaluating key performance indicators and collecting data on a consistent set of metrics. Finally, stakeholders should pilot and experiment with a variety of initiatives and scale up the ones that demonstrate measurable success.

In this chapter, we highlight three imperatives that are particularly relevant to women and interventions that could be effective in helping women to meet them: (1) developing skills for the workplace of the future; (2) enhancing flexibility and mobility to aid transitions; and (3) broadening access to technology, enhancing the skills to use it, and ensuring women's participation in technology creation and leadership. We explore measures that could be effective in each of the three areas. Many of the interventions we describe are gender agnostic, supporting both women and men to make the transitions that will be necessary. For example, access to training, reskilling, and income and transitional support would benefit both genders, as would addressing gaps in protection for independent workers. Other interventions focus on women, including measures to help women better balance unpaid care work and paid work, and creating more effective pathways into tech fields.

Women need a range of measures to develop the skills required for successful labor-market transitions

As many millions of women transition from their existing jobs, increasingly working alongside automated systems, and move into new occupations and sectors, they need to achieve higher levels of educational attainment and to develop the skills required in the workplace of the future. Men will also need support to reskill—their success is clearly of equal importance to prosperity and economic growth. Many interventions that we discuss are relevant to both men and women. However, women face specific challenges in reskilling compared with men, and therefore interventions must be designed with women's specific needs in mind.

Women in mature economies are generally graduating at rates on a par with, or even higher than, men. According to WEF, in developed economies more women than men graduate with at least a secondary degree. For instance, in Western Europe, on average 90.9 percent of women attain a secondary degree, compared with 90.5 percent of men, and on average 79.8 percent of women hold a tertiary qualification, compared with 66.7 percent of men.[112] This should position them well for the jobs that will be most in demand, but it remains important

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

[111] *Partnering for parity; Strengthening collaborations for gender equality,* McKinsey & Company, October 2017.

[112] Note that net secondary education is the percentage of girls and boys in the official age range for secondary education who are enrolled in secondary education. Gross tertiary education is the total enrollment in tertiary education, regardless of age, expressed as a percentage of the most recent five-year age cohort that has left secondary school. See *The global gender gap report,* World Economic Forum, 2018.

that they match their skills as closely as possible to where the most job opportunities will be. There is some concern that women are not acquiring skills needed for high-growth fields, such as PST. For instance, among first-year full-time students pursuing higher education in the United Kingdom, only 37 percent of women studied science subjects in 2016–17, compared with 48 percent of men.[113]

Women's education in emerging economies has improved markedly in recent years, suggesting that women should be better positioned than they would have been in the past to adapt to shifting labor demand. In South Asia, for instance, the female-to-male adult literacy ratio has risen significantly, according to UNESCO. The female-to-male ratio in net secondary enrollment rates has risen substantially in several countries including Cambodia and Nepal. Notably, the female-to-male ratio of gross tertiary enrollment has increased in almost every country in Asia Pacific, with the largest growth occurring in Nepal, Cambodia, Malaysia, and China.[114] However, large gender gaps persist in education, and even more so in the skills that women will need in the labor market of the future. In low-income and lower-middle-income countries, such as India, where about 60 percent of employed women work in agriculture and tend to have a narrow skill set that may be hard to adapt, transitioning into new occupations and sectors is likely to be highly challenging.

37%

of UK first-year full-time female students studied science in 2016-17 vs 48% of male students (study)

Women could also find vocational training and other reskilling programs more challenging to attend than men because of societal and economic constraints including cost, access to transportation, and family obligations. One study of women and men in vocational training in Malawi found that women dropped out at higher rates than men. Women were more likely to drop out of the program if they lived further from the training center or if they became sick or injured. Moreover, women were more likely to cite family commitments, marriage, or transportation challenges as the reason for not enrolling in the program.[115]

We should note that having the right education or set of skills is not sufficient to propel women into quality jobs, given the influence of many other barriers, including cultural barriers, in both mature and emerging economies. MGI studies have found that even where women and men graduate in roughly equal numbers, significantly fewer women take entry-level positions, and the erosion in share continues throughout the talent pipeline. In our Asia Pacific study, we found that the proportion of women enrolled in tertiary education is relatively lower in some countries, which narrows the female labor pool at an early stage. The Asia Pacific countries with the largest drop in share of women from graduation to entry-level jobs are India, where the share falls from 43 percent of graduates to only 25 percent of entry-level professionals, the Philippines where the drop is from 53 to 43 percent, and Australia where the decline is 56 to 44 percent.[116] Women also face other constraints due to challenges with labor mobility and balancing paid and unpaid work, which may make reskilling and negotiating labor-market transitions hard.

[113] *Higher education student statistics: UK 2016/17 – qualifications achieved*, Statistical First Release SFR247, HESA, January 11, 2018.
[114] *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.
[115] Yoonyoung Cho et al., *Gender differences in the effects of vocational training: Constraints on women and drop-out behavior*, Gender Action Portal, Harvard Kennedy School, June 2016.
[116] *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.

Governments and companies both need to enable women to develop their skills

To help women develop the skills they will need (so they can benefit from shifting labor-market trends), some potentially effective measures include company provision of training, government subsidies to enable more women to undertake training, public and private investment in digital learning platforms, and improved transparency of labor demand trends in order to help workers match skills to that demand.

Broadly, the skills development playing field needs to be leveled so that men and women are equally equipped to make the necessary transitions to thrive in the future of work. A number of key interventions merit consideration.

Investment in training and reskilling, including lifelong learning

Employers have a clear interest in fostering the skills of both men and women but seem to struggle in implementing the right approaches. In a recent McKinsey survey, 66 percent of executives saw addressing potential skills gaps related to automation or digitization as a top-ten priority, but only 16 percent of private-sector business leaders in this group felt "very prepared" to help their workforce make future transitions.[117]

54%

of employers provided additional training in 2018 vs 20% in 2014 (study)

Industry initiatives can take many forms; they can be conducted by the organization itself or in partnership with other institutions including schools, colleges, and nongovernmental organizations. In the United States, IBM has pioneered P-Tech, a six-year integrated STEM program for students pursuing a high school diploma and an associate degree in a STEM field.[118] Upon graduation, participants are first in line for jobs at IBM or other industry partners and have the skills to access high-demand occupations in technology. Companies can sponsor employees at college or run their own apprentice programs. Governments can also serve as facilitators for such programs. The Australian Apprenticeships Incentives Programme, for instance, provides incentives for private companies to train people in occupations with high-demand skills.[119] Making women a specific target of programs could help level the playing field for skills development, enabling more women to seize new employment opportunities with different or changing skill requirements. In China, for instance, the All-China Women's Federation partners with a number of private-sector companies including Alibaba to provide training and networking for women, especially in e-commerce and technology sectors.[120]

Lifelong learning has historically been a part of education policy discussions and will become more important than ever in the new age of automation. However, few recent examples of effective large-scale retraining of midcareer workers exist, and more work will need to be done on designing, piloting, and scaling up such programs. Increasingly, midcareer workers need to refresh or develop their skills; 54 percent of employers in 2018 were providing additional training and development opportunities to their existing workforce in order to fill skills gaps, compared with only 20 percent in 2014.[121] In the United States, Disney's Code: Rosie initiative recruits and trains women in nontechnical positions for software engineering roles that are in high demand through intensive reskilling, a 12-month apprenticeship program, and a mentorship program.[122] AT&T has spent over $250 million on employee education and professional development programs, with more than 140,000 employees actively engaged in acquiring skills for new roles.[123] Companies need to ensure that such efforts apply equally to men and women, including women who have temporarily left the

[117] Pablo Illanes et al., *Retraining and reskilling workers in the age of automation,* McKinsey & Company, January 2018.
[118] *The model: How it works*, P-tech, **ptech.org/how-it-works/the-model/.**
[119] Australian Apprenticeships Incentives Programme, December 10, 2018, **business.gov.au/assistance/australian-apprenticeships-incentives-programme.**
[120] *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.
[121] *Solving the talent shortage*, 2018 Talent Shortage Survey, Manpower Group, 2018, **manpowergroup.co.uk/wp-content/uploads/2018/07/MG_TalentShortage2018.pdf.**
[122] Harry McCracken, "How Disney is turning women from across the company into coders," *Fast Company,* May 30, 2018.
[123] John Donovan and Cathy Benko, "AT&T's talent overhaul," *Harvard Business Review*, October 2016.

labor force due to family responsibilities. The Goldman Sachs Returnship program, Rekindle with Amazon, and the Intuit Again returnee program, among others, offer opportunities for women in the United States and India to reenter the workforce after an extended break by helping them gain the skills required in fast-paced careers such as working alongside new technologies.[124] The women who participate in these programs often have valuable skills and experience but struggle to reenter the workforce without structural support.

Training subsidies

Subsidizing the cost of reskilling could be particularly helpful to women who may have financial constraints that prevent them from participating in such programs. Singapore's SkillsFuture Credit provides all Singaporeans aged 25 and over a credit of 500 Singapore dollars or approximately $360 to use for approved work-related skills programs.[125] The government program includes partnerships with industries to prepare workers for specific growth sectors and occupations, such as air transportation.[126] Mindful of the fact that women lag behind men in skills development, Singapore's education minister in 2017 unveiled plans for a national initiative called SkillsFuture Engage to include reaching out to women returning to work from having children.[127] On-campus subsidized childcare to enable women to reskill full time can help women, and even more so single mothers, to participate in reskilling. Consider that in the United States, for example, one in five children lives in a single-female-led household.[128] Initiatives that address this problem in the United States are in their early stages, but there are signs of change. One initiative is currently being discussed in New York that would provide childcare support to all single parents attending community college.[129]

Investment in digital learning platforms

Public and private investment in digital learning platforms can eliminate geographic or financial barriers to reskilling, especially in technology-enabled occupations. These digital learning platforms could be of particular benefit to women who may lag behind in their access to technology as well as education levels, particularly in emerging economies. Massive open online courses offered by platforms such as Coursera and edX are often free or low-cost, highly scalable, and accessible around the world. Companies can use the courses to supplement their own skills training. Tenaris, a global steel manufacturer, partnered with edX to create employee training programs and has opened several courses to the public.[130] A number of initiatives are looking to digital platforms specifically to support women. For instance, Goldman Sachs' 10,000 Women initiative has launched a global online education partnership with Coursera, providing female entrepreneurs access to a free digitized curriculum tailored to meet the needs of female business owners in emerging markets.[131]

Increased transparency about labor demand

As labor demand shifts, it is important to ensure that skills development matches likely demand, which requires transparency about the skills that employers need. For example, McKinsey research found that Spain saw a 170 percent increase in students graduating in architecture between 2005 and 2014 despite the fact that the construction sector lost 60 percent of its jobs during this period.[132] This is of great importance for women, who tend to be less aware of potential opportunities and career paths than men, in part because they have less access to career networks than men (see the discussion later in this chapter). One example of how job market transparency can be created by public-sector entities is in

[124] Intuit Again, intuitagain.com/; Goldman Sachs Returnship Program, goldmansachs.com/careers/professionals/returnship/; Rekindle with Amazon, amazon.jobs/en/landing_pages/rekindle.
[125] *About SkillsFuture,* SkillsFuture Singapore, skillsfuture.sg/AboutSkillsFuture.
[126] *SkillsFuture Singapore to roll out a new SkillsFuture earn and learn programme for the air transport sector*, SkillsFuture, January 7, 2019.
[127] Charissa Yong, "MPs suggest ways to level playing field for women," *Straits Times*, April 4, 2017.
[128] *About one-third of U.S. children are living with an unmarried parent*, Pew Research Center, April 2018.
[129] *Governor Cuomo announces 2019 women's justice agenda proposal to launch family empowerment community college pilot program*, New York State, February 2019, governor.ny.gov/news/governor-cuomo-announces-2019-womens-justice-agenda-proposal-launch-family-empowerment
[130] *Case study: How Tenaris University built a successful MOOC for employee training,* Edu4me, June 2016.
[131] *Goldman Sachs 10,000 Women launches online education partnership with Coursera,* Goldman Sachs, May 21, 2018.
[132] *Education to employment: Getting Europe's youth into work*, McKinsey Center for Government, January 2014.

the United States, where the federal education department requires universities to publish statistics about their graduating classes, including expected salary after graduation, raising awareness of expected outcomes for students.[133] Any informational campaigns to help people identify the most promising employment opportunities should ensure that they target women in particular. Recruiting practices, for example, are a major factor in efforts to increase awareness of future job opportunities and help advance women in the workplace, and interventions in this area should pay specific attention to attracting and encouraging women.

Structural barriers to women's mobility in the labor market need to be reduced

Making labor-market transitions successfully will require workers to have more mobility and more flexibility. Labor mobility and flexibility help women move between occupations, sectors, employers, and locations as needed in order to respond to the needs of the evolving labor market, and they are crucial as workers find and pursue new opportunities. However, women face more structural challenges on this front than men. There are a number of key barriers, for all women, and specific challenges for low-income women, particularly in rural areas of emerging economies (see Box 7, "In India and other emerging economies, low-income women face specific barriers and a rural-urban divide").

$10t

of output from unpaid care work by women every year

Balancing work and family responsibilities

Many millions of women have less time than men not only to earn money but also to undertake educational or training courses because they bear a disproportionate share of the jobs of running households and caring for children and the elderly. Three-quarters of the world's unpaid care work, including childcare, elder care, cooking, and cleaning, falls to women. MGI has conservatively estimated that this work, which is not accounted for in traditional measures of GDP, has a value of $10 trillion of output every year, or 13 percent of GDP.[134] Women currently spend more than 1.1 trillion hours a year on unpaid care of children and the elderly, compared with less than 400 billion hours for men.[135] The double burden is very real. In China, on average, women work nearly nine hours a day and only just over half of that is paid. Factoring in paid and unpaid work, on average women in China work almost one entire day a week more than men.[136]

The time that women spend on unpaid work and the need to juggle this with paid employment (where possible) inevitably makes women less flexible and mobile than men. In the automation age, when mobility is critical and flexibility can help ease transitions, this challenge with balancing care responsibilities could penalize women and, arguably even more than now, limit their economic opportunity. Flexible work practices are essential to helping women (and men) undertake paid and care work, but they are not as broadly available as they need to be, even in advanced economies. In a 2018 survey, 23 percent of employers said they offer flexible or remote working options.[137] Governments also can do more to give working women flexibility. For instance, 60 percent of women workers—nearly 750 million women—have no statutory right to maternity leave.[138]

Women are often more likely than men to be in dual-career marriages (or partnerships) and this could constrain their ability to move geographies to take advantage of job opportunities.[139] Finally, women's family responsibilities also, in practical terms, mean that they have less time to develop the skills they will need as labor demand shifts.

[133] *Change is on the way for the College Scorecard*, The Hechinger Report, October 2018.
[134] *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015.
[135] OECD Gender, Institutions and Development Database 2018, United Nations Department of Economic and Social Affairs, Population Division (2017 revision).
[136] *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.
[137] *Solving the talent shortage*, 2018 Talent Shortage Survey, Manpower Group, 2018.
[138] *Women at work; Trends 2016*, ILO, 2016.
[139] Kimberlee A. Shauman and Yu Xie, "Geographic mobility of scientists: Sex differences and family constraints," *Demography*, November 1996, Volume 33, Issue 4.

Box 7

In India and other emerging economies, low-income women face specific barriers and a rural-urban divide

Women with low incomes in largely agrarian emerging economies face steeper challenges—and often of a different nature—than women in more advanced and more urban economies. These women will need specific interventions to enable them to ensure that they have viable employment prospects even as automation changes the labor landscape.

Many women in these economies work in in agriculture.[1] In India, 42 percent of all employment is in agriculture, which employs about 60 percent of all women workers and 37 percent of men. The weight of agriculture in women's employment is similar or even greater in other emerging economies. In Afghanistan, for instance, 74 percent of all women work in agriculture, as do 60 percent of men. In Pakistan, the equivalent figures are 72 percent and 33 percent.

As we noted in chapters 1 and 3, many women may face a major transition out of agriculture into other occupations. In India, agriculture is the top sector driving job losses for men and women, but more so for women—45 percent of women's job losses occur within the agriculture sector, compared with 26 percent for men. As a consequence of job loss, many women may leave the labor force. In India, ILO estimates suggest that the female-to-male participation ratio fell from 0.44 to 0.34 between 2005 and 2012 and has not shifted since. The biggest decline in the ratio was among non-literate rural women without a secondary education.[2] During this period, urbanization in India rose, as did the relative share of higher educational attainment, but less educated, lower-skilled, rural women were left behind. The implication is that these women will find it very difficult to navigate the necessary transitions in a labor market that is subject to technological change and potentially spreading automation.

The overarching imperative is to create jobs for women in order to accelerate progress toward gender parity in work. MGI research in 2015 highlighted certain sectors to which women were particularly drawn including textiles and garments, healthcare services, beauty services, and IT-enabled services, and that leisure and hospitality (tourism services) and electronics assembly and manufacturing are promising sectors for women's employment.[3]

For women in rural areas, ensuring that programs and initiatives to support reskilling actually reach the women affected is a particular challenge. It will require a focus on rural initiatives as well as reducing barriers to mobility.

Skills. India has made considerable strides in raising educational attainment among girls, virtually eliminating the gap between girls and boys at the primary and secondary levels, according to UNESCO. However, India and other emerging economies face an urgent

1 The challenge goes beyond a shift out of agriculture—a standard stage for economies as they develop. In India, for instance, 120 million women, or 97 percent of all female workers, work informally, many of them in low-paid activities such as picking up waste and domestic work. See *Leave no one behind: A call to action for gender equality and women's economic empowerment,* Report of the UN Secretary-General's High-Level Panel on Women's Economic Empowerment, 2016.

2 *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.

3 *The power of parity: Advancing women's equality in India*, McKinsey Global Institute, November 2015.

Fear for physical safety

Women's physical security is a global concern, affecting labor-market choices and mobility.[140] Specifically, many women are reluctant to travel for work because it is dangerous. One study of 600 women in two outer suburbs of Paris found that every single woman surveyed had experienced some form of gender-based sexual harassment on public transportation.[141] India's IT and business-process outsourcing firms are providing safe transportation for women employees using vehicles with tracking devices. In the workplace, too, sexual

140 MGI included an indicator for physical security and autonomy in its 2015 research report on gender equality comprising three elements: sex ratio at birth (ratio of male to female births), child marriage (the percentage of girls married between the ages of 15 and 19), and violence against women (as measured by the percentage of women who have experienced violence from an intimate partner at some time in their lives). On the first two dimensions, the gender gap has largely been bridged, although progress is still uneven among countries. However, violence against women is a source of high inequality globally, with 30 percent of women having experienced violence from an intimate partner. We chose that measure of violence against women because of the availability of global data, but women are subject to many other forms of violence, including attacks while travelling. See *The power of parity: How advancing women's equality can add $12 trillion to global growth*, McKinsey Global Institute, September 2015.

141 Oliver Gee, "Sexual harassment rife on Paris trains," *Local,* April 16, 2015.

imperative to enable and support women to equip themselves for different types of work. MGI found that almost three-quarters of vocational courses chosen by Indian women related to training in textiles and garments, computers, healthcare, and beauty services, but that the other sectors with potential, namely tourism and manufacturing, were not among the top five areas where women were obtaining training, suggesting scope for expansion.[4] We note that an additional challenge is that women in India and many other economies spend significant time on unpaid care, which could affect the time they have available for paid work as well as reskilling. Women in India perform nearly ten times as much unpaid care work as men.

Mobility and flexibility. Routine domestic work accounts for 85 percent of the time Indian women spend on unpaid care work. If women have good access to household infrastructure such as clean running water, more effective cooking fuels, and sanitation, the time they take for routine work in the home can be reduced, freeing them to pursue other opportunities (and training). Using improved cooking stoves could reduce time spent by women on cooking by 30 to 70 minutes a day in three states of India, Nepal, and Bangladesh.[5] Access to higher quality household infrastructure has been low In India overall, but the country has made significant Improvements. To improve women's access to clean cooking fuel, one government scheme launched in 2015 aims to provide free liquefied petroleum gas connections to about 50 million families currently below the poverty line by 2019; only women are allowed to apply. In 2016–17, 20 million connections were issued, outstripping the target of 15 million.

Tech. India has the second-largest gender gap in digital inclusion in Asia Pacific. In 2016, only 25 percent of internet users in rural areas, and only 40 percent in urban areas, were women.[6] Moreover, only 46 percent of women own a mobile phone.[7] Digital literacy, required for an increasing number of jobs, is low; 35 percent of women (and 26 percent of men) surveyed by GSMA said they lacked knowledge of the internet and this was a barrier for them. Digital inclusion needs to be higher, particularly given that technology is already empowering women in myriad ways. Notably, digital jobs platforms are helping Indian women to seek out employment in jobs that were not traditionally associated with them. In 2015–16, the BabaJob job portal experienced a sevenfold increase in demand from employers for female cab drivers and an increase of more than 150 percent in applications for driving jobs from women.

4 *The power of parity: Advancing women's equality in India*, McKinsey Global Institute, November 2015.
5 Ibid.
6 *Internet in India—2016: An IAMAI & KANTAR IMRB report, internet and Mobile Association of India and Kantar IMRB Technology Practice, 2016.*
7 *Key findings from NFHS-4, National Family Health Survey, Government of India, Ministry of Health and Family Welfare, rchiips.org/NFHS/factsheet_NFHS-4.shtml.*

harassment deters women workers regardless of age, location, income, or social status. In the United States, 80 percent of women harassed at work left their jobs within two years.[142] These issues can compromise women's ability to switch jobs and limit the breadth of choices they explore when faced with transitions.

Deficient infrastructure

In emerging economies, limited access to—and, as we have noted, poor safety on—transportation systems is regarded as the greatest obstacle to women's participation in the labor market. One study estimated that this issue reduced the probability of participation for women in low-income economies by 16.5 percentage points.[143] A lack of infrastructure can add

142 Heather McLaughlin, Christopher Uggen, and Amy Blackstone, "The economic and career effects of sexual harassment on working women," *Gender & Society,* July 2017, Volume 31, Issue 3, journals.sagepub.com/doi/pdf/10.1177/0891243217704631.
143 *World Employment Social Outlook: Trends for Women*, ILO, 2017.

to the time women spend on unpaid care and, by implication, can reduce the time available for paid work or training. For instance, in Asia, women spend an average of 90 minutes per day traveling for household or medical purposes.[144] In Indonesia, traffic congestion and a lack of efficient public transportation make it difficult for women to engage in paid work while looking after their families. One survey showed that in Jakarta, 15 percent of women with a child under the age of five had left a job for transportation-related reasons.[145] Bus rapid transit projects have had some success in addressing this problem.[146] In rural Peru, 77 percent of surveyed women reported that the availability of rehabilitated roads and tracks had enabled them to travel farther, and 43 percent reported that they could obtain more income.[147]

Legal gaps that limit women's mobility

The law can often affect women's ability to balance paid and unpaid work and to gain access to a full range of job opportunities. Globally, nearly 40 percent of women in wage employment do not have access to social protections, such as pensions, unemployment benefits, and maternity protection.[148] In 155 out of 173 economies, at least one gender-based legal restriction exists on women's employment and entrepreneurship.[149]

155/173

economies have at least one gender-based legal restriction on women's employment and entrepreneurship (study)

Gender differences in occupations

As noted in Chapter 1, entrenched gender lines between occupations and sectors exist even in relatively advanced economies, and societal attitudes reinforce them. This is a significant barrier to women moving between occupations and sectors in search of employment opportunities. Both men and women are affected, but women arguably more so than men when it comes to the impact on wages. For example, a recent US study showed that women's sectoral and occupational employment accounted for more than 50 percent of the gender pay gap.[150] What's more, these gender barriers have proven "sticky," persisting despite increased awareness and efforts to improve labor mobility.

Limited access to networks

Women do not have access to the same extent as men to networks that help them develop their skills and achieve career progression. Women are more likely than men to report that they never have substantive interactions with senior leaders about their work. They are also more likely to say they never have informal interactions with senior leaders, such as casual conversations or lunch meetings. Because senior leaders are often the ones who create opportunities and open doors, this lack of access puts women at a disadvantage when navigating transitions and job switches, as well as promotions, of course.[151] In a 2006 study by the American College of Healthcare Executives, women in healthcare noted that they are still locked out of the informal networks that are important pipelines for promotion. The report said that 48 percent of men but only 33 percent of women have lunch with other managers at least once a month.[152] As highly visible campaigns highlighting sexual harassment in the workplace have gained traction—notably #MeToo in late 2017 and early 2018—some evidence shows that men are becoming more reluctant to be alone with a woman, potentially compromising mentorship and networking opportunities even further. One survey found that 30 percent of male managers said they were uncomfortable working alone with a woman, double the previous share; senior men were 3.5 times more likely to hesitate about having a

[144] OECD Time Use Surveys.
[145] Firman Witoelar et al., *How Jakarta's traffic affects labor market outcomes for women and people with disabilities: Results from a baseline survey,* Australia Indonesia Partnership for Economic Governance, September 2017.
[146] Nadja Kogdenko, *Successfulness of bus rapid transit systems in Asia: Ex-post evaluation,* Energy Research Center of the Netherlands, February 2011.
[147] "Gender differences and why they matter," in *World Development Report 2012,* World Bank, September 2011, siteresources.worldbank.org/INTWDR2012/Resources/7778105-1299699968583/7786210-1315936222006/chapter-5.pdf.
[148] Ibid.
[149] *Women, business, and the law 2016: Getting to equal,* World Bank, 2016.
[150] Francine D. Blau and Lawrence M. Kahn, *The gender wage gap: Extent, trends, and explanations*, IZA discussion paper number 9656, January 2016.
[151] *Women in the workplace 2018*, McKinsey & Company and Lean In, 2018.
[152] *A comparison of the career attainments of men and women healthcare executives,* American College of Healthcare Executives, November 2018, ache.org/learning-center/research/about-the-workplace/gender-studies/a-comparison-of-the-career-attainments-of-men-and-women-healthcare-executives.

working dinner with a junior woman, and five times more likely to hesitate about traveling for work with a junior woman.[153]

A range of measures is needed to improve women's labor market flexibility and mobility

Women need to improve their labor mobility so that they can make the transitions required to move into better-paying fields. Public- and private-sector leaders can partner to challenge barriers impeding labor mobility by, for instance, reducing the unpaid care burden and increasing physical security on public transportation. Industry leaders can play a principal role in eliminating work-related barriers such as limited access to networks, balancing paid and unpaid work, and reducing gender stereotypes in various occupations.

Help women balance paid and unpaid care work

Many governments around the world are taking action to give women more flexibility, thereby encouraging them to take up paid employment if they choose to. Government budgetary support of maternity leave, childcare, and family sick and care leave are all important components of what needs to be a broad effort. For example, India's Maternity Benefit Act requires companies with 50 or more employees to provide nursery facilities, while Australia provides government subsidies to help cover childcare costs.[154] Public investment in childcare can generate new jobs that are likely to be in female-dominated fields such as childcare and education. In Turkey, for instance, a UN Women report found that prioritizing state spending to expand care infrastructure was expected to create over 700,00 new jobs, improve gender equality in the labor market, and reduce poverty by expanding the number of dual-earner households.[155]

Companies can increase their provision of flexible work options such as telecommuting or provide access to employer-assisted or employer-provided childcare options. In Australia, McKinsey & Company found that companies providing at least eight types of flexible working arrangements (such as parental leave) have 11 percent higher representation of women on their staffs than companies that offer fewer options, but that just 52 percent of Australian companies have a flexible working policy; only 13 percent of companies offer eight or more flexible work options, regarded as best practice.[156] Teleworking is clearly a valuable option for women seeking to balance work and family. To illustrate its value, consider that the Philippines loses an estimated $60 million a day in productivity due to traffic congestion.[157]

Providing flexible working arrangements for women has helped companies retain women, and this may become increasingly important in the war for talent as companies compete for high-skill workers. When Google increased paid maternity leave in 2007 from 12 to 18 weeks (and increased paid paternity leave from seven to 12 weeks), the rate at which new mothers left the company dropped by 50 percent.[158]

Invest in infrastructure and public safety

Investment in infrastructure and public safety can increase women's mobility and labor-force participation, especially in urban markets in emerging economies. Infrastructure investment that improves mobility of both men and women can increase accessibility to all types of jobs. In emerging economies, insufficient access to public transportation can limit formal employment options and push those on the periphery into informality. In São Paulo, Brazil,

[153] *Sexual harassment in the workplace: Key findings*, Lean In and SurveyMonkey, 2018, leanin.org/sexual-harassment-backlash-survey-results/.
[154] *India: Maternity benefit amendments: Closer to reality*, Mondaq, April 5, 2017; and *Child care subsidy*, Department of Human Services, Australia, humanservices.gov.au/individuals/services/centrelink/child-care-subsidy.
[155] *Investing in early child care would generate hundreds or thousands of jobs in Turkey*, UN Women, September 18, 2015.
[156] *Women in leadership: Lessons from Australian companies leading the way*, McKinsey & Company, November 2017.
[157] *Billions of pesos lost in traffic; Legarda pushes for sustainable transport,* Senate of the Philippines press release, January 24, 2017.
[158] *The power of parity: Advancing women's equality in the United States*, executive briefing, McKinsey Global Institute, April 2016.

informality rates fell faster in areas that received new public infrastructure than in areas that did not.[159] Governments need to make improving women's safety on public transportation a priority. Many countries have attempted to increase women's mobility by introducing women-only train cars and other gender-segregated travel options. Even seemingly minor changes, such as better lighting, can significantly improve women's perceptions of safety. In Mexico, a pilot project called *¡Hazme el paro!* supported by the World Bank ran a marketing campaign to raise bystander awareness of harassment, train bus drivers on nonconfrontational interventions, and create a technology-enabled reporting system.[160]

Foster more dynamic career paths and enable women's access to networks

If women had more access to professional networks, they could have a better chance of moving into higher-paying professional occupations. A 2018 study by McKinsey and Lean In found that one in five professional women is frequently the only woman in the room. This experience is twice as common for women in tech roles and in senior positions—40 percent of these women are often the only woman in the room, because relatively few women rise to senior levels, and women are underrepresented in the tech industry.[161] Some companies are trying to address this. US-based hotel company Hilton has created Team Member Resource Groups, which are network groups for women and other underrepresented groups of employees.[162] Companies and universities can also encourage or sponsor participation in external networks, especially in cases where the organizations or institutions do not have a critical mass of women. For women who are underrepresented in technical fields, networking opportunities such as the Grace Hopper Celebration of Women in Computing conference can bring women together for networking and career development.[163] To help women navigate transitions and capture opportunities, and to make the most of their high-skill talent, companies should reevaluate who they are considering for international and other dynamic opportunities, assess their internal policies for gender bias, and examine barriers facing high-performing women who are opting out of these roles. Individual women should also seek out opportunities to participate in external networking forums to develop their networks.

70%

of all event speakers are male (study)

Another aspect of fostering dynamic career paths is helping women identify and seek new opportunities. Digital talent platforms are an effective way to provide transparency and a bridge between those looking for work and those offering employment. MGI has estimated that up to 540 million individuals could potentially benefit from online talent platforms, with as many as 230 million shortening search times between jobs, reducing the duration of unemployment.[164]

Reduce stereotypes in gender-concentrated occupations

Women and men need help to overcome stereotypes if they are to transition into sectors in which workers of the opposite gender currently dominate. Companies and other organizations can actively seek to increase the number and visibility of role models in order to counteract, for example, gender-biased representation of men or women in the media. A concerted push to make public appearances more gender balanced is one effort that is gaining attention. All-male panels or speaking engagements are all too common. One study of public speaking events found that 70 percent of all event speakers are male.[165] Even in sectors such as healthcare where women have high shares of employment in professional occupations (those most likely to engage in public speaking), men make up the majority of speakers at events. Institutions can also address stereotype-reinforcing factors in the workplace such as training modules that lack diversity, and increase the visibility of female leaders.

[159] Ana Isabel Moreno-Monroy and Frederico Roman Ramos, *The impact of public transport expansions on informality: The case of the São Paulo Metropolitan Region*, 2015.
[160] Bianca Bianchi Alves and Karla Dominguez Gonzalez, *Smart measures in transport: Moving beyond women's-only buses*, World Bank, November 2, 2015.
[161] *Women in the workplace 2018,* McKinsey & Company and Lean In, October 2018.
[162] Ibid.
[163] *2018 impact*, Grace Hopper Celebration of Women in Computing, 2018.
[164] *A labor market that works: Connecting talent with opportunity in the digital age*, McKinsey Global Institute, June 2015.
[165] Shivina Kumar, *New study: Almost 70% of professional event speakers are male*, Bizzabo, November 1, 2018.

Enhance legal protections and safety nets for workers

Many women and men may find themselves in need of support during the transitional disruption of automation. Many will become unemployed, and it is in the interests of public budgets and economic growth for them to return to work as quickly as possible. Given the opportunity cost trade-offs between work and caregiving responsibilities and the challenges of navigating job transitions, support could prevent displaced women from permanently leaving the workforce. In Europe, past MGI research estimated that, in 2025, European governments may need to increase annual spending on unemployment benefits and reskilling programs by an average of 0.5 to 1 percent of GDP.[166] Labor agencies can focus on providing benefits and assistance to the unemployed: serving as job counselors, offering career guidance, and enabling access to potential training and job opportunities for those temporarily out of the workforce. In Germany, caseworkers are assigned to every unemployed individual and offered incentives to find their clients work. This policy, among others, helped to reduce Germany's unemployment from 10 percent in 2003 to below 5 percent by 2015.[167] In Sweden, employers pay into "job-security councils," which provide financial support and other services to laid-off workers.[168] Governments must consider policies that affect the unemployed, including labor legislation on hiring and firing, unemployment insurance, and portable benefits that can be transferred from employers to individuals. Some economies including Finland and the Netherlands are testing universal basic income programs, although the case in favor of them is not yet clear. For women reentering the workforce, the Malaysian government has offered tax incentives for up to one year to encourage a return to work.[169]

Women need to be more engaged in technology to thrive in access, skills, employment, and leadership

Women continue to lag behind men in their access to technology, the skills they need to use it, and employment and leadership in tech sectors. This is of significant concern given that some of the strongest job growth will be in PST, and that demand for workers with technical skills is rising significantly. More broadly, new digital solutions such as independent work platforms offer women a wealth of new opportunities in the world of work. Technology can help to overturn many of the barriers women face that were discussed in the previous section, enabling them to be more flexible, participate in reskilling programs, and more easily take advantage of employment opportunities, thus better preparing them for the labor market of the future and the transitions many will need to make. For entrepreneurs, technology can empower women to create new ventures, work independently, and increase their power and influence in an increasingly digital world.

Technology can break down many of the barriers facing women and enable entrepreneurship

Technology can help women in myriad ways as they participate in the workforce and navigate transitions. For example, by enabling work from home, technology can overcome the difficulties many women traveling for work encounter. The assistance may affect traditional employment—for example, teleworking using advancements in ICT—or take the form of more entrepreneurial paths. Here we highlight two areas in which technology grants women access to a wider range of employment and entrepreneurial work opportunities than they would otherwise have, and that could prove vital as millions of women negotiate transitions in the automation age: (1) the independent or gig economy and (2) e-commerce.

[166] *Notes from the AI frontier: Modeling the impact of AI on the world economy*, McKinsey Global Institute, September 2018. Also see *Testing the resilience of Europe's inclusive growth model*, McKinsey Global Institute, December 2018.
[167] Niklas Engbom, Enrica Detragiache, and Faezeh Raei, *The German labor market reforms and post-unemployment earnings,* IMF working paper number 15/162, July 2015.
[168] Alana Semuels, "What if getting laid off wasn't something to be afraid of?" *Atlantic*, October 25, 2017
[169] Sean Lim, "Malaysia is offering a tax exemption for women who return to work in 2019—and it could last for a whole year," *Business Insider Malaysia*, November 27, 2018.

Women and the gig economy

Many women are now working independently in what is popularly known as the gig economy, taking advantage of technology that enables new and more flexible ways of working.[170] In emerging economies, increased connectivity, the low cost of labor, and a rise in e-commerce have propelled an increase in gig work in middle-income countries as an alternative to traditional self-employment. MGI estimates that as much as 30 percent of the working-age populations of the United States and the EU-15 are engaged in independent work.

~30%

of working-age populations in the United States and EU-15 engaged in independent work

Women in particular could benefit from independent work platforms for many reasons. The platforms are growing fastest in service roles where women are well represented, including retail and accommodation and food services. The platforms offer flexibility, which could especially help women who face challenges on this front. Women who participate in independent work are more motivated to do so than men because of the flexibility it offers—76 percent of women versus 58 percent of men.[171] An MGI survey of women in the United States and Europe found that women—including retirees, students, and caregivers who are otherwise not participating in the workforce—are more likely than men to work independently to supplement their incomes.[172] Platforms can help create transparency on job opportunities for women, reduce costs for them to access markets, and enable them to participate in global trade.

However, the platforms have limitations that should be addressed, including the fact that transportation-related gig work such as food delivery and ride-sharing raises security concerns for women, that women in emerging economies do not have sufficient access to the internet, and that women have a lack of benefits. Some evidence shows that women earn less than men in the gig economy. A Stanford University study found a 7 percent gender wage gap between male and female Uber drivers and attributed it to three factors: (1) experience on the platform (or lack of it); (2) women's preferences about where to work that differ from men's and are associated largely with where women live as well as safety concerns; and (3) preferences about driving speed.[173] The study found no reason to expect the gig economy could close gender differences.

Women and e-commerce

The flexibility of using technology platforms, often from home, helps to explain why so many women have become e-commerce entrepreneurs. Digital technologies offer channels to new customers and business models. For example, a McKinsey survey in Indonesia found that women-owned micro, small, and medium-size enterprises (MSMEs) generate 35 percent of e-commerce revenue, compared with only 15 percent of offline MSME revenue.[174] Digital technologies enable individual microentrepreneurs and even one-woman micromultinationals to sell to global markets at a low cost and with a high degree of flexibility—attractive characteristics for women balancing home and work responsibilities, and who may find it challenging to make inroads in more traditional supply chains.[175]

China's fast-growing, dynamic e-commerce and technology sectors could point the way to a more gender-equal future. China is home to 114 of the world's 147 self-made female billionaires (the United States ranks second with 14) and is the most gender-equal country in the world on this measure.[176] Fifty-five percent of new internet businesses are founded by women, and Alibaba's Taobao e-commerce platform has an equal number of female and male

[170] Independent work, also known as the gig economy, is defined by three characteristics: a high degree of worker autonomy, payment by task, and a short-term relationship between worker and client. For a broad discussion of the gig economy, see *Independent work: Choice, necessity, and the gig economy,* McKinsey Global Institute, October 2016.
[171] *The state of independence in America, 2018: The new normal*, MBO Partners, 2018.
[172] *Independent work: Choice, necessity, and the gig economy*, McKinsey Global Institute, October 2016.
[173] Cody Cook et al., *The gender earnings gap in the gig economy: Evidence from over a million rideshare drivers*, March 8, 2019.
[174] McKinsey survey of Indonesian e-commerce merchants, 2017. N = 700.
[175] *Global flows in a digital age: How trade, finance, people, and data connect the world economy*, McKinsey Global Institute, April 2014.
[176] 2017 Hurun Global List data as of January 2018; the female-to-male ratio considers only countries with more than one female billionaire.

store owners. We observe a similar phenomenon in Indonesia, with one of the strongest bases of women entrepreneurs in the world; they contribute more than 9 percent of GDP, according to the World Bank.[177] The relative success of women in e-commerce proves the power of digital to open the door to entrepreneurship by giving women the flexibility they often lack and by overcoming the difficulties accessing capital that many women face because setting up an e-commerce business is much less expensive than establishing a traditional business.

Women risk missing out on the advantages of technology because they lag behind men in access, skills, employment, and leadership

A persistent digital divide exists between men and women. According to International Telecommunication Union data for 2018, approximately 3.9 billion people have online access, representing 51 percent of the global population.[178] However, almost half of the world remains offline. Globally, men are 33 percent more likely than women to have access to the internet; that gap worsens when focusing on women in poor urban communities.[179] In South Asia, women are 28 percent less likely than men to own a mobile phone and 58 percent less likely to use mobile internet.[180] GSMA estimates that 433 million women in low- and middle-income countries around the world are unconnected.[181] According to another report, about 250 million fewer women than men are online, and the disparity is more pronounced in emerging countries.[182]

35%

of higher-education STEM students globally are women (study)

The digital divide has broader ramifications. Take the example of financial inclusion. In emerging economies in particular, lack of access to the internet, which is increasingly available via mobile phones, limits women's access to finance. MGI research has found that mobile payments can lower the cost of providing financial services by as much as 90 percent, enabling providers to serve people with lower incomes in rural areas. Overall, digital finance has the potential to provide access to financial services for 1.6 billion people in emerging economies, more than half of them women. Today, an estimated 57 percent of women are financially excluded in South Asia, 54 percent in China, and 49 percent in Southeast Asia.[183]

Broadly, women lag behind men in their acquisition of tech skills. Women account for only 35 percent of STEM students in higher education globally, and they tend to pursue natural sciences more than applied sciences related to ICT.[184] Only 3 percent of female students in higher education choose ICT-related studies.[185]

Looking at some different parts of the world, in the United States, girls represent 47 percent of middle and high school students interested in learning computer science, but girls take only 23 percent of Advanced Placement computer science exams. Women receive only 19 percent of computer and information science bachelor's degrees.[186] In Europe, most girls become interested in STEM at the age of 11 and a half, but their interest starts to wane by the age of 15.[187] At Singapore's Nanyang Technological University, for example, female undergraduates made up just 27 percent of the 2015–16 computer science program even though half of all undergraduates were women. At the National University of Singapore, the student body is gender equal, but only 32 percent of computing undergraduates are female.[188]

[177] *Women-owned SMEs in Indonesia: A golden opportunity for local financial institutions*, International Finance Corporation, March 2016; and *The power of parity: Advancing women's equality in Asia Pacific*, McKinsey Global Institute, April 2018.
[178] *New ITU statistics show more than half the world is now using the internet,* International Telecommunication Union, December 6, 2018, news.itu.int/itu-statistics-leaving-no-one-offline/.
[179] *The case for the web,* The Web Foundation, 2018.
[180] *Connected women, The mobile gender gap report 2019*, GSMA, 2019.
[181] Ibid.
[182] *Taking stock: Data and evidence on gender equality in digital access, skills and leadership,* EQUALS Global Partnership, 2018.
[183] *Digital finance for all: Powering inclusive growth in emerging economies*, McKinsey Global Institute, September 2016.
[184] *Taking stock: Data and evidence on gender equality in digital access, skills and leadership*, EQUALS Global Partnership, 2018.
[185] *Girls' and women's education in science, technology, engineering and mathematics (STEM)*, UNESCO, en.unesco.org/themes/education-and-gender-equality/stem.
[186] *Rebooting representation: Using CSR and philanthropy to close the gender gap in tech*, McKinsey & Company and Pivotal Ventures, 2018.
[187] Andrew Trotman, *Why don't European girls like science or technology?* Microsoft, March 1, 2017.
[188] Linette Lim, "Gender imbalance: Are females missing out on Singapore's tech revolution?" Channel News Asia, June 13, 2016.

Women are highly underrepresented in tech jobs, with fewer than 20 percent of tech workers being female in many mature economies (Exhibit 23).[189] OECD data show that only 1.4 percent of female workers have jobs developing, maintaining, or operating ICT systems, compared with 5.5 percent of male workers.[190]

Women are underrepresented among those who finance, lead, and develop technology, too, raising the risk of continuing gender bias in the industry. For instance, only 8 percent of venture capital investors—increasingly focused on tech sectors—are women.[191] In US tech companies, just 11 percent of chief information officers are women, and women fill only 11 percent of senior positions.[192] Looking at entrepreneurship in technology, healthcare, and other fields in China, 35 percent of startups have at least one woman on the founding team; the comparable figures are 17 percent in the United Kingdom and 24 percent in the United States.[193]

[189] The share of women in tech is different from the share in PST jobs. PST is a broader category of occupations specializing in expertise and providing services to clients in a variety of industries including legal, accounting, architectural, engineering, design, computer, consulting, research, advertising, photographic, translation, and veterinary services. A forthcoming McKinsey research report, *The diversity opportunity in tech,* will provide further detail about the underrepresentation of women in tech employment.

[190] *Taking stock: Data and evidence on gender equality in digital access, skills and leadership*, EQUALS Global Partnership, 2018.

[191] *The diversity opportunity in tech*, McKinsey & Company, forthcoming.

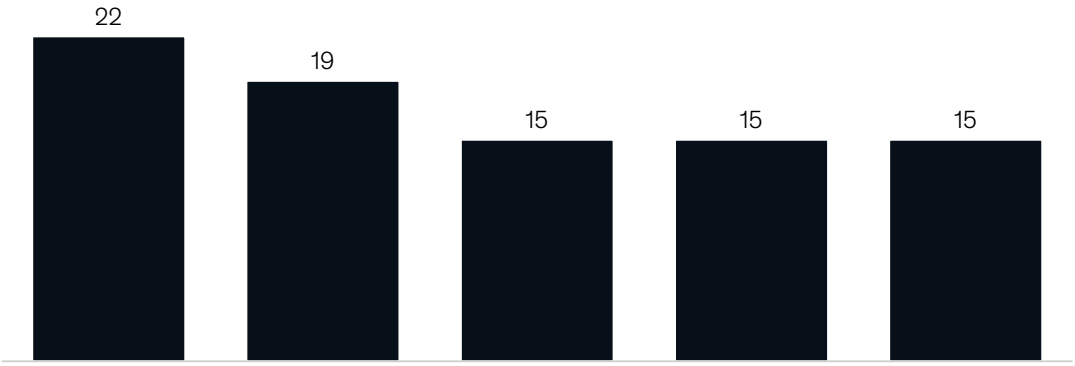
[192] *Rebooting representation: Using CSR and philanthropy to close the gender gap in tech*, McKinsey & Company and Pivotal Ventures, 2018, rebootrepresentation.org/wp-content/uploads/Rebooting-Representation-Report.pdf.

[193] *Women in Technology Leadership 2018: Key insights from the Silicon Valley Bank Startup Outlook Survey,* Silicon Valley Bank, 2018, svb.com/globalassets/library/uploadedfiles/content/trends_and_insights/reports/women_in_technology_leadership/svb-suo-womenintech-report-2018.pdf.

Exhibit 23

Women account for less than 20 percent of workers in technology sectors in many countries.

Female representation in information and communication technology sector, 2017,[1]
female % of total tech workers



	United States	France	United Kingdom	Germany	Japan
Women in tech, Thousand	1,438	177	240	316	570
Women in workforce, %	48	49	47	47	42

[1] Mapped country-specific occupation databases to the ISCO08 ILO occupation database. Note that the definition of tech roles varies by country. In general, tech roles within the ISCO08 ILO occupation database were defined as applications programmers, computer network and systems technicians, computer network professionals, database and network professionals not elsewhere classified, database designers and administrators, electrical engineering technicians, electrical engineers, electronics engineers, engineering professionals not elsewhere classified, information and communications technology operations technicians, information and communications technology services managers, information and communications technology user support technicians, mechanical engineering technicians, mechanical engineers, software and applications developers and analysts not elsewhere classified, software developers, systems administrators, systems analysts, telecommunications engineers, web and multimedia developers, and web technicians.

Source: National statistics offices and government data; *The diversity opportunity in tech*, McKinsey & Company, forthcoming; McKinsey Global Institute analysis

In the new wave of automation, only 14 percent of AI professionals are women.[194] This matters because of potential AI bias, an increasingly prominent technological issue. Algorithms use data as a social mirror, and if those data are biased, they perpetuate the bias.[195] In image recognition, for instance, cleaning is often associated with women and sports with men.[196] In addition, less data are available on certain populations, including women.[197] For instance, one study found that, on LinkedIn, which acts as a notice board for job opportunities, women were less likely than men to be alerted to high-paying jobs because the algorithms may have been biased. Initial users of product features that related to high-paying jobs were predominantly men, which reinforced the bias.[198]

A diverse range of interventions should be considered to strengthen women's ability to leverage technology

To boost the representation of women in technology, improving their access, skills, and role in the creation of technology will require measures including creating pathways for women in tech, increasing access to enabling technologies in emerging economies, easing the path to women working in the gig economy, and addressing the funding gap for female entrepreneurs.

Create pathways for women in tech fields

Imbalances in the numbers of women and men in STEM jobs, and tech in particular, start early in the education system, a situation that needs to be addressed. Companies, schools, government agencies, and other institutions can work together to encourage girls in school and women in higher education to study and pursue careers in tech. The government of Canada's Choose Science campaign aims to encourage young women to work in the sciences.[199] Nonprofits across the world from Afghanistan to the United States are focused on developing girls' coding skills.[200] In Kenya, Scientific Camps of Excellence for Mentoring Girls in STEM aims to address gendered enrollment challenges in science and engineering fields.[201] Companies in these fields can invest in and partner with nonprofits and colleges to develop a broader pipeline of women going into tech fields. In partnerships, companies can, for instance, support women's communities and clubs and offer networking and early internship opportunities.[202] Even when women are working in tech-related careers, more can be done to help retain their talent and capabilities when they start families, addressing high attrition rates across the world. Tech companies must take bold and innovative measures to increase the representation of women in management and leadership positions; women hold just 11 percent of senior leadership roles in major tech companies.[203] SAP, a global firm headquartered in Germany, set a target (and measured progress toward it) of having 25 percent women in leadership by 2017, enabling women's upward trajectory through leadership acceleration programs, digital professional development opportunities, and community networks.[204] After meeting the target, SAP extended its commitment by setting an additional milestone of reaching 30 percent by the end of 2022.[205]

[194] *The diversity opportunity in tech*, McKinsey & Company, forthcoming.
[195] Moritz Hardt, *How big data is unfair*, Medium, September 26, 2014.
[196] Tom Simonite, "Machines taught by photos learn a sexist view of women," *Wired*, August 21, 2017.
[197] Eva Noble, *Without data equality, there will be no gender equality*, Women Deliver, June 11, 2018.
[198] Hope Reese, *Bias in machine learning and how to stop it*, TechRepublic, November 18, 2016.
[199] *Government of Canada launches interactive campaign to build network of mentors for young women in science*, Innovation, Science, and Economic Development Canada, February 2018.
[200] *Cracking the code: Girls' and women's' education in science, technology, engineering, and mathematics (STEM),* United Nations Educational, Scientific and Cultural Organization, 2017.
[201] *Kenya: Empowering girls through mentoring in STEM for informed career choices*, United Nations Educational, Scientific, and Cultural Organization, unesco.org/new/en/natural-sciences/priority-areas/gender-and-science/supporting-women-scientists/kenya-empowering-girls-through-mentoring-in-stem/
[202] *Rebooting representation: Using CSR and philanthropy to close the gender gap in tech*, McKinsey & Company and Pivotal Ventures, 2018.
[203] Ibid.
[204] *SAP: A Global Beacon for Women in Tech,* AnitaB.org
[205] *Women in Leadership at SAP: The Journey to 25%*, SAP, July 2017.

Increase access to basic enabling technology

Particularly in emerging economies, access to the internet and mobile technologies is vital for women. These technologies are the gateways to online learning, independent work platforms, and finance. More investment in infrastructure will be needed. Equality in access to information and communications technology depends not only on the availability and use of mobile phones but also on women's ability to employ the technology effectively; there are notable differences in use between genders. These differences partly reflect the fact that women lag behind in digital literacy (as discussed below) and partly reflect cultural attitudes. In some emerging economies, girls and women are discouraged from using the internet and mobile phones. In India, for instance, men reportedly favor restrictions on internet usage by girls and women.[206] Moreover, in lower-income households, men tend to have priority access to technology. In one survey in New Delhi, 60 percent of men agreed that they have priority over women in internet access.[207] Ensuring that such stereotypes are addressed, and that the utility from accessing digital technologies is made clear, will need to go hand-in-hand with addressing the infrastructure barriers to digital inclusion.

35%

of women in India cited lack of knowledge about how to use the internet as a barrier (survey)

More support for women to develop digital skills

Women lag behind men in the skills required to make the most out of digital access, and they need more targeted support. In Indonesia, for instance, a GSMA survey found that 40 percent of women said that they need help to use mobile phones, compared with 25 percent of men. In India, 35 percent of women surveyed by GSMA said lack of knowledge about how to use the internet was a barrier (versus 26 percent of men). In India, Google and Tata Trust have partnered to fund the internet Saathi program to increase digital literacy among rural women.[208] In Singapore, many firms have started sending staff members to SkillsFuture's Digital Workplace program. However, more needs to be done. In a 2015 study, GSMA found only a few examples of large-scale initiatives specifically focused on teaching women mobile literacy and digital skills, but it noted that a number of mobile network operators, for instance, had begun to address the gap in emerging countries. In India, Airtel's Each One Teach One digital literacy campaign makes its 1.4 million retailers and 20,000 executives in the field into internet "ambassadors" in their community. Idea Cellular runs an internet on Every Mobile program that provides lessons to users.[209] The International Telecommunication Union and Telecentre.org have together trained more than one million people to become digitally literate.[210]

Ease the path for women to work in the gig economy

The gig economy offers opportunities for women as well as challenges. Transportation-related gig work (for instance, food delivery and ride-sharing) tends to be less penetrated by women, possibly due to concerns about physical security. Tech companies can innovate and modify their platforms and policies for better inclusion and empowerment of women. For example, following the legalization of women drivers in Saudi Arabia, Uber piloted and launched a feature allowing female drivers to opt for female passengers.[211] In emerging economies, women are less likely than men to have the basic infrastructure necessary to enter the modern gig economy because they lack access to the internet and mobile devices necessary to take advantage of digital platforms. Women (and men) working in the gig economy lack benefits and worker protection, another front for possible action. Independent workers must cover their own health or disability insurance (depending on national healthcare policy), may not have access to traditional retirement plans, and do not receive paid parental leave. Without a steady stream of income, gig workers might face financial instability or have

[206] Feminist Approach to Technology, fat-net.org/. Restrictions are even more common in limiting (rather than prohibiting) use. More than half of men in one survey in New Delhi agreed that men have the responsibility to restrict what women access on the internet, and 65 percent agreed that women should be restricted from using the internet in public places on their own. See *Women's rights online*, World Wide Web Foundation, webfoundation.org/our-work/projects/womens-rights-online/.

[207] *Women's rights online*, World Wide Web Foundation, webfoundation.org/our-work/projects/womensrights-online/.

[208] "Google, Tata Trusts to expand internet Saathi programme," *Hindu Business Line*, January 2018.

[209] *Accelerating digital literacy: Empowering women to use the mobile internet*, GSMA, 2015.

[210] *Digital literacy,* International Telecommunication Union, itu.int/en/ITU-D/Digital-Inclusion/Women-and-Girls/Pages/Digital-Literacy.aspx.

[211] Michael Grothous, "Uber now allows female drivers in Saudi Arabia to choose to only drive other women," *Fast Company,* April 17, 2019.

limited access to credit. Additionally, without formal contracts, worker protections and the bargaining power of labor are low. Various policy recommendations have been proposed to address this. Key policy recommendations of the United Kingdom's Taylor Review in July 2017, for instance, included expanding the definition of "worker," extending minimum wage standards, and ensuring that benefits such as vacation and sick pay cover independent workers.[212] It is important to note that increasing social protections for workers in the gig economy could decrease the amount of gig economy work, for example by increasing costs and consequently reducing demand for workers. Public- and private-sector organizations need to work together to find solutions that can both tap into the benefits, as well as address the challenges, of these types of platforms.

Address the funding gap faced by women entrepreneurs

In 2018, all-male founding teams received 85 percent of total venture capital investment in the United States, all-women teams received 2 percent, and gender-diverse teams 13 percent.[213] This is especially notable because much of venture capital funding goes toward technology-related businesses. The numbers in Europe are even lower, with 93 percent of capital raised in 2018 going to all-male founding teams.[214] This is not just an entrepreneur gap, but an investor gap. Only 11 percent of US venture capitalists are women.[215] Seventy-one percent of venture capital firms in the United States have no female partners.[216] This argues for investors to redouble efforts to promote gender diversity in their own ranks and thereby address gender bias in funding. The broader entrepreneurship ecosystem also needs to better serve female founders through improved access to networks, mentorship opportunities, and eliminating potential biases in incubator or accelerator recruitment and selection processes.

Organizations, including companies, can create opportunities for women to overcome these barriers and build a more inclusive ecosystem. For example, in the United States, JPMorgan supports digitalundivided, a social enterprise that hosts an incubator for startups with black or Latina women founders.[217] In India, Facebook has launched SheLeadsTech, a year-long program for women entrepreneurs.[218] In emerging economies, the financial services industry together with governments should consider how to address financial and nonfinancial barriers that may disproportionately affect women, including constraints related to access to credit. The World Bank's Women Entrepreneurs Finance Initiative funds emerging-market initiatives to tackle both financial and nonfinancial constraints faced by women entrepreneurs. The initiative's first round of approved projects expects to provide $800 million in new financing to woman-owned and -led SMEs.[219]

Many women today are impeded from participating equally in the world of work and from seizing economic opportunities by particular—and disproportionate—structural challenges. In the automation age, which demands even more mobility, and different skills, these barriers urgently need to be addressed. On all fronts, targeting and tailoring measures to enable women to overcome current barriers must be an imperative. Women could raise their chances of making the transitions needed for them to advance in a dynamically changing labor market. Action is needed. Effective measures can help women to maintain or improve their current share of employment and increase their representation in technical fields and tech leadership roles.

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[212] Matthew Taylor, *Good work: The Taylor review of modern working practices, Report for the UK government,* July 2017.
[213] Kate Clark, *Female founders have brought in just 2.2% of US VC this year (yes, again)*, TechCrunch, December 2018.
[214] *Diversity & inclusion in tech: A practical guidebook for entrepreneurs,* Atomico, 2018, inclusionintech.com/.
[215] Includes those with check-writing abilities: partners, general partners, and managing directors
[216] Allraise.org.
[217] *JPMorgan Chase announces $1 million investment to support women entrepreneurs of color in tech,* JPMorgan, March 2018.
[218] Tanvi Dubey, *Facebook launches SheLeadsTech programme to help women entrepreneurs overcome barriers and build successful tech startups,* Yourstory, March 2017.
[219] *Women Entrepreneurs Finance Initiative allocates first round funding: Expected to mobilize twice the original target,* World Bank, April 19, 2018

Conversely, a lack of concerted action could leave women falling further behind in the world of work. Progress toward gender equality in work is already slow, and the diffusion of automation technologies promises significant disruption, and perhaps more women falling out of the workforce altogether. However, while times of significant technological change always bring challenges, digital, internet, mobile, and AI technologies can also open new doors to women—to gain skills, secure higher-paying jobs, and pursue entrepreneurism. It is vital that everything possible is done to help women overcome the challenges of the automation age and seize its opportunities.

Country data

Canada

Economic and demographic context

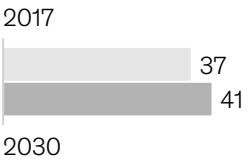
Per capita GDP, $ thousand PPP, 2017

47

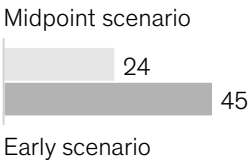
Female labor-force participation rate, 2017

61%

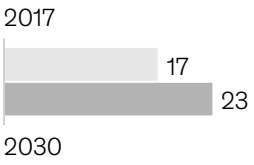
Population, Million



% of work activity hours automatable by 2030



% aged over 65

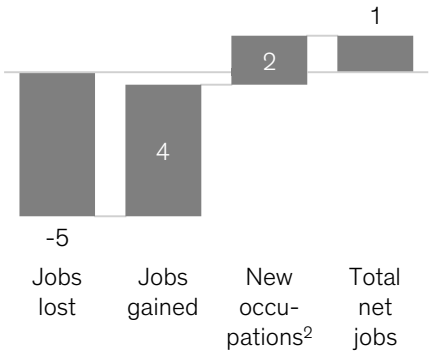


Summary: How women are positioned for the future

Women Men

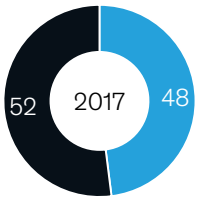
0.8M–2.7M women and **0.9M–3.4M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



	Jobs lost	Jobs gained	New occupations[2]
% of 2017 employment	26	24	9

Share of employment,[1] %



Female share of employment could increase by **1–2 pp** by 2030

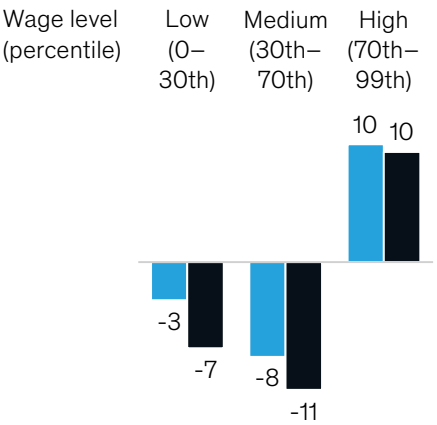
Potential effects on employees by 2030, % of 2017 base employment

Net jobs demanded by wage level and education

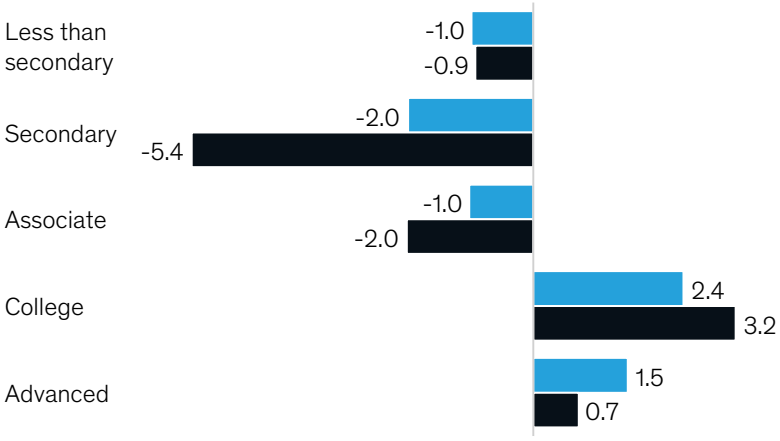
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

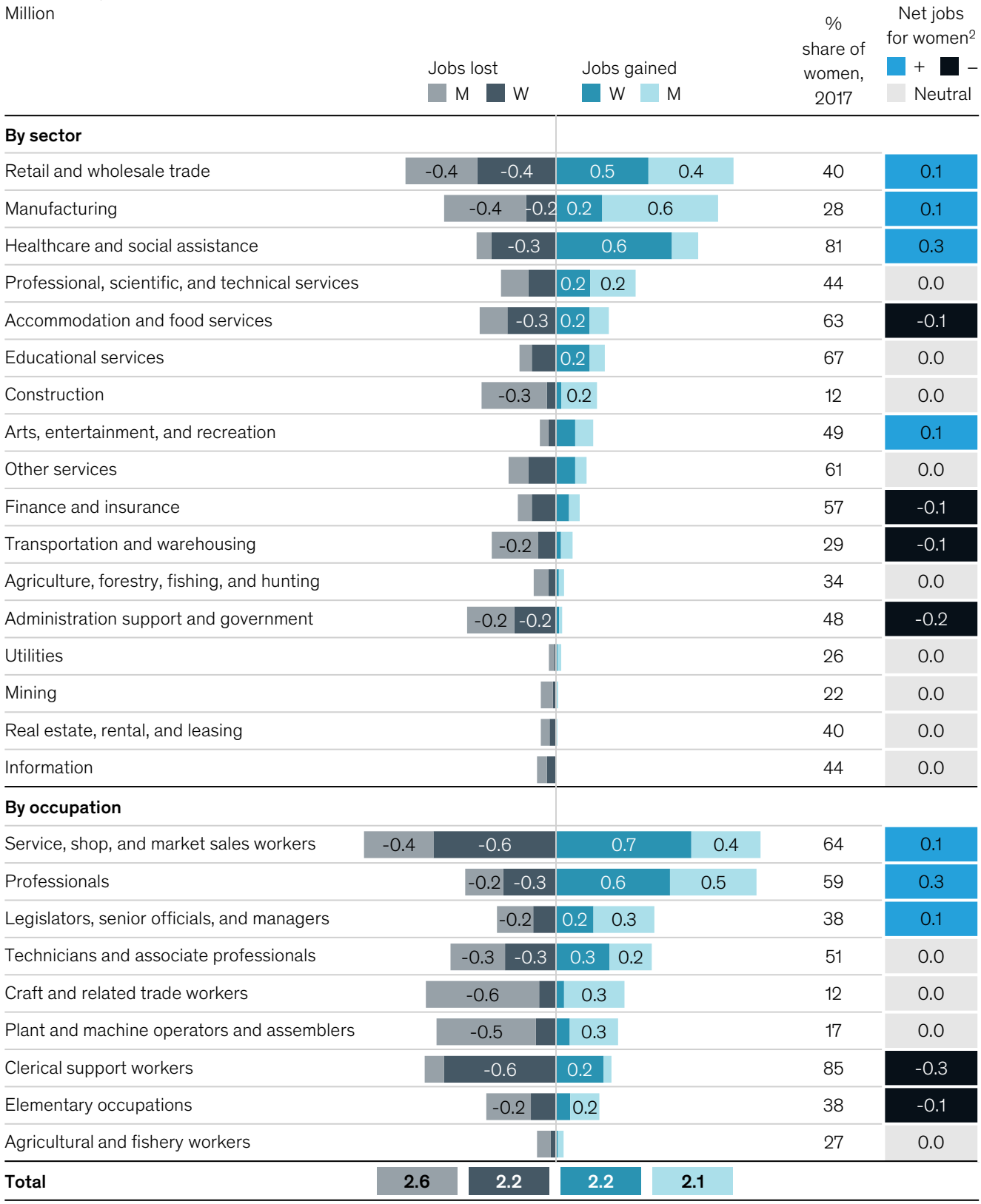


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: Statistics Canada, 2016 census; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: Statistics Canada, 2016 census; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

France

Economic and demographic context

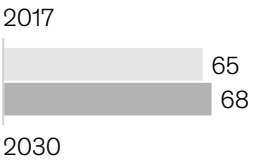
Per capita GDP, $ thousand PPP, 2017

43

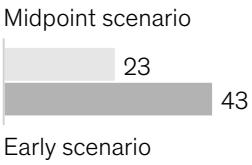
Female labor-force participation rate, 2017

50%

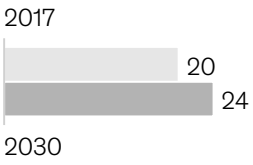
Population, Million



% of work activity hours automatable by 2030



% aged over 65

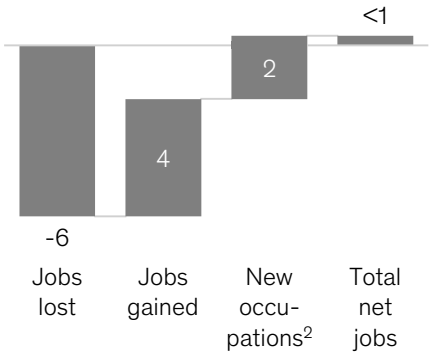


Summary: How women are positioned for the future

Women Men

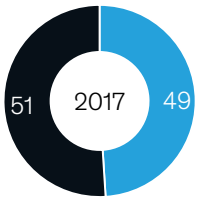
1.3M–4.0M women and **1.6M–4.7M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



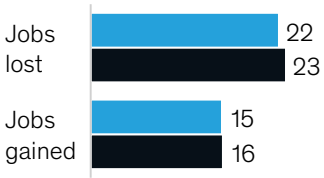
	Jobs lost	Jobs gained	New occupations[2]	Total net jobs
% of 2017 employment	23	16	8	

Share of employment,[1] %



Female share of employment could increase by **0–1 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

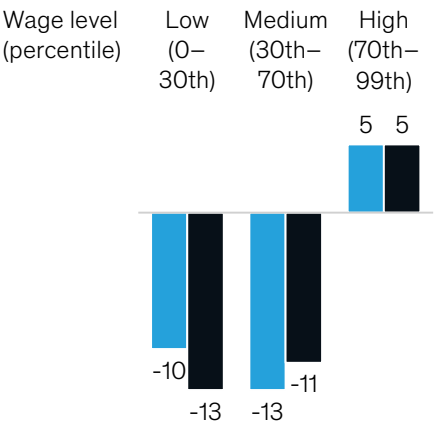


Net jobs demanded by wage level and education

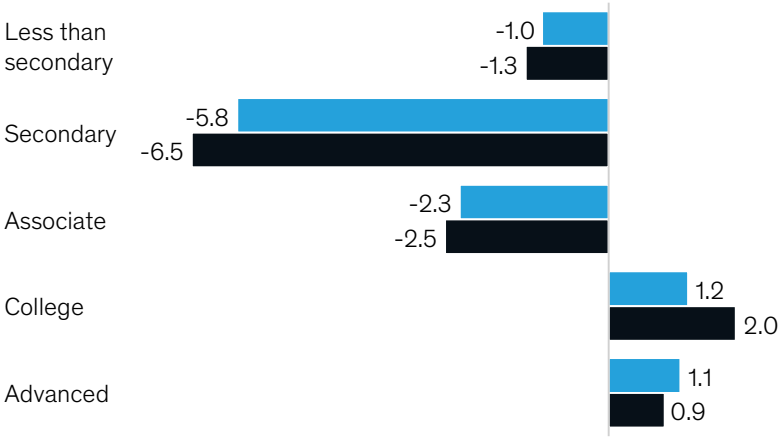
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

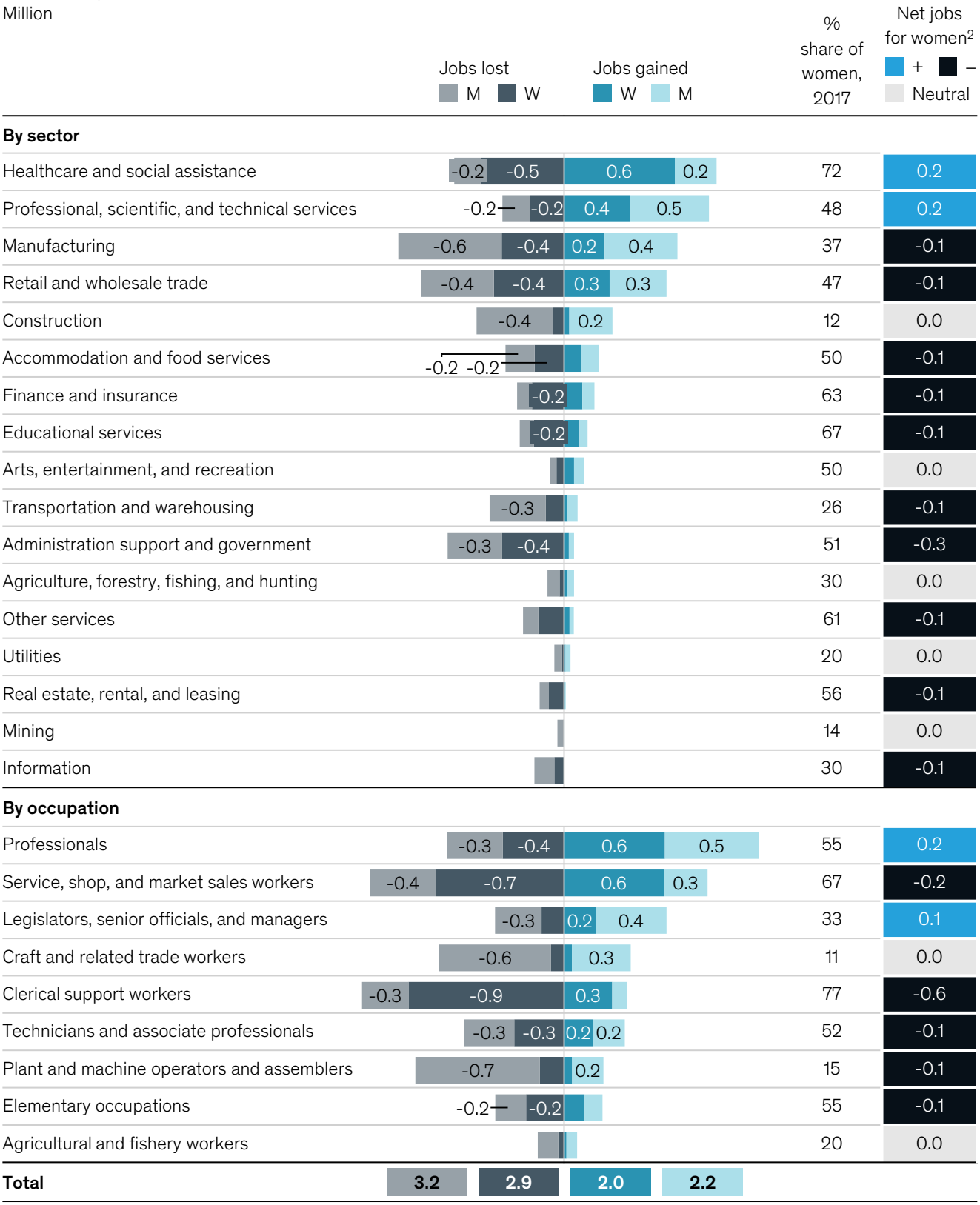


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: EuroStat, 2015; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: EuroStat, 2015; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Germany

Economic and demographic context

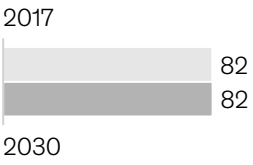
Per capita GDP, $ thousand PPP, 2017

51

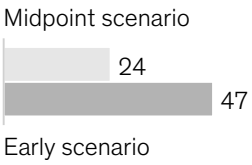
Female labor-force participation rate, 2017

55%

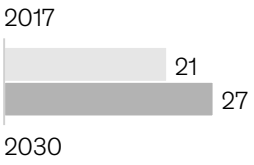
Population, Million



% of work activity hours automatable by 2030



% aged over 65

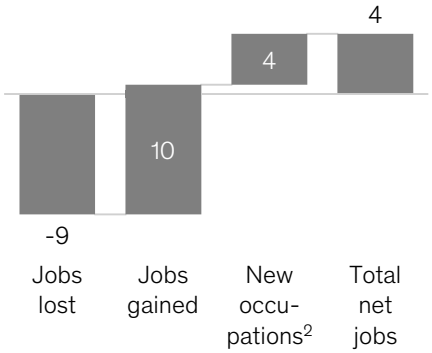


Summary: How women are positioned for the future

Women Men

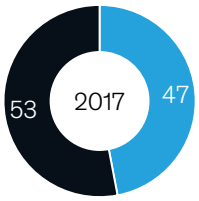
1.3M–4.7M women and **1.9M–7.4M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



	Jobs lost	Jobs gained	New occupations[2]
% of 2017 employment	22	23	9

Share of employment,[1] %



Female share of employment could change by **-1 to 0 pp** by 2030

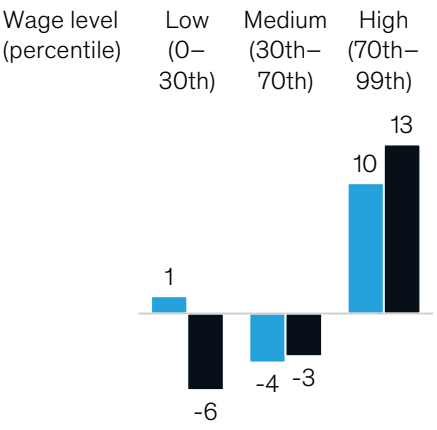
Potential effects on employees by 2030, % of 2017 base employment

Net jobs demanded by wage level and education

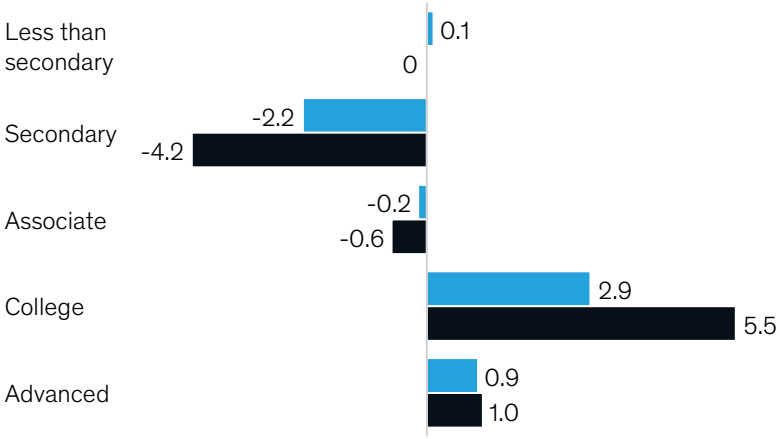
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

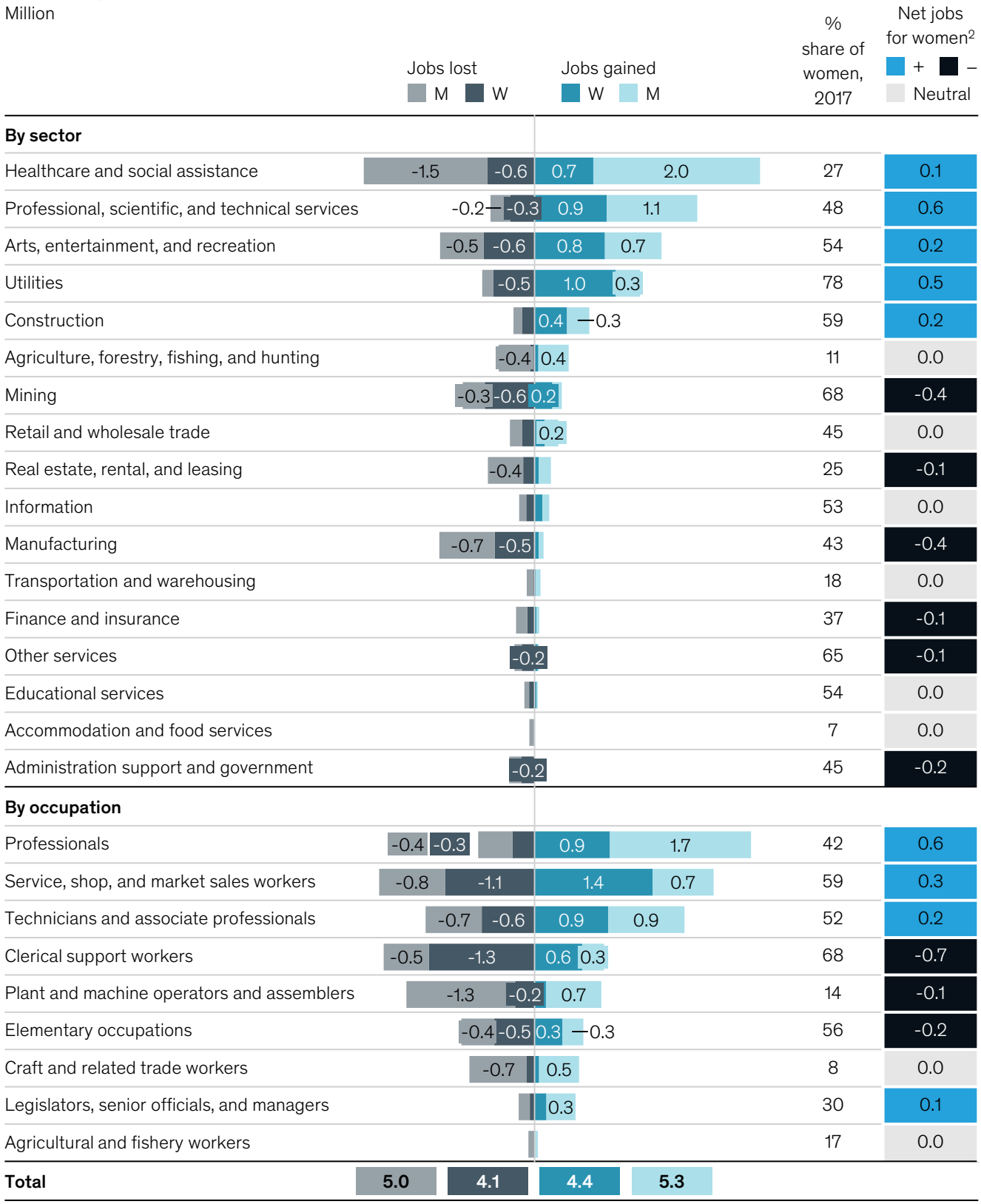


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: EuroStat, 2015; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



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[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: EuroStat, 2015; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Japan

Economic and demographic context

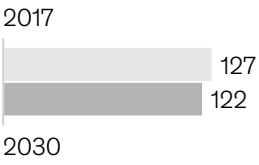
Per capita GDP, $ thousand PPP, 2017

43

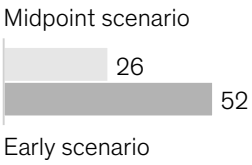
Female labor-force participation rate, 2017

50%

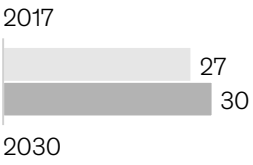
Population, Million



% of work activity hours automatable by 2030



% aged over 65

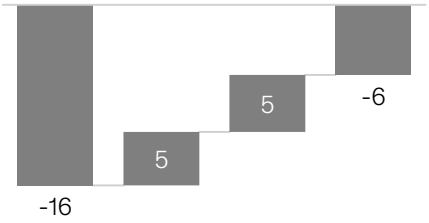


Summary: How women are positioned for the future

Women Men

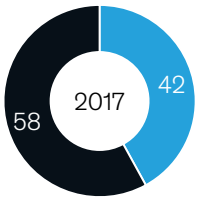
4.1M–10.1M women and **7.0M–17.2M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



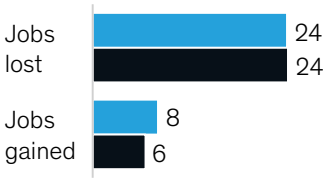
	Jobs lost	Jobs gained	New occupations[2]	Total net jobs
% of 2017 employment	24	7	7	

Share of employment,[1] %



Female share of employment could increase by **0–1 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

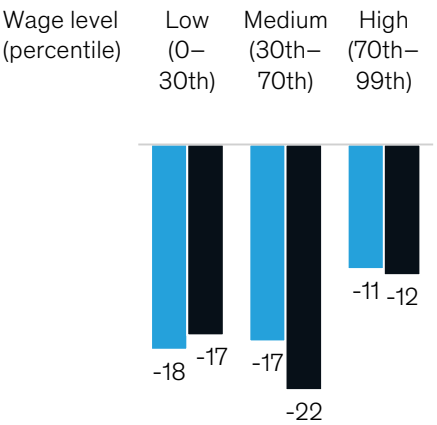


Net jobs demanded by wage level and education

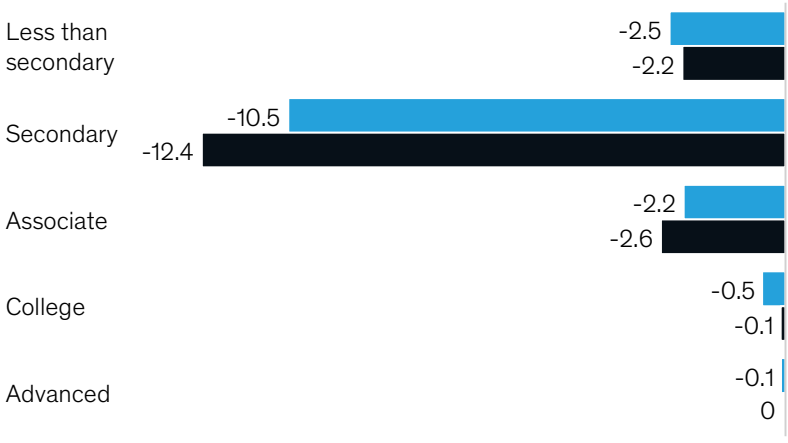
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
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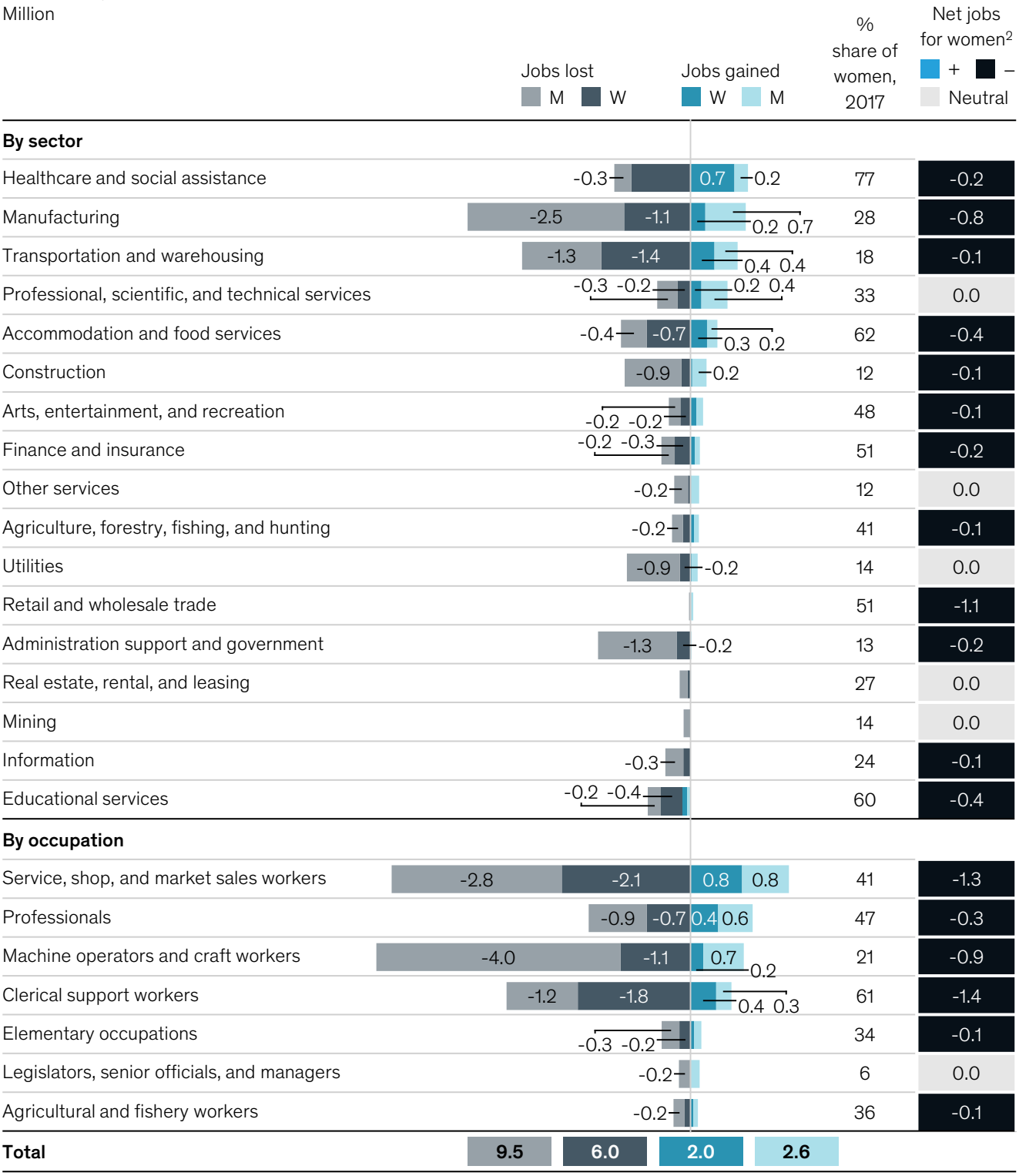
Note: Figures may not sum to 100% because of rounding.

Source: Japan National Survey; ILO, 2017; World Bank, 2018, UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



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[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: Japan National Survey; ILO, 2017; World Bank, 2018, UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

United Kingdom

Economic and demographic context

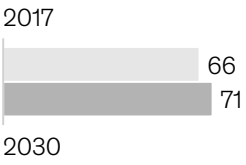
Per capita GDP, $ thousand PPP, 2017

43

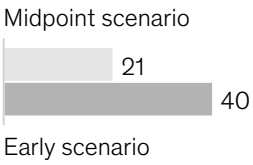
Female labor-force participation rate, 2017

57%

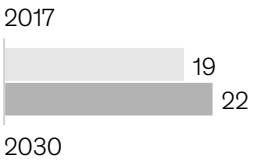
Population, Million



% of work activity hours automatable by 2030



% aged over 65

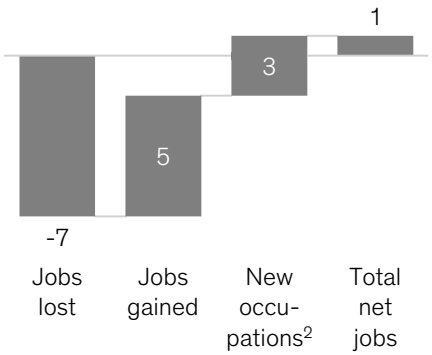


Summary: How women are positioned for the future

Women Men

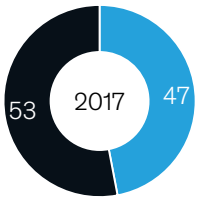
1.4M–4.5M women and **1.7M–5.4M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



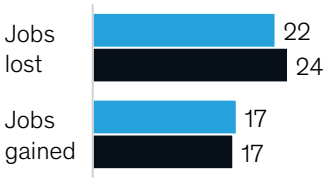
	Jobs lost	Jobs gained	New occupations[2]	Total net jobs
% of 2017 employment	23	17	8	

Share of employment,[1] %



Female share of employment could increase by **0–1 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

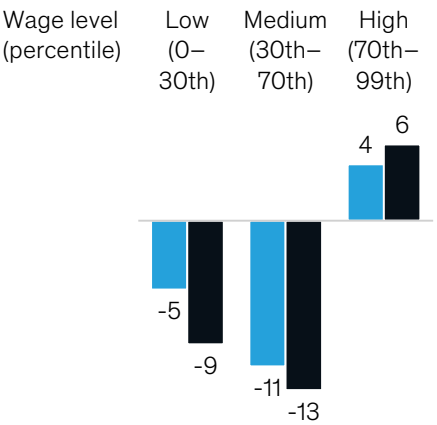


Net jobs demanded by wage level and education

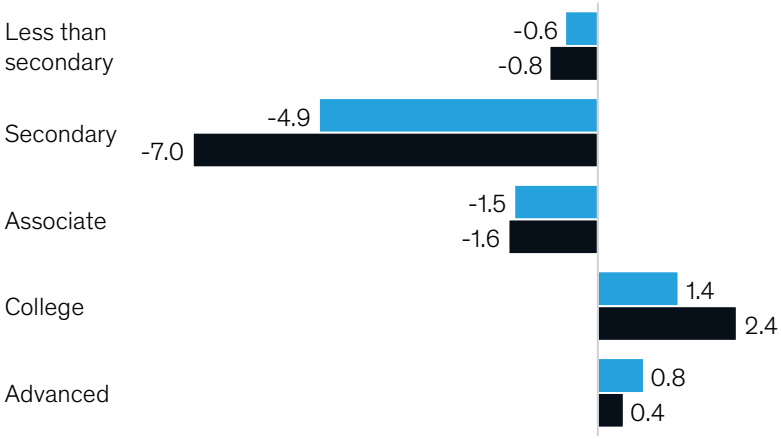
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

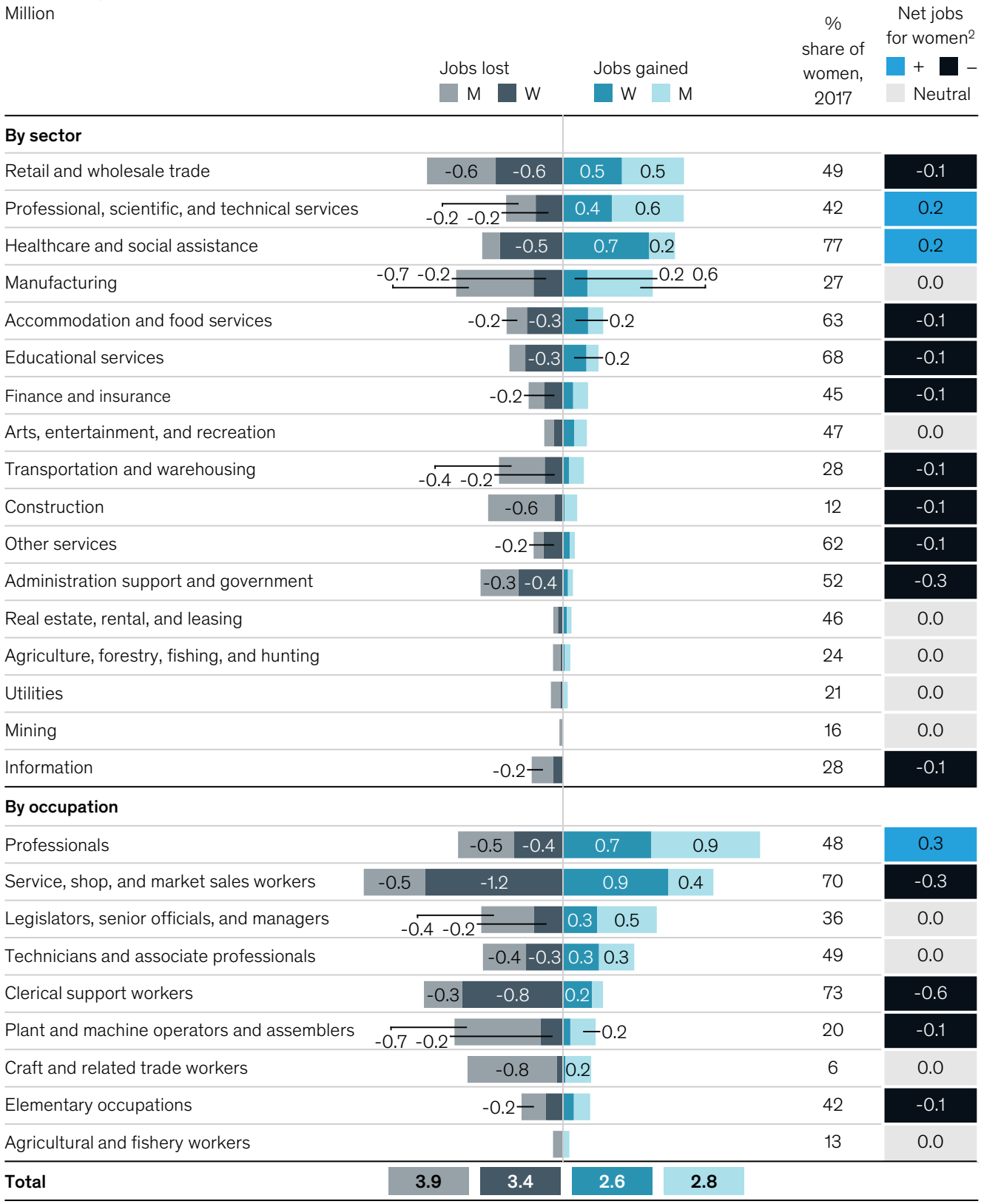


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: ONS, 2017; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: ONS, 2017; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

United States

Economic and demographic context

Per capita GDP, $ thousand PPP, 2017

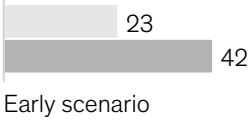
60

Female labor-force participation rate, 2017

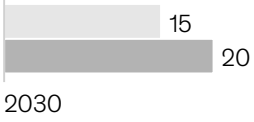
56%

Population, Million

% of work activity hours automatable by 2030



% aged over 65

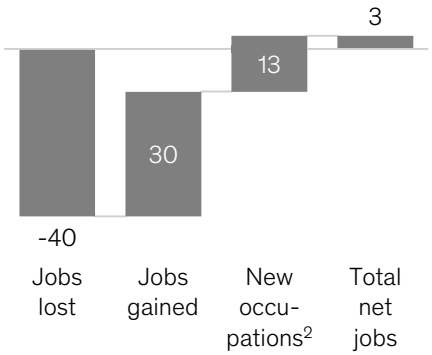


Summary: How women are positioned for the future

Women Men

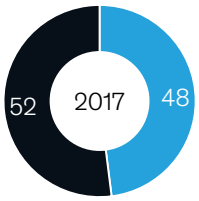
7.7M–24.2M women and **8.7M–28.0M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



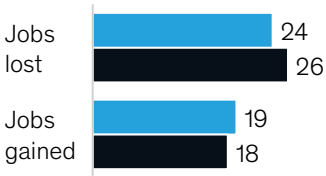
% of 2017 employment: 25 | 19 | 8

Share of employment,[1] %



Female share of employment could increase by **0–1 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

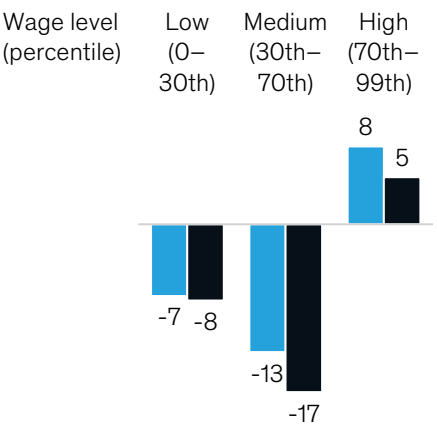


Net jobs demanded by wage level and education

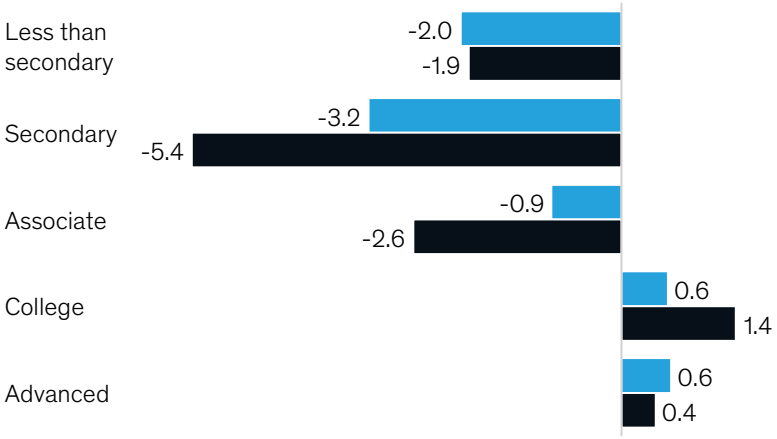
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

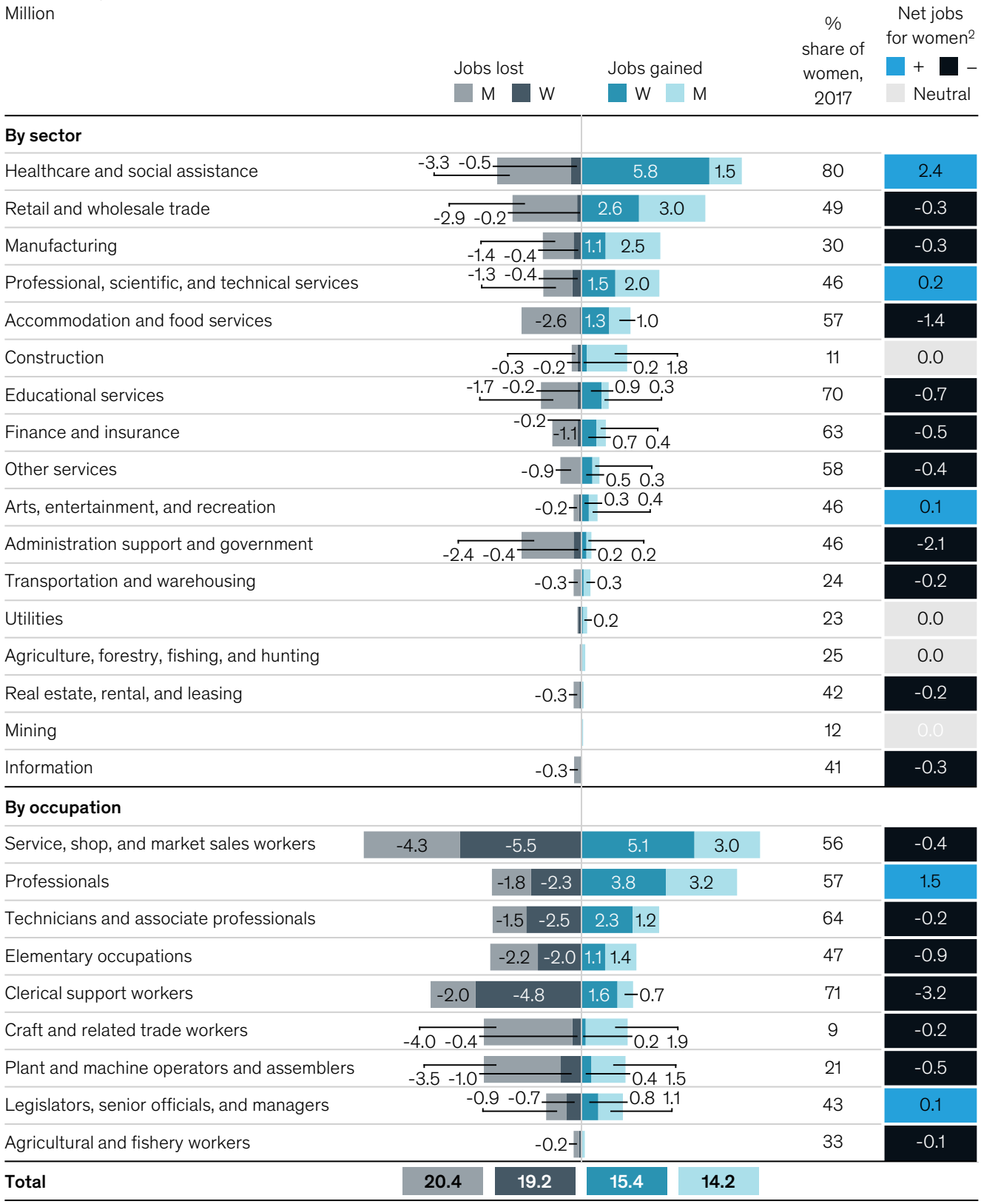


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details. In a forthcoming MGI report on the United States, we will explore another scenario.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: CPS IPUMS; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: CPS IPUMS; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

China

Economic and demographic context

Per capita GDP, $ thousand PPP, 2017

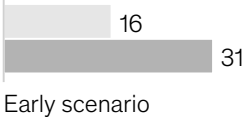
17

Female labor-force participation rate, 2017

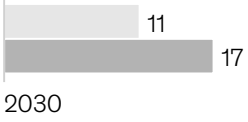
61%

Population, Million

% of work activity hours automatable by 2030



% aged over 65

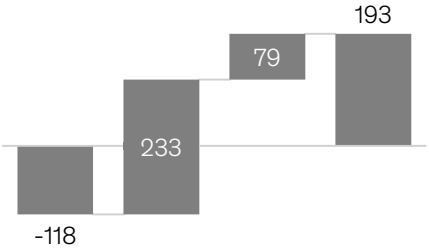


Summary: How women are positioned for the future

Women Men

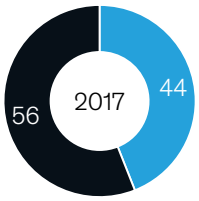
4.0M–35.7M women and **8.3M–66.5M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



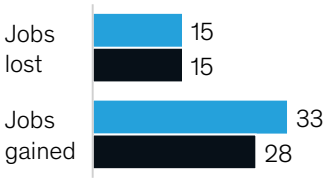
	Jobs lost	Jobs gained	New occupations[2]	Total net jobs
% of 2017 employment	15	30	10	

Share of employment,[1] %



Female share of employment could increase by **0–1 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

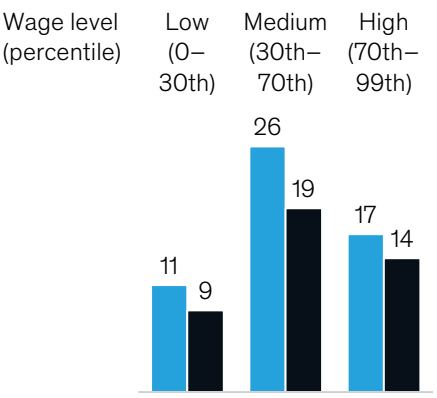


Net jobs demanded by wage level and education

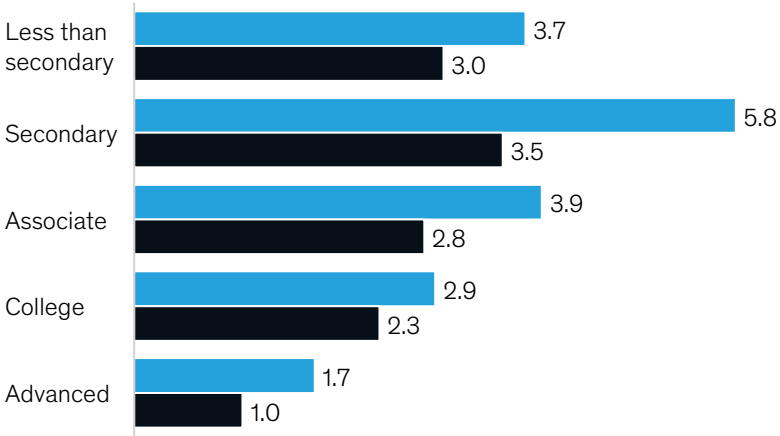
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

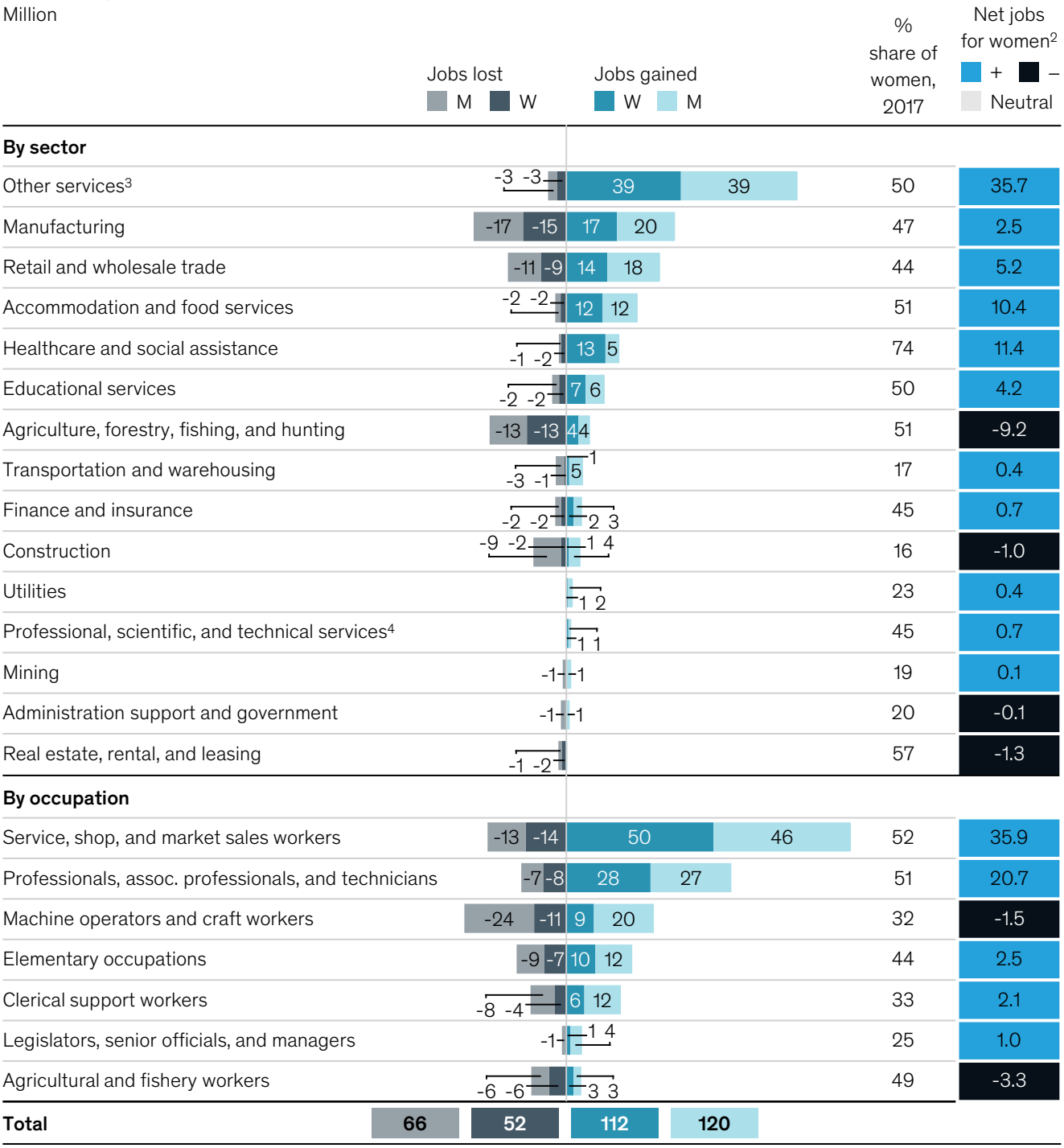


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: China Population Census; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
[3] Other services includes arts, entertainment, and services, given limited gender data; arts, entertainment and services is positioned to grow rapidly in China, given large rising incomes and increased spend on leisure.
[4] Using gender split in finance as a proxy for gender split in professional, scientific, and technical services.
Note: Data labels <1 not shown.

Source: China Population Census; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

India

Economic and demographic context

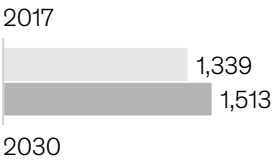
Per capita GDP, $ thousand PPP, 2017

7

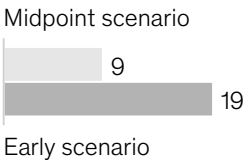
Female labor-force participation rate, 2017

27%

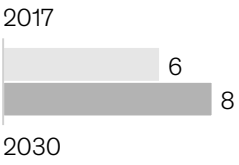
Population, Million



% of work activity hours automatable by 2030



% aged over 65

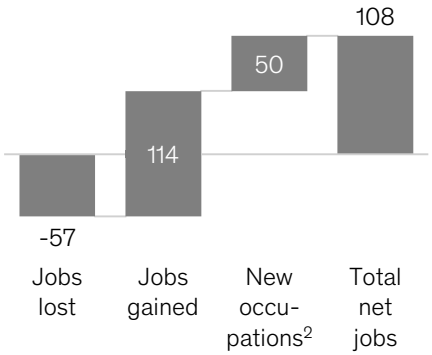


Summary: How women are positioned for the future

Women Men

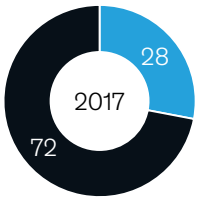
0.6M–10.9M women and **2.1M–26.9M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



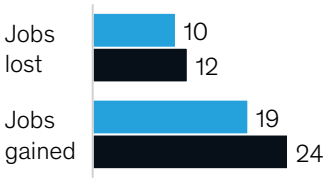
% of 2017 employment	Jobs lost	Jobs gained	New occupations[2]	Total net jobs
	11	23	10	

Share of employment,[1] %



Female share of employment could change by **-1 to 0 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

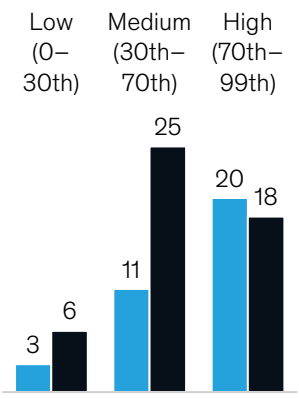


Net jobs demanded by wage level and education

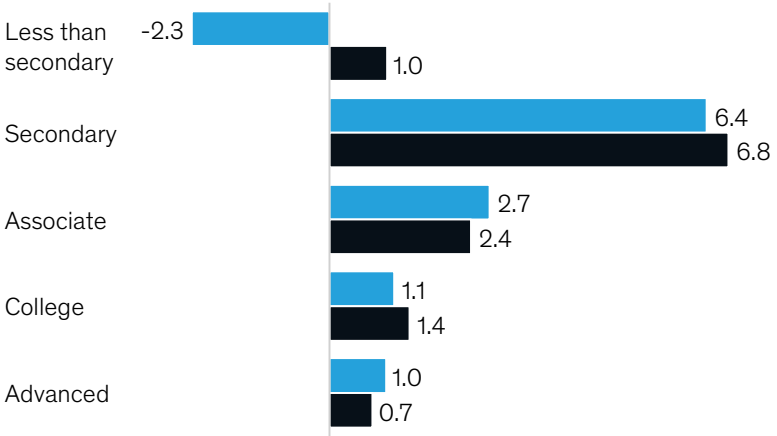
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

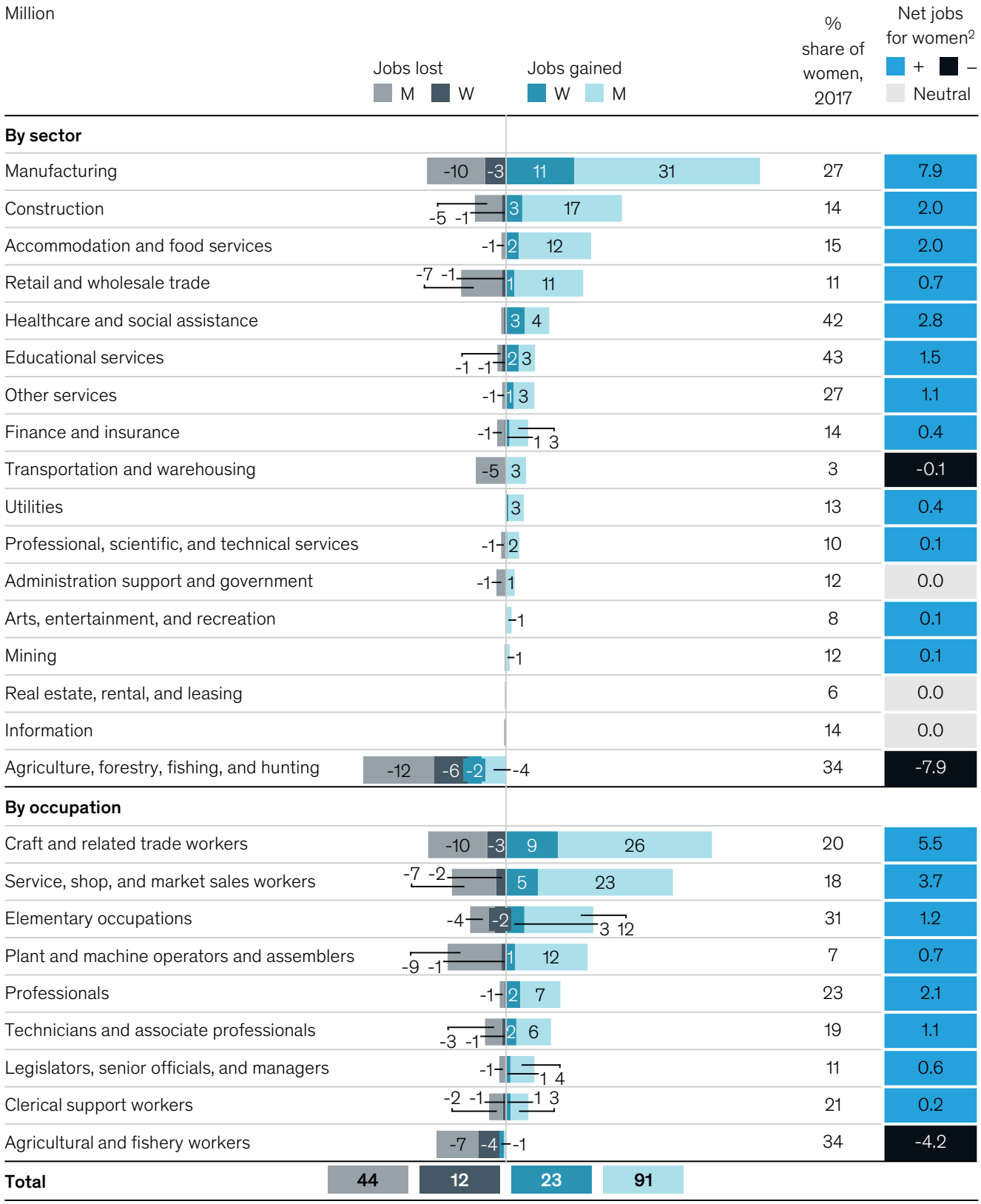


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: NSS; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <1 not shown.

Source: NSS; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Mexico

Economic and demographic context

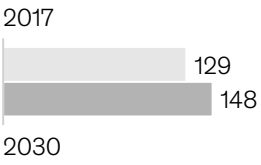
Per capita GDP, $ thousand PPP, 2017

18

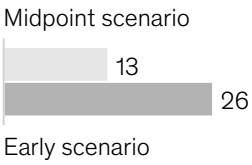
Female labor-force participation rate, 2017

44%

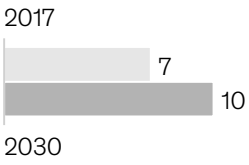
Population, Million



% of work activity hours automatable by 2030



% aged over 65

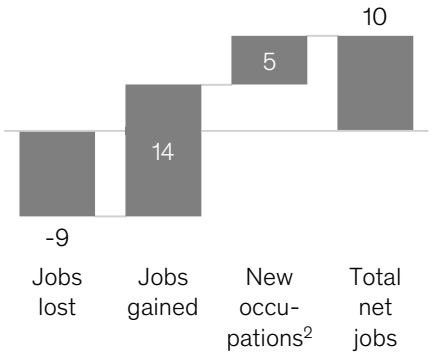


Summary: How women are positioned for the future

Women Men

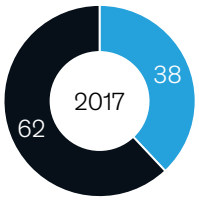
0.4M–2.5M women and **0.8M–4.9M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



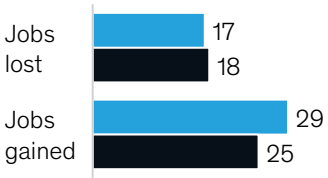
	Jobs lost	Jobs gained	New occupations[2]	Total net jobs
% of 2017 employment	17	27	10	

Share of employment,[1] %



Female share of employment could increase by **0–1 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

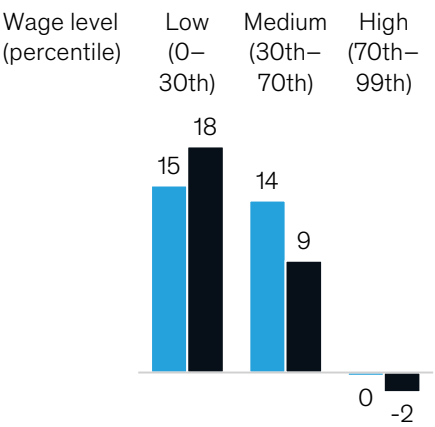


Net jobs demanded by wage level and education

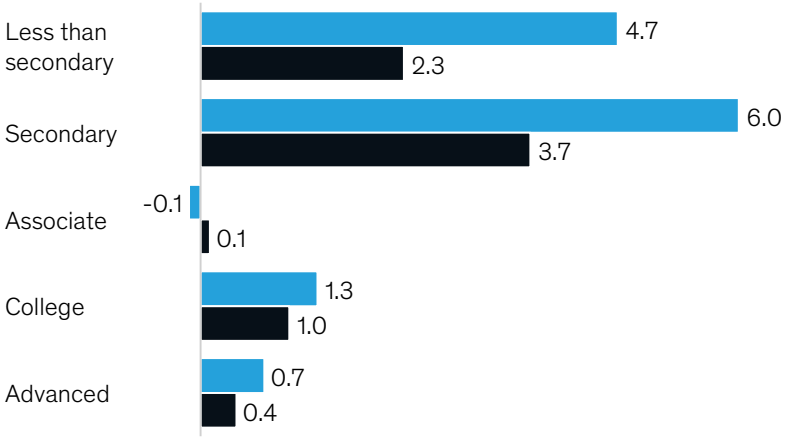
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

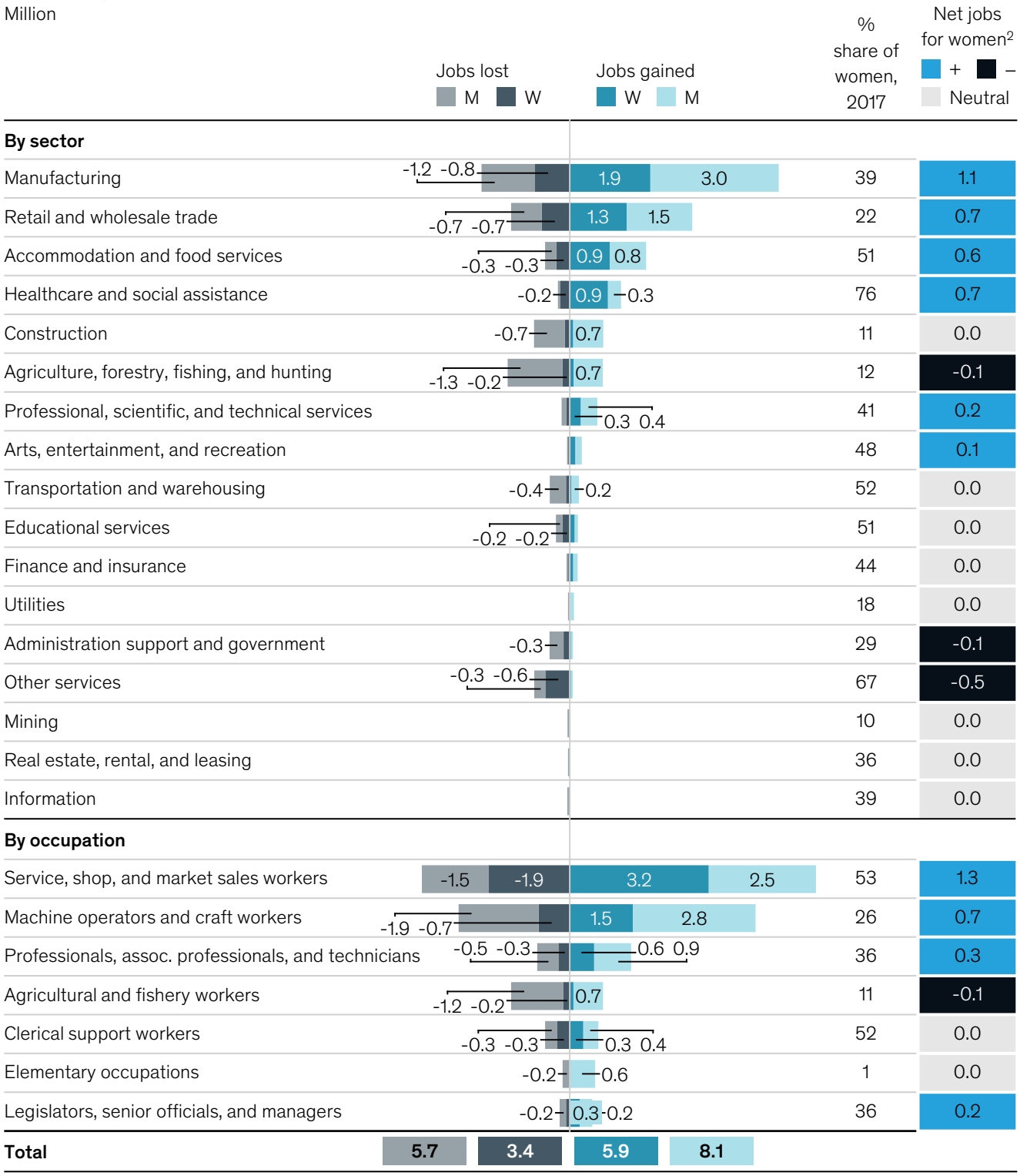


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: INEGI; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: INEGI; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

South Africa

Economic and demographic context

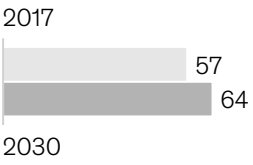
Per capita GDP, $ thousand PPP, 2017

13

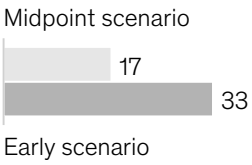
Female labor-force participation rate, 2017

48%

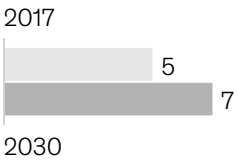
Population, Million



% of work activity hours automatable by 2030



% aged over 65

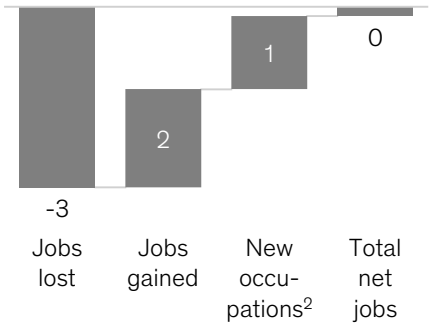


Summary: How women are positioned for the future

Women Men

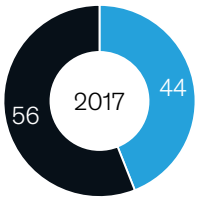
0.7M–1.9M women and **1.3M–3.4M** men may have to transition between occupations or skill levels by 2030

Change in total male and female labor demand in the period to 2030, Million



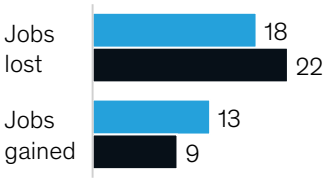
% of 2017 employment: 20 | 11 | 8

Share of employment,[1] %



Female share of employment could increase by **1–2 pp** by 2030

Potential effects on employees by 2030, % of 2017 base employment

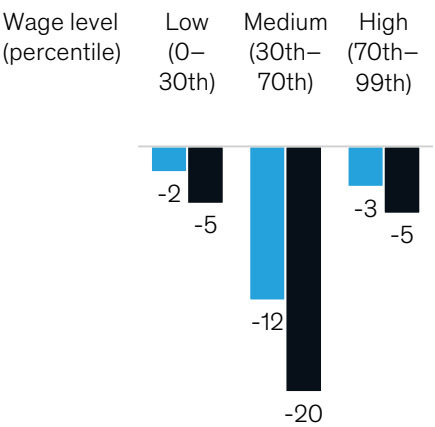


Net jobs demanded by wage level and education

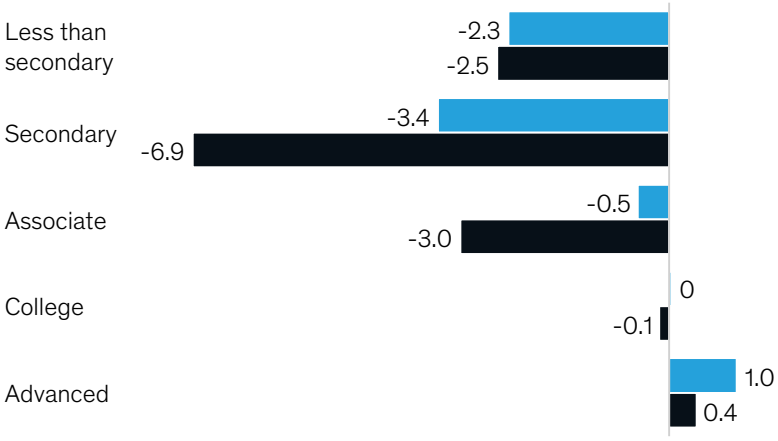
Women Men

% change relative to employment by gender in the period to 2030

By wage level (relative to tercile employment)



By education (relative to total employment)

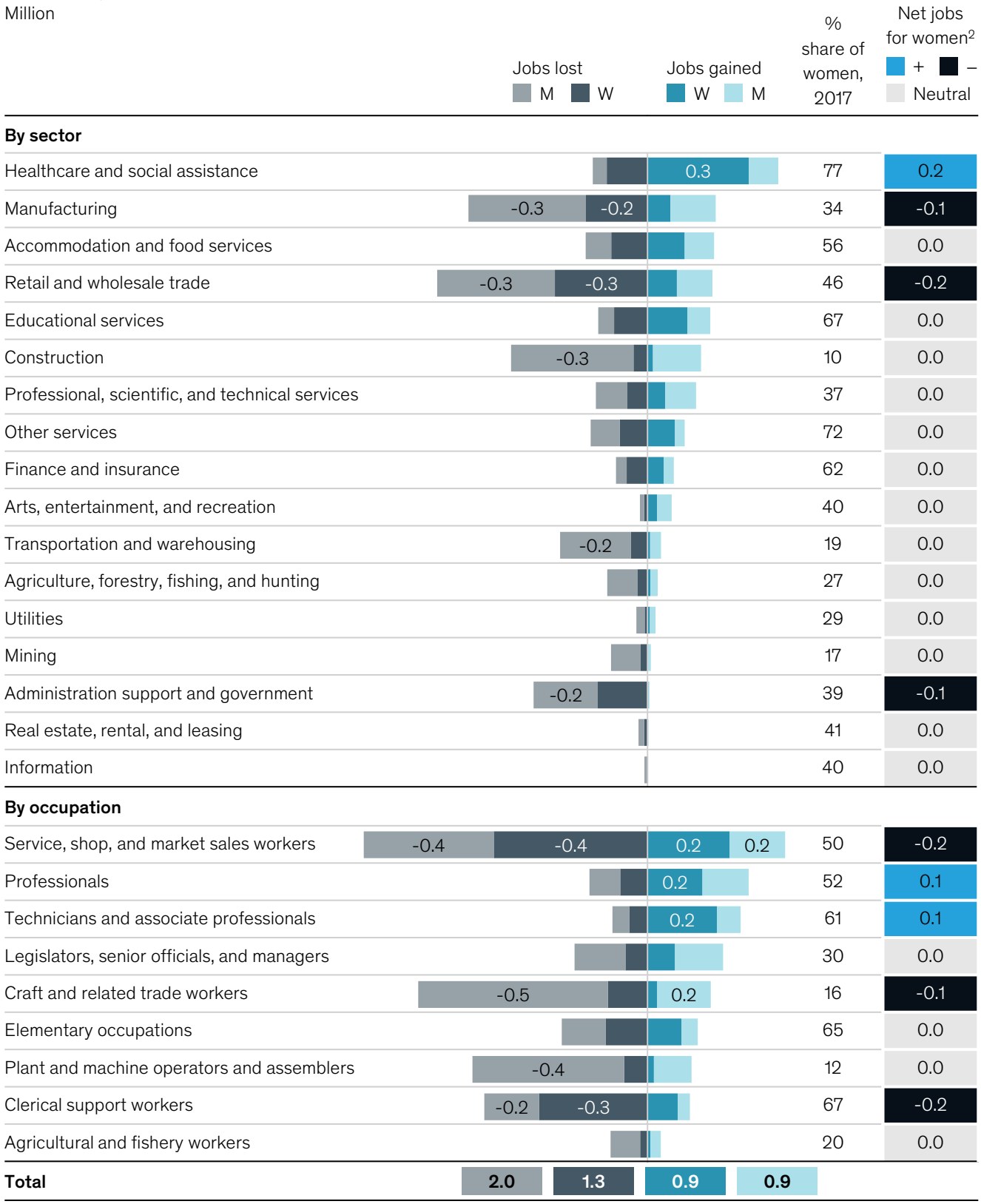


[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Historical analysis suggests that 8-9% of the 2030 labor supply could be employed in entirely new occupations.
Note: Figures may not sum to 100% because of rounding.

Source: South Africa Quarterly Labour Force Survey, 2018; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Sector and occupation shifts

Incremental jobs gained or lost in the period to 2030,[1]
Million



[1] Based on a trend-line scenario for jobs gained and a midpoint automation scenario. See technical appendix for details.
[2] Assumes current level of female representation across sectors and occupations stays the same.
Note: Data labels <0.2 not shown.

Source: South Africa Quarterly Labour Force Survey, 2018; ILO, 2017; World Bank, 2018; UNDP World Population Prospects, 2017; McKinsey Global Institute analysis

Technical appendix

This appendix provides details on the methodology employed in our research in the following sections:

1. Overview of selected recent studies on women, automation, and the future of work
2. Methodology for calculating Gender Concentration Index
3. Assessing impact of automation and potential for job creation
4. Applying a gender lens to jobs lost and jobs gained
5. Assessing potential transitions
6. Methodology for calculating partial automation (jobs changed)
7. Methodology for calculating Gender Parity Score (GPS)

1. Overview of selected recent studies on women, automation, and the future of work

Exhibit A1

Selected recent studies on women, automation, and the future of work.

Publication/scope	Summary of approach	Key relevant findings
International Monetary Fund, *Gender, technology, and the future of work*, October 2018 30 countries (including 28 OECD members, Cyprus, and Singapore)	• Used individual-level data on task composition, task frequency, and extent of ICT use at work from PIACC survey • Constructed routine task intensity (RTI) index for each worker, given current technology • Defined high risk of displacement as higher than 70% likelihood of being automated • Accounted for differences in worker characteristics (eg, age, education, gender, literacy and numeracy skills, and a broad subset of task characteristics)	• 10 percent of total workforce (54 million workers) in 30 countries is at high risk of displacement • A larger proportion of female workforce (11%) is at high risk for automation compared with male workforce (9%) • In the 30 countries, 26 million female jobs are at high risk of displacement • Extrapolating globally,180 million female jobs are at high risk of being displaced
Institute for Women's Policy Research, *Women, automation, and the future of work*, March 2019 US labor market	• Compiled database from ten-year occupational projections from BLS, probability of automation from Frey and Osborne (2013), digitization scores from Muro et al. (2017), and employment and earnings data from the American Community Survey • Projected employment growth and the shares of workers by sex, race, and ethnicity in the occupations with the highest and lowest risk of automation, as well as the highest and lowest levels of digitalization	• Women are more likely than men to be in occupations with both lowest and highest risk of technological substitution. Women are the majority of workers (58%) at highest risk of automation, as well as majority (52%) in jobs at lowest risk of automation • 20.2 million women work in high-risk occupations, compared with 14.4 million men • Automation will affect men the most in low-earning occupations, while women's automation risk is more equally spread across differently paid occupations
Office for National Statistics, *The probability of automation in England: 2011 and 2017*, March 2019 England labor market	• Applied a modified version of OECD methodology with PIAAC survey to calculate automation probability for individuals on Annual Population Survey (APS) to produce detailed demographic breakdowns • Grouped automation likelihood into low (<30% automation probability), medium (30-70%), and high (>70%) • Included just under 20M occupations in 2017	• Out of the 19.9 million jobs analyzed, 7.4% (1.5 million people) were employed in jobs at high risk of automation, while 27.7% (5.5 million people) were in jobs at low risk of automation in 2017 • Women, young people, and part-time workers are at high risk of automation • Women account for 70.2% of employees in jobs that have high automation risk (vs 42.6% in low-risk jobs) • Industries in which half or more of the workforce is high-skill have a probability of automation under 35%
New America, *The future of work for women: Technology, automation and the overlooked workforce*, February 2019 US labor market	• Used data from Frey Osborne (2013) that provided automation risk for >700 occupations • Mapped automation risk to BLS occupational data and developed gender breakdown of occupations using Current Population Survey	• Women are 54% of workers in occupations with high automation risk • Growth is fast in high-paid jobs tied to technology. However, women have low STEM graduation rates and low representation in STEM jobs (19% of software developers and 21% of computer programmers are women) • Higher education reduces exposure to automation. Workers with a BA or higher have lower automation probability compared with workers with a high school degree or less
McKinsey Global Institute, *The future of women at work: Transitions in the age of automation*, June 2019 10 countries (Canada, China, France, Germany, India, Japan, Mexico, South Africa, the United Kingdom, and the United States)	• Used MGI 2017 automation methodology to project jobs lost and gained to 2030, based on technical automation potential and adoption; kept current female and male employment shares in occupations and sectors constant • Analyzed male and female transitions toward 2030 to allocate jobs lost and jobs gained between occupations and skills • Explored jobs changed due to partial automation, as well as trends in entirely new occupations	• Women could face slightly lower automation risk than men (20% of females or 107 million vs 21% of males or 163 million) • Women may be marginally better placed than men in most countries to take advantage of new job opportunities (20% of women or 171 million vs 19% of men or 250 million) • Evidence from the United States shows that approximately 60 percent of recently created occupations were in male-dominated occupations • Women are slightly more prone to having their jobs partially automated compared with men • Globally, 40 million to 160 million women may need to transition between occupations and skills, compared with 60 million to 275 million men

Source: McKinsey Global Institute analysis

2. Methodology for calculating Gender Concentration Index

To better understand what drove differences in men and women's outcomes in our modelling, we first aimed to understand structural patterns of gender employment by building a "Gender Concentration Index" designed to provide a sense of the degree to which men and women tend to cluster within different sectors and occupations. We looked at 17 sectors and seven to nine occupational categories for each of our ten focus countries (depending on data availability and quality—see section 4 for more detail).

Using national employment data, we calculated women's share of employment (WSE) for each occupation and sector by country. To calculate the gender concentration index, we then assessed the deviation of this share of employment in each occupation or sector from equal gender representation—namely 50 percent female representation. For example, a country with 50/50 gender representation within each sector or occupation would have a score of zero, meaning that all sectors or occupations have full parity (equal representation of men and women). Conversely, a Gender Concentration Index of one indicates that each sector and occupation is 100 percent dominated by either men or women. The higher a country's concentration index score, the more gendered its workforce tends to be.

Using a modified sum-of-squares analysis, we calculated the variance from this 50 percent value adjusted for the total number of sectors or occupations. This analysis resulted in a Gender Concentration Index, calculated as follows:

$$Gender\ Concentration\ Index = \sqrt{\frac{\sum(0.5 - WSE)^2}{n}} \times 2$$

WSE = women's share of employment; n = # of occupations or sectors

Note the multiplication by two is to enable us to create a zero to 100 range for the overall score. This analysis does not weight based on the proportion of total employment in each occupation or sector, but rather looks across sectors and occupations to determine whether structural barriers could influence how effective men and women are at moving across occupations and sectors. We note some key findings from this analysis:

— All economies are gendered. Even in economies where the female labor share is high, very few occupations or sectors were within 5 percent of gender parity. The female labor force participation rate is based on data from the International Labour Organization, extracted in March 2019.

— Economies that have low female participation rates tend to be more gendered. In India, women do not make up the majority of a single sector or occupational category, because not enough women have entered the labor force even in sectors where women are well represented in other countries. As more women participate in the economy, they tend to enter traditionally male-dominated sectors and occupations.

— In seven of the ten countries analyzed, the Gender Concentration Index for occupations was higher than the index for sectors.

3. Assessing impact of automation and potential for job creation

This report leverages the methodology and findings of previous MGI research on the future of work and jobs lost, jobs gained.[220] Full details of the methodology used in the first report, and revisions applied to the second report, can be found in the appendices of those reports. Here, we provide a brief summary with a focus on our additions and updates.[221] The 2017 jobs lost, jobs gained report assessed automation and job growth in 46 countries, with a particular emphasis on six core countries. In this report, we have expanded the scope of the analysis to 53 countries, with an emphasis on ten core countries. For each of the following components, we drew on this past methodology and applied a gender lens (see section 4) to the output:

- **Jobs lost.** MGI's jobs lost, jobs gained report estimated work hours that could be automated to create a scenario of job displacement under automation.[222] To assess how many work hours could be automated—and therefore how many jobs displaced—it broke more than 800 occupations into a composite set of over 2,000 activities. Next, it categorized each of the 2,000-plus activities into 18 capabilities. The model took into account five factors that affect the pace and extent of automation, and modeled it using four stages: technical automation potential, solution development, economic feasibility, and societal adoption. From a technical standpoint, this approach assumed that a task is automatable only after all of its core capabilities are automatable; similarly, an occupation is automatable only after all tasks required of the role are automatable. From an adoption standpoint, this approach assumed that an occupation is automated only after it is cost-effective and socially acceptable to do so. Based on this framework, which was informed by academic research, McKinsey expertise, and industry advisers, each occupation was assigned a percentage range for automation adoption. The starting point of the analysis was 2014. Our research here instead focuses on the period from 2017 to 2030. We have projected forward from the 2014 starting point to create a 2017 baseline by preserving industry level employment splits and scaling employment figures to 2017 based upon 2017 employment data by country. The model for jobs lost considers three scenarios of displacement based on early, midpoint, and late automation adoption timelines: early assumes very little automation adoption, while late assumes rapid automation adoption. This report relies primarily on a midpoint scenario—the midpoint between early and late—that is on a par with the scale of the great employment shifts of the past, such as out of agriculture or manufacturing.

- **Jobs gained.** We used the approach taken in MGI's jobs lost, jobs gained report to create a scenario for increased labor demand as a result of seven catalysts.[223] The seven catalysts are (1) rising incomes; (2) increased spending on healthcare as a result of aging populations; (3) development and deployment of new technology; (4) infrastructure investment; (5) investment in residential and commercial buildings; (6) energy transitions and efficiency; and (7) marketization of currently unpaid work. The previous research captured both indirect and direct jobs that could be created from each catalyst, accounted for a decline in hours worked per person, and factored in globalization of work. The model offered a static view that did not take into account the interplay between supply and demand drivers or feedback from factors such as changing wages. It estimated potential labor demand but did not assess the likelihood of this potential being captured, which depends on choices and investments by businesses, policy makers, and workers. The model estimated demand associated with entirely new occupations, but did not factor it into the net job estimates. The calculation of the magnitude of entirely new occupations relied on studies that suggest that 8 to 9 percent of the 2030 labor supply could be employed in new occupations (or 0.5 percent annually).

[220] *A future that works: Automation, employment and productivity*, McKinsey Global Institute, January 2017; and *Jobs lost, jobs gained: Workforce transitions in a time of automation,* McKinsey Global Institute, December 2017.
[221] All analyses are based upon MGI future of work models as of April 2019. These models are subject to change as we continue to refine and update the underlying data.
[222] *A future that works: Automation, employment and productivity*, McKinsey Global Institute, January 2017
[223] *Jobs lost, jobs gained: Workforce transitions in a time of automation,* McKinsey Global Institute, December 2017.

Increased consumption is the underlying driver of much of the growth in labor demand estimated in the jobs lost, jobs gained analysis. This factor was modeled using per capita GDP growth. The model used input-output multipliers to translate increased spending (as a result of factors such as increased per capita GDP) into a higher number of jobs demanded across different sectors. For all labor drivers, we calculated indirect jobs using indirect job multipliers based on source data from the World Input-Output Database, making adjustments as necessary informed by expert input. This model also considered global trade, assessing both locally and globally driven labor demand. Finally, the model considered both a trend-line and a step-up scenario of spending with which to assess increased job demand. The trend-line is based on observed patterns across countries, while step-up extends the drivers considered to include increased government investment (incremental additional growth on top of existing levers) in infrastructure and marketization of unpaid work (a lever considered only in the step-up scenario). In jobs lost, jobs gained, MGI estimated the average amount of unpaid time currently spent on childcare, adult care, cooking, and cleaning using time-use surveys. As these unpaid activity hours move to the marketplace, we expect labor demand to increase for them. We decrease the time spent on these activities in each country using a linear coefficient between the minimum and maximum values across countries. Note that for much of the analysis in this report, we focus on the trend-line scenario, but also use the step-up scenario to help provide a range to some of the outcomes discussed. The trend-line scenario is based on current spending and investment patterns, while the step-up scenario assumes additional government stimulus and job-creation efforts.

- **Skills and wages.** Our skills analysis uses education levels as a proxy for skill requirements in a given occupation, and shows the net change in jobs demand by education level as a proportion of total 2017 employment for women (or men, as the case may be). This helps quantify the magnitude of skills shift needed in each country. The five educational categories used in the analyses are less than secondary, secondary, associate degree, bachelor's degree, and advanced degree. These classifications map to the five job zones defined by the US Bureau of Labor Statistics' O*NET and take into account educational degrees, amount of training required, and years of experience necessary in order to qualify for a given job. In our wage analysis, we keep wages constant in the period to 2030 and classify each occupation by tercile based on average wage at purchasing power parity in 2014. In reality, we would expect wages to adjust to shifts in response to automation and new labor demand, but modeling these effects dynamically is beyond the scope of our analysis. We calculate net change in jobs demand as a proportion of 2017 total employment within each wage tercile in order to show the magnitude of impact upon workers in each category.

- **Full-time equivalents.** The jobs lost, jobs gained report used full-time equivalent workers (FTEs) in all of its analysis. We assume throughout that "jobs" are equivalent to FTEs. The report also assumed that each hour of work that can be automated will result in proportional "job" loss. For instance, if 10 percent of current work activity hours in an occupation could be automated, then 10 percent of FTEs (referred to as "jobs") in that occupation would be displaced. This report makes similar assumptions throughout.

- **Country coverage.** In this report, we focus on ten countries: six mature economies (Canada, France, Germany, Japan, the United Kingdom, and the United States) and four emerging economies (China, India, Mexico, and South Africa), which account for about half of the world's population and that are representative of a wide range of demographic profiles, stages of economic development, and progress toward gender parity. For our transition analysis, we rely on (gender-agnostic) jobs lost and jobs gained analysis for a broader set of 53 countries, 13 of which are in Asia, 19 in Europe, eight in Latin America, eight in the Middle East and North Africa, and three in Sub-Saharan Africa.

4. Applying a gender lens to jobs lost and jobs gained

MGI's previously developed model of jobs lost and gained provides output for current employment, jobs lost, and jobs gained for workers in the ten countries in this research, capturing FTE workers at both the occupation and sector level. A given "cell" (output for a specific sector and occupation) reports, for instance, how many FTEs work as office clerks in the manufacturing industry. To apply a gender lens to this output, we used national survey data for each of our ten countries, which provides employment data by sector and by occupation for men and women. In other words, by matching our future of work model output with national employment data, we could, for instance, assess how many of those office clerks working in manufacturing were men and how many were women.

A key aspect of the scenarios we model in this research of our model is that we hold the representation of women and men within each sectoral and occupational cell constant from 2017 to 2030; this approach was designed to test how well positioned women are for the future of work given their current representation in the workforce. We note that the future of work model output (used in jobs lost, jobs gained*)* uses FTEs as units, while national employment data record number of employees. We treated them as equivalent in this analysis.

To make the data broadly comparable across countries, we conducted our analysis at the level of nine major occupational categories and 17 major sectors, given that many countries do not provide gender data on employment on a more detailed level (see Exhibit A2 for a glossary of occupational categories).

Occasionally, depending on data availability for certain countries (for instance, China), the categories of "professionals" and the "technicians and associate professionals" were combined into a category called "professionals and associate professionals." Similarly, in some cases, we condensed the "plant and machine workers" and "craft and related trade workers" occupational categories into a single category called "machine operators and craft workers."

We made similar adjustments for sector data in many cases, based on the level of detail of gender data available For instance, we combined the category of "management of companies and enterprises" with the "professional, scientific, and technical services" sector before applying a gender split. We similarly needed to combine retail and wholesale trade. The original jobs lost and gained analysis relied on occupational classifications using SOC, and sectoral classification using NAICS. Occasionally for countries we also had to convert from a different occupational or sectoral classification (for instance, NOC) to the occupational classification used in the original jobs lost, jobs gained analysis.

One exception to the approach described is China for which we were unable to obtain employment data split by gender at the intersection of sector and occupation. We therefore conducted independent analysis at the sectoral and then occupational level for China. For most of the China results presented in the report, we have relied on the sector-level analysis and resulting estimates for jobs lost, jobs gained, and net jobs because more granular data were available at the sector rather than occupational level. We obtained sectoral employment estimates by gender for China from ILO.

To apply a gender lens to the education analysis, we used US Bureau of Labor Statistics (BLS) data to map an average level of educational attainment to each occupation category (we assumed that education requirements for occupations were relatively constant across countries). We then applied the gender lens data to this education mapping, assuming that the level of educational attainment of men and women within occupations did not vary.

For the wage analysis, we built upon the methodology created in the jobs lost, jobs gained report that segmented detailed occupations by their average wage level into three wage terciles and calculated the percentage change in net demand from 2017 to 2030 in each of

the three income brackets. For this report, we applied gender splits to those same detailed occupations by making the simplifying assumption that gender splits at the occupation category level reflected that at the detailed occupation level. We applied these splits to each occupational category and calculated the percentage change in net demand by wage bracket for both men and women.

In the main report, we have described how job losses and gains could look different for men and women across occupations (for job lost) and sectors (for jobs gained). Exhibits A3 and A4 show results for jobs lost by sector and jobs gained by occupation respectively.

Exhibit A2

Occupational category glossary

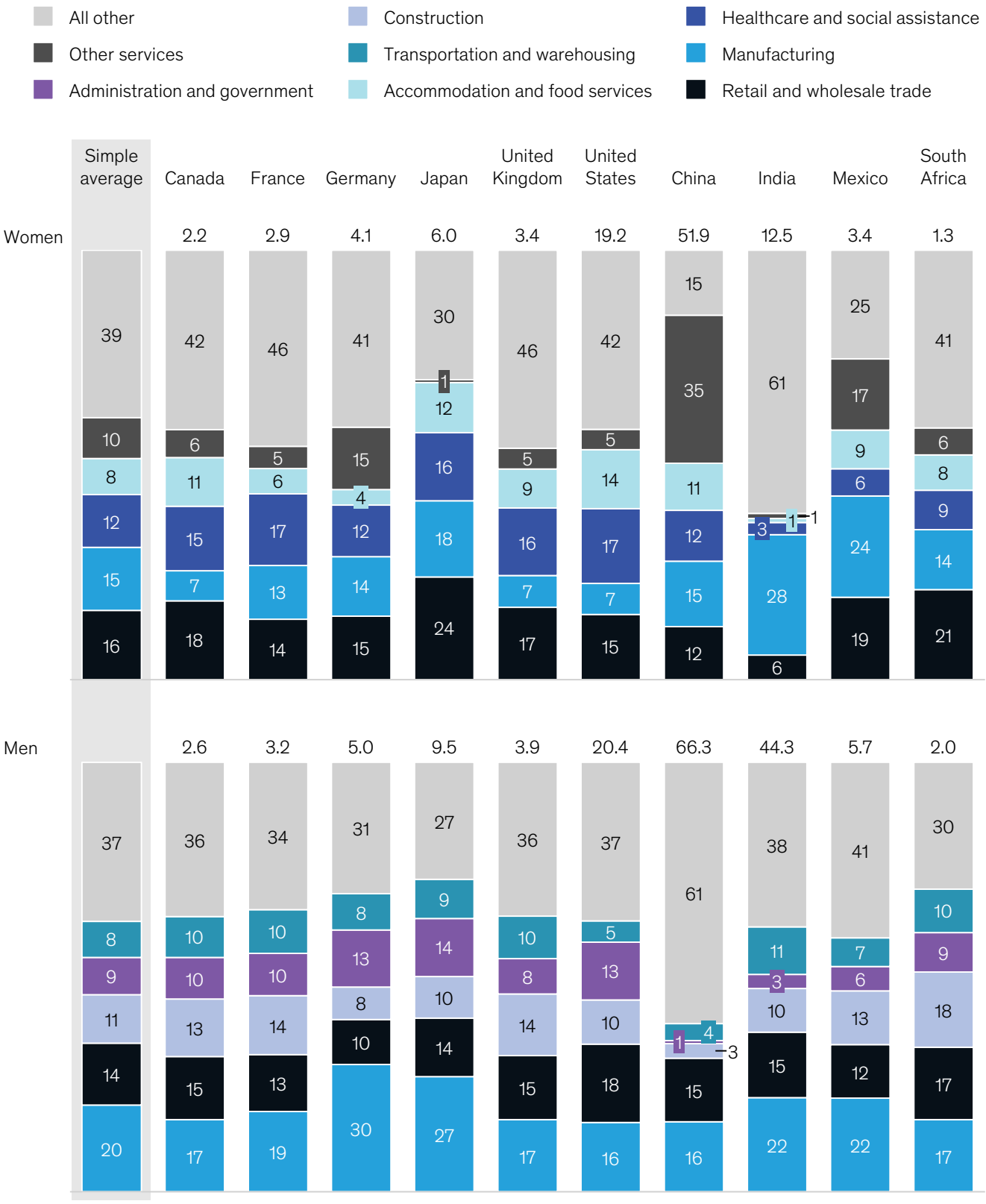
Occupational category	Description
Clerical support workers	Employment in office and administrative support, such as auditing clerks, receptionists, and secretaries and administrative assistants
Craft and related trade workers	Craft and related workers apply their specific knowledge in fields such as mining, construction, metal work, and machine repair and maintenance; examples include electricians and welders
Elementary occupations	Elementary occupations consist of simple and routine tasks that mainly require the use of hand-held tools and often some physical effort; tasks performed usually include selling goods in streets and public places, providing various street services, and cleaning, washing, pressing
Legislators, senior officials and managers	Legislators, senior officials, and managers determine, formulate, direct or advise on government policies, as well as those of special-interest organizations and corporations
Plant and machine operators	Plant and machine operators and assemblers operate industrial and agricultural machinery, drive and operate trains, motor vehicles and mobile machinery and equipment, or assemble products from component parts according to strict specifications and procedures
Professionals	Professionals increase the existing stock of knowledge, apply scientific or artistic concepts and theories, or teach; examples include engineers, professors, and health workers
Service workers, shop and sales workers	Service workers, and shop and market sales workers provide personal and protective services related to travel, housekeeping, catering, personal care, or protection; examples include retail salespeople
Agricultural and fishery workers	Agricultural and fishery workers grow and harvest crops, breed, tend or hunt animals, produce a variety of animal husbandry products, cultivate, conserve and exploit forests, breed or catch fish
Technicians and associate professionals	Technicians and associate professionals perform mostly technical and related tasks connected with research and the application of scientific or artistic concepts and operational methods, and teach at certain educational levels

Source: US Bureau of Statistics; ILO

Exhibit A3

Manufacturing and retail are among the largest sectors of potential job displacement for both men and women.

Share of potential job displacement by 2030 across sectors, %[1]
(Total = million FTE)



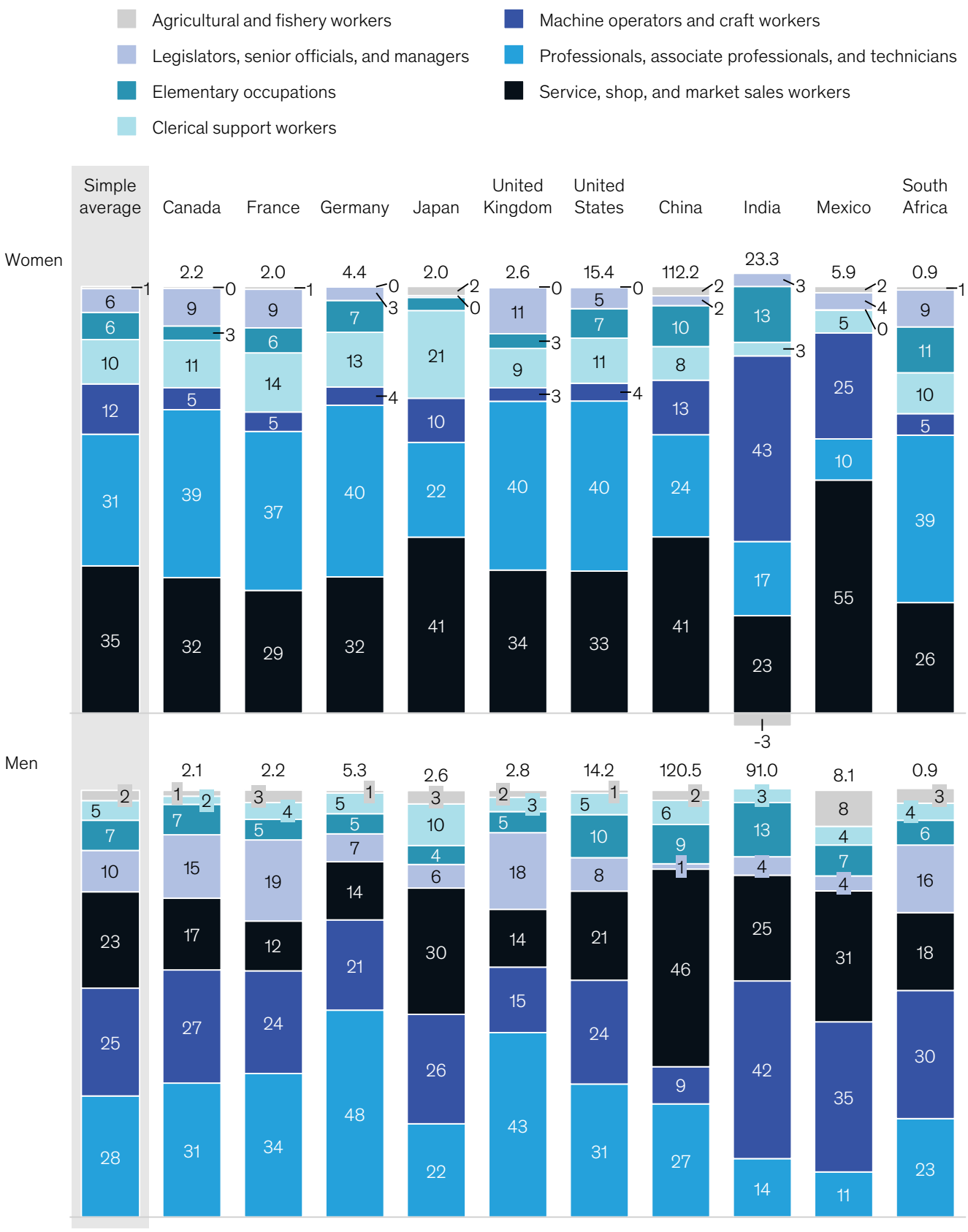
[1] Top 5 sectors based upon simple average by gender across all countries.
Note: Figures may not sum to 100% because of rounding. These data are based upon a midpoint scenario of automation.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015; South Africa Quarterly Labour Force Survey, 2018; ONS, 2017; Statistics Canada, 2016 Census; China Population Census; McKinsey Global Institute analysis

Exhibit A4

About one-third of potential jobs demanded in advanced economies could be in professional, associate professional, and technician professions.

Share of potential job demand by 2030 across occupations, %
(Total = million FTE)



Note: Figures may not sum to 100% because of rounding. These data are based upon a trend-line scenario of job creation.

Source: CPS IPUMs; NSS; ILO, 2017; INEGI; Japan National Survey; Eurostat, 2015; South Africa Quarterly Labour Force Survey, 2018; ONS, 2017; Statistics Canada, 2016 Census; China Population Census; McKinsey Global Institute analysis

5. Assessing potential transitions

To assess the size of potential transitions in the ten countries in our analysis, we built upon the methodology used in MGI's jobs lost, jobs gained report. There, we estimated work hours that could be automated—and therefore jobs displaced—for 59 detailed occupational categories and five skill levels in both a midpoint and an early automation scenario. We chose the 59 occupational categories after assessing which of the 800-plus detailed BLS occupations were distinct enough and therefore where moving from one to another would represent a true transition. This assessment was informed by academic research, internal expertise, and industry experts. For each of the 59 occupations and five skill levels, we also estimated additional demand for work driven by the catalysts described. We combined jobs lost and gained to develop a net view of jobs displaced and demanded by 2030. For any occupational or skill category (except for transitions within skill level 1) with a negative number of net jobs, workers will need to make a transition. To calculate the number of transitions, we therefore summed the number of such negative net jobs. We excluded occupations that would require transitioning from the lowest to the second-lowest skill level on the assumption that these transitions do not require significant reskilling.

To apply a gender lens on the number of transitions, we first mapped the nine occupational categories for which we had a gender split to the 59 detailed occupational categories and applied gender splits from the occupational categories to the detailed occupations. This approach allowed us to split our original estimate for the size of transitions (capturing net jobs across 59 occupations and five skill levels) by gender.

Finally, we extrapolated these findings from our core set of ten countries to a global number. First, we mapped each country for which we were extrapolating to one of the ten countries studied in this report; this mapping was determined by country region and per capita GDP. The rate of transition by gender from one of the ten countries was then applied to the extrapolated country.

Our estimates diverge slightly from those in the original jobs lost, jobs gained report. That research estimated that 75 million to 375 million people may need to transition, while in this report our estimated range is 100 million to 440 million. There are two reasons for this difference: (1) our global extrapolation is to a broader set of countries (seven additional countries from the original research because of expanded data availability in certain countries); (2) the original analysis focused on a detailed assessment of transitions for six countries, and extrapolated to all others, while we have expanded the detailed assessment from six to ten countries, which has further refined the numbers.

6. Methodology for calculating partial automation (jobs changed)

MGI analyzed prospects for partial automation to understand jobs changed. Our automation model is based on FTEs although we use "jobs" to describe some of the resulting trends. Our analysis of jobs changed builds upon this analysis, as partial automation within occupations could result in the same number of jobs in an occupation while the required activities and skills in the jobs change. Essentially, jobs might not be lost due to automation, but they may change. Understanding jobs lost, gained, and changed together provides a rounded view of how automation is having an impact on the world of work.

MGI used the BLS O*NET database to break about 800 occupations down into more than 2,000 activities to understand how much time could be technically automatable using existing technology for each of the occupations.[224] Technical automation for 2030 includes early, midpoint, and late scenarios based on different estimates of what technology will be available to technically automate tasks in 2030. In our jobs changed analysis, we refer to the midpoint scenario of technical automation. We use technical automation instead of automation adoption because technical automation is country agnostic—that is, solely based on available automation technology. Automation adoption considers more factors (including, for instance, the cost of automation compared with wages) that are country specific. Therefore, our view of jobs changed without the gender splits is global. Note that the jobs lost analysis looks at automation adoption (not only technical automation) to create country-specific views.

To understand gender differences for jobs changed, we applied US gender and employment data to about 800 occupations (based on the same 800 occupations in the US BLS O*NET database in our initial analysis). As a result, our gender insights for jobs changed apply only to the United States. The US BLS provides some gender disaggregated data for about 500 occupation categories, which are less detailed than the 800 categories. The 500-level group includes, for instance, "physicians and surgeons" as a category, while the 800-level group includes subcategories such as "surgeons" and "pediatricians" separately. Note that while US BSL provides gender data for most occupations on the 500-level list, there are some occupations for which data are not provided. These occupations for which gender data are not provided tend to employ a relatively low number of people (below 50,000).

Based on the gender splits in BLS data, we tagged each occupation as female-dominated, male-dominated, or gender-neutral. Female-dominated occupations are defined as jobs in which women make up 60 percent or more of employees in the occupation. Correspondingly, male-dominated occupations are defined as jobs in which men make up 60 percent or more of employees in the occupation. Gender-neutral refers to the remainder of occupations. As previously mentioned, note that US BLS does not publish gender splits for some occupations. Within the 800-level occupations, about 250 did not include gender-split data and about 150 were gender-neutral. For our purposes, we excluded gender-neutral occupations along with occupations that did not have gender splits when comparing differences in jobs changed between male-dominated and female-dominated occupations.

In summary, we looked at the range of technically automatable time across occupations (from 0 percent automatable to 100 percent automatable) to understand partial automation in female-dominated occupations (171 occupations out of 820) and male-dominated occupations (243 occupations out of 820).

[224] *Jobs lost, jobs gained: Workforce transitions in a time of automation,* McKinsey Global Institute, December 2017.

7. Methodology for calculating gender parity score (GPS)

Gender Parity Score (GPS) indicators

This report used 15 indicators of gender equality in work and gender equality in society. These were selected for our analysis of gender inequality in 125 countries, building on and refining the 15 indicators originally used to compile a Gender Parity Score, or GPS, in MGI's first report on gender inequality in September 2015 (for our current indicators, see Exhibit A5).[225]

The indicators used are measures of outcomes, which enables us to make an objective assessment of a country's performance on gender equality. The indicators we chose typically measure the difference between the position of men and women, and these are expressed as a female-to-male ratio. The exceptions include sex ratio at birth and unpaid care work, which are expressed as male-to-female ratios. For indicators that apply only to females—child marriage, violence against women, family planning, and maternal mortality—we used the absolute level expressed as a prevalence rate in percentage terms. In addition, the legal protection indicator only covers females because it is a composite index of the extent of protection given to women by 11 different legal provisions (for instance, the right to inherit and to access jobs). For many of the indicators, we employed standard definitions used in the literature. For instance, we chose the ILO's major groupings of occupational classifications for our definitions of professional and technical jobs as well as leadership positions; this aligned with the World Economic Forum's (WEF's) approach for these two indicators.[226]

Some features of the indicators are worth highlighting:

- Five of the 15 indicators—education, financial inclusion, digital inclusion, political representation, and legal protection—are composites constructed using subgroup indicators. The rationale for constructing these composite indicators was to include multiple aspects of inequality in each case. In the case of digital inclusion, for instance, we included female-to-male ratios for both mobile and internet use. The methodology we used to construct composite indicators was the same as that used to construct a GPS for individual countries.

- The indicator we chose for leadership is based on the ILO's major occupational group classifications. The indicator includes positions labelled as "legislators, senior officials, and managers" in ISCO 88 or "managers" in ISCO 08 (where legislators and senior officials are still included). We gave preference to ISCO 08 data as this is the more recent classification system unless data were unavailable in which case we used ISCO 88. Although there is some overlap in the case of legislators with our measure of political representation, we opted for this approach because it used the ILO's standard classification and is in line with the indicator used by the WEF.[227] In any case, it is difficult to obtain more detailed occupational splits of this ILO major group. We used the major group of professional and technical jobs for similar reasons.

- The legal indicator comprises 11 subindicators constructed from the answers to the questions listed here that are contained in the World Bank's Women, Business and the Law database:

  - ☐ Is there legislation that specifically addresses domestic violence?

  - ☐ Is there legislation that specifically addresses sexual harassment?

  - ☐ Can a married woman apply for a national ID card in the same way as a man?

[225] For details on how we selected the indicators, see *The power of parity: How advancing women's equality can add $12 trillion to global growth*

[226] *The global gender gap report*, World Economic Forum, 2018.

[227] Ibid.

- ☐ Does a woman's testimony carry the same evidentiary weight in court as a man's?
- ☐ If there is a non-discrimination clause in the constitution, does it explicitly mention gender?
- ☐ Do sons and daughters have equal inheritance rights to property?
- ☐ Are there laws mandating non-discrimination based on gender in hiring?
- ☐ Does the law mandate equal remuneration for men and women for work of equal value?
- ☐ Can non-pregnant and non-nursing women do the same jobs as men?
- ☐ Does the law mandate paid or unpaid parental leave?
- ☐ Does the law mandate paid or unpaid paternity leave?

We first grouped the 11 subindicators into four logical categories (for instance, the first two questions that tackle violence against women are grouped into a single category) by taking a simple average. We then used a sum-of-squares approach described in the next section. This is the same composite indicator definition that MGI used in its 2015 research. We note that the World Bank's Women, Business and the Law database does update and correct data, and that therefore some 2014 data today may be different from the 2014 data used in the 2015 report.

We adjusted some indicators used in MGI's 2015 power of parity report for this research. The key changes were:

- **Added a formal employment indicator.** We chose to add a formal employment indicator. About two billion people, or more than 60 percent of the total workforce, are employed in the informal economy.[228] Women's share tends to be skewed toward the informal economy, making this an important aspect to track when considering gender parity. Currently, the United Nations SDG organization is tracking this metric (SDG indicator 8.3.1) and is relevant to goal 5, which is to "achieve gender equality and empower all women and girls." ILO now has sufficient data to track and incorporate this indicator. To calculate our measure of formal employment, we use the metric of 1 minus the percentage share of informal employment in total employment from the ILO report *Women and men in Informal economy, 2018.* To measure gender equality across formal employment, we take the female-to-male ratio. We did this to ensure that the constructed measure ranged from zero to one, with one corresponding to full parity within formal employment.
- **Excluded the gender wage gap indicator.** We chose to remove the perceived wage gap indicator, which was included in the 2015 report, from our analysis. We did this to limit our set of indicators to 15, and because this was the only indicator in our dataset that was survey- and perception-based.
- **Changed the measurement of the violence against women indicator.** We opted to replace the indicator used in MGI's 2015 power of parity research from violence against women from an intimate partner experienced during their lifetime to violence against women from an intimate partner in the past 12 months. This enabled us assess more clearly the "current state" of violence against women, rather than rely on the former stock-based measure. We sourced data from the Georgetown Institute for Women, Peace and Security, which in turn drew on a number of sources including the United Nations database on intimate partner violence and national reports.

[228] *Women and men in the informal economy: A statistical picture. Third edition*, ILO, April 2019.

Exhibit A5

Summary of gender equality indicators and data (1/2).

Indicator	Description	Data source
Labor-force participation rate	Female-to-male ratio; age 15+ labor-force participation rate	Latest ILO Actual data (if Actual data missing, latest ILO Modelled Estimates)
Professional and technical jobs	Female-to-male ratio; representation (number) in professional and technical jobs (professionals, technicians, and associate professionals)[1]	Latest ILO Actual data (if Actual data missing, latest ILO Modelled Estimates)
Leadership positions	Female-to-male ratio; representation (number) in leadership positions (legislators, senior officials, and managers)[1]	Latest ILO Actual data (if Actual data missing, latest ILO Modelled Estimates)
Formal employment	Female-to-Male ratio; percentage formal employment in total employment	ILO report: "Women and men in the informal economy: A statistical picture"
Unpaid care work	Male-to-female ratio; time spent in unpaid care work	OECD: Gender, Institutions and Development Database
Unmet need for family planning	Female only; percent of married or in-union women aged 15–49 who want to stop or delay childbearing but are not using contraception	United Nations Estimates and Projections of Family Planning Indicators
Maternal mortality	Female only; maternal deaths per 100,000 live births in a specified year[2]	WHO
Education level	Female-to-male ratio; composite indicator of 1. Adult literacy rate 2. Net secondary enrollment rate 3. Gross tertiary enrollment rate	UNESCO (if UNESCO data missing, WEF The Global Gender Gap Report)
Financial inclusion	Female-to-male ratio; composite indicator of 1. F/M ratio of account holders at a financial institution 2. F/M ratio of borrowing from a financial institution in the previous 12 months 3. F/M ratio of mobile phone or the internet used to access financial account	World Bank Global Findex database
Digital inclusion	Female-to-male ratio; composite indicator 1. F/M ratio of internet users 2. F/M ratio of mobile phone users	International Telecommunication Union (ITU), GSMA, and local country sources
Legal protection	Female only; composite index of the extent of protection given to women based on 11 different legal provisions (eg, right to inherit, access jobs)	World Bank: Women, Business and the Law
Political representation	Female-to-male ratio; composite indicator 1. % of women in parliamentary seats 2. % of women in ministerial positions	Inter-Parliamentary Union
Sex ratio at birth	Male-to-female ratio; number of male births to number of female births	United Nations World Development Indicators
Child marriage	Female only; percent of girls and young women aged 15–19 who are married	United Nations World Marriage Data
Violence against women	Prevalence of women aged 15 years and older who experienced physical or sexual violence by an intimate partner in the last 12 months	Georgetown Institute for Women, Peace and Security (GIWPS)[3]

[1] ILO employment by occupation data used for the leadership positions and professional and technical jobs indicators is not always comparable across years, due to revisions in methodology from local sources. For instance, we see that 2014 data and 2017 data within the leadership positions indicator for Luxembourg are not comparable due to revision in methodology. Other examples exist, which could lead to outlier differences between our recreated 2015 model and the 2019 model.

[2] Includes female deaths from any cause related to, or aggravated by, pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 live births, for a specified year.

[3] Jeni Klugman et al., *Women, Peace, and Security Index 2017/18: Tracking Sustainable Peace through Inclusion, Justice, and Security for Women*, Washington, DC: GIWPS and PRIO, 2017.

Source: McKinsey Global Institute analysis

Exhibit A5

Summary of gender equality indicators and data (2/2).

Indicator	2015 GPS: Data year or range	2015 GPS: Country coverage	2019 GPS: Data year or range	2019 GPS: Country coverage
Labor-force participation rate	2012-2014	125	2016-2018	125
Professional and technical jobs	2012-2014	125	2016-2018	125
Leadership positions	2012-2014	125	2016-2018	125
Formal employment	2018	82	2018	82
Unpaid care work	2014	55	2019	80
Unmet need for family planning	2014	125	2018	124
Maternal mortality	2000-2013	125	2000-2015	125
Education level	UNESCO latest available data (2000–2014) or WEF The Global Gender Gap Report (2014)	125	UNESCO latest available data (2000–2018) or WEF The Global Gender Gap Report (2018)	125
Financial inclusion	Latest available data, 2011, 2014	121	Latest available data, 2011, 2014, 2017	121
Digital inclusion	Latest available data, 2001–2014	62	Latest available data, 2001–2018	92
Legal protection	2014	115	2018	125
Political representation	Latest available data, 2000–2014	125	Latest available data, 2000–2018	125
Sex ratio at birth	2014	125	2017	125
Child marriage	Latest available data, 2000–2014	125	Latest available data, 2000–2017	125
Violence against women	Latest available data based on GIWPS	101	Latest available data based on GIWPS	101

[1] ILO employment by occupation data used for the leadership positions and professional and technical jobs indicators is not always comparable across years, due to revisions in methodology from local sources. For instance, we see that 2014 data and 2017 data within the leadership positions indicator for Luxembourg are not comparable due to revision in methodology. Other examples exist, which could lead to outlier differences between our recreated 2015 model and the 2019 model.

[2] Includes female deaths from any cause related to, or aggravated by, pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, per 100,000 live births, for a specified year.

[3] Jeni Klugman et al., *Women, Peace, and Security Index 2017/18: Tracking Sustainable Peace through Inclusion, Justice, and Security for Women*, Washington, DC: GIWPS and PRIO, 2017.

Source: McKinsey Global Institute analysis

- **Changed the measurement of the financial inclusion indicator.** The financial inclusion indicator in this report is composed of the following three subindicators by gender: (1) being an account holder at a financial institution; (2) borrowing from a financial institution in the previous 12 months; and (3) having used a mobile phone or the internet to access an account in the previous 12 months. The first two sub-indicators are the same as those used in MGI's 2015 power of parity research. The third differs. In the 2015 report, it was the use of mobile phones to send money in the previous 12 months. We made this change because the sub-indicator used in the 2015 report was not available in the latest release of World Bank Findex, and this new sub-indicator also provided a more expansive view on the use of mobile and internet technologies for banking more broadly (rather than just sending money).

- **Expanded the number of countries covered.** We were able to increase the scope of our GPS score from 95 countries in the 2015 research to 125 countries, with an additional three countries in the Middle East and North Africa region, 12 more countries in Sub-Saharan Africa, and 15 more countries in Latin America.

To ensure that we could make a direct comparison between the 2015 and 2019 GPS—and establish evidence of progress on each of the 15 indicators in the intervening four years—we recreated the former using historical data for the current set of 15 indicators. We attempted to gather data for the year 2014 (corresponding to a "2015" GPS) and 2018 (corresponding to a "2019" GPS) where possible, but in some instances, ran into data availability issues. In such instances, we had to rely on the latest available data up to 2014 for the 2015 GPS, and the latest available data up to 2018 for the 2019 GPS. In some instances we also had an overlap between data used for the 2015 and the 2019 GPS due to data availability issues. Specifically, there was overlap for three indicators, namely violence against women, formal employment, and financial inclusion. For violence against women and formal employment, the same data were used in the re-created 2015 model and the new 2019 model because time-series data were not available. For financial inclusion, the first two sub-indicators have time-series data for many countries, but the third sub-indicator was new and did not include time-series data due to data updates to the World Bank Findex database. There was also overlap for certain countries on other indicators. For instance, there is an overlap for 14 countries in the case of women in parliament, part of the political representation indicator, as there was limited time-series coverage available for these countries. There were also overlaps in data for 66 countries for child marriage, eight countries for being an account holder at a financial institution (within financial inclusion), five countries for borrowing from a financial institution (within financial inclusion), and one country for internet usage (within digital inclusion). These overlaps largely reflect the fact that latest data for these countries go up to 2014. Therefore, the same values are used in both models.

Gender Parity Score (GPS) calculations

In MGI's 2015 research on the power of parity, the 15 GPS indicators were grouped into four categories: equality in work, essential services and enablers of economic opportunity, legal protection and political voice, and physical security and autonomy. The last three categories were also combined to create a category of "gender equality in society" indicators. For each of the four categories, each of the 15 indicators used, and each of the 125 countries in the sample used in this report, we calculated how close women are to gender parity. We then combined average gender parity levels into one number—the GPS. To aggregate country scores into regional scores, we weighted our results based on the size of the female population in each country in the region. We weighted the 15 indicators equally. A GPS value of 1.0 indicates full gender parity, while a GPS value of zero indicates inequality

To arrive at the level of gender inequality, we combined the country's position on our 15 gender indicators using the sum-of-squares method and assuming equal weight to each indicator as:

$$GPS = 1 - \sqrt{\frac{(1-a_1)^2 + (1-a_2)^2 + \cdots + (1-a_n)^2}{n}}$$

where, a_1 = F/M ratio in gender equality indicator 1, a_2 = F/M ratio in gender equality indicator 2, etc. For further details on the GPS methodology, please refer to the technical appendix of the original 2015 report.[229]

MGI determined different thresholds to classify inequality by indicator, as well as for the GPS more broadly. We chose to use an absolute measure of equality levels across indicators, rather than relative thresholds for each indicator, to ensure an objective assessment of equality. This approach is consistent with our 2015 work, and the thresholds were chosen by examining the education indicator, which we believe is a core gender equality indicator and one where significant progress has been made. Based on our 2019 GPS, only one country has a gender gap of greater than 50 percent for this indicator, about 16 percent of countries have gaps greater than 25 percent, and about 60 percent of countries have gaps smaller than 5 percent.

For a few indicators, the thresholds used differed from this main threshold methodology, given the different distribution of data for this indicator. For physical security and autonomy indicators, where we felt the severity of the indicators warranted different thresholds, we defined extremely high inequality as greater than or equal to 33 percent distance from no prevalence (of child marriage or violence against women), or one in three women affected. For maternal mortality, the thresholds were informed by the relative distribution of maternal mortality ratios across countries. For example, we used a cut-off of ten deaths per 100,000 live births for "low" equality, based on maternal mortality ratios typically seen in highly developed countries such as the Scandinavian countries. Similarly, we used a threshold of 200 deaths per 100,000 live births for "extremely high" inequality, as it represented a natural break in the relative performance of countries. For sex ratio at birth, a review of literature on this topic found that the natural male-to-female ratio at birth is typically around 1.06.[230] However, data for 2005 to 2010 from the UN typically had values significantly above this number. We therefore set our threshold for "extremely high" and "low" equality at 1.09, which was slightly above the world average of 1.086 and above which we saw significantly higher values for a few countries (including India and China).

It is important to point out that digital inclusion has the lowest country coverage compared with the other indicators. This is based on data availability of the indicator by gender. While digital reach data are available for most countries, the data by gender split are still sparse. The United Nation's International Telecommunication Union is the primary source of data on internet use, and Sustainable Development Goal indicator 5.b.1, proportion of individuals who own a mobile telephone, by sex (percent), covers mobile phone use in 46 countries.

In some instances, where there were extensive gaps in available data for a country, we used regional averages to extrapolate missing values and calculate the GPS for the country. We did this to ensure that scores were not skewed significantly due to missing data. We undertook such extrapolations to ensure that countries with missing data were sufficiently comparable with their peer group of countries.

[229] *The power of parity: How advancing women's equality can add $12 trillion to global growth,* McKinsey Global Institute, September 2015.
[230] Stephan Klasen and Claudia Wink, "Missing women: Revisiting the debate," *Feminist Economics*, 2003, Volume 9, Issue 2–3.

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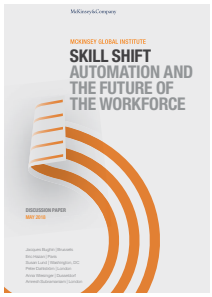

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