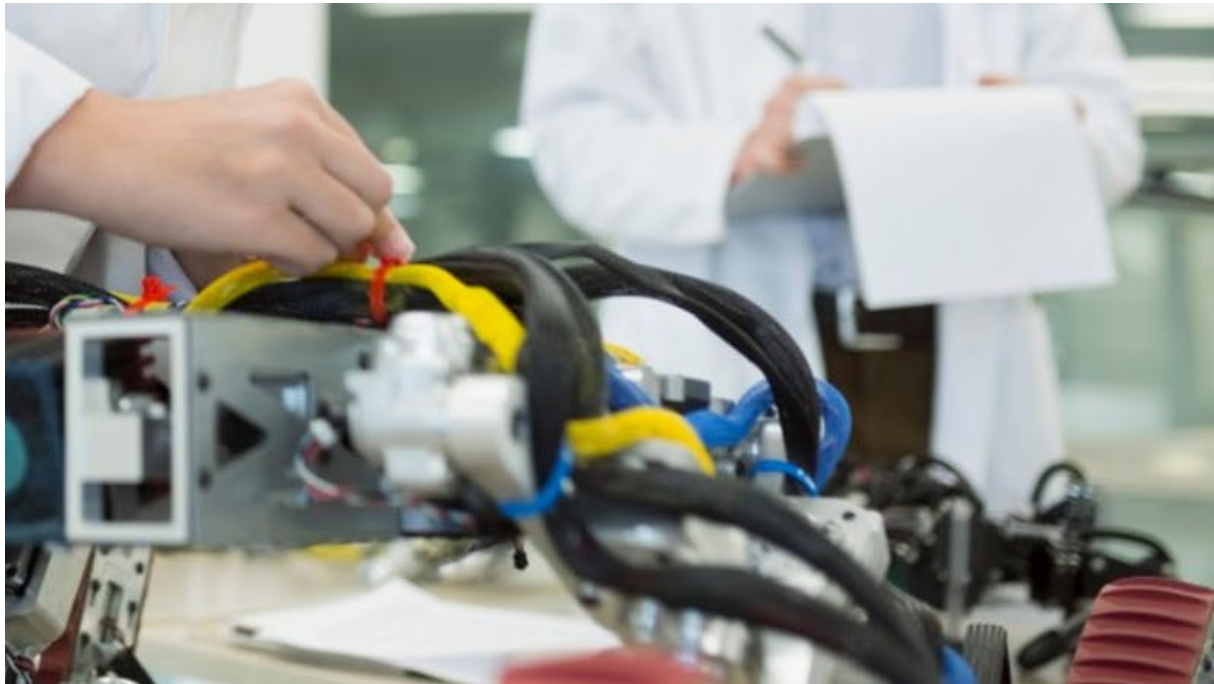
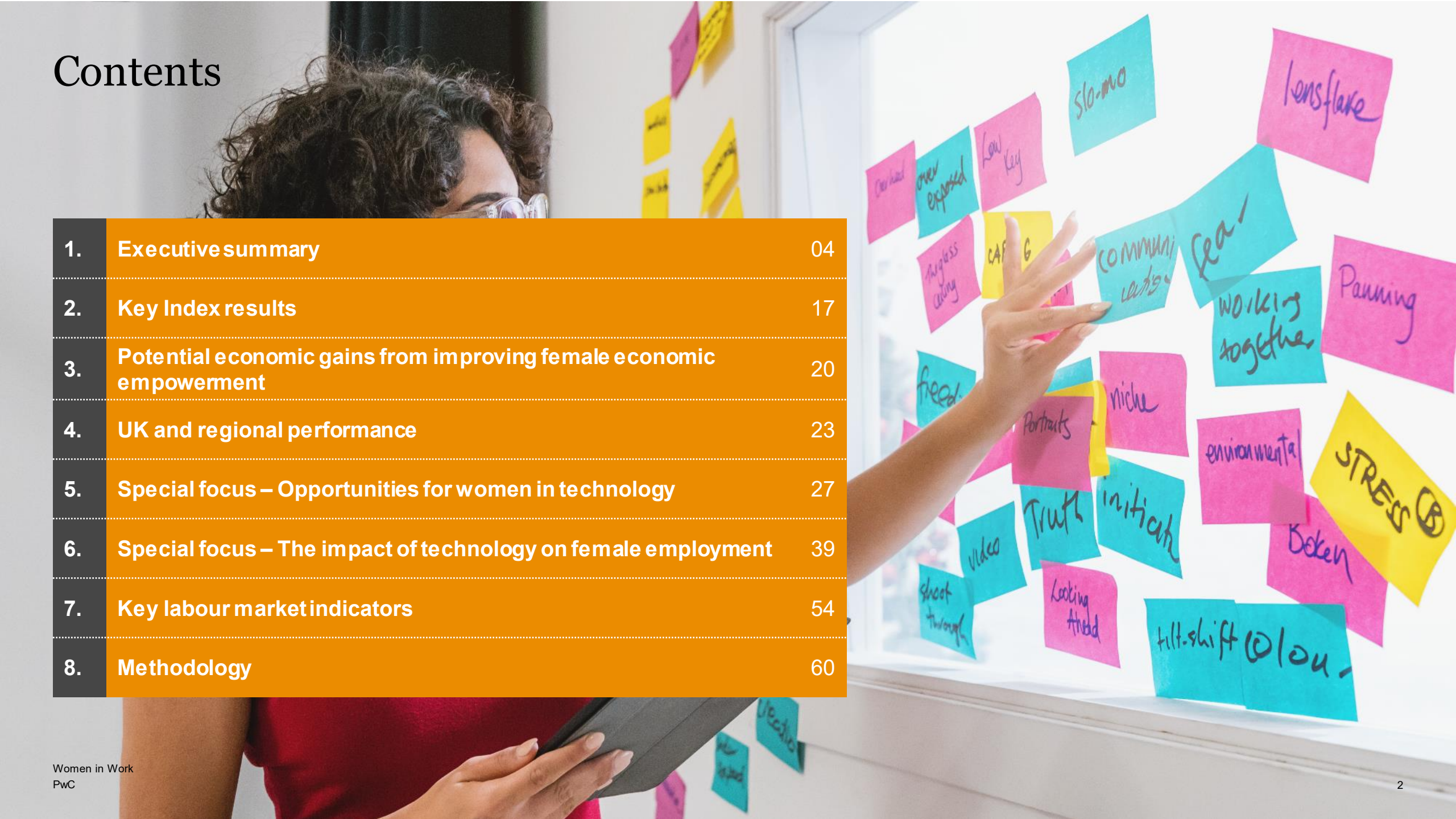
Women in Work

The opportunities and challenges of the tech revolution

March 2020



Contents



Foreword

International Women's Day 2020 is an opportunity for us to celebrate the successes and continued strides that women have achieved in the workplace. Our Index this year shows that once again, Iceland and Sweden take the top place, while the UK remains in 16th place.

However, while progress has no doubt been made, the pace of improvement remains slow. The World Economic Forum Global Gender Gap Report 2020 projects that on current trends, the global gender gap will take nearly a century to close. Progress has also brought its own challenges: around the world, the backlash against women's rights has been growing, which means that the gains that have been made cannot be taken for granted.[1]

But there is a huge prize at stake from accelerating progress: Our index shows improving female participation in work across the OECD could boost OECD GDP by US$6 trillion, while closing the gender pay gap could boost OECD GDP by US$2 trillion.

The theme of this year's Women in Work 2020 report focuses on the opportunities and challenges that technology presents to women in the workplace.

In the first of our two special articles, we explore how women have been able to take advantage of opportunities in the tech sector across the G7. We find that Canada is the best performing country within the G7 in terms of gender representation and equality in the tech sector.

However, the sector still has a lot of catching up to do compared to others. Despite the large amount of evidence to support the positive impact of diversity on business performance, on average across the G7, women account for only 30% of the tech workforce, and even fewer women occupy the top positions of tech companies.

Examples of the pitfalls of lacking a diverse workforce in the tech sector are abound, from the development of products that don't work as well for women as men (such as smartphones largely designed for male hands), to algorithms that perpetuate gender biases (such as in CV screening software for recruitment purposes).

But there is much that tech companies can do to address this. One of the most important priorities is to build and sustain a pipeline of diverse talent, and in this regard, PwC UK is a proud supporter of the Tech She Can® Charter in the UK, which is campaigning to inspire and educate young girls and women to get into tech careers.

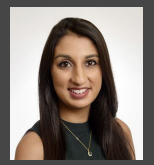
However, the power of new technology can also bring new sets of challenges. AI, robotics and other forms of automation are advancing at a rapid pace, bringing great benefits to the economy, but also a lot of disruption to labour markets. A recent global PwC survey found that more than half of workers globally believe that automation will either significantly change or make their job obsolete within the next ten years[2]. In our second article, we explore in which countries are women most vulnerable to automation, building on our previous research on the impact of automation on jobs,[3] and the potential for female job creation in the future. We find that there could be a small gain to female workers in the OECD, but the distribution of gains and losses can vary markedly across countries and industry sectors.

There is much that policymakers and businesses can do to help people, especially women adapt to technological change throughout their working lives. Governments and businesses can offer workers, especially women, increased training in digital skills and STEM subjects, and support retraining into other jobs in sectors where the "human touch" is crucial.

This also means offering opportunities for formal or on-the-job training in softer skills, such as creativity, problem solving and flexibility. PwC can also help business organisations understand which segments of their workforce are more likely to be exposed to automation, and hence provide employees with targeted support to retrain or upskill. With the right interventions, everyone including women can benefit from the gains in productivity from technology and automation.

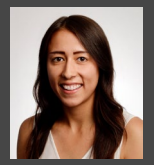
We hope you find this year's study useful. Please do get in touch if you have further questions or comments about this study, or to discuss how we can help your organisation address these issues.

Jing Teow
Senior Economist, PwC UK



Alisha Kapoor
Economist, PwC UK

Alex Cooper
Economist, PwC UK



Tara Shrestha Carney
Economist, PwC UK

1

Executive summary

The Organisation for Economic Cooperation and Development (OECD) continues to make gains to female economic empowerment, however continued progress is needed to achieve gender-parity in the workplace

The eighth update of the Women in Work Index provides our assessment of female economic empowerment in 2018 across 33 OECD countries. The Index is a weighted average of five indicators that reflect female participation in the labour market and equality in the workplace.

Between 2017 and 2018, our Index shows the OECD continued to achieve incremental gains to female economic empowerment, mainly as a result of increasing the female labour force participation rate and the female full-time employment rate, as well as reducing the female unemployment rate.

The top **three** performing OECD countries remain the same as last year, with **Iceland** and **Sweden** retaining the top two positions on the Index for the fifth year in a row, and **Slovenia** in 3rd.

Estonia and **Ireland** recorded the biggest decline in their ranking on the Index, both falling by 4 positions mainly due to a decrease in the female full-time employment rate in **Estonia** and a widening of the gender pay gap in **Ireland**.

Czechia experienced the biggest improvement in its ranking on the Index of all OECD countries between 2017 and 2018, rising 4 places from 23rd to 19th, owing to small but positive improvements across all of the indicators in the Index, in particular the participation rate gap and the female unemployment rate.

Belgium and **Poland** recorded the greatest increase in absolute performance, due to strong improvements across nearly all indicators, with the **Poland** seeing the largest decrease in the gender pay gap across the OCED.

Note that the Index results for 2017 have changed compared to those reported in the Women in Work Index 2019 due to retrospective changes to the historical data. More detail can be found in the Methodology section of the report

The OECD continues to make gains to female economic empowerment, however continued progress is needed to achieve gender-parity in the workplace

The top 3 performing countries remain unchanged, with Nordic countries occupying the top two positions on the Women in Work Index, and Slovenia in third place.

Source: PwC analysis, all data sources are listed in the Methodology section.

Potential long-term economic gains

- Significant economic benefits can be generated in the long-term from increasing the female employment rate to match that of Sweden. The GDP gains across the OECD could be over US$6 trillion.
- Across the OECD, fully closing the gender pay gap could increase total female earnings by US$2 trillion.

Boost to OECD GDP from increasing female employment rates to match Sweden's

$6tn

Boost to OECD female earnings from closing the gender pay gap

$2tn

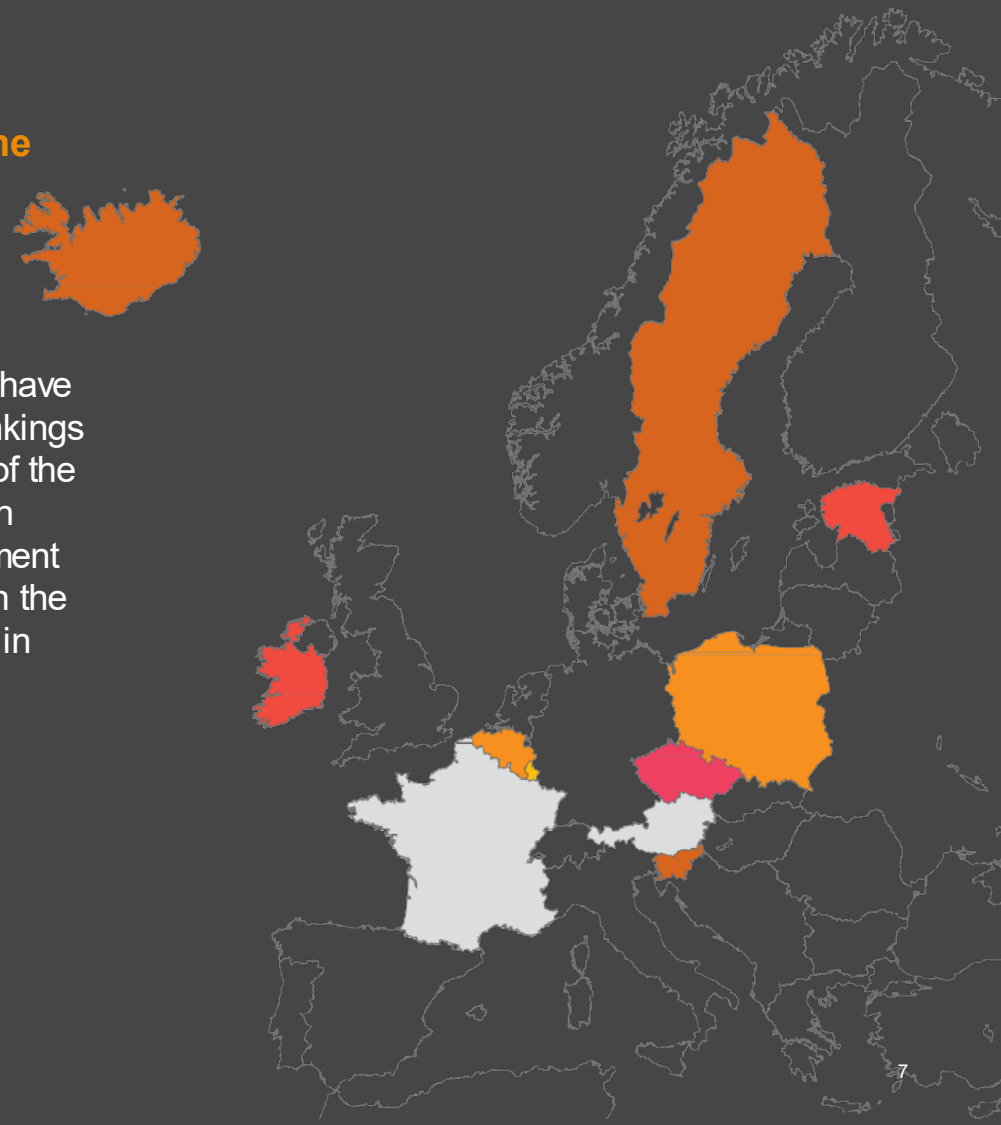
Source: PwC analysis, all data sources are listed in the Methodology section.

The OECD continues to make gains to female economic empowerment, however continued progress is needed to achieve gender-parity in the workplace

Over the longer term there have been significant movements in country rankings, largely due to changes in the gender pay gap, the female unemployment rate and the gender gap in labour force participation.

▼ Since 2000, **Luxembourg** and **Poland** have made significant improvements on the Index, as a result of a substantial reduction in the participation rate gap and the gender pay gap in **Luxembourg** and a large decrease in the female unemployment rate in **Poland**.

▲ Conversely, **France** and **Austria** have both fallen significantly on the rankings since 2000, owing to a widening of the gender pay gap in **France**, and an increase in the female unemployment rate and a substantial reduction in the female full-time employment rate in **Austria**.



Source: PwC analysis, all data sources are listed in the Methodology section.

The UK's position on the Index remains unchanged at 16th, but it is increasingly being out-paced by greater improvements elsewhere in the OECD

UK Ranking #16

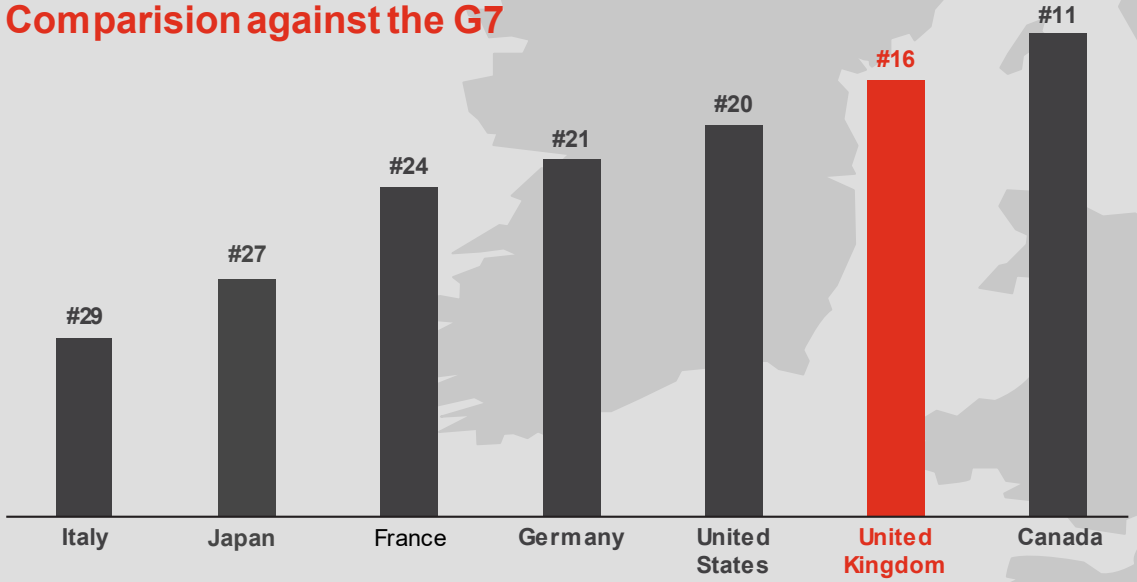
The UK continues to perform above the OECD average, but the gap is closing

From 2017 to 2018, the UK charted improvements across all indicators of the Index, except the female labour force participation rate, which fell marginally.

That said, the UK performs better than the OECD on average. Between 2000 and 2011, the UK's Index score was below the OECD average, but it then began to outperform the average from 2012 onwards, pulling away quickly until 2015. However since then, the gap between the UK and OECD has narrowed and the UK's rank has remained the broadly the same, which suggests that improvements made elsewhere in the OECD are outpacing progress in the UK.

The UK performs well when compared to other G7 economies. Overall, it is second only to Canada and performs above the G7 average with respect to all indicators.

Comparision against the G7



Source: PwC analysis, all data sources are listed in the Methodology section.

Women's employment opportunities have improved across the regions, with poorer performing regions closing the gap

This year's update to the UK regional index points to a narrowing of regional inequality in women's employment opportunities

All regions except Scotland have improved their absolute score on the index since last year.

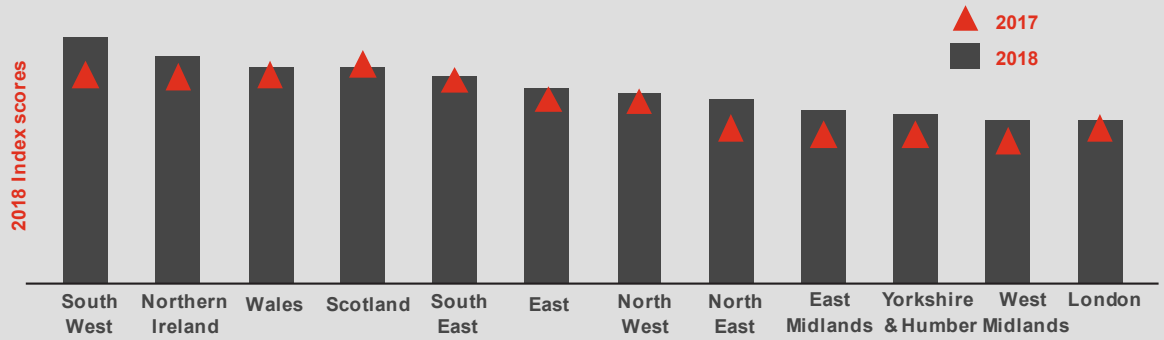
The South West now takes first position, unseating Scotland, as a result of improvements on all indicators, most notably the gender gap in labour force participation and the gender pay gap. Northern Ireland has improved from 4th place to 2nd due to the largest improvement of all regions in its female labour force participation rate, although it still lags behind other UK regions on this indicator.

London has fallen three places to 12th as a result of a widening gender pay gap and gender labour force participation gap. It is the region that has achieved the the biggest improvement in its index score since 2010, but progress has stalled more recently.

The biggest improvements in absolute terms have been observed in the poorer performing regions, thus these places are closing the gap with the rest of the UK.

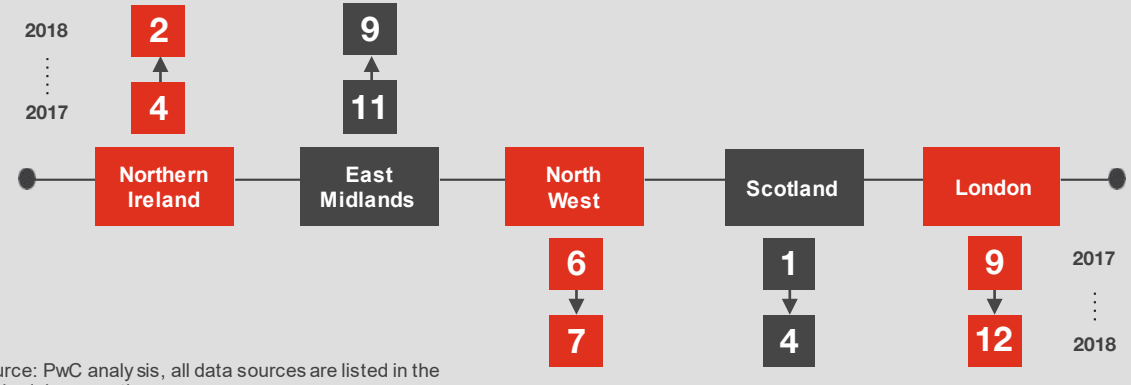
In particular, the East Midlands, North East and West Midlands have achieved increases in their index score of over 12% since last year, mainly driven by broad-based improvements to female labour force participation and full-time employment, as well as the gender pay.

Women in Work regional index score, 2018 and 2017



Source: PwC analysis, all data sources are listed in the Methodology section.

Biggest movers in the PwC Women in Work Index ranking between 2017 and 2018



Source: PwC analysis, all data sources are listed in the Methodology section.

Canada leads the way for women in tech in the G7, however all countries have a long way to go to improve gender diversity in the tech industry

On average for the G7

1 in 5
Of ICT graduates are females

23%
Percentage of women on boards in technology, media and telecommunications

30%
Female share of employment in the technology industry[6]

18%
Gender pay gap in the technology industry[7]

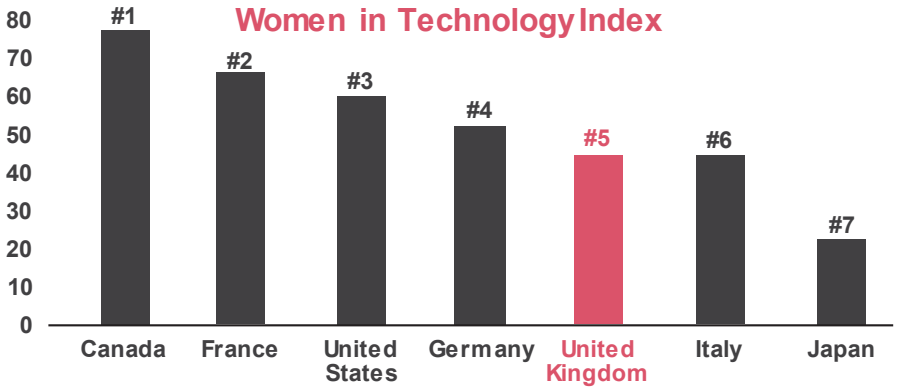
Source: PwC analysis, all data sources are listed in the Methodology section.

More women than ever before are choosing the fast-growing technology industry as a pathway to career success.[4] Our Women in Technology Index provides an assessment of female representation in tech across the G7.[5]

- Similar to its position in the G7 on the main Women in Work Index, Canada is the best performing country in the G7 on the Women in Technology Index. This is due to its strong and better than average performance on all indicators except the share of women on boards in the technology, media and telecoms (TMT) sector.
- France comes in second place, due to its to better than average performance on all indicators except for the female share of ICT graduates. France also has by far the highest share of women on boards in TMT in the G7 (38%).
- In contrast to the main Index, on which it is the second best performing country in the G7 and ranks in the top half of the OECD overall (16th), the UK ranks in 5th place in the Women in Technology Index for the G7. The UK's poor performance on the Women in Technology Index is driven by its worse than average performance on all indicators except the share of women on boards in TMT.
- Italy takes sixth, with Japan in last place. Both countries' poor performance is due to their below-average performance on most indicators. Italy in particular has the lowest female share of ICT graduates, and Japan the lowest female share of technology employment and share of women on boards in TMT in the G7.

How does the technology industry compare to the wider economy?

- On average, across the G7, the technology industry performs worse than the average for all industries on various measures of equality, particularly on the pipeline measure (the female share of ICT graduates compared to the share of graduates in general that are women), as well as share of employment. However, the G7 tech sector appears to be performing similarly to other sectors on female board representation.
- This suggests that the tech sector faces a unique challenge on female representation, and that there may be drivers that are specific to, or are more pronounced in the tech sector.



Source: PwC analysis, all data sources are listed in the Methodology section.

Women face a number of challenges in the tech sector

Why are women in tech underrepresented, and what can technology organisations do to increase opportunities for women in the sector?

We identify a number of challenges facing women throughout their career life cycle.

Gender stereotypes and a lack of female role models

Women face a number of challenges in entering, as well as staying in the tech sector. Gender stereotypes and biases that technology, both as an occupation and a product, is for men, can contribute to female underrepresentation and gender inequality in the tech industry.[8] They can discourage women from aspiring to a career in tech and acquiring digital skills from an early age, which limits the available pipeline of women seeking careers in tech.

The lack of senior women in tech suggests that women are less visible in the sector, and that younger women also lack the mentorship and networks to provide coaching and advice, and support their career progression. [9]

Skills and qualifications

The acquisition of technical knowledge, such as numeracy and STEM-related subjects, is crucial in taking up technical roles in the tech sector. However, women tend to be less equipped with these skills,[10] despite no gender differences in ability for learning these skills. This suggests that there are other social and cultural factors at work influencing the take-up of these skills by women.

Workplace experiences for women

Many women join the tech sector to develop their skills through technical roles that enable direct involvement in the development of products and services. However women tend not have the same access to core, creative technical roles as men and are more often clustered into execution and project management roles.[11]

Tech firms can foster an environment, which leads to women feeling isolated or lacking a sense of belonging in tech workplaces.[12]

Women also often feel stalled in mid-level positions due to the lack of leadership and development opportunities,[13] and a lack of mentors, sponsors and informal networks can mean that women's accomplishments are less visible, which can limit progression.[14]

However organisations can take action today to promote opportunities for women and improve female representation in tech

Organisations in the tech sector can implement a range of policies to address these challenges.

Developing the pipeline of female talent

Female role models, and encouraging girls and young women to develop STEM skills and aspire to careers in technology are crucial to developing the pipeline of female tech talent. Tech companies and other public sector and third sector organisations can contribute to this by collaborating with educational institutions to promote and celebrate successful women in technology and educate and inspire pupils and teachers about technology careers.

Attracting women into the industry

Recruiting more women into the technology industry is vital to improving female representation and challenging gender stereotypes. Organisations can help achieve this by ensuring that branding and job descriptions are gender-neutral and that recruitment teams are gender-balanced. Furthermore, setting targets for the number of women on vacancy shortlists is demonstrably effective in improving representation.[15]

Fostering an inclusive workplace culture

Promoting inclusivity in the workplace is crucial to attracting, retaining and developing female talent within the technology industry.[16] Organisations can implement a number of initiatives such as mentorship schemes to support career planning, women's networking groups and events to provide a forum for support and discussion, to help organisations better understand the issues women face in the workplace and how these can be addressed. There is also scope for cross-industry learning and the sharing of best practices.

Providing opportunities for development

One way organisations can help address both the pipeline and progression of women in tech is by focusing on training and education. For example, by implementing retraining and returner programmes and creating alternative hiring pathways to allow employees to move into different roles. Learning and development initiatives are particularly important to facilitate progression in the technology industry, as technical roles, and especially those that are senior, often require a high level of skills and specific expertise in order to access them.

Women are less susceptible to automation than men

The growth of advanced technology will present both challenges and opportunities for the labour force. AI and related technologies such as robotics, drones and driverless vehicles could displace many jobs formerly done by humans, but may also create many additional jobs as productivity and real incomes rise and new and better products are developed.

Understanding the different impact that new technologies may have on male and female employment can inform policy to help mitigate disproportional gender-specific effects.

Fewer female jobs are expected to be lost from automation relative to jobs lost for the male population in the OECD.

Our analysis shows men tend to be concentrated in sectors that are more highly automatable, such as transport and manufacturing, while women are slightly less susceptible to automation as they are more concentrated in sectors, such as health and social care and education, which are less automatable.

The gains from the income effect are likely to be bigger for men than women.

Technological adoption can also result in an income effect that counteracts the jobs displacement effect, as tech-driven cost savings improve production efficiency, leading to lower prices and boosting household real incomes. Job creation is more likely to benefit male workers rather than female workers, as high levels of job creation are estimated in the manufacturing sector, which is typically dominated by men. For women, this “income effect” is highest in the human health and social work sector.

The health and social care sector, the largest employer of women in the OECD, is expected to experience a net increase in female employment as a result of technology

The health and social care sector, as well as the education sector, is expected to experience a small net gain in female jobs resulting from the effects of technology.

The human health and social work sector could see a net increase in jobs (around 3%) for female workers. This is largely driven by the expected rapid growth in the sector as demand for health and social care increases to care for an ageing population and the lower exposure to automatability estimated over the next 20 years.

On the other hand, the number of jobs for female workers in the wholesale and retail trade, manufacturing, and other services sectors, could decline as a result of technology and automation. These sectors collectively account for 30% of female employment currently, and there could be a net loss of around 10-20% of these jobs.

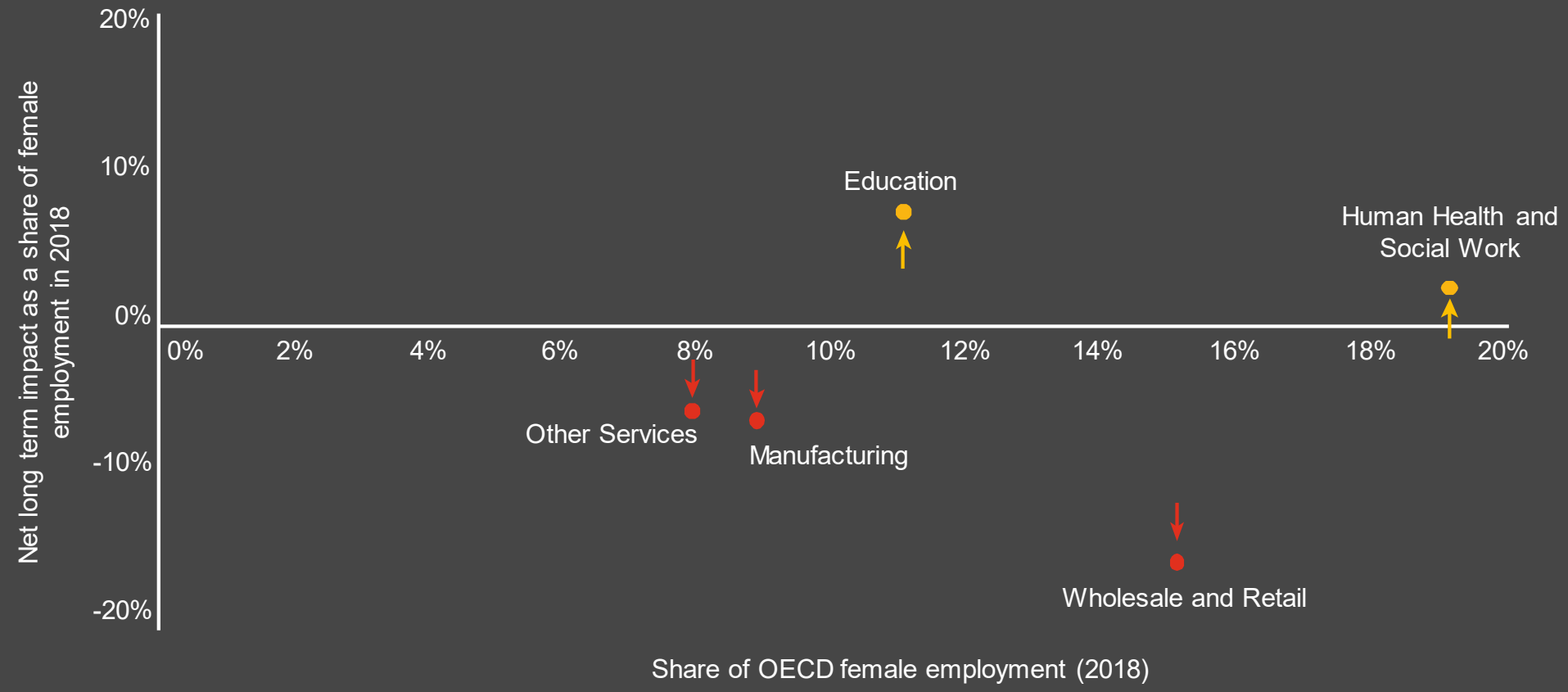
Ultimately, other factors, particularly education, are more important drivers than gender for determining the impact of automation.

Our previous research found that workers with low and medium levels of education have notably higher automation rates across countries, compared to those with higher levels of education.

Education and skill levels are also an important determinant of the types of occupations workers perform, which can also vary significantly in terms of automatability. Some occupations, such as machine operators and clerical workers, are more exposed to automation as these tend to involve routine or simple computational tasks. In contrast, the risk is lower for professionals and managers that require social skills and literacy skills, as well as dealing with more complex computational tasks that are less automatable.

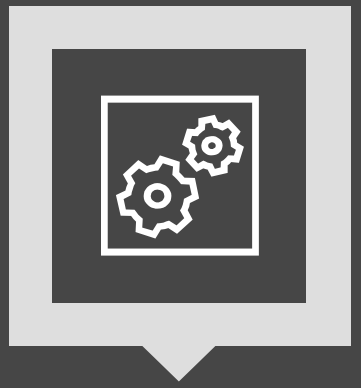
The health and social care sector, the largest employer of women in the OECD, is expected to experience a net increase in female employment as a result of technology

Net impact of technology on female employment and share of female employment across the OECD

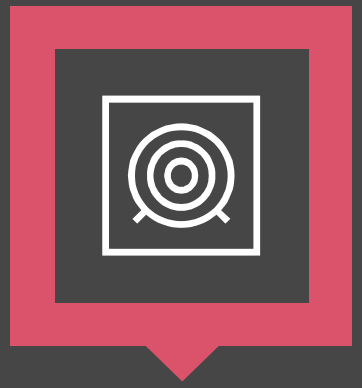


With the right interventions, everyone, including women, can benefit from the gains in productivity from technology and automation

Businesses and governments can collaborate to retrain and upskill the workforce to have the skills they need to succeed in the future



Stronger social safety nets can help manage the impact of automation on women and the economy



Effective regulation and competition policy can help consumers benefit from technological advances

Careful engagement with AI and technology is needed to maximise the potential value from technology, while minimising its negative impacts on workers

2

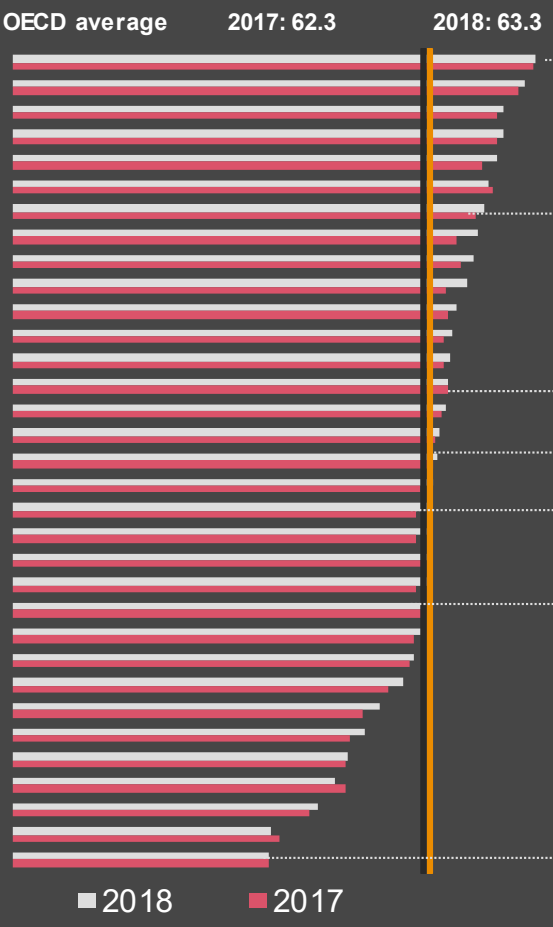
Key Index results

The OECD continues to make gradual progress to improve female economic empowerment, mainly driven by a closing of the gender pay gap and a fall in the female unemployment rate

PwC Women in Work Index, 2018 vs. 2017

Rank (2017)		Rank (2018)	
1	=	1	Iceland
2	=	2	Sweden
3	=	3	Slovenia
4	=	4	New Zealand
6	↑	5	Luxembourg
5	↓	6	Norway
7	=	7	Denmark
9	↑	8	Poland
8	↓	9	Finland
12	↑	10	Belgium
11	=	11	Canada
13	↑	12	Australia
14	↑	13	Switzerland
10	↓	14	Ireland
15	=	15	Portugal
16	=	16	United Kingdom
17	=	17	Hungary
20	↑	18	Netherlands
23	↑	19	Czechia
22	↑	20	United States
18	↓	21	Germany
21	↓	22	Israel
19	↓	23	Estonia
24	=	24	France
25	=	25	Austria
26	=	26	Slovak Republic
27	=	27	Japan
28	=	28	Spain
30	↑	29	Italy
29	↓	30	Chile
31	=	31	Greece
32	=	32	Mexico
33	=	33	Korea

Source: PwC analysis, all data sources are listed in the Methodology section.



Iceland remains the top performer on the Index, improving on its index score from 2017 due to a reduction in the gender pay gap and the female unemployment rate, as well as an increase in the female full-time employment rate.

Norway fell from 5th position to 6th due to its worsening index score since 2017, driven by a rise in the gender pay and participation gap and a decrease in the female full-time employment rate.

Ireland experienced the biggest decline in its ranking across the OECD (along with Estonia), falling by 4 places from 10th to 14th place, mainly as a result of a widening of the gender pay gap.

Despite improvements on all indicators except the female participation rate, the UK's position remained the same at 16th due to significant improvements in female employment prospects elsewhere in the OECD.

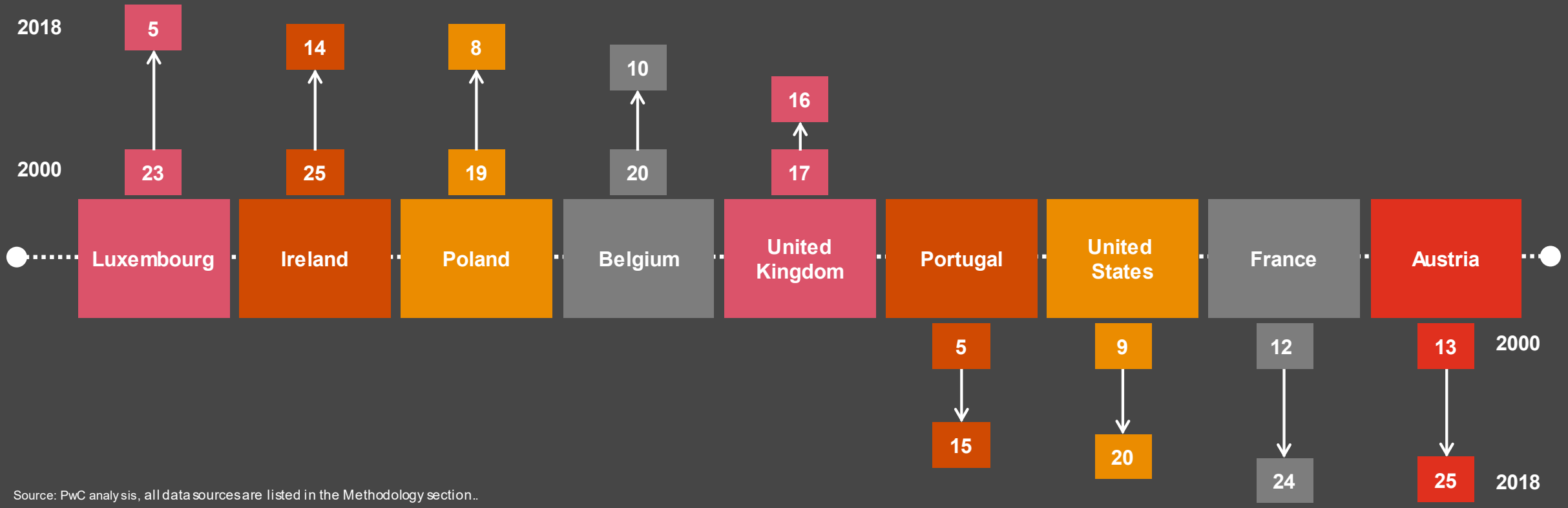
Czechia experienced the largest improvement in its ranking across the OECD – rising by 4 places from 23rd to 19th. Its improvement was due to small but positive improvements across all of the indicators in the Index, in particular the participation rate gap and the female unemployment rate.

Estonia recorded the biggest decline in its ranking across the OECD (along with Ireland), falling by four places from 19th to 23rd, mainly due to a decrease in its female full-time employment rate.

Korea remains at the bottom of the Index with a lower index score than 2017, owing to a worsening of its gender pay gap, female unemployment rate and female full-time employment rate, and a lack of significant improvement on other indicators.

Since 2000, Luxembourg has made the greatest improvement in its ranking, whereas Austria and France have seen the largest decline

Biggest movers in the PwC Women in Work Index ranking between 2000 and 2018



Source: PwC analysis, all data sources are listed in the Methodology section..

3

Potential economic gains from improving female economic empowerment

Increasing the female employment could boost GDP across the OECD by over US$6 trillion

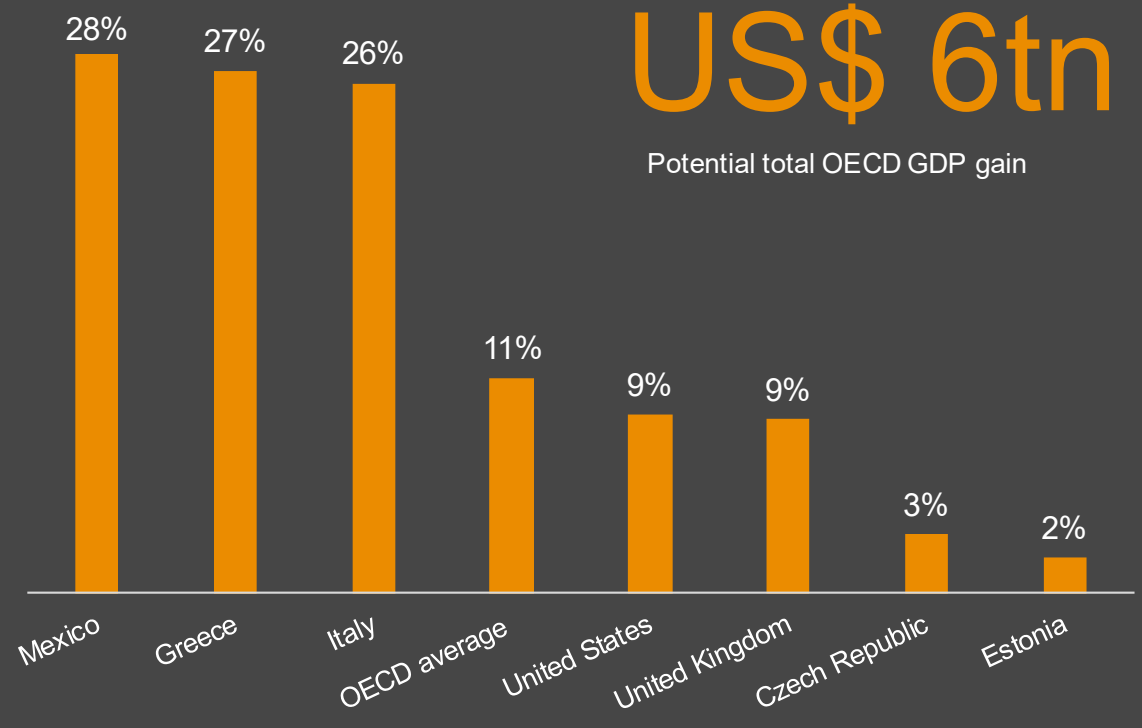
Our analysis provides estimates of the broad order of magnitude of potential gains for each country from increasing female employment rates to match those of Sweden – a consistently top performer in our Index with a female employment rate of 69%

- The potential long-term economic gains across the OECD from an increase in women in employment amount to a **GDP increase of over US$6 trillion.**
- In absolute terms, **the US is expected to gain the most, as much as $1.8 trillion**, almost three times as much as the next biggest winner, Mexico.
- Countries with relatively low female employment rates such as Mexico, Italy and Greece are likely to accrue the largest potential gains in percentage terms. Increasing female employment rates to those in Sweden could generate **GDP increases of nearly 30%** for these countries.
- Countries that already have a high share of women in work, such as Estonia and Czechia, would enjoy a smaller boost in GDP.

The economic benefit to the UK from improving gender equality in the workplace could be substantial:

- Increasing the female employment rate from 58% to that of Sweden (69%) results in **gains of around 9% of UK GDP, or US$270 billion (or £189 billion).**

Potential gains from increasing the female employment rate across the OECD to match Sweden's



Source: PwC analysis.

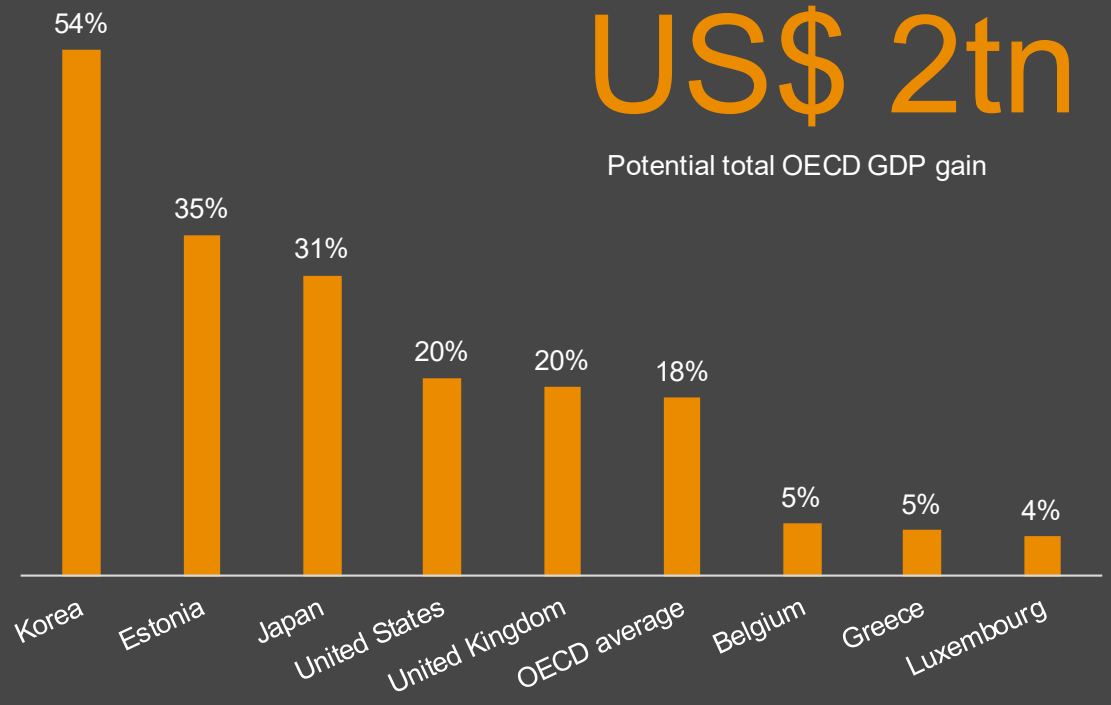
Closing the gender pay gap could boost female earnings across the OECD by over US$2trillion, an increase of 21%

We consider the potential gains from closing the pay gap between men and women across the OECD.

Closing the pay gap by increasing female average wages to match their male counterparts would generate a significant increase in female earnings.

- The gains to female labour earnings from closing the gender pay gap could be over **US$2 trillion across the OECD.**
- Of the OECD countries, the United States is anticipated to achieve the most gains in absolute terms from closing the pay gap, with total female earnings increasing by **$801 billion**, almost three times as much as the next biggest winner, Japan.
- The largest gains in percentage terms could be found for countries with the largest gender pay gaps, notably Korea, Estonia and Japan. The increase in female labour earnings from closing the pay gap in these countries could range from one-quarter to two-thirds of the current value**. Korea's female earnings could see a large increase of 55% from pay parity across males and females.**
- Countries with relatively small gender pay gaps such as Luxembourg, Greece and Belgium are likely to generate a smaller increase in female earnings.
- Closing the gender pay gap in the UK possibly **increases female earnings by £93 billion (US$ 116 billion), implying an increase of 20% of its current value.**

Potential gains from closing the pay gap across the OECD



Source: PwC analysis.

4

UK and regional performance

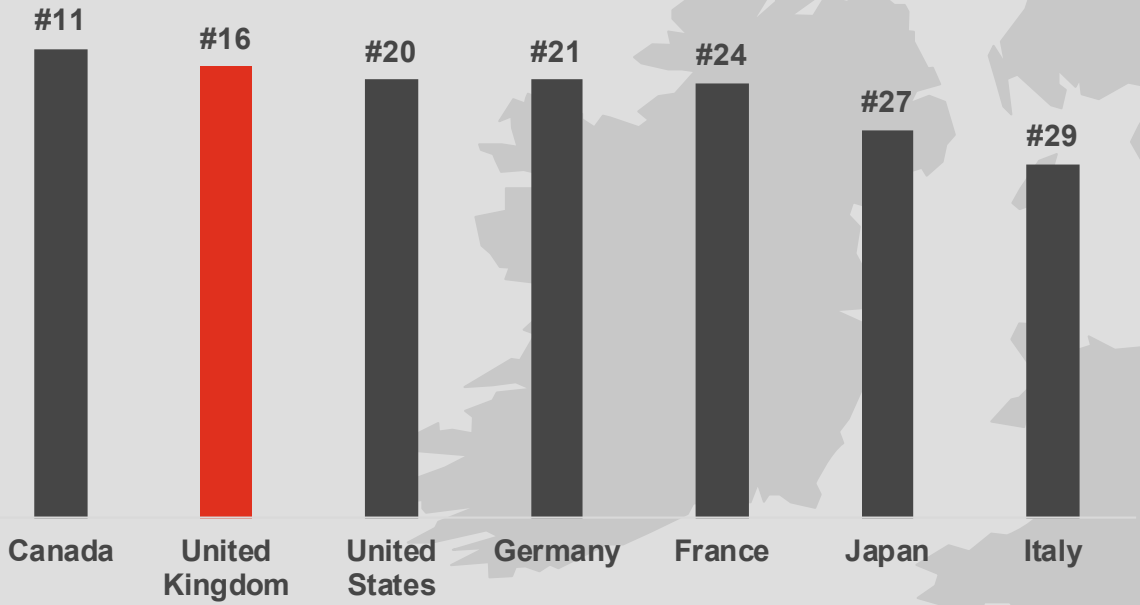
The UK's position on the Index remains unchanged at 16th, but it is increasingly being out-paced by greater improvements elsewhere in the OECD

UK Ranking #16

UK performance 2017-2018

- The UK saw no change in its position between 2017 and 2018, remaining in 16th position. Over this period, the UK saw small improvements on all indicators except for the female labour force participation rate, which decreased marginally.
- One of the key areas holding back the UK's progress is a persistent gender pay gap (16%),[17] which continues to be higher than the OECD average and barely changed between 2017 and 2018.
- Another area of weakness for the UK is the female full-time employment rate, which is significantly below the OECD average. Following the economic downturn in 2008, female full-time employment in the UK decreased while part-time employment increased. This trend has since reversed and there has since been steady growth in female full-time employment since 2012.[18] Nonetheless, in 2018, the UK female full-time employment rate remains 12 percentage points below the OECD average.
- The UK performs well when compared to other G7 economies, being only second to Canada. This is due to the UK performing better than the G7 average on all indicators. However it lags behind Canada on all indicators except the female unemployment rate and the gender pay gap.

Comparision against the G7



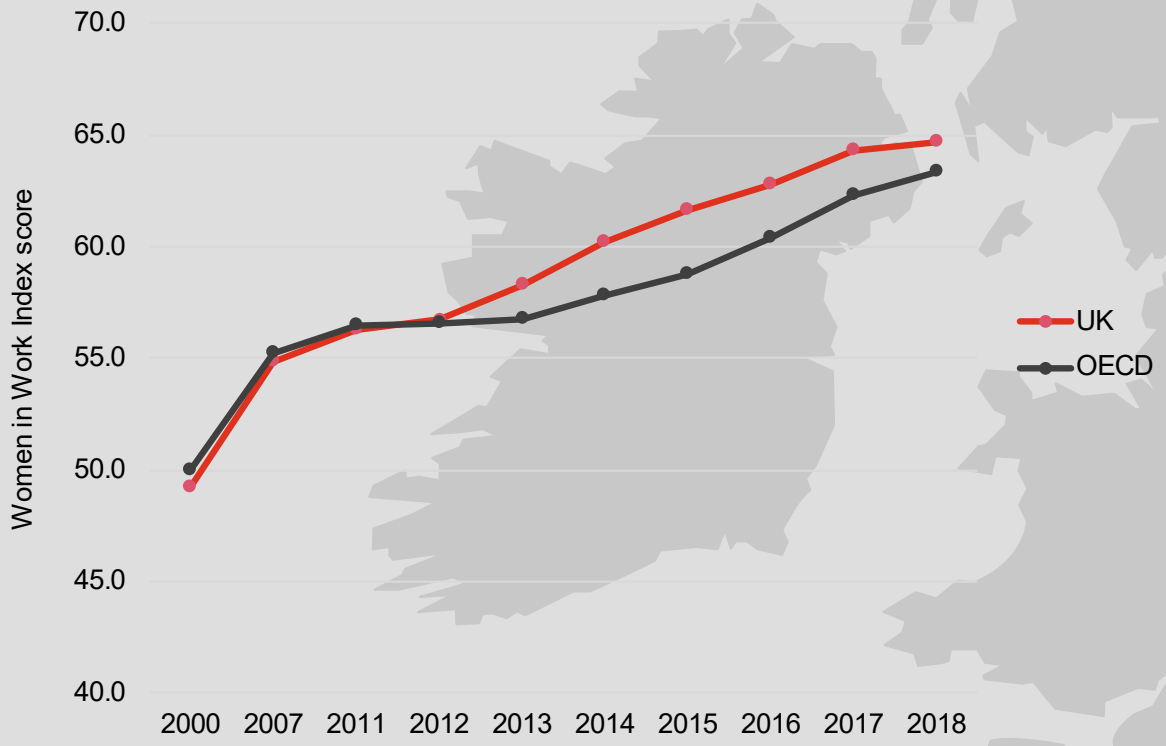
Source: PwC analysis, all data sources are listed in the Methodology section.

The UK continues to outperform the OECD, but a persistent gender pay gap remains an obstacle to progress

Long term trends: UK performance since 2000

- The UK's position has barely budged since 2000 when it stood at 17th position on the Index, demonstrating slow progress over the years.
- However, it performs better than the OECD on average. Between 2000 and 2011, the UK's Index score was below the OECD average, but it then began to outperform the average from 2012 onwards, pulling away quickly until 2015. However since then, the gap between the UK and OECD has narrowed and the UK's rank has remained broadly the same, which suggests that improvements made elsewhere in the OECD are outpacing the UK.
- Compared with 2000, the UK has improved its performance across all five indicators, with the largest improvement made in reducing the gender pay gap and the gender gap in labour force participation, which have fallen by 10 and 6 percentage points respectively.
- Similarly, over the longer term, the UK's key strength relative the rest of the OECD has been the female labour force participation rate, on which it has consistently outperformed the OECD average by at least 4 percentage points since 2000.
- In contrast, an area of weakness for the UK is the female full-time employment rate, on which it has consistently remained below the OECD average since 2000 by more than 11 percentage points.

UK Index performance compared to the OECD average



Source: PwC analysis, all data sources are listed in the Methodology section.

Women's employment opportunities have improved across the regions, with poorer performing regions closing the gap

This year's update to the UK regional index points to a narrowing of regional inequality in women's employment opportunities

All regions except Scotland have improved their absolute score on the Index since last year.

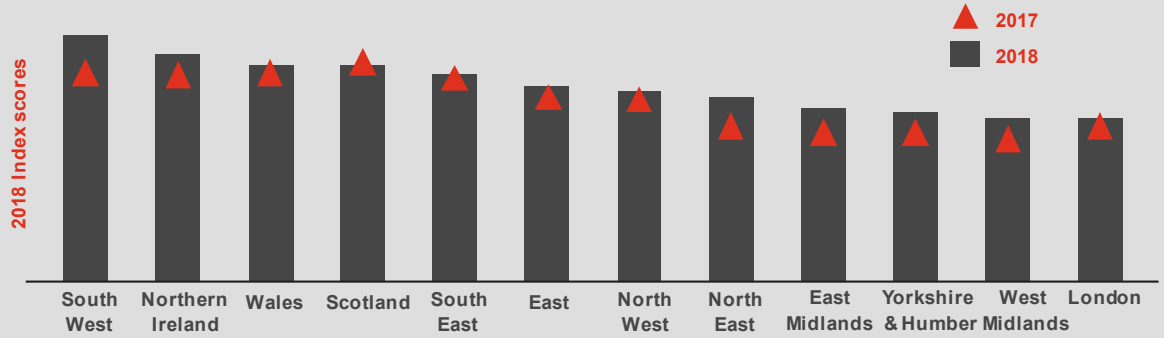
The South West now takes first position, unseating Scotland, as a result of improvements on all indicators, most notably the gender gap in labour force participation and the gender pay gap. Northern Ireland has improved from 4th place to 2nd due to the largest improvement of all regions in its female labour force participation rate, although it still lags behind other UK regions on this indicator.

London has fallen three places to 12th as a result of a widening gender pay gap and gender labour force participation gap. It is the region that has achieved the the biggest improvement in its index score since 2010, but progress has stalled more recently.

The biggest improvements in absolute terms have been observed in the poorer performing regions, thus these places are closing the gap with the rest of the UK.

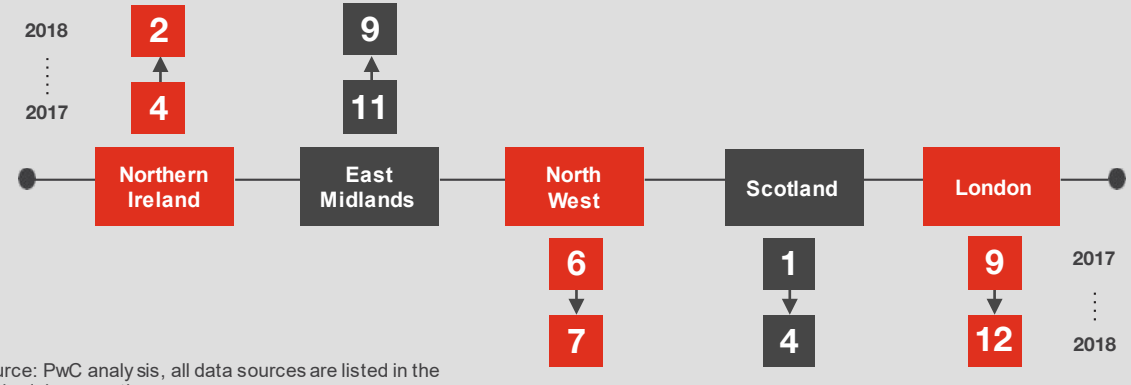
In particular, the East Midlands, North East and the West Midlands have achieved increases in their index score of over 12% since last year, mainly driven by broad-based improvements to female labour force participation and full-time employment, as well as the gender pay.

Women in Work Regional Index score, 2018 and 2017



Source: PwC analysis, all data sources are listed in the Methodology section.

Biggest movers in the PwC Women in Work Index ranking between 2017 and 2018



Source: PwC analysis, all data sources are listed in the Methodology section.

5

Special focus – Opportunities for women in technology

Increasing gender diversity brings significant benefits for the tech sector

More women than ever before are choosing the fast-growing technology sector as a pathway to career success.[19] However, despite efforts by technology companies and governments alike to increase female representation in technology, on average across the G7, women occupy only 30% of jobs in the tech industry. In this edition of Women in Work, we assess the opportunities and challenges faced by women in the tech industry that drive female representation in the sector. We also consider what businesses and policymakers can do to promote gender diversity and equality in the technology workplace.

Gender diversity is crucial to the financial performance of tech companies and industry as a whole

- A wealth of research shows that diverse organisations tend to be associated with better financial performance.[20] Diverse teams are more creative and innovative, this is particularly important in the tech sector where these traits can mean the difference between success and failure.[21] A recent study found that companies with more diverse management teams have 19% higher revenues due to innovation and these effects are stronger for companies which have high investment in digital technology.[22]
- One of the reasons that more diverse teams are associated with better financial performance is because they create better products.[23] The digital products and services that are created by people are shaped by their biases and personal experience. For example, the lack of gender diversity within technology companies can mean that employees lack the data, understanding and experience, to design and deliver products and services that are tailored to women, and function optimally for both men and women. Unsuitable product design can, in turn, have financial implications for technology companies, potentially in the form of lower sales, revenue and profit.

1 in 5
Of ICT graduates are female on average for the G7

30%
Average female share of employment in the technology industry for the G7

Source: PwC analysis, all data sources are listed in the Methodology section

However there is still a long way to go to achieve gender equality in the tech workplace

The tech sector still has a long way to go to improve female representation

- Despite the creative and financial benefits from increasing gender diversity, female representation in the tech sector remains low. On average across the G7, women make up less than a quarter of ICT graduates and occupy less than a third of jobs and less than a quarter of board positions in the tech industry.

- In addition, the tech sector has struggled with providing a conducive workplace environment for women, with lawsuits and allegations of gender discrimination and harassment being brought against a number of large and high-profile technology companies.[24]

- These cases show that not only does the tech sector still have a long way to go in fostering gender-equal and inclusive workplaces, but that these cases have also had a negative impact on the brand image of these companies. These failures can bring significant costs, both reputational and financial, from a workplace environment that does not promote diversity and inclusivity.

Improving opportunities for women in tech will be crucial to all industries and wider society in the tech revolution

Technology is expanding rapidly across the globe, creating new industries and increasingly shaping and disrupting existing ones. Many organisations outside of the tech sector employ significant proportions of their workforce in technology roles. Digital goods and services are used on daily basis by workers and consumers across all industries too. As a result, the impact of increasing gender diversity in tech stretches beyond the sector itself, bringing wider economic and societal benefits. Therefore the lessons and outcomes from increasing opportunities for women in tech are increasingly transferrable across all industries.

Gender diversity in tech is critical to ensuring that digital products and services better reflect the needs of users and wider society

- As highlighted, gender diversity in the tech sector has implications for digital product and service design. Furthermore, digital products and services with inherent gender biases that are subsequently used in workplace may serve to perpetuate biases and lead to gender discrimination. For example, artificial intelligence technology used by an organisation in any industry to screen applicants' CVs for recruitment purposes, which is gender-biased, might inadvertently discriminate against female job applicants.[25]

- Having diverse teams in the creation and development of digital goods and services are important. Firstly, to ensure they better reflect the needs of users and wider society. Secondly, to reduce gender biases from being incorporated into digital products and services. Finally, to help mitigate the secondary impact that these inherent biases can have on those who use these products and services. For example, in Europe and North America, crash-test dummies commonly used in vehicle safety tests are often designed to fit the specifications of the average male body and not those of the average female, which can have serious implications for women's safety on roads.[26] Inclusive teams, from design to development and deployment, can help businesses avoid these pitfalls.

Improving opportunities for women in tech will be crucial to all industries and wider society in the tech revolution

Increasing opportunities for women in tech will be vital to the future performance of the economy in the tech revolution

Organisations across all industries are increasingly employing workers in technology roles and using technology to facilitate their day-to-day business activities. The digitisation of the economy will require adaptable workers with new skills. In the UK, it is estimated that around 90% of all jobs over the next 20 years will require some level of digital skills.[27] These roles tend to be well-remunerated, with occupations requiring digital skills paying 29% more than occupations that do not.[28]

However, in many countries there exists a large digital skills gap. Upskilling and providing opportunities for women to enter the technology industry can help build a strong pipeline of digitally skilled employees for current and future workforces, and provide greater earning potential and career choices for women. The impact of improving women's access to opportunities in tech could be economically significant in terms of the GDP and employment impacts,[29] and reduce the risk of women falling behind in the digital age as more jobs become automated.[30]

Canada is the best-performing country in our Women in Technology Index of the G7 in terms of female access to opportunities in tech

Our Women in Technology Index assesses the representation of women in the tech sector across the G7

The Index is a weighted average of four indicators that reflect female participation and gender equality in the technology sector across different stages of the career life cycle:

- Female share of ICT graduates
- Female share of technology industry employment
- Share of women on boards in the technology, media and telecommunications industry (TMT)
- Gender pay gap in the technology industry

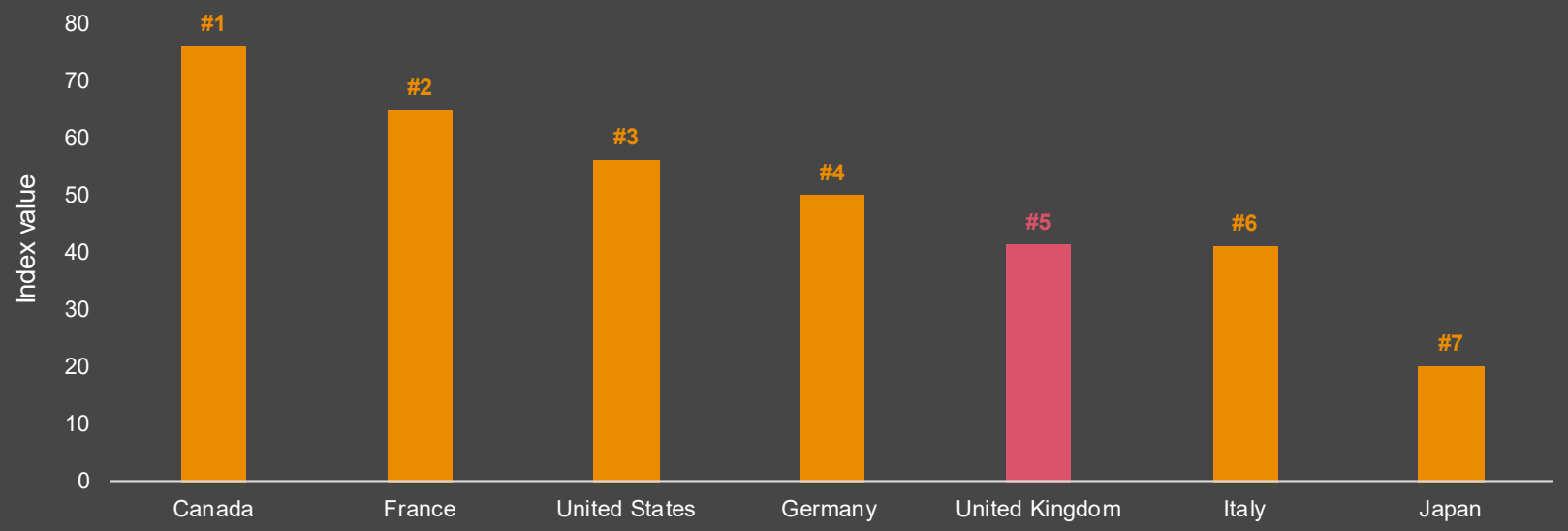
Country rankings and performance

- Similar to its position in the G7 on the main Women in Work Index, Canada is the best performing country in the G7 on the Women in Technology Index. This is due to its strong and better than average performance on all indicators except the share of women on boards in TMT. In particular, its top position is driven by having the highest female share of ICT graduates and the smallest technology gender pay gap in the G7.
- In second place, France performs significantly better on the Women in Technology Index than on the main Index, in which it ranks 5th among the G7. France's strong showing is due to better than G7 average performance on all indicators except for the female share of ICT graduates. In particular, France has by far the highest share of women on boards in TMT in the G7 (38%), significantly above the G7 average (23%).
- The US and Germany broadly occupy the same positions on the Women in Technology Index as in the G7 main index. The US performs better than the G7 average on all indicators except the share of women on boards in TMT. Germany has the highest female share of technology employment in the G7, but also the widest gender pay gap in the sector among the G7.
- In contrast to the main Index, on which it is the second best performing country in the G7, the UK ranks in fifth place in the Women in Technology Index. The UK's poor performance on the Women in Technology Index is driven by its worse than average performance on all indicators, except the share of women on boards in TMT.
- Italy and Japan occupy the bottom two position on the Women in Technology Index, which is broadly similar to their positions on the main Index for the G7. Italy has the lowest female share of ICT graduates of the G7, at 15%, while Japan has the lowest female share of technology employment and share of women on boards in TMT.

Canada is the best-performing country of the G7 in terms of female access to opportunities in tech

Women in Technology Index

Canada occupies the top position on the Women in Technology Index, followed by France, with the United States in third place



Source: PwC analysis, all data sources are listed in the Methodology section

18%

Average gender pay gap in the technology industry for the G7

Source: PwC analysis, all data sources are listed in the Methodology section

However, most countries have some way to go to improve the representation of women in the tech sector

In recent years, the rapid expansion of the tech industry across the G7 has seen more women than ever before entering the industry.[31] However, women remain significantly under-represented in the tech industry in comparison with other sectors. Across the G7, the average female share of ICT graduates, technology industry employment and board positions in TMT are below 30%, and the average technology gender pay gap is above the G7 average for all industries. This suggests that the tech sector faces a unique challenge to female representation, and that there may be drivers that are specific to, or are more pronounced in the tech sector.

On average, across the G7, the technology industry performs worse than the average for all industries on all indicators except for the percentage of women on boards, on which its performance matches the all-industry average. This shows that gender inequality appears to be more pronounced in the tech industry compared to other industries and that further efforts are needed to improve female representation in the industry.

At 20%, the G7 average female share of ICT graduates is substantially below the G7 average for the share of graduates that are women, which stands at 55%. Across the G7, ICT is among the worst performing subjects with respect to the female share of graduates, besides subjects related to engineering, manufacturing and construction.

Across the G7, the average female share of technology industry employment is 30%, which is significantly below the G7 average for all industries, at 46%, where the average gap in the share of female employment in tech being around 13-19 percentage points lower than the average for all industries.

In contrast to the other indicators, the technology industry performs similarly to other industries on the share of women on boards. This is true for all G7 countries.

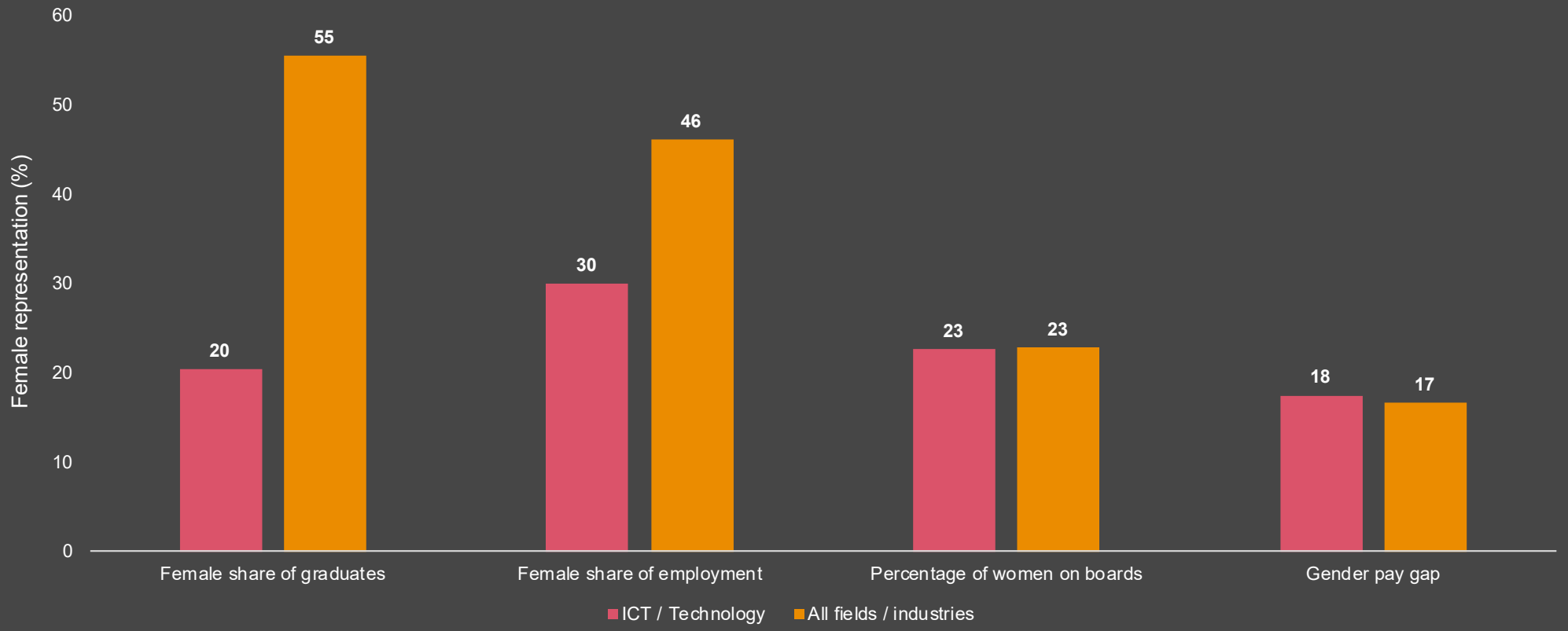
On average, the gender pay gap is slightly higher for the technology industry than the average for all industries. However, in countries such as Canada and France, the technology gender pay gap is significantly lower than the national average (10% and 11% vs 17% and 15% respectively), whereas in Italy, it is substantially higher (19% vs 6% respectively).

Source: PwC analysis, all data sources are listed in the Methodology section.

Source: PwC analysis, all data sources are listed in the Methodology section

However, most countries have some way to go to improve the representation of women in the tech sector

G7 average performance: technology industry vs all industries



Source: PwC analysis, all data sources are listed in the Methodology section.

Women face a number of challenges when entering, as well as staying in the tech sector

What explains the lack of female representation in technology? We identify a number of challenges facing women throughout their career lifecycle, from their aspirations to entering the tech sector, through to staying in and rising to the top within the industry.

Attraction and aspiration | **Skills acquisition and access** | **Inclusion and progression**

Gender stereotypes and the lack of female role models

Gender stereotypes and biases mean technology, both as an occupation and a product, can contribute to female underrepresentation and gender inequality in the tech industry.[32] This often permeates throughout the career lifecycle, and can discourage women from aspiring to a career in tech and acquiring digital skills from an early age. For example, a survey of over 2,000 school and university students in the UK found that only 27% of our female respondents said they would consider a career in technology, compared to 62% of males.[33]

This results in the lack of female role models in the industry, which in turn, reduces attraction to the tech sector for other women, which reinforces gender stereotypes that technology is for men.

The lack of senior women in tech suggests that women are less visible in the sector, and that younger women also lack the mentorship and networks to provide coaching and advice, and support their career progression.[34]

Skills and qualifications

The acquisition of technical knowledge, such as numeracy and STEM-related subjects, is crucial in taking up technical roles in the tech sector, such as software engineers, systems administrators and application developers.

However, women tend to be less equipped with these skills, which restricts the available pipeline of women into the technology industry.[35]

For example, women make up a significantly lower percentage of graduates from STEM programmes in tertiary education compared to non-STEM programmes. The average female share of graduates from ICT programmes at university for the G7 was 20%, compared to 51% for business, administration and law programmes.[36]

This is not because girls are less competent than boys in STEM subjects: at age 15, there is little difference between girls and boys performance in science across the OECD, but only 0.5% of girls wish to become ICT professionals, compared to 5% of boys.[37] This suggests that lack of female uptake of STEM subjects at school and university is due to social and cultural factors, not differences in ability.

Workplace experiences for women

Many women join the tech sector to develop their skills through technical roles that enable direct involvement in the development of products and services. However, women tend not to have the same access to core, creative technical roles as men and are more often clustered into execution and project management roles.[38] Surveys of current and former science, engineering and tech employees in the US and from three multi-national corporations, found that more than 40% of respondents felt that "women are pushed in to execution roles".[39] This limits women's contribution to product innovation, which may explain why levels of female patenting is low, given patenting often requires being in a technical role.

Tech firms can foster an environment, which leads to women feeling isolated or lacking a sense of belonging in tech workplaces.[40] Women also report feeling stalled in mid-level positions due to lack of leadership and development opportunities, despite aspiring towards leadership roles.[41] Lack of mentors, sponsors and informal networks can mean women's accomplishments are less visible, limiting progression.

Although many reasons for the underrepresentation of women in the technology apply to other sectors dominated by men, the tech sector stands out for having much higher female attrition rates and pay gaps.[42] Studies show that the majority of women do not leave the tech industry due to family reasons,[43] and that roughly half of women go on to apply their technical knowledge in jobs in other industries.[44] This suggests the lack of development and leadership opportunities are higher within the tech sector.[45]

Attitudes towards the importance of diversity in the tech sector also lag behind others. For example, the *Future of Jobs* survey conducted by the *World Economic Forum*, which surveys senior talent and strategy executives of leading global employers, found that the share of respondents from the ICT industry that agreed with the statement "women's economic power and aspirations are a driver of change in their industry", was less than half of the share of respondents from other sectors that agreed with the statement.[46]

How can organisations promote opportunities for women in the technology industry?

Given the range of factors influencing levels of female representation and participation in the technology industry, what different policies and interventions can technology organisations implement to address these factors, and to promote opportunities for women in the technology industry throughout the career life cycle?

Developing the pipeline of female talent

One of the key drivers of female under-representation in the tech industry is the lack of girls and young women pursuing STEM subjects and careers, which creates a shortage of female talent entering the tech sector. Female role models and encouraging young women to develop STEM skills and aspire to careers in tech are vital in developing this pipeline.

Tech companies, and companies in other industries, can contribute to this by collaborating with educational institutions to promote and celebrate successful women in tech and educate and inspire pupils and teachers about tech careers. An example is the Tech We Can® initiative, created as part of The Tech She Can Charter – a commitment by over 140 organisations to increase the number of women working in technology roles in the UK. Tech We Can is a portal for teachers to access free technology toolkits and lesson plans that demonstrate the breadth of tech careers and highlight female role models to young people.

Following the pilot of Tech We Can in 14 schools across the UK, 47% of girls said that they would consider a future career in technology compared to 29% previously, demonstrating how such initiatives can inspire young women to pursue studies and professions in technology.[47]

Attracting women into the industry

Despite a desire by technology companies to employ more women, attracting applications for roles from women can be difficult, but recruiting more women into the technology industry is vital to improving female representation and challenging gender stereotypes.

Organisations in the tech industry can help achieve this by ensuring that branding and job descriptions are gender-neutral and recruitment teams are gender-balanced. Collaboration and joint working by organisations across the sector is key. For example, as part of the UK Tech Talent Charter (TTC) – an industry collective in which technology organisations pledge to take action to promote greater diversity and inclusion – a number of organisations have since highlighted the work and achievements of female employees in the organisation on their website, and encouraged those involved in recruitment activities to undertake unconscious bias training.

Furthermore, setting targets for the number of women on vacancy shortlists has been shown to be effective in improving representation. For example, of the signatories of the TTC that have established a target for female candidates on hiring shortlists, 64% were above the national average for the number of women in technical roles. [48]

Fostering an inclusive workplace culture

A work environment and organisational structure where women feel that they are valued, their achievements are recognised and they have ample progression opportunities is vital in attracting, retaining and developing female talent within the technology industry.[49] In industries where women are under-represented, such as in technology, workplace inclusivity is essential to engage and empower women in the existing workforce and also attract new female talent.[50]

Inclusive employers also stand a better chance of hiring the best: A PwC survey of over 4,000 employees across 70 countries found that when considering a potential employer, 61% of women look at the diversity of the employer's leadership team, 67% on whether it has positive role models similar to them, and 56% on whether the organisation publicly shares its progress on diversity.[51]

Technology companies can implement a number of initiatives such as mentorship schemes to support career planning, women's networking groups and events to provide a forum for support and discussion, to help organisations better understand the issues women face in the workplace and how these can be addressed. There is also scope for cross-industry learning and the sharing of best practices.

Providing opportunities for development

One of the reasons for the lack of senior women in tech is the lack of leadership and development opportunities.

One way organisations in the tech industry can help address both the pipeline and progression of women is by focusing on training and education, including investment in alternative routes into tech. Learning and development initiatives are particularly important to facilitate progression in the technology industry, as technical roles, and especially those that are senior, often require a high level of skills and specific expertise to access them.

For example, returner programmes for women returning to work following a career break provide an opportunity for organisations to attract experienced and technically skilled women back into the workforce. Retraining schemes and alternative hiring pathways create opportunities for existing employees to develop new skills and transition into different, perhaps more technical, roles.

Many of the signatories of the TTC reported that training and education initiatives were among their most successful D&I initiatives, with 75% of the signatories that have implemented retraining or returners programmes recording above average numbers of women in technical roles.[52]

Harnessing the technology industry's comparative advantage: using data to achieve greater diversity and inclusion

If there's one thing that the technology industry has in abundance, it's data, and the technology and skills required to collect, analyse and interpret large amounts of it. As such, one way in which technology organisations could promote greater diversity and inclusion is by leveraging their data and analytical capabilities to collect data on relevant workplace metrics, identify trends, diagnose diversity and inclusion issues and design appropriate interventions to address them.

Data-driven diagnosis and design

Tech organisations could collect data on the gender breakdown of different roles, distinguishing between technical and non-technical, and looking granularly at types of technical roles. This may help to identify if women are underrepresented in technical roles, and the types of technical roles women hold (e.g. creative vs support). These findings can inform the design of interventions. For example, if the data shows that, in general, women are equally represented in technical roles as men, but tend to be in support rather creative roles, then the organisation may wish to devise initiatives to address this balance. Such initiatives might include retraining programmes, and creating new hiring pathways within creative technical roles. To address issues, including job satisfaction, tech organisations could conduct surveys to understand employee perceptions and experiences of the current work environment.

Embracing data analytics whilst exercising caution

Data analytics can be used to identify and reduce gender bias in the workplace. For example, analysis of large datasets relating to historical pay, bonuses, attrition rates and many other workplace metrics can help to identify patterns of bias that the organisation management may not be (consciously) aware of. The use of machine learning in recruitment can also help to reduce unconscious bias that might be likely to occur in the recruitment process. However, it must be acknowledged that there are risks to the use of data analytics to address diversity issues: if the data, algorithms or analytics programs have inherent biases then their use can serve to accentuate bias in the workplace rather than eliminating it.

The importance of evaluation, benchmarking and transparency

In due course, the effectiveness of any diversity and inclusion policies and interventions should be evaluated and evaluation data should be used to assess whether the desired outcome is being achieved and refine them if required. Data collected on diversity metrics can also be compared with industry, national and international benchmarks to allow organisations in the technology industry to assess where they are driving diversity forward and conversely where their performance falls below average and further improvement is needed. Data should also be made internally transparent and, if possible, externally transparent, in order to build trust amongst employees and demonstrate the firm's commitment to improving diversity.

6

Special focus – the impact of technology on female employment

New technology has the potential to disrupt labour markets across the OECD, with potentially asymmetric impacts for men and women

The growth of advanced technology will present both challenges and opportunities for the labour force. AI and related technologies such as robotics, drones and driverless vehicles could displace many jobs formerly done by humans, but may also create many additional jobs as productivity and real incomes rise and new and better products are developed.

Our Women in Tech article highlights the opportunities that technology-focussed sectors can offer women, and the importance of promoting women in these industries. However, these technological developments will have significant implications for women employed across all sectors and all countries.

Our previous studies have shown how automation will both displace and create jobs in different sectors, with these countervailing effects broadly offsetting each other.[53] However, even if the overall effect is estimated to be neutral, there will be 'winners' and 'losers'. Some industry sectors could see a net increase in jobs in the long-term, while others could see a decline. This has gender implications as men and women tend to cluster in different sectors and different occupations within those sectors. Furthermore, the occupational composition of industries means that certain industries are more automatable in certain countries than others. This will have important impacts on employment as workers may not be able to retrain easily, and moving to a different, less automatable, sector could require significant upskilling. For example, moving from the mining and quarrying industry to education.

This article extends on our previous analysis to identify the gender impacts of the rise in technology across the OECD, and understand countries and industries where women may be more vulnerable to technological change over the next 20 years. We do this by examining how differences in female employment patterns and industry automatability in each country will result in differing impacts of AI and related technologies across the OECD.

Understanding the different impact that new technologies may have on male and female employment can inform policy to help mitigate disproportional gender-specific effects. We therefore also discuss the actions that government and businesses can take to help promote the opportunities for workers that the digital revolution will generate, or to help them adapt to change.

More information on our methodology can be found in the Methodology section.

New technology has the potential to disrupt labour markets across the OECD, with potentially asymmetric impacts for men and women

What are the potential impacts of automation and technological disruption?

Automation and technological disruption will affect jobs largely through the displacement and income effects. This article first considers the impact of the displacement effect, whereby jobs are lost as the use of technology becomes more efficient and firms are incentivised to seek cost savings through substituting towards technology and away from human labour.

We then examine how the impact of the income effect could counteract the displacement effect over the next 20 years. This refers to the dynamic effect of firms' technology-associated cost savings leading to lower quality-adjusted prices, which increase households' real incomes and spending. As a result, firms increase their production both by investing in more technology and hiring more workers.

How are different industries affected by the displacement effect?

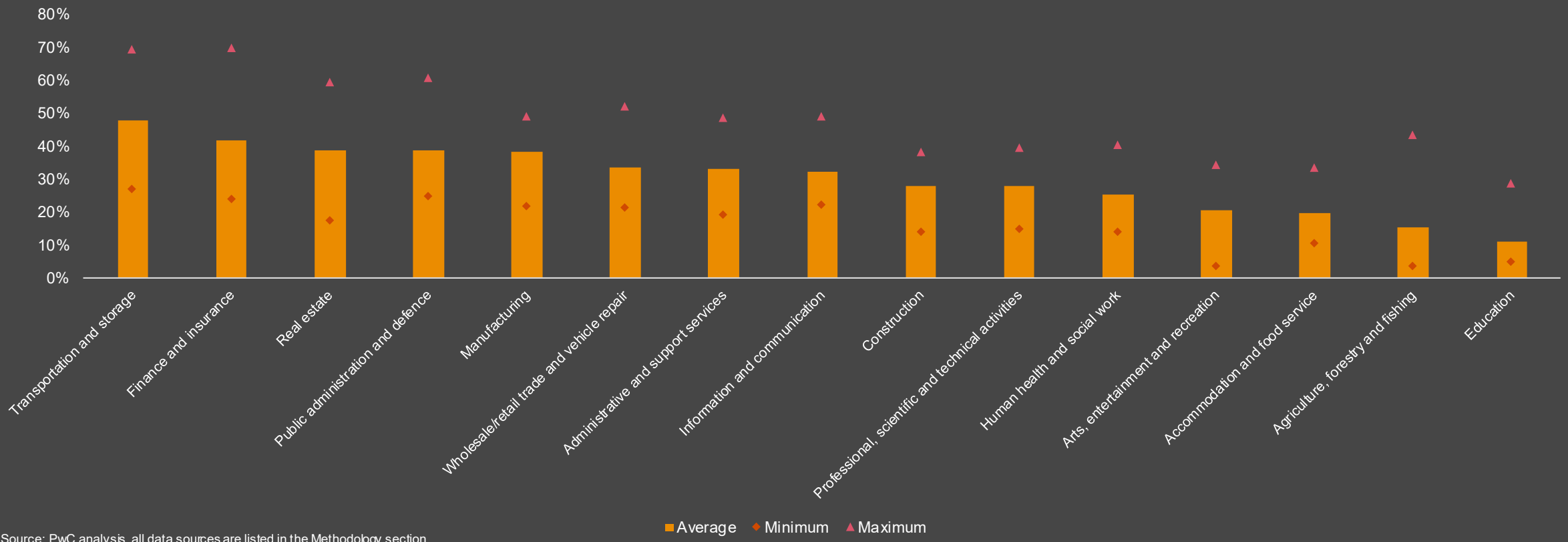
Our previous analysis found that sectors such as transportation and storage and the financial services sector have a high degree of automatability. Differences in the potential for automation in each sector is driven mostly by the composition of tasks involved in jobs in that sector. For example, workers in the transport and storage sector spend a large proportion of their time on routine tasks, while workers in financial services spend a high proportion of their time on computational tasks, all of which are likely to be automated by machines that can perform these activities more efficiently and accurately.

The potential for automation in a sector can also differ between countries due to differences in the composition of tasks within job roles, which is influenced by factors such as educational requirements. For example, automation rates in South Korea, where educational requirements are particularly high, are relatively low.[54]

The following slide shows the minimum, maximum and average potential for automation in each industry across the OECD.

PwC's analysis indicates the range of automation potential across the OECD is greatest in the finance and insurance sector, and smallest in the accommodation and food sector

Minimum, maximum and average automation potential by industry across the OECD



Source: PwC analysis, all data sources are listed in the Methodology section.

The transportation and storage, manufacturing and financial services sectors are likely to be susceptible to automation

How will automation lead to job displacement?

Technological developments have long been feared for their potential to disrupt the labour market. These concerns have become more pressing as new smart technologies go beyond the traditional machines capable of replacing repetitive, manual tasks. A combination of AI, robotics and other related technologies are already leading to innovations that are able to automate more complex decision-making and tasks using a combination of deep learning, advanced sensors and digital connectivity.

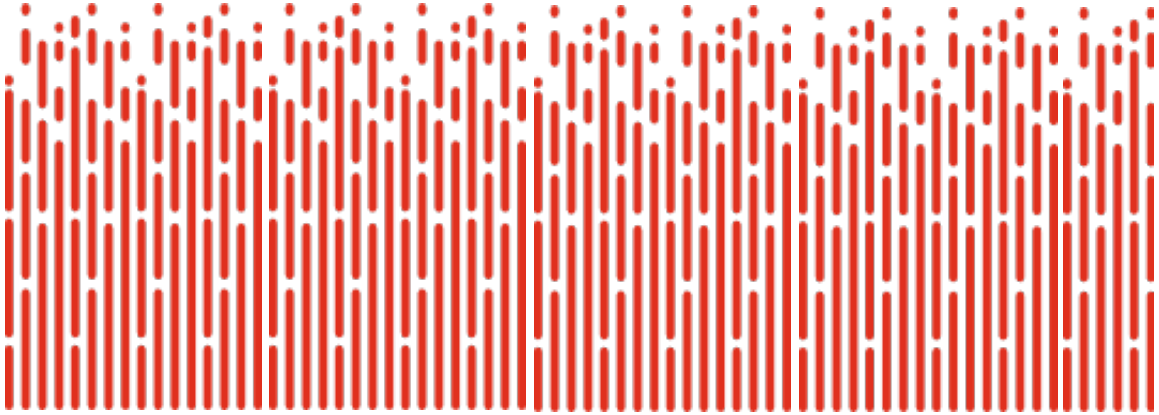
Previous PwC studies identified how automation could lead to job displacement in three overlapping waves: [55]

- **Algorithm wave:** the automation of simple computational tasks and analysis of structured data in areas of finance, information and communications.
- **Augmentation wave:** the automation of repeatable tasks such as filling forms, communicating and exchanging information through technological support, and statistical analysis of unstructured data in semi-controlled environments.
- **Autonomy wave:** the automation of physical labour and manual dexterity, and problem solving in dynamic real-world situations that require responsive actions.

What does this risk mean for female employment?

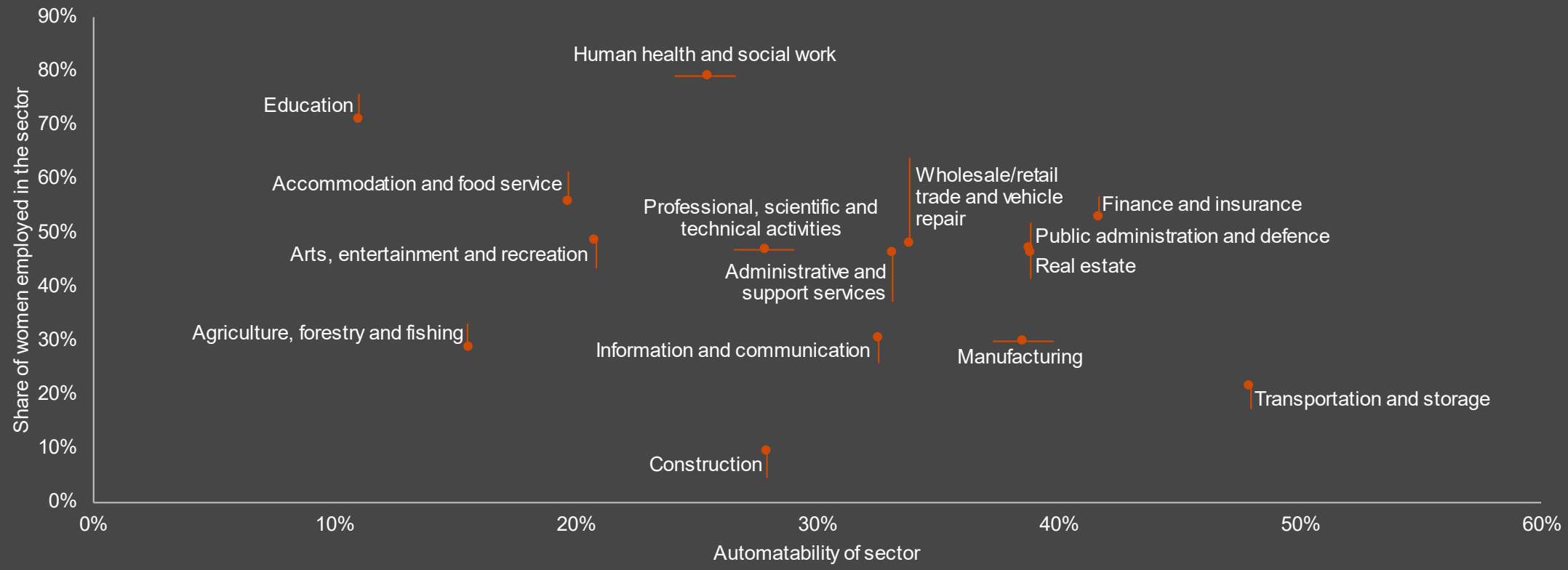
There appears to be a negative correlation between the share of female employment in a sector and the feasibility of automation in that sector over the next 20 years. Women tend to be clustered in sectors such as education, healthcare and domestic work that tend to be less easily automatable, possibly due to the importance of the 'human touch'.

However, there are a number of sectors that are vulnerable to automation but also have a relatively high share of female representation. Wholesale and retail trade, finance and insurance, and public administration and defence stand out as sectors with both a high feasibility of automation and a relatively high share of female employment.



The transportation and storage, manufacturing and financial services sectors are likely to be susceptible to automation

Automatability and share of female employment by sector, OECD average



Source: ILOSTAT (2018) and PwC analysis

The wholesale and retail trade and health and social care sectors account for the largest share of female job losses expected from automation

Fewer female jobs are expected to be lost from automation relative to jobs lost for the male population across the OECD

Male jobs are expected to account for 58% of total losses over the next 20 years, while female job losses are expected to account for 42%. This is largely because men tend to be concentrated in sectors that are more highly automatable, such as transport and manufacturing.

On the other hand, women are less susceptible to automation as they are more concentrated in sectors that require higher levels of education and social skills, such as health and social care and education.

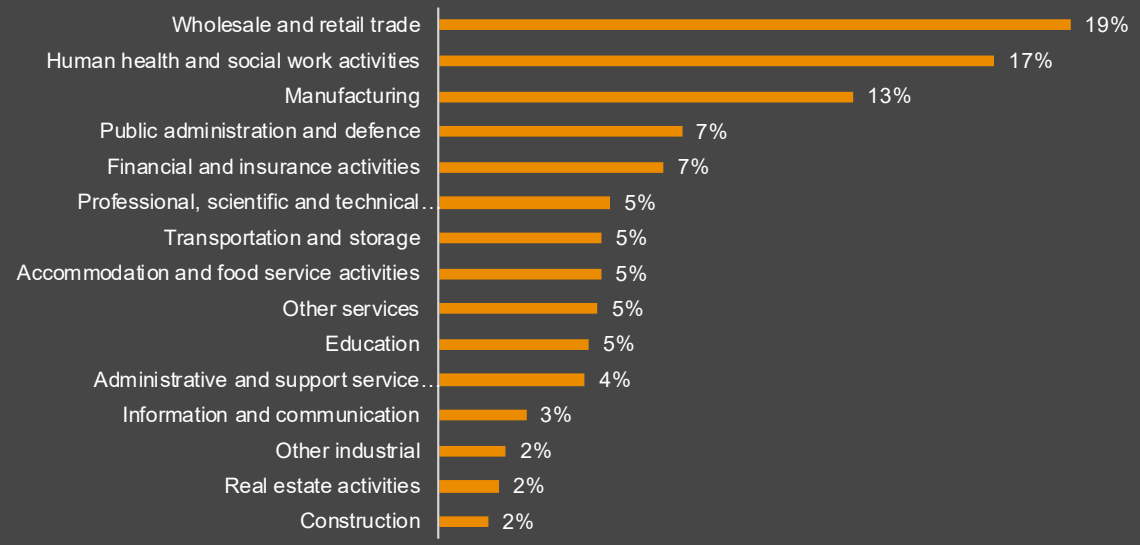
The wholesale and retail trade, and health and social care sectors account for the largest share of female job losses expected across the OECD.

The **wholesale and retail trade sector** accounts for 19% of all female jobs that are vulnerable to automation over the next 20 years.

The **health and social care sector** accounts for 17% of all female jobs that are vulnerable to automation across OECD countries in 20 years, largely because this sector dominated by women. In all countries, women comprise the majority of the labour force for the health and social care sector.

Despite **the manufacturing sector** having a relatively high male-to-female ratio, the sector accounts for a large share of estimated female job losses across the OECD, around 13%. This is the result of the combination of the sector's relatively high exposure to automation, as well as the sector's large size. Although the sector is dominated by men, it accounts for around 9% of female employment on average across the OECD.

Percentage of total female job losses expected in sector over the next 20 years, % of total female job losses across the OECD



Source: PwC analysis, all data sources are listed in the Methodology section.

Technology will create new job opportunities for men and women, although women are less likely to benefit than men in all OECD economies

How will the rise in technology lead to job creation?

The rise in technology could lead to an increase in jobs across different industries as:

- Firms experience technology-associated cost savings leading to lower quality-adjusted prices, increasing incomes and spending.
- Firms then increase their production both by investing in more technology and hiring more workers.

We term this job creation as a result of new technology as the "income effect".

How do we estimate the income effect?

We apply a simplifying assumption that the total jobs created from technology in a country is equal to the total jobs estimated to be lost to automation. This assumption is based on the findings of our July 2018 study that the net effect from the displacement effect and the income effect is broadly neutral for the UK.[56] This study combined insights from earlier research on job automation and the economic benefits of AI.[57] This analysis was for the UK, but the UK is around the OECD average for job automation estimates, so may generalise to other mature developed economies.

We then project each industry's output over a 20-year period (which alters the sectoral composition of the economy), and distribute the job gains based on each sector's expected share of the economy in the future. This approach results in the number of jobs that are created being bigger for larger and faster-growing sectors. We apply the existing gender ratios in each industry to determine the split of job growth between male and female workers.

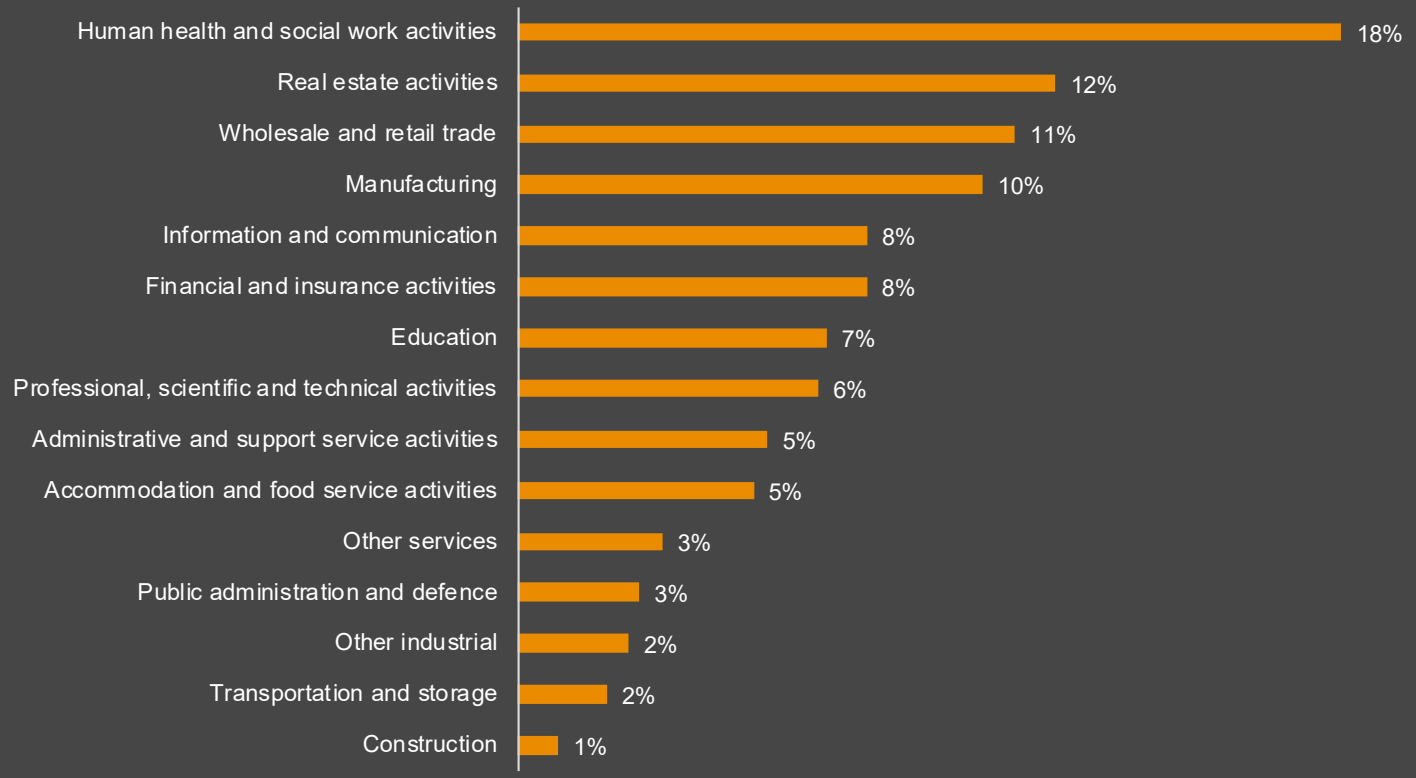
In all OECD countries, the number of jobs created from technology is more likely to benefit male workers rather than female workers

Of this, around 43% of these jobs created are likely to go to female workers, with the remaining 57% estimated to go to male workers. This is due to high levels of job creation estimated in the manufacturing sector, which is typically a sector, where the majority of workers are men.

For women, this "income effect" is highest in the human health and social work sector. The human health and social work sector combined with real estate activities, wholesale and retail trade and manufacturing sectors account for 50% of the jobs likely to be created for women across the OECD.

The “income effect” from technology is expected to be highest in the human health and social work sector for women

Expected share of jobs created for women by sector over next 20 years, % of total jobs possibly created



Source: PwC analysis, all data sources are listed in the Methodology section.

Women are less likely to benefit from the increase in job opportunities from technology than men

The health and social care sector, as well as the education sector, is expected to experience a small net gain in female jobs resulting from the effects of technology

The **human health and social work sector** could see the biggest net increase in jobs (around 3%) for female workers. This is largely driven by the expected rapid growth in the sector as demand for health and social care increases to care for an ageing population and the lower exposure to automatability estimated over the next 20 years, relative to other sectors such as wholesale and retail trade and manufacturing. The sector also accounts for a significant share of female employment (around 19%), meaning that, if current employment patterns continue, the future increase in jobs are likely to go to women.

Similarly in the **education sector**, technology will complement teaching rather than result in teachers being replaced, meaning these jobs are less susceptible to automation. The net impacts of technology and automation could increase jobs for women in this sector by around 6%.

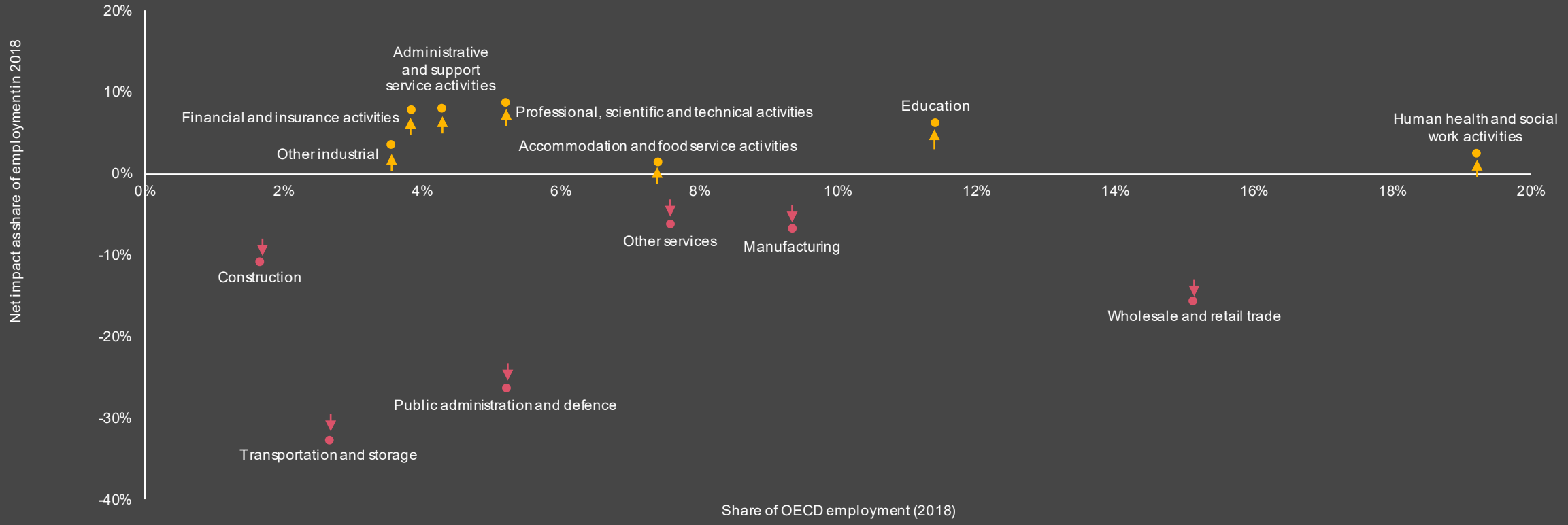
Three of the top 5 largest sectors for female employment today are expected to see a net decline in jobs for women

The number of jobs for female workers in the **wholesale and retail trade, manufacturing, and other services sectors**, could decline as a result of technology and automation. These sectors also collectively account for a significant share of female employment - around 30% currently.

It is unsurprising that these sectors are less likely to benefit from the "income effect", as the impact of technology, particularly in wholesale and retail trade, can already be observed, through replacing human cashiers with self-service tills, as well as in warehouses and distribution centres that are increasingly staffed by robots. For this reason the displacement effect outweighs the income effect for manufacturing and wholesale and retail trade, meaning that overall the number of jobs for women in these sectors could decline as a result of technology.

The health and social care sector, the largest employer of women in the OECD, is expected to experience a net increase in female employment as a result of technology

Net impact of technology on female employment and share of female employment across the OECD



Source: PwC analysis, all data sources are listed in the Methodology section.

There is likely to be winners and losers from technology for women across the OECD

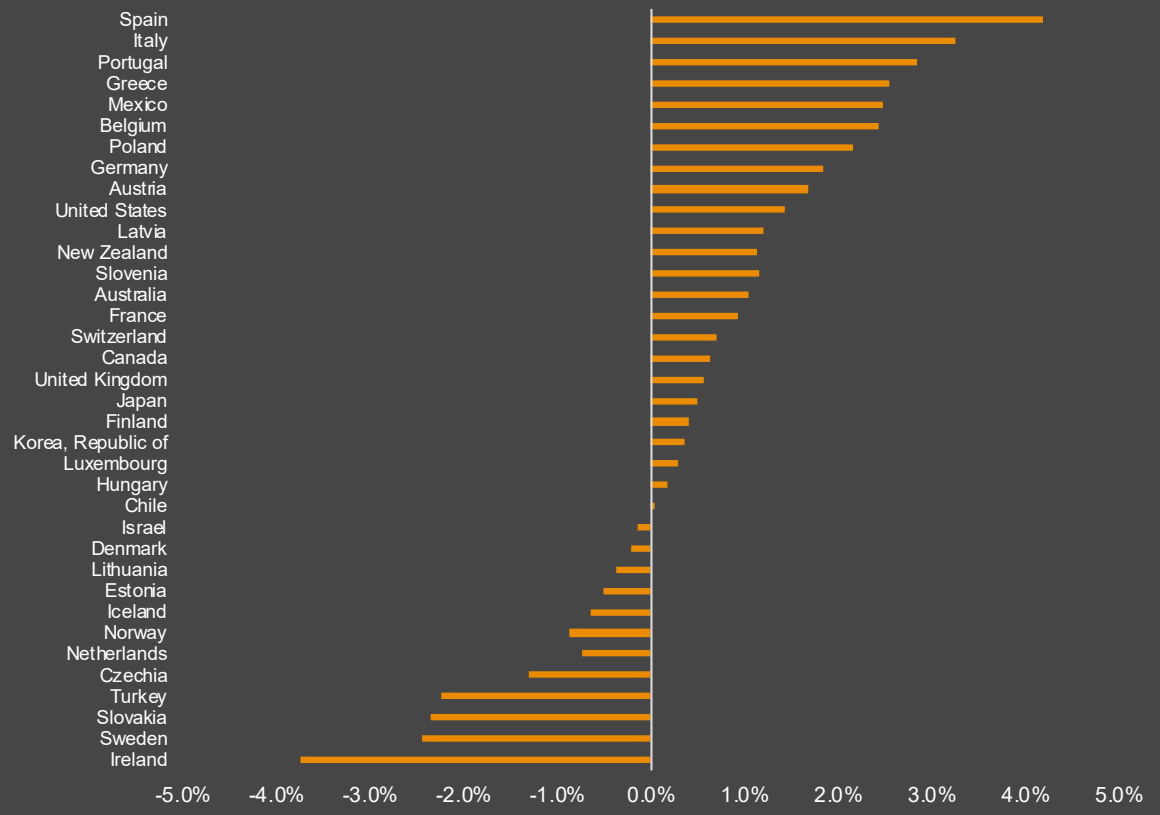
The net gain in 20 years to women across the OECD could result in an additional increase in female jobs today by 1.2%, although this gain should not be overstated

Our analysis shows that the net gains – or the difference in jobs created through technology and growth and the jobs displaced through automation - to female workers could be around 3m, assuming that there is no net increase in employment in the economy in the future. This represents a 1.2% increase in female jobs today.

Spain, Italy and Portugal have the largest net positive impact across the OECD relative to the size of their female labour force today

The net jobs gain for female workers, as a share of female jobs in 2018, is largest for Spain (4.2%), Italy (2.8%) and Portugal (2.4%), while women in Ireland could see up to 4% of total female jobs lost as a result of technology and automation.

Possible net impact on female employment as % of jobs (based on 2018 figures)



Source: PwC analysis, all data sources are listed in the Methodology section.

Ultimately, other factors, particularly education, are more important drivers than gender for determining the impact of automation

Although there could be varying impacts of automation and technology by gender, there are a number of other drivers that are more important in determining whether a worker is at risk of automation or not.

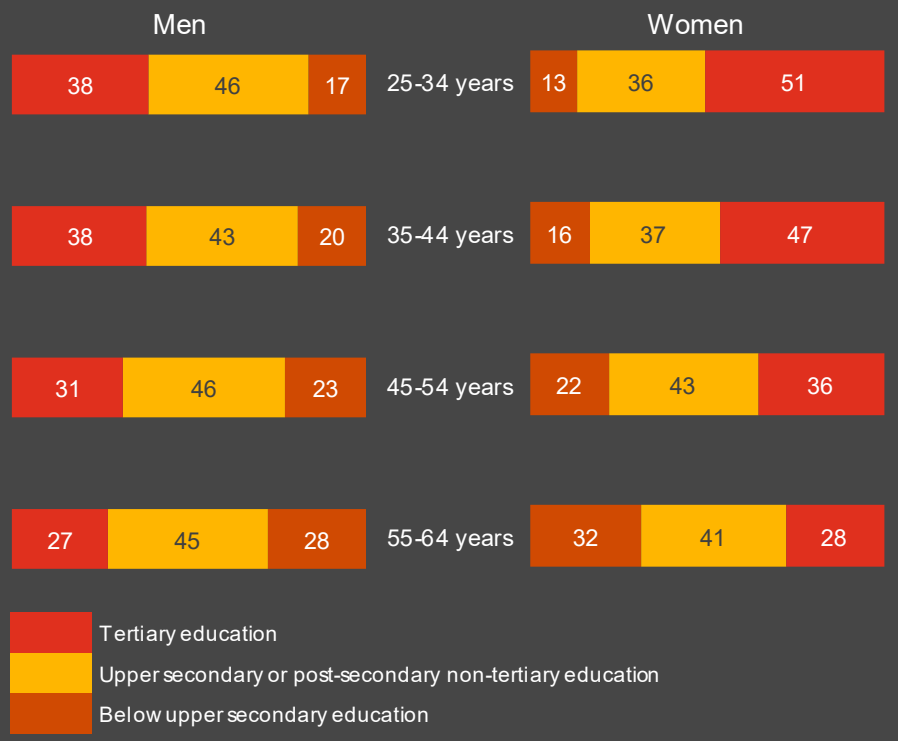
Educational attainment is one such factor. Our previous research found that workers with low- and medium-levels of education have notably higher automation rates across countries, compared to those with higher levels of education, such as university graduates. Highly-qualified workers tend also to be over-represented in professional, scientific and technical and education sectors, which tend to be less automatable than average. Relatively highly educated workers are also in a better position to adapt to new waves of technology so that technology is complementary to their roles rather than being replaced by them.

Women across the OECD also tend to be more highly qualified than men. Particularly in younger age groups, a significantly higher share of women have university-level qualifications than men. These trends may also explain why women are less vulnerable to automation than men.

Education and skill levels are also an important determinant of the types of occupations workers perform, which can also vary significantly in terms of automatability. Some occupations, such as machine operators and assemblers, and clerical workers, are more exposed to automation as these tend to involve routine or simple computational tasks. In contrast, the risk is lower for professionals and managers that require social skills, literacy skills, as well as dealing with more complex computational tasks that are less automatable. These are also the types of occupations that are more likely to be occupied by more highly-educated workers.

The importance of education and skills as a key determinant of automation emphasises the need for increased investment in lifelong learning and retraining.

Share of male and female population by education attainment across OECD, 2018



Source: PwC analysis, all data sources are listed in the Methodology section.

With the right interventions, everyone including women can benefit from the gains in productivity from technology and automation

Most of the debate on the impact of technology on the workplace has focused on the negative impacts from job losses, which can lead to a negative immediate reaction towards the introduction of technology in the workplace.

The debate often overlooks the fact that technology can often have nuanced impacts. For example, labour markets constantly evolve but quite slowly, and technological changes don't impact jobs overnight and can take time to filter through. Governments and businesses will need to consider the relative cost of labour and capital in determining the extent to which implementing new technologies is an optimal choice.

Automation may replace certain tasks within a role, but this frees up time to focus on service-oriented tasks or where creativity is needed. Fears that job losses will occur very quickly can therefore sometimes be unfounded.

A digital economy may also increase the share of "hybrid" jobs that are complex and multi-disciplinary, and will require a breadth of skillsets (commercial acumen, data analysis and interpretation, leadership and teamwork skills). The key to maximising the benefits is to help workers develop the skills that are likely to be in demand in a tech-enabled future.

However, the fact that potential automation rates can vary widely across different types of workers raises the issue that even if new technologies are good for the economy as a whole, there can also be important distributional impacts. This raises some important issues for public policy.

Businesses and governments could collaborate to retrain and upskill the workforce to have the skills they need to succeed in the future

The World Economic Forum estimates that by 2022 54% of employees are going to need significant re- and up-skilling as a result of technological changes.[58]

Governments should invest in broader opportunities for people to develop STEM skills that will become most useful as advanced smart technology becomes more widespread. These skills will enable workers to improve their job prospects by taking advantage of the new jobs that these technologies will create. Understanding where automation is likely to occur can inform the direction of the retraining opportunities provided.

Training and apprenticeships can also provide greater opportunities for younger workers to develop the skills they will need to succeed.[59] This is important as lower skilled young people may be more vulnerable to automation.[60]

Businesses can better prepare their workforce by investing in the digital skills of their employees. However, according to our recent global survey on technology, jobs and skills, while 77% of adults would learn new skills now or completely retrain to improve their future employability, only 33% of workers say they are given many opportunities to develop digital skills outside their normal duties.[61]

Engaging with employees to understand how technology can improve their jobs and identify where upskilling is needed will also help businesses achieve the largest benefits from new technologies.

Stronger social safety nets can help manage the impact of automation on women and the economy

While mass technological unemployment is unlikely, patterns of employment and the likelihood of automation mean that job losses could be concentrated amongst certain sections of society. If new technologies favour those with stronger digital skills, the rise in technology could lead to greater wealth and income inequality.

Effective government policy can help mitigate the costs of the displacement effect by providing safety nets for those most at risk or most likely to struggle to adapt to new technologies.

Government intervention will be equally important in facilitating job creation, as upskilling the workforce will only support the economy if jobs are available and accessible to all.

With planning, national investment to boost the long-term productivity of the economy, will help create jobs that are not fully automatable. Local strategies focused on university research, science parks and other enablers of business growth will be most effective when informed by the existing industrial make-up of the region.

Understanding the differences in male and female employment and the likelihood of this employment being automated can inform policy to create a more equal labour market and ensure benefits of technology are shared by all.

Careful engagement with AI and technology, together with effective regulation can help workers and consumers maximise the benefits of technology

Careful engagement with AI and technology is needed to maximise the potential value from technology, while minimising its negative impacts on workers

Whether technology will destroy or create jobs and how these effects will be felt depends on the way in which individuals, businesses and governments engage with it.

For example, the destruction of jobs in some industries could mean that the gender patterns of employment shift as there is an incentive for people to move into less automatable sectors. These dynamic effects could have important consequences for men and women, for example if women are disproportionately squeezed into less automatable roles that are also lower-paid (such as care work or cleaning), while men continue to cluster in higher-paying sectors and occupations that are less vulnerable to automation. The challenge will be to ensure that women are able to move into higher paid occupations during this new wave of automation.

Given the historical concentration of male employment in technology-focussed sectors, as highlighted by our Women in Tech article, the promotion of female employment is particularly important to ensure that the benefits of the digital revolution are shared with women.

Careful attention must also be paid to ensure that existing organisational biases do not play a part in determining roles that are automated first, to avoid female-dominated professions from being inadvertently prioritised for automation.

Effective regulation and competition policy can help consumers benefit from technological advances

Maintaining competitive pressure in both the technology sector and in the sectors using it may help to distribute the productivity benefits of AI and related technologies more widely in the economy. PwC's assessment suggests that consumers in particular will largely gain from these advancements through lower quality-adjusted prices. Therefore competition policy can help balance the need for investors to earn a reasonable return with the long-term benefits to consumers.

Regulation can also help manage the privacy implications of such technologies, particularly AI, which often relies heavily on data collection. Recent developments have highlighted the challenges of regulating fast-moving technology. Therefore governments and regulators may need to rethink regulatory structures that can adapt to a digital environment.

33%

of women think that their job is likely to be made obsolete or significantly changed by automation in the next 10 years, compared to 30% of men.

89%

of women think the government should provide free/subsidised training courses for those made jobless, compared to 86% of men.

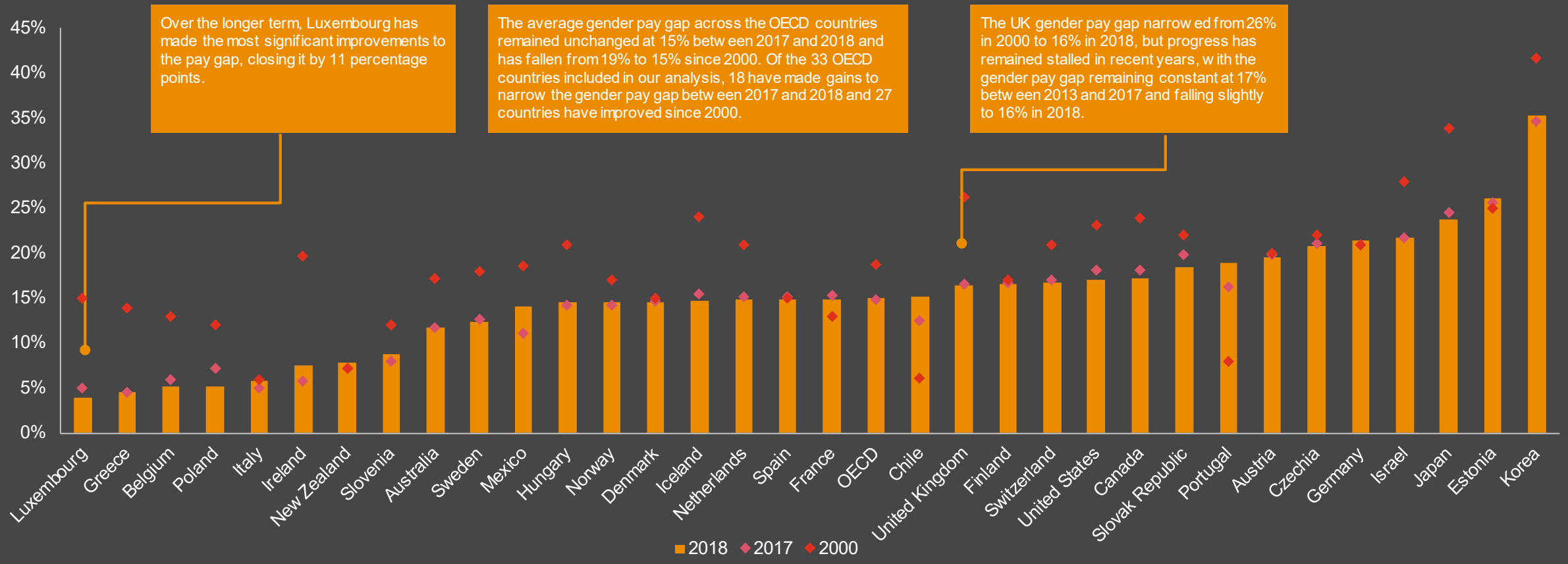
Source: PwC Future of Government (2019).

7

Individual labour market indicators

The gender pay gap

Figure 7.1: Gender wage gap, 2000 - 2018



Source: OECD, Eurostat. OECD data refers to the difference in the median earnings for all full-time employees, w hile Eurostat compares the mean earnings. Data extrapolated using linear interpolation w here data unavailable.

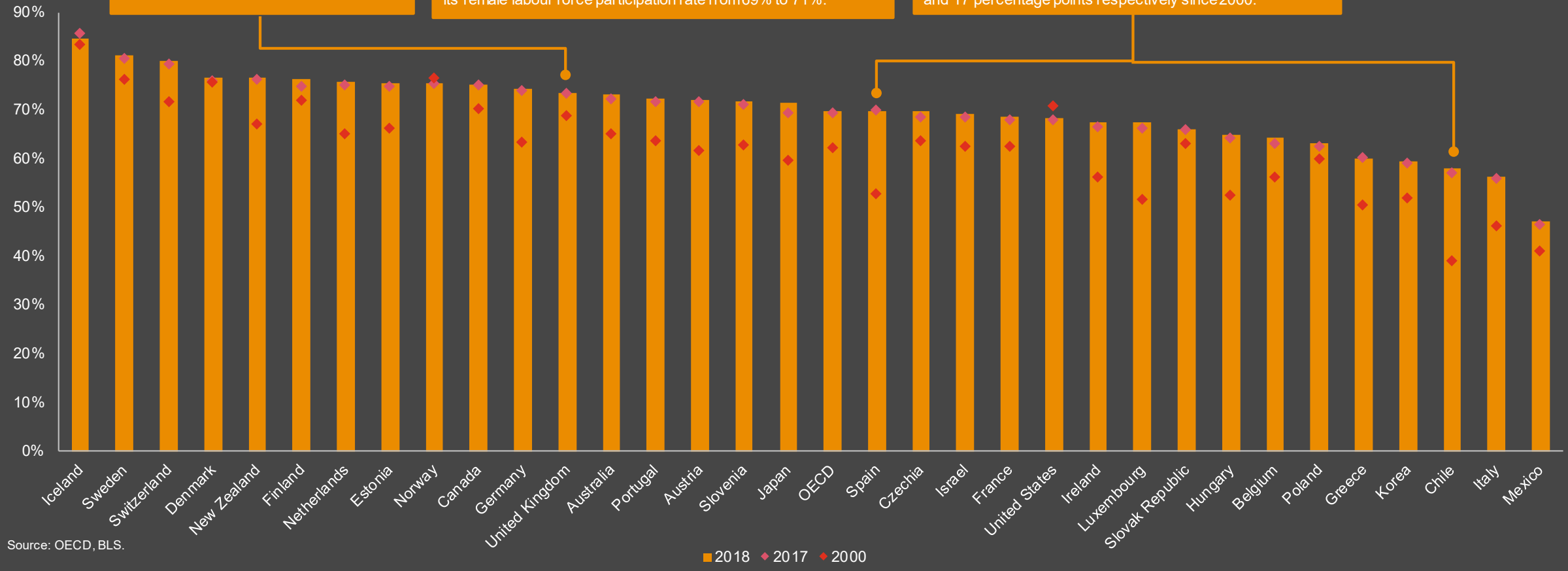
Female labour force participation rate

Figure 7.2: Female labour force participation rate, 2000 - 2018

The UK female labour force participation rate has increased from 69% to 74% when compared against 2000.

The female labour force participation rate increased slightly from 69% to 70% on average across the OECD from 2017 to 2018. The largest short-term gains were observed in Japan, which increased its female labour force participation rate from 69% to 71%.

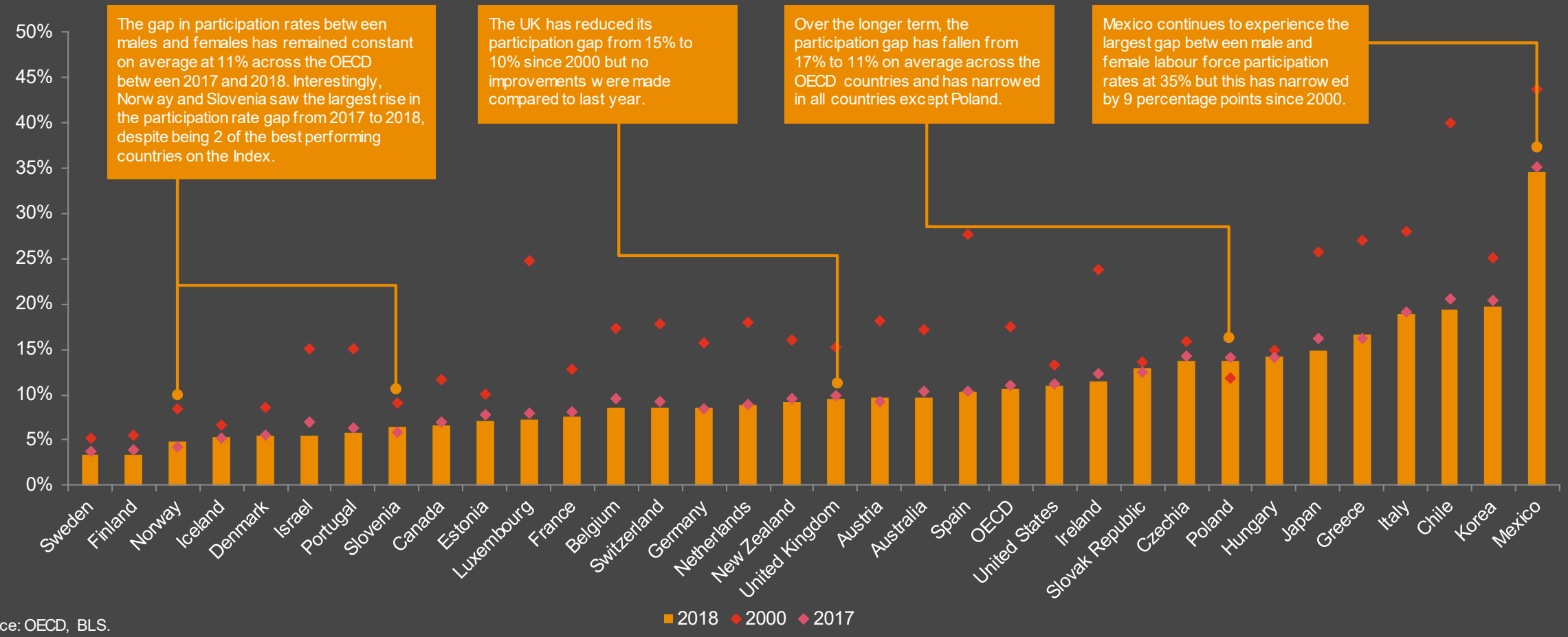
Over the longer term, the average female labour participation rate across OECD countries has increased from 62% to 70%. Chile and Spain have seen the largest improvements of 19 and 17 percentage points respectively since 2000.



Source: OECD, BLS.

Gap between male and female labour force participation rate

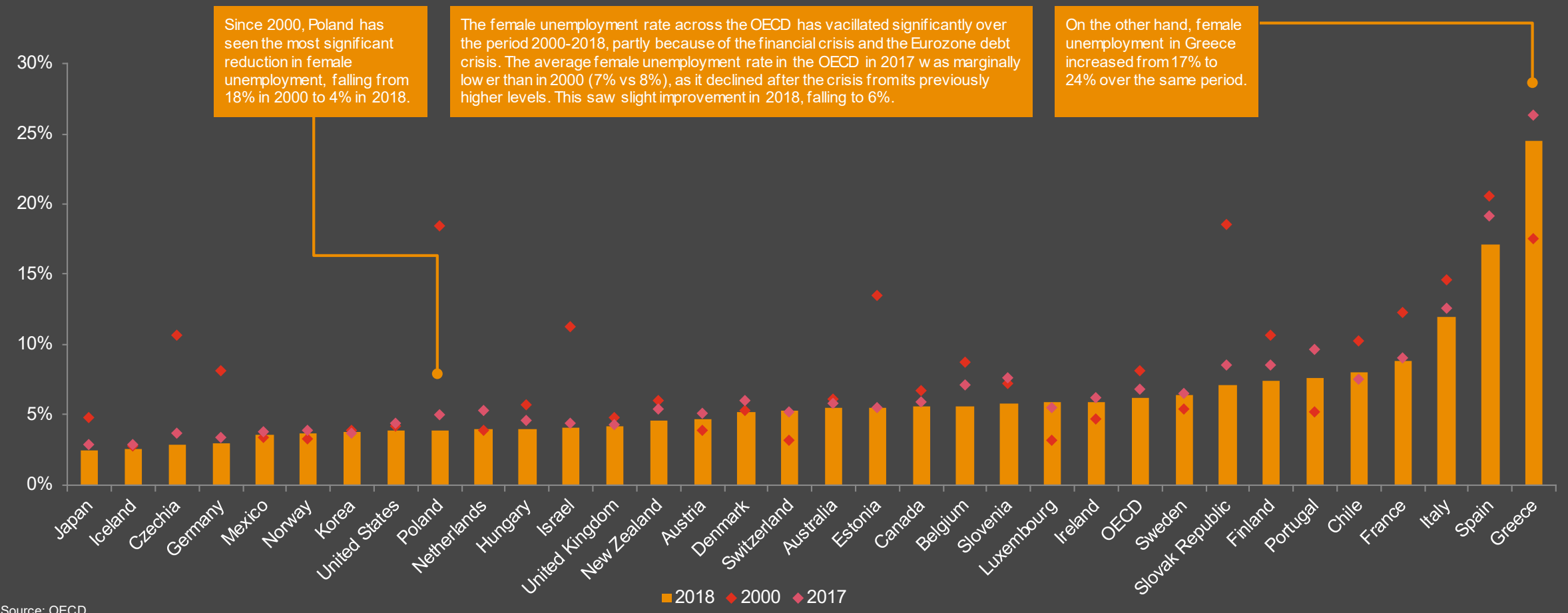
Figure 7.3: Gap between male and female labour force participation rate, 2000 - 2018



Source: OECD, BLS.

Female unemployment rate

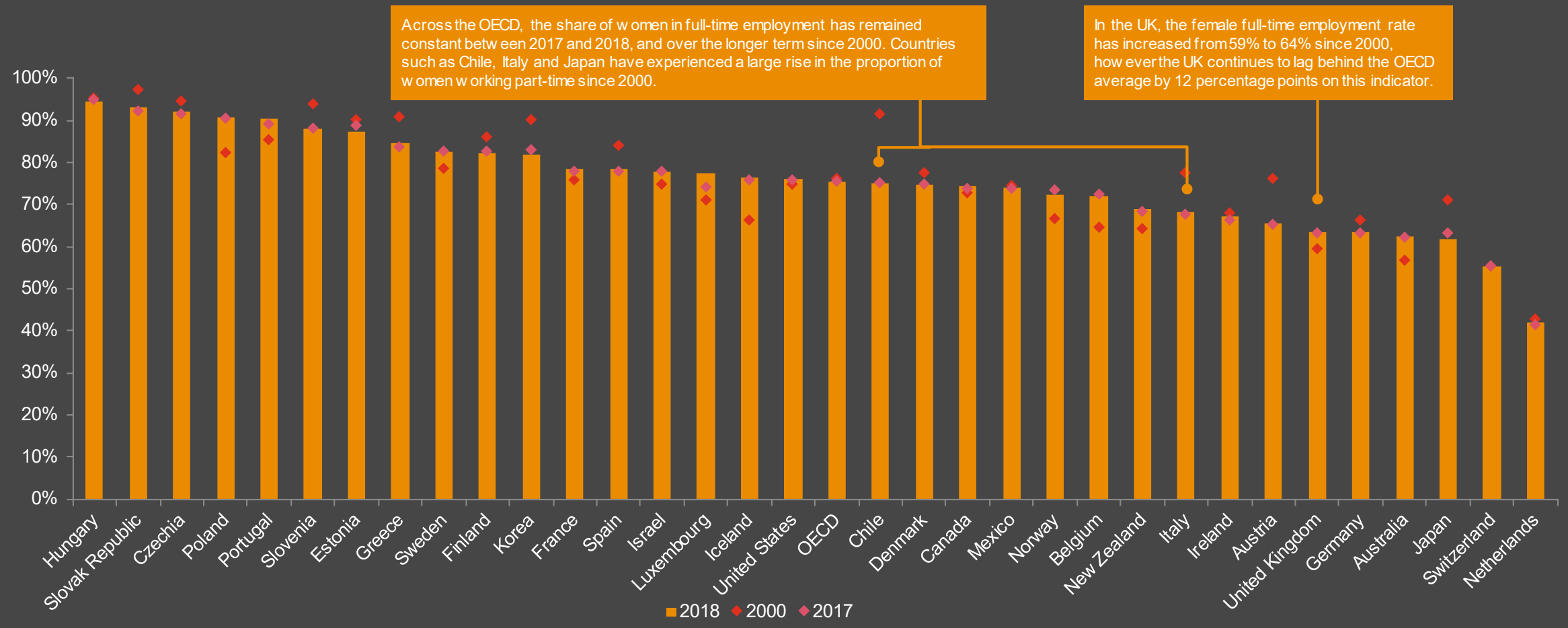
Figure 7.4: Female unemployment rate, 2000 - 2018



Source: OECD

Female full-time employment rate

Figure 7.5: Female full-time employment rate, 2000 - 2018



Source: OECD

8

Methodology

Changes to PwC's Women in Work Index results for 2017

Due to retrospective changes to the 2017 OECD and Eurostat gender pay gap data used in our main Index, PwC's Women in Work Index results for 2017 have changed compared to those reported in the Women in Work Index 2019. Changes to the rankings of each country can be seen here.

- Ireland's ranking changed the most, moving 7 places from 17th to 10th place, following a revision down of its gender pay gap for 2017 from 10% to 6%.
- The UK's ranking moved 3 positions, from 13th to 16th, due to changes in the gender pay gap for 2017 elsewhere in the OECD. The UK's gender pay gap for 2017 remained at 17%, despite revisions to the gender pay gap in other countries.
- Hungary also saw its ranking change by 3 places, due to a revision down of the gender pay gap for 2017 from 15% to 14%.

Changes to Index rankings for 2017

	2017 (old)	2017 (new)	Difference
Australia	15	13	-2
Austria	25	25	0
Belgium	10	12	2
Canada	11	11	0
Chile	30	29	-1
Czechia	24	23	-1
Denmark	7	7	0
Estonia	20	19	-1
Finland	9	8	-1
France	22	24	2
Germany	18	18	0
Greece	31	31	0
Hungary	14	17	3
Iceland	1	1	0
Ireland	17	10	-7
Israel	21	21	0
Italy	29	30	1
Japan	27	27	0
Korea	33	33	0
Luxembourg	6	6	0
Mexico	32	32	0
Netherlands	19	20	1
New Zealand	3	4	1
Norway	5	5	0
Poland	8	9	1
Portugal	16	15	-1
Slovak Republic	26	26	0
Slovenia	4	3	-1
Spain	28	28	0
Sweden	2	2	0
Switzerland	12	14	2
United Kingdom	13	16	3
United States	23	22	-1

Index methodology – Variables included in scoring

Variable	Weight %	Factor	Rationale
Gap between female and male earnings	25	Wider pay gap penalised	Earnings equality underpins the fundamental principle of equal pay for equal work.
Female labour force participation rate	25	Higher participation rates given higher score	Female economic participation is one of the cornerstones of economic empowerment, which is a factor of the level of skills and education of women, conducive workplace conditions, and broader cultural attitudes outside the workplace (e.g. towards shared childcare and distribution of labour at home).
Gap between female and male labour force participation rates	20	Higher female participation rate relative to male participation rate given higher score	Equality in participation rates reflect equal opportunities to seek and access employment opportunities in the workplace.
Female unemployment rate	20	Higher unemployment penalised	The female unemployment rate reflects the economic vulnerability of women. Being unemployed can have longer-term impacts in the form of skills erosion, declining pension contributions and increased reliance on benefits.
Share of female employees in full-time employment	10	Higher share of full-time employment given higher score	The tendency for part-time employment may adversely affect earnings, pensions and job security. However, this factor is given a lower weight in the Index since some women may prefer part-time jobs to fit flexibly with caring roles.

Methodology for calculating potential GDP impacts from increasing employment rates

We break down GDP in the following way

GDP boost	=	GDP/FTE	x	Difference between Sweden's FFTE and a given country's FFTE, if Sweden's FFTE is higher

We calculate full-time equivalent employment (FTE) as full-time employment plus half of part-time employment. We consider the potential boost to GDP under two different scenarios:

- Increasing the female full-time equivalent employment rates (FFTE) to that of a benchmark country (holding the male rates constant). We use Sweden as our benchmark country as it has the second highest female labour force participation rate. Iceland has the highest female labour force participation rate, however we use Sweden as it is a reasonably large economy and therefore a more suitable comparator country for the OECD.

Simplifying assumptions

In order to estimate the GDP impacts of increasing female employment rates, with the data available, we have made the following simplifying assumptions:

- Total employment in the economy is equal to employment within the 15-64 age group.
- A full-time (FT) worker is twice as productive on average as a part-time (PT) worker.

Methodology for calculating potential GDP impacts from increasing employment rates

We break down annual total earnings in the following way

Total earnings	**=**	**Average male earnings * Male workers**	**+**	**Average female earnings * Female workers**
		where		
Average male earnings	**=**	**Average female earnings**	**/**	**(1 – gender pay gap)**

In order to estimate the potential gains from closing the gender pay gap, we made the following simplifying assumptions:

- Total employment in the economy is equal to employment within the 15-64 age group.
- The median wages are equivalent to mean wages.
- The gender pay gap is closed by increasing female wages to match male wages.

- The elasticity of female employment to a change in wages is 0, meaning that a 1% increase in wages results in no change in female employment. This takes into account the counteracting effects of labour supply and demand elasticities: an increase in wages makes it more expensive for employers to hire more workers, however higher earnings also incentivise potential workers to seek employment. Our literature review suggests that
  - Estimates of labour supply elasticity range from 0.5 to 0.9.[62]
  - Estimates of labour demand elasticity range from – 0.5 to – 0.3.[63]
- We take a conservative view that the counteracting effects cancel each other out with no resulting change in female employment.
- The simplifying assumptions provide us with conservative gain estimates because:
  - The gender pay gap is likely to be higher at the mean, which may be skewed upwards by a small number of high earners amongst male employees, than at the median which has been used to obtain data for at least 10 countries, as noted in the data sources above.[64]
  - The 64+ age group has not been included in the analysis.

Data sources – UK regional data

We have applied the same methodology as for the main Index to construct the UK regional index. This includes using the same weights and factors.

Indicator	Source
Female labour force participation rate	Annual Population Survey, Office of National Statistics (2010, 2018) Labour Force Survey, Office of National Statistics (2000)
Gap in male and female labour force participation rates	Annual Population Survey, Office of National Statistics (2010, 2018) Labour Force Survey, Office of National Statistics (2000)
Female unemployment rate	Annual Population Survey, Office of National Statistics (2010, 2018) Labour Force Survey, Office of National Statistics (2000)
Female full-time employment rate	Annual Population Survey, Office of National Statistics (2010, 2018)
Gender pay gap	Annual Survey of Hours and Earnings, Office of National Statistics (2000, 2010, 2018)

Women in Technology Index methodology – Variables included in scoring

We have applied the same methodology as for the main Index to construct the Women in Technology Index. The only difference is that for the Women in Technology Index, each variable is given equal weight, unlike for the main Index.

Variable	Weight %	Factor	Rationale
Female share of ICT graduates	25	Higher female share given higher score	The number of women obtaining ICT degrees forms a key part of the pipeline of women into the technology industry. The female share of ICT graduate indicates the extent to which women are acquiring technical knowledge compared to men.
Female share of technology industry employment	25	Higher female share given higher score	The female share of technology industry employment reflects the ability of women to access and obtain employment in technology and is a factor of the level of technical skills of women and workplace conditions for women.
Percentage of women on boards in the telecommunications, media and technology industry	25	Higher percentage of women given higher score	The share of women on boards reflects the extent to which women can access and obtain senior leadership positions and progress professionally within the technology industry.
Gender pay gap in the technology industry	25	Wider pay gap penalised	Earnings equality underpins the fundamental principle of equal pay for equal work.

Data sources – Women in Technology Index

Indicator	Country	Definition	Classification	Year	Source	Adjustments and assumptions
Female share of ICT graduates	All	Share of graduates by gender in fields of education, Information and Communication Technologies	Total tertiary education (ISCED2011 levels 5 to 8)	2017	OECD	For Japan, there is no data for ICT as it is included in another category. Therefore, the data point used is the average of the female share of natural sciences, mathematics and statistics and engineering graduates, and the female share of manufacturing and construction graduates.
Female share of technology industry employment	All except Canada Canada	Female employment / total employment Female share of all jobs in in the ICT sector	ISIC REV.4: J. Information and communication NOC 1-30	2018 2018	ILO Women in Communications and Technology	Employment in information and communication is used as a proxy for employment in the technology industry. Employment in occupations defined by NOC 1-30 is used as a proxy for employment in the technology industry.
Percentage of women on boards in the telecommunications, media and technology industry	All	Percentage of women on boards in technology, media and telecommunications industry		2018	Deloitte, MSCI ESG Research	The percentage of women on boards in the telecommunications, media and technology industry is used as a proxy for the percentage of women on boards in the technology industry.

Data sources – Women in Technology Index

Indicator	Country	Definition	Classification	Year	Source	Adjustments and assumptions
Gender pay gap in the technology industry	France, Germany, Italy, UK	(Male – female) / male, Average gross hourly earnings of employees	NACE Rev.2 J - Information and communication	2017	Eurostat	The gender pay gap for information and communication is used a proxy for the gender pay gap for the technology industry.
	Japan	(Male – female) / male, Mean nominal monthly earnings of employees	ISIC REV.4: J. Information and communication	2017	ILO	The gender pay gap for information and communication is used a proxy for the gender pay gap for the technology industry.
	USA	(Male – female) / male, Median weekly earnings of full-time wage and salary workers	Computer and mathematical occupations	2018	US Bureau of Labor Statistics	The gender pay gap for computer and mathematical occupations is used a proxy for the gender pay gap for the technology industry.
	Canada	(Male – female) / male, Average salary in tech	Top 5% of technology occupations as defined by skills involved in the occupation	2016	Brookfield Institute	The gender pay gap for the top 5% of technology occupations based on skills is used a proxy for the gender pay gap for the technology industry.

Methodology for calculating the gender impact of technology

The analysis applies PwC methodology developed in previous studies to calculate the displacement and income effects of AI and related technologies by country and sector over the next 20 years.

There are two effects on jobs that are likely to result from the acceleration in the development and adoption of new technology. These are:

- **The displacement effect – the loss of jobs as the use of technology becomes more efficient and firms are incentivised to seek cost savings through substituting towards technology and away from human labour.**
- **The income effect – the dynamic effect of firms' technology-associated cost savings leading to lower quality-adjusted prices which increase real incomes and spending. As a result, firms increase their production both by investing in more technology and hiring more workers.**

To estimate the displacement effect, we draw on research by Frey and Osborne (2013) and Arntz, Gregory and Zierahn (2016). The original Frey and Osborne (2013) study involved hand-labelling a sample of occupations as either automatable or not automatable and using a machine learning algorithm to generate a 'probability of computerisation' across US jobs, based on a standardised set of occupational characteristics.[65]

This methodology was extended by Arntz, Gregory and Zierahn (2016), and subsequently refined by PwC using the OECD Programme for the International Assessment of Adult Competencies (PIAAC) database, which includes more detailed data on the different types of tasks for each occupation and the characteristics of individuals performing them.[66] This resulted in more granular estimates of the automatability of jobs by industry sector and for each country, taking into account differences in occupational characteristics within each sector and country. These estimates also account for changes in the automatability of these jobs for each sector over time.

We multiply these estimates of automatability by the number of jobs in each industry to calculate the number of jobs at risk in each sector by OECD country over the next 20 years.

We also apply a simplifying assumption that the estimate of automatability for each industry applies similarly to men and women. This may be a strong assumption, as within each industry sector, women may cluster in particular occupations that are more (or less) automatable than occupations performed by men.

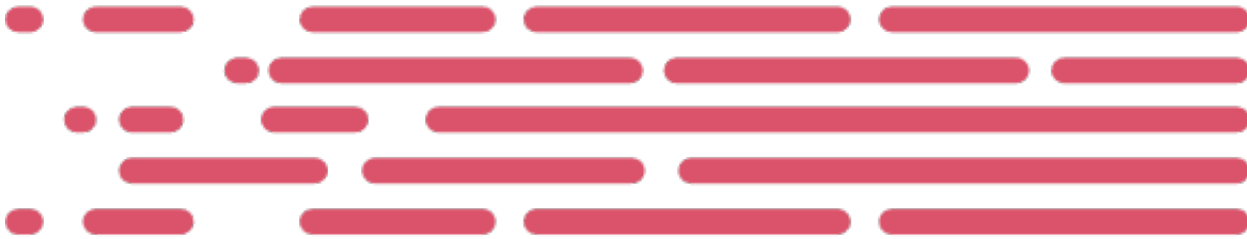
Methodology for calculating the gender impact of job automation

To estimate the impacts from the income effect, we assume that on aggregate, the jobs created via the income effect is equal to the number of jobs that are displaced. This is based on the findings of our July 2018 study that the net effect from the displacement effect and the income effect is broadly neutral for the UK.[67] This study in turn built on combining insights from earlier research on job automation and the economic benefits of AI.[68] This analysis was for the UK, but the UK is around OECD average for job automation estimates, so may generalise to other mature developed economies. Looking at the past, there is no evidence as it stands that tech trends and investments are taking jobs away. For example, overall UK employment rates are at a record high, despite all the advances in AI and related digital technologies seen over the past decade.

However, these additional jobs are expected to be distributed across sectors based on their relative gross value added to the economy. A larger sector is therefore expected to benefit from a bigger increase in jobs as a result of the income effect.

We collect OECD data on gross value added (GVA) at the SIC1 industry sector-level for each OECD country. Using trends in the long-term growth rate for each industry sector, we apply these trends to project the size of these sectors over a 20-year horizon. Because these growth rates differ across industry sectors, these will result in a change in the industry-sector composition of the economy in the future.

To project these impacts over a 20-year horizon, we also assume that the share of male and female employment in each industry will remain constant over this period. We also assume that the number of total jobs in a country remains constant, as we are mainly interested in the impact of existing patterns of female employment by industry (and how it drives vulnerability to automation) rather than the impact on overall employment.



Methodology for calculating the gender impact of technology

SIC1 sector	OECD industry
Agriculture, forestry and fishing	Agriculture, forestry, fishing
Mining and quarrying	Industry, including energy
Manufacturing	Manufacturing
Electricity, gas, steam and air conditioning supply	Industry, including energy
Water supply; sewerage and waste management	Industry, including energy
Construction	Construction
Wholesale and retail trade; repair of motor vehicles	Wholesale, retail trade, repairs, transport; accommodation, food services
Transportation and storage	Wholesale, retail trade, repairs, transport; accommodation, food services
Accommodation and food service activities	Wholesale, retail trade, repairs, transport; accommodation, food services
Information and communication	Information, communication
Financial and insurance activities	Finance and insurance
Real estate activities	Real estate
Professional, scientific and technical activities	Professional, scientific, support services
Administrative and support service activities	Professional, scientific, support services
Public administration and defence	Public administration, defence, education, health, social work
Education	Public administration, defence, education, health, social work
Human health and social work activities	Public administration, defence, education, health, social work
Arts, entertainment and recreation	Other services activities
Other service activities	Other services activities

Bibliography

Arntz, M., Gregory, T., Zierahn, U. (2016). The risk of automation for jobs in OECD countries: a comparative analysis. OECD Social, Employment and Migration Working Papers No 189.

BCG. (2017). BCG Diversity and Innovation Survey.

BCG. (2017). The Mix That Matters: Innovation Through Diversity.

Burning Glass Technologies. (2019). No Longer Optional: Employer Demand for Digital Skills

Criado Perez, C. (2019). Invisible Women: Exposing Data Bias in a World Designed for Men

Deloitte. (2013). Waiter, is that inclusion in my soup? A new recipe to improve business performance.

Frey, C.B., Osborne, M.A. (2013). The Future of Employment: How Susceptible are Jobs to Computerisation? University of Oxford.

Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.

Krishnan, H. A., Park, D. (2005). A few good women — on top management teams. Journal of Business Research, 58(12), 1712–1720.

Lorenzo, R., Reeves, M. (2018). Havard Business Review. How and Where Diversity Drives Financial Performance.

McKinsey & Company. (2007). Women matter: Gender diversity, a corporate business driver, 12–

National Center for Women & Information Technology. (2016). Women In Tech: The Facts.

OECD. (2018). Bridging The Digital Gender Divide.

PwC. (2017). Will robots steal our jobs? The potential impact of automation on the UK and other major economies. UK Economic Outlook March 2017.

PwC. (2018). What will be the net impact of AI and related technologies on jobs in the UK? UK Economic Outlook July 2018.

PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation.

PwC. (2019). Upskilling Hopes and Fears – PwC's global survey on technology: jobs and skills.

PwC. (2017). Winning the fight for female talent How to gain the diversity edge through inclusive recruitment.

PwC. (2017). Women in Tech: Time to close the gender gap.

PwC. (2018). Youth Employment Index 2018

Rohner, U., Dougan, B. (2012). Gender diversity and corporate performance. Technical report, Credit Suisse Research Institute, Zurich.

Tech Talent Charter. (2019). Diversity in Tech 2019.

The Economist. (2019). Ladies of the lab.

The New Yorker. (2017). The tech industry's gender-discrimination problem.

World Economic Forum. (2016). The Future of Jobs.

Vassallo,T., Levy,E., Madansky,M., Mickell,H., Porter,B., Leas,M., Oberweis, J. (2015). The Elephant in the Valley.

Endnotes

1. The New York Times, (2019). Across the Globe, a 'Serious Backlash Against Women's Rights'. https://www.nytimes.com/2019/12/04/us/domestic-violence-international.html
2. PwC. (2019). Upskilling Hopes & Fears. https://www.pwc.com/gx/en/issues/upskilling.html
3. PwC. (2018). What will be the net impact of AI and related technologies on jobs in the UK? UK Economic Outlook, July 2018. https://www.pwc.co.uk/economic-services/ukeo/ukeo-july18-full-report.pdf
4. ILO data shows that the number of women employed in the information and communication industry has increased over the period 2014 -2018 (inclusive) in Germany, France, Italy, Japan, the United Kingdom and the United States. Research conducted by The Information and Communications Technology Council Canada shows that the number of women employed in ICT has increased over the period 2008 - 2018 (inclusive).
5. Throughout this edition of the Women in Work Index, the technology industry/sector/companies/organisations refers to (companies and organisations within) the information and communication industry as this is the industry classification for which data on employment and the gender pay gap is available for all G7 countries and includes a number of technology occupations. Women in technology refers to women employed in all roles in the information and communication industry. Women employed in technical/technology roles in other industries/ sectors are not included. Other industries refers to industries other than information and communication. Further detail can be found in the Methodology section.
6. The female share of employment in the technology industry is defined as the number of females employed in the information and communication industry divided by the total number of people employed in the information and communication industry.
7. The gender pay gap is calculated for the information and communications industry for France, Germany, Italy Japan, and the UK, computer and mathematical occupations in the US, and the top 5% of technology occupations based on skills in Canada.
8. OECD. (2018). Bridging The Digital Gender Divide. http://www.oecd.org/internet/bridging-the-digital-gender-divide.pdf
9. Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.; National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
10. OECD. (2018). Bridging The Digital Gender Divide http://www.oecd.org/internet/bridging-the-digital-gender-divide.pdf
11. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf ; Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.
12. Hewlett et al. 2014 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf ; National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
13. Hewlett et al. 2014 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
14. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf ; Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.; Hewlett et al. 2014 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
15. Tech Talent Charter. (2019). Diversity in Tech 2019. https://cdn2.hubspot.net/hubfs/3418747/2019%20Diversity%20in%20Tech%20Report%20(released%20Jan%202020)/TTC_Diversity%20in%20Tech%20Report_2019.pdf
16. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf,
17. This differs from the ONS measure of the gender pay gap as the OECD measure only considers full-time employees, therefore part-time employees are not included.
18. Powell, A. (2019). Women and the Economy. House of Commons Briefing Paper, CBP06838. http://researchbriefings.files.parliament.uk/documents/SN06838/SN06838.pdf
19. ILO data shows that the number of women employed in the information and communication industry has increased over the period 2014 -2018 (inclusive) in Germany, France, Italy, Japan, the United Kingdom and the United States. Research conducted by The Information and Communications Technology Council Canada shows that the number of women employed in ICT has increased over the period 2008 - 2018 (inclusive).
20. Credit Suisse Research Institute (2012). Gender diversity and corporate performance. https://wappp.hks.harvard.edu/files/wappp/files/gender_diversity.pdf; McKinsey & Company. (2007). Women matter: Gender diversity, a corporate business driver. https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Organization/Our%20Insights/Gender%20diversity%20a%20corporate%20performance%20driver/Gender%20diversity%20a%20corporate%20performance%20driver.ashx; Krishnan, H. A., & Park, D. (2005). A few good women — on top management teams. Journal of Business Research, 58(12), 1712–1720.
21. Lorenzo, R., Reeves, M. (2018). Harvard Business Review. How and Where Diversity Drives Financial Performance. https://hbr.org/2018/01/how-and-where-diversity-drives-financial-performance
22. Measured as investment in digital technology as a percentage of operating expenses. See BCG. (2017). BCG Diversity and Innovation Survey. https://www.bcg.com/publications/2018/how-diverse-leadership-teams-boost-innovation.aspx
23. BCG. (2017). The Mix That Matters: Innovation Through Diversity. https://www.bcg.com/en-gb/publications/2017/people-organization-leadership-talent-innovation-through-diversity-mix-that-matters.aspx
24. The New Yorker. (2017). The tech industry's gender-discrimination problem.https://www.newyorker.com/magazine/2017/11/20/the-tech-industrys-gender-discrimination-problem ; Vassallo,T., Levy,E., Madansky,M., Mickell,H., Porter,B., Leas,M., Oberweis, J. (2015). The Elephant in the Valley. https://www.elephantinthevalley.com/
25. https://www.bbc.co.uk/news/technology-45809919
26. Criado Perez, C. (2019). Invisible Women: Exposing Data Bias in a World Designed for Men
27. PwC. (2016). Why do we need more women in tech? https://www.pwc.co.uk/who-we-are/regional-sites/yorkshire-north-east/insights/5-days-of-women/why-do-we-need-more-women-in-tech-.html
28. Burning Glass Technologies. (2019). No Longer Optional: Employer Demand for Digital Skills. https://www.burning-glass.com/wp-content/uploads/no_longer_optional_report.pdf
29. The Economist. (2019). Ladies of the lab. https://www.economist.com/europe/2019/07/18/why-half-the-scientists-in-some-eastern-european-countries-are-women
30. PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf
31. ILO data shows that the number of women employed in the information and communication industry has increased over the period 2014 -2018 (inclusive) in Germany, France, Italy, Japan, the United Kingdom and the United States. Research conducted by The Information and Communications Technology Council Canada shows that the number of women employed in ICT has increased over the period 2008 - 2018 (inclusive).

Endnotes

32. OECD. (2018). Bridging The Digital Gender Divide. http://www.oecd.org/internet/bridging-the-digital-gender-divide.
33. PwC. (2017). Women in Tech: Time to close the gender gap. https://www.pwc.co.uk/women-in-technology/women-in-tech-report.pdf
34. Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.; National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
35. OECD. (2018). Bridging The Digital Gender Divide. http://www.oecd.org/internet/bridging-the-digital-gender-divide.
36. PwC analysis, OECD.
37. OECD. (2018). Bridging The Digital Gender Divide. http://www.oecd.org/internet/bridging-the-digital-gender-divide.
38. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf ; Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.
39. Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.
40. Hewlett et al 2014 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf ; National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
41. Hewlett et al 2014 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
42. World Economic Forum. (2016). The Future of Jobs. http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf ; Glass et al 2013 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
43. Glass et al 2013 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
44. Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy
45. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf ; Hewlett, S.A., Buck Luce, C., Servon, L., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). The Athena factor: Reversing the brain drain in science, engineering, and technology. New York: Center for Work-life Policy.; Hewlett et al. 2014 cited in National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
46. World Economic Forum. (2016). The Future of Jobs. http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf
47. https://www.pwc.co.uk/press-room/press-releases/the-tech-she-can-charter-launches-free-tech-we-can-lesson-plans-to-all-schools-across-uk.html
48. Tech Talent Charter. (2019). Diversity in Tech 2019. https://cdn2.hubspot.net/hubfs/3418747/2019%20Diversity%20in%20Tech%20Report%20(released%20Jan%202020)/TTC_Diversity%20in%20Tech%20Report_2019.pdf
49. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
50. National Center for Women & Information Technology. (2016). Women In Tech: The Facts. https://www.ncwit.org/sites/default/files/resources/womenintech_facts_fullreport_05132016.pdf
51. PwC. (2017). Winning the fight for female talent How to gain the diversity edge through inclusive recruitment. https://www.pwc.com/gx/en/about/diversity/iwd/iwd-female-talent-report-web.pdf
52. Tech Talent Charter. (2019). Diversity in Tech 2019. https://cdn2.hubspot.net/hubfs/3418747/2019%20Diversity%20in%20Tech%20Report%20(released%20Jan%202020)/TTC_Diversity%20in%20Tech%20Report_2019.pdf
53. PwC. (2018). UK Economic Outlook, July 2018. https://www.pwc.co.uk/economic-services/ukeo/ukeo-july18-full-report.pdf
54. PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf
55. PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf
56. PwC. (2018). What will be the net impact of AI and related technologies on jobs in the UK? UK Economic Outlook July 2018. https://www.pwc.co.uk/economic-services/ukeo/ukeo-july18-full-report.pdf
57. PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation. https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf ; PwC. (2017). Sizing the prize: what's the real value of AI for your business and how can you capitalise? https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf
58. World Economic Forum. (2018). The Future of Jobs. http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf
59. PwC. (2018). Youth Employment Index 2018. https://www.pwc.co.uk/services/economics-policy/insights/youth-employment-index.html
60. PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation. https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf
61. PwC. (2019). Upskilling Hopes and Fears. https://www.pwc.com/gx/en/issues/upskilling.html
62. Blundell, R. et al. (2013). Female Labour Supply, Human Capital and Welfare Reform. IFS Working Paper W13/10.
63. Merikull, J. and Room, T. (2014). Are foreign-owned firms different? Comparison of employment volatility and elasticity of demand. European Central Bank Working Paper Series No 1704.
64. ONS. (2015). Annual Survey of Hours and Earnings, 2015 Provisional Results.
65. Frey, C.B., Osborne, M.A. (2013). The Future of Employment: How Susceptible are Jobs to Computerisation? University of Oxford.
66. Arntz, M., Gregory, T., Zierahn, U. (2016). The risk of automation for jobs in OECD countries: a comparative analysis. OECD Social, Employment and Migration Working Papers No 189.
67. PwC. (2018). What will be the net impact of AI and related technologies on jobs in the UK? UK Economic Outlook July 2018. https://www.pwc.co.uk/economic-services/ukeo/ukeo-july18-full-report.pdf
68. PwC. (2018). Will robots really steal our jobs? An international analysis of the potential long term impact of automation. https://www.pwc.co.uk/economic-services/assets/international-impact-of-automation-feb-2018.pdf ; PwC. (2017). Sizing the prize: what's the real value of AI for your business and how can you capitalise? https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

For more information about this report, please contact members of our team

Our Economics practice in the UK offers a wide range of services covering: market reform in a range of industry sectors (including energy, water, media and telecoms, financial services, health and government services); competition policy, disputes and other investigations; economic, social and environmental impact analysis; financial economics; fiscal policy and macroeconomics. This practice forms part of Strategy&, PwC's strategy consulting business.

For more information about our Economics services please visit: www.pwc.co.uk/economics

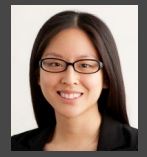
Our Women in Work Index is one of a series of related PwC labour market indices. Please take a look at our other indices for older and younger workers at the links below:

PwC's Golden Age Index

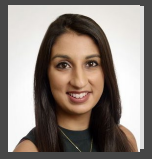
https://www.pwc.co.uk/services/economics-policy/insights/golden-age-index.html

PwC's Youth Employment Index

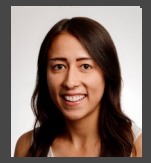
https://www.pwc.co.uk/services/economics-policy/insights/youth-employment-index.html



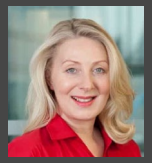
Jing Teow
Senior Economist
yong.jing.teow@pwc.com



Alisha Kapoor
Economist
kapoor.alisha@pwc.com

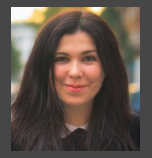


Tara Shrestha Carney
Economist
tara.shrestha.x.carney@pwc.com



Sheridan Ash
Technology and investments innovation and Women in Tech Leader
sheridan.ash@pwc.com

Alex Cooper
Economist
alexandra.x.cooper@pwc.com



Katy Bennett
Director, Diversity and Inclusion Consulting
katy.e.bennett@pwc.com

Thank you

pwc.co.uk

200213-083942-IB-UK