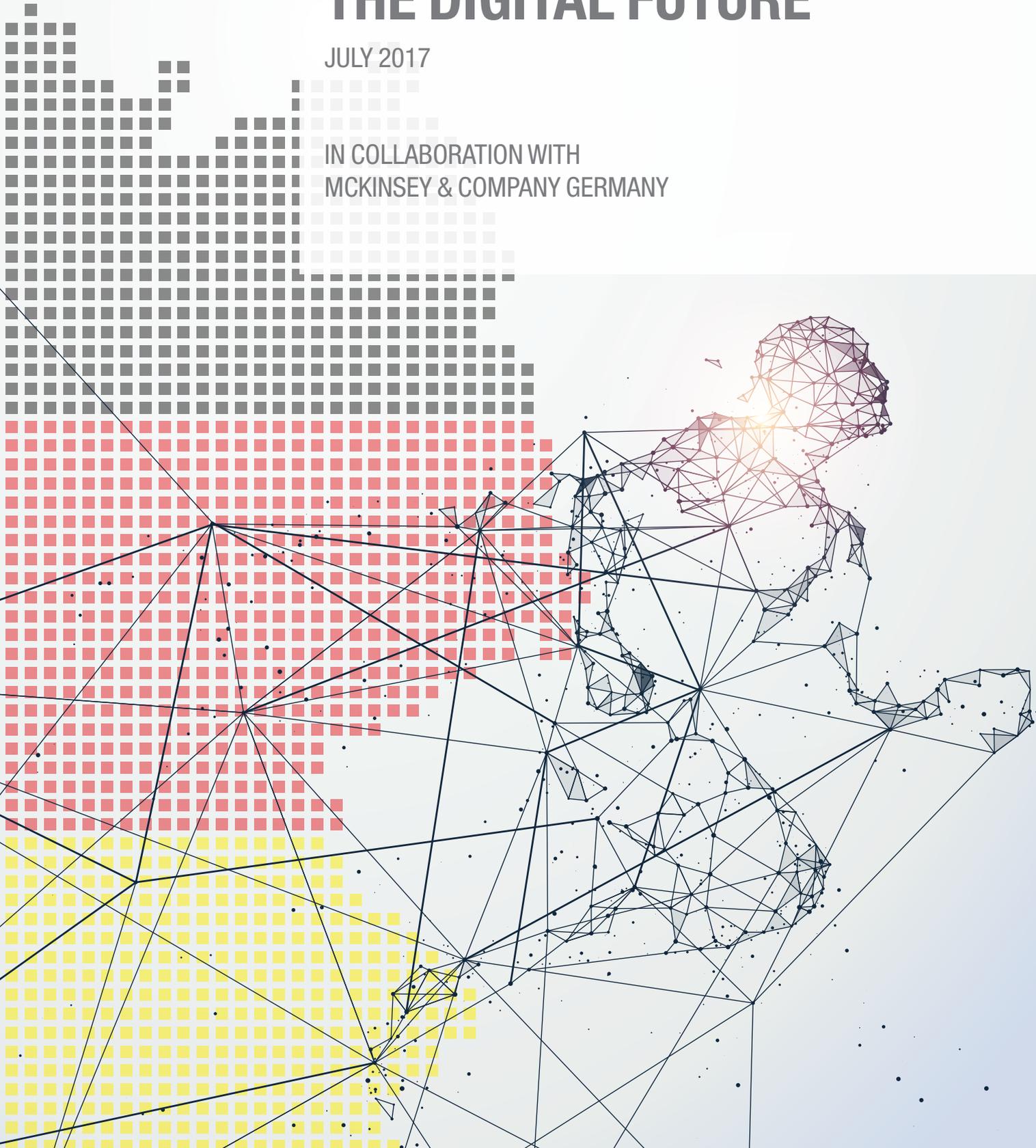


MCKINSEY GLOBAL INSTITUTE

DRIVING GERMAN COMPETITIVENESS IN THE DIGITAL FUTURE

JULY 2017

IN COLLABORATION WITH
MCKINSEY & COMPANY GERMANY



MCKINSEY GLOBAL INSTITUTE

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IN BRIEF

DRIVING GERMAN COMPETITIVENESS IN THE DIGITAL FUTURE

Germany's economy is one of the most competitive in the world. Its GDP grew 1.9 percent in 2016, faster than any other G7 economy, and its employment rate has risen by 10 percentage points over about a decade. This puts the country in a strong position to face potentially disruptive trends, including an ageing population, rising global competition, and especially digitisation and automation. But to preserve Germany's strong competitive position, business leaders and policymakers will need to adapt to rapidly changing global conditions, do more to harness the potential of new technologies, and make the most of Germany's competitive advantages.

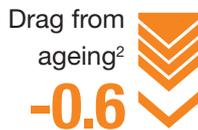
- German business leaders are optimistic. A recent MGI survey of 2,000 businesses in six EU countries found that German companies were some of the most optimistic in Europe. They expected their investment in the EU to grow 15.6 percent on average over the next three years, compared with a 6.9 percent average among all companies surveyed. A clear majority of executives in Germany, 55 percent, expect increased digitisation to have a positive effect on their business.
- Quick adoption of automation technology could add up to 2.4 extra percentage points to Germany's annual per capita GDP growth to 2030. By 2030, that could represent as much as €15,750 extra GDP for each German. This could help compensate for a 0.6 percentage point annual drag on per capita GDP growth from ageing over that time frame, and allow Germany to broadly sustain its historical per capita GDP growth rate of 2.1 percent per year, assuming that other elements of productivity continue to increase.
- German industry is generally in a good position to capture these opportunities, as it has already taken many of the steps needed for digitisation and has the resources to move further quickly. A recent McKinsey survey found that nearly one-third of German businesses have assigned clear responsibilities for implementing the changes associated with digital manufacturing, and individual companies are becoming industry leaders in the internet of things (IoT).
- To reap these benefits, however, Germany will need to accelerate its embrace of emerging digital technologies and automation. The country has currently captured just 10 percent of the global "digital potential", which we define as the upper bounds of digitisation by the leading sectors globally, and many sectors and firms are lagging behind. AI is now turbocharging digital transformation, yet Germany and Europe more broadly lag behind China and the US in full-scale adoption. Germany also lacks large-scale consumer tech companies and online platforms for business transactions to rival global giants such as Apple, Alphabet, and Alibaba. As a result Germany runs a digital services trade deficit with the United States to the tune of over 4 percent of total services trade.
- Businesses need to accelerate investment in and adoption of digital technologies and seek opportunities to build home-grown platforms that can compete globally. They will need to be bolder in digital transformations across the value chain, build new business models, and capture new markets. Public policy makers can help a digital culture take root in Germany by establishing the necessary infrastructure, such as broadband networks, and business ecosystems, which combine finance, talent, and academic support. They can also lead by example and digitise government operations and functions, and enable scale by driving the EU Digital Single Market.
- Policymakers also need to take steps to prepare the workforce for the upcoming transition. Because of Germany's ageing demographics, the impact of automation on overall job creation and employment levels should be less of a concern than wages and inequality. Recent MGI research estimates that 62 to 77 percent of the hours worked by low-skilled Germans could be automated by adapting currently demonstrated technology versus 18 percent for the highest-skilled, putting further pressure on relative wages and demand. Education, labour, and welfare institutions will need to evolve to ensure everyone can equitably participate in the new digital economy, while protecting those who fall behind.
- Though many of these trends and changes are still evolving, German business and policy leaders can begin with a program of five action items each to ensure competitiveness for a digital future (see "Priorities to drive German competitiveness in the digital future").

Driving German competitiveness in the digital future

Automation could boost Germany's economy and offset population decline

Potential impact on Germany's GDP per capita (2014-30)¹

CAGR (percentage point growth per year)

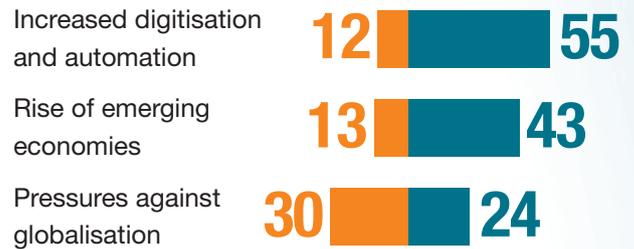


German businesses also expect to thrive in the digital era

Expected impact of incoming trends on business

■ Total positive
■ Total negative

Percent of German C-suite executives



But Germany still has far to go to capture this opportunity...

Share of digitisation potential realised

Percent



... and it needs to actively spread the benefits throughout society

Labour associated with technically automatable activities in Germany

Percent of hours worked in 2014



¹ Assumes the total population will decline from 82.6 million in 2014 to 79.6 million in 2030. Assumes the working population will fall from 40.1 million in 2014 to 34.9 million in 2030.

² Calculated change to GDP per capita assuming a constant 2014 productivity rate and a declining working population.

³ Considers the benefits of labour substitution only, and assumes that all FTE hours displaced by automation will be reallocated to equally productive work. Shows the difference in per capita income growth under a scenario with automation and one without.

⁴ Europe is the weighted average of the UK, Netherlands, Sweden, France, Germany and Italy, which make up 60% of the population and 72% of GDP in the EU-28 grouping.

SOURCE: The Conference Board Total Economy database; UN Population Division; Eurostat; OECD; 2017 European Business Survey; McKinsey Global Institute analysis



PRIORITIES TO DRIVE GERMAN COMPETITIVENESS IN THE DIGITAL FUTURE

This paper presents both immediate and long-term considerations for German competitiveness as the country moves further into the digital age. Many of these trends and changes are still evolving, which means the responses they will require are still murky. However, Germany can work on the following priorities to make the transition successful, whatever the details of its future:

Actions for policy makers

- 1. Digitise the public sector:** Set a clear and ambitious digitisation target for all levels of government, and drive it aggressively.
- 2. Catch up in lagging sectors:** Help the less digitised German sectors—like construction, real estate, and the fragmented tail in banking—to catch up with the most digitised firms.
- 3. Attract foreign talent, and nurture and retain talent in Germany:** Further encourage and facilitate migration of highly-skilled tech leaders to Germany, and work with businesses to motivate more of the best workers to stay. Strengthen training and education programmes to help young people—including women and the children of asylum seekers—prepare for the future of work.
- 4. Provide digital infrastructure and ecosystems:** Build high performance broadband networks, drive the EU digital single market, and otherwise create an environment where digitised businesses can thrive.
- 5. Plan for future labour markets:** Modify labour institutions to better support independent workers and others already navigating the future of work, including those who may be left behind in the transition.

Actions for businesses

- 1. Set a clear and bold digital agenda from the top:** Making digital transformation a C-level priority will improve its chances of success.
- 2. Digitise across value chain:** Ensure marketing and distribution, supply chains, and products themselves—among other elements—take advantage of digitisation and AI.
- 3. Seek and scale opportunities outside traditional boundaries:** Identify new and adjacent markets opened up by the digital age, and test them for growth.
- 4. Reinvest savings from digital into new opportunities:** New tech tools will change businesses' cost structures, which can create the headroom for additional investments in the tools of the future.
- 5. Embrace flat and agile working structures:** The stereotypical “German engineering” culture will need to adapt to the more flexible working models favoured in the digital age.



GERMANY COULD MATERIALLY INCREASE PER CAPITA GDP BY EXPANDING AUTOMATION

Germany is one of the most competitive economies globally, and it experienced robust GDP growth last year relative to other major economies. With many of its large, world-leading industrial companies already joining the race to digitise, Germany has an early advantage in the digital revolution that is radically changing economies and employment. In order for Germany to remain economically vibrant in the future, the country will need to accelerate the adoption of the technological tools of tomorrow's economy, from data-driven automation to digitally enabled gig work. Doing so could improve productivity enough to boost per capita GDP by as much as 2.4 percentage points per year in Germany.

GERMANY IS WELL POSITIONED TO BENEFIT FROM A DIGITAL BOOM

In 2016, German GDP **grew by 1.9 percent** (1.8 percent on a calendar-adjusted basis), the fastest growth among the G7 economies.¹ The European Commission forecasts continued strong growth for Germany, with projections of 1.6 percent GDP growth in 2017 and 1.9 percent in 2018.²

The World Economic Forum ranked Germany the **fourth most competitive country** in the world in 2015–16, just behind Switzerland, Singapore, and the United States. It climbed from seventh place in 2009–10.³ Germany is also a highly connected country. It was ranked as the fourth-highest country in McKinsey's Connectedness Index in 2014, driven by all types of flows but finance. It was ranked number 2 in the world for data-flow intensity, behind only the Netherlands.⁴

Due to its competitiveness and connectedness (combined with currency effects in the eurozone), Germany in 2016 ran a current-account surplus of more than €260 billion, or 8.6 percent of GDP, which is the largest in the world in total value terms.⁵ Germany was the world's **third-largest export economy** in 2016, behind the United States and China, with \$1.283 trillion in merchandise exports.⁶

Germany experienced a **rapid rise in employment** despite the global financial crisis of 2007-2009, building on its sustained economic growth, substantial domestic labour market reform (including the Hartz laws but also reforms to pensions and childcare systems), and macroeconomic effects. Between 2004 and 2015, the employment rate in Germany surged by almost 10 percentage points and overtook the US by a wide margin (Exhibit 1). By 2015, Germany had the seventh-highest employment rate in the OECD, and it was a full 7.9 percentage points higher than the EU-15 average, although critics suggest a rising low-wage and part-time sector accounts for at least some of this increase.⁷

1.9%
growth of German
GDP in 2016

10PP
increase in
employment rate
over a decade

¹ Destatis (German Federal Statistical Office).

² Eurostat.

³ World Economic Forum Global Competitiveness Index, 2005–2015.

⁴ *Digital globalization: The new era of global flows*, McKinsey Global Institute, March 2016.

⁵ Destatis; Mattern, Frank, "Germany's trade surplus: How bad is 'bad' —and how to make it 'good'", LinkedIn, May 2017.

⁶ CIA World Factbook.

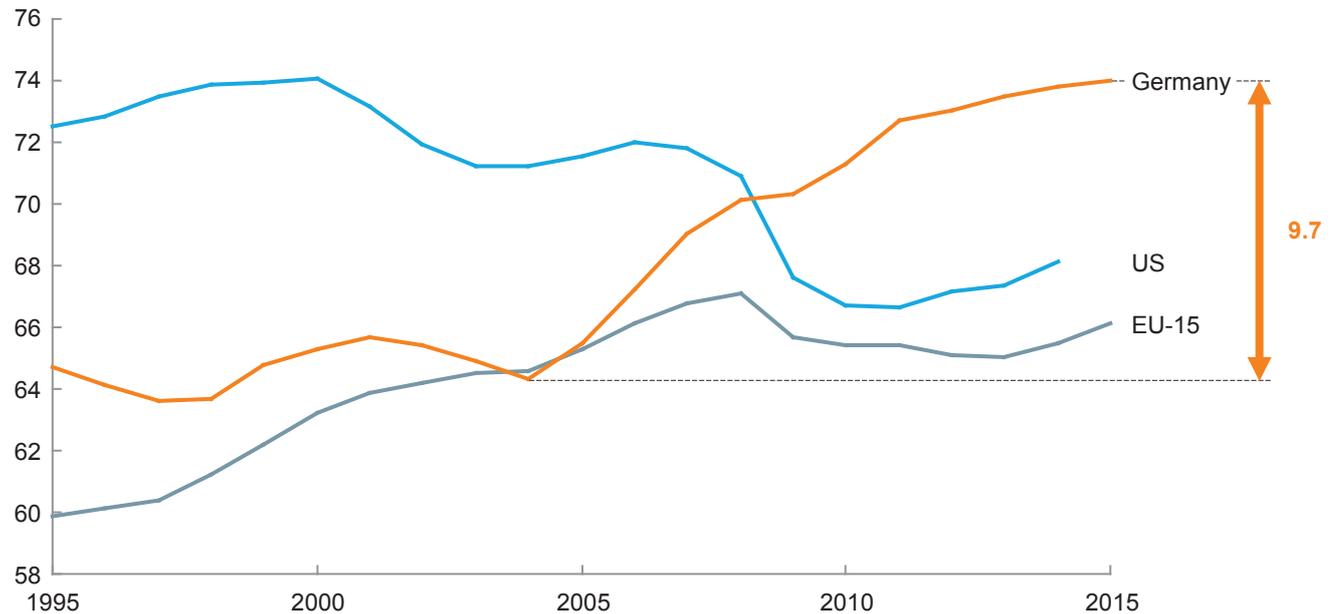
⁷ OECD; Eurostat.

Exhibit 1

Since 2004, the employment rate in Germany has surged and even overtaken that of the US

Rate of employment within the working age population (15-64 years)

Percent



SOURCE: OECD; Eurostat; McKinsey Global Institute analysis

Germany has a particularly high prime-age female labour force participation rate at 82.5 percent of women aged 25 to 54 in 2015, well ahead of the United States (74 percent).⁸ However, these high employment rates belie lingering differences in working hours, compensation, and leadership roles between men and women in Germany. Creating still more equal employment opportunities and **participation for women** in Germany could add an extra **12 percent to German GDP** by 2025 according to the **Chefsache Initiative**, effort by large German corporations and the public sector to advocate equal employment opportunities for men and women, including in top management positions.⁹ The emerging digital age—and the flexible working models it enables—could facilitate this change.

Businesses are positive about the future. In a recent survey of 2,000 C-suite executives in six EU countries, MGI found that 53 percent of German companies said they expected to grow their revenue by at least 2 percent in the coming year, compared with only 45 percent of companies across the EU. German companies also said that over the next three years they expect to expand their workforces by 3.4 percent on average, compared with 2.4 percent in the EU overall, and expect their investment in the EU to increase by an average of 15.6 percent, compared with the EU average of 6.9 percent (see Box 1, “Our survey of European businesses”).¹⁰

⁸ OECD; Eurostat; US Bureau of Labor Statistics.

⁹ “Flexibles Arbeiten in Führungspositionen: Ein Handlungsleitfaden für Chefetagen”, Chefsache Initiative, 2017.

¹⁰ *European business: Overcoming uncertainty; strengthening recovery*, McKinsey Global Institute, May 2017.

Box 1: Our survey of European businesses

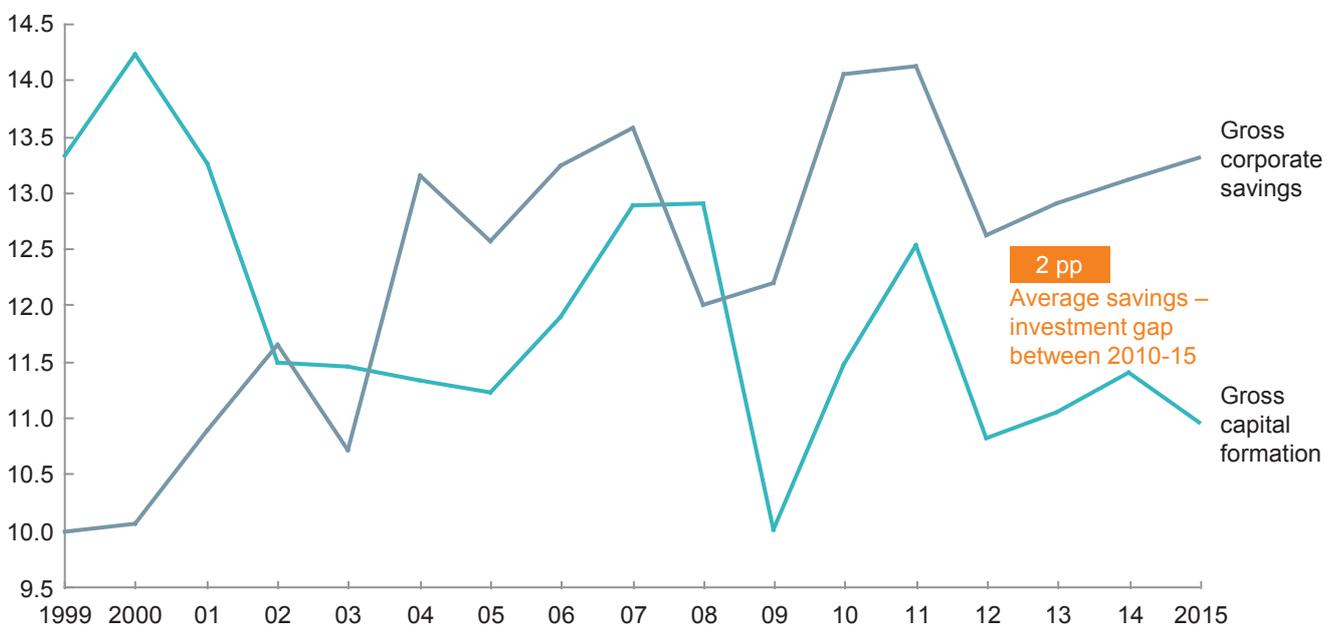
We surveyed around 2,000 C-suite business executives in six EU countries—France, Germany, Italy, Poland, Spain, and the United Kingdom. The online survey was run between February 17 and March 14, 2017. We asked questions about corporate performance, the outlook for the economy, views on global trends that could affect them, and their sentiment about policies and the future of the eurozone and the EU. A broader set of survey results and comparisons—along with full technical details—was published in our recent report, *European business: Overcoming uncertainty, strengthening recovery*, in May 2017.

There are **abundant resources to raise investment** in digital and beyond if business and government leaders can be persuaded to unlock their reserves. Gross corporate savings represented 13 percent of GDP in 2015, when gross corporate capital formation was just 11 percent of GDP (Exhibit 2).¹¹ German companies, more than those of any other country surveyed, said they had increased their cash flow position in order to prepare for future crises: 56 percent of German companies who had increased their cash position cited this as a reason, compared with 47 percent on average across the other savers in the EU. The German government has also been running surpluses more than investing. The country's growing economy and fiscal stringency enabled the government to build a budget surplus of €23.7 billion, or 0.8 percent of its GDP, in 2016.¹² However, in 2015 government investment was 1.8 percent of GDP, well below its high of 2.4 percent of GDP in 2007.¹³

Exhibit 2

Companies are amassing cash to hedge risk and enable future investment

Gross corporate savings and gross capital formation (GCF) in Germany
Percent of GDP



SOURCE: AMECO; McKinsey Global Institute analysis

¹¹ AMECO.

¹² Eurostat.

¹³ AMECO.

GERMAN COMPANIES ARE OPTIMISTIC ABOUT THEIR ABILITY TO CAPTURE THE TECHNOLOGY OPPORTUNITY, AND ARE TAKING STRONG EARLY STEPS

German **businesses are optimistic about the digital age**. A recent MGI survey found that 55 percent of German executives expect increased digitisation and automation to have a positive impact on their businesses in the coming years, and just 12 percent expect a negative impact.¹⁴

German companies are similarly **optimistic about the data-driven technological advances characterised as Industry 4.0**. In a separate McKinsey survey, 50 percent of German executives said they expect Industry 4.0 to increase their business's competitiveness, not far behind the United States (57 percent) and Japan (54 percent). Nearly one-third (31 percent) of German businesses have assigned clear responsibilities for implementing changes, compared with 30 percent of businesses in the United States and 10 percent in Japan.¹⁵

The government is supporting businesses in that regard. In 2011, the Federal Government launched a strategic effort to establish Germany as a lead market and provider of advanced manufacturing solutions. Through this effort, known as "Industrie 4.0", they are taking important steps to enable a digital and automation transformation, including defining a legal framework to **enhance data security**, connecting industry to education providers to help **build the talent needed** for a digital future, and making it easier for foreign digital talent to come to Germany.¹⁶

Many German **businesses are also making operational changes to begin using the IoT** and other technologies to drive innovation and improvements. For example, established German manufacturers are beginning to integrate software development and the IoT into their offerings and operations; Bosch's IoT suite now manages more than 5 million IoT devices around the world. Siemens' MindSphere connects machines and physical infrastructure with industrial apps and digital services to unleash productivity and efficiency.

Further, there is a growing set of **digital startups** looking to bring software solutions to traditional German strengths in hardware. McKinsey and *Handelsblatt* recognised three companies that are becoming global leaders in this space with their **inaugural Spark Award** in 2016, recognising them as "drivers of the digital revolution in Germany."¹⁷ Relayr GmbH, for example, helps companies retrieve temperature, weight, humidity, and other data, enabling remote equipment maintenance. Konux Incorporated monitors railway conditions, helping to predict failures and coordinate predictive maintenance. NavVis GmbH maps interior spaces, creating digital images of production lines in factories or consumer movement through shopping areas.

AUTOMATION COULD PROVIDE A PRODUCTIVITY REVOLUTION TO OFFSET GERMANY'S AGEING AND SHRINKING WORKFORCE

Digitisation and automation can help Germany to stay competitive amid demographic and geopolitical changes, including its own rapidly **ageing population and increasing competition from emerging economies**.

A **shrinking workforce** (as a share of the population) could **represent a drag on per capita GDP of 0.6 percentage points** per year between 2014 and 2030 in Germany. The overall population is expected to decline slightly, from 82.6 million in 2014 to 79.6 million in 2030, but the number of workers is likely to shrink substantially: from 40.1 million full-time equivalent workers (FTEs) in 2014 to 34.9 million in 2030. Dependency ratios will thus rise

-0.6PP
drag of a shrinking
workforce on
per-capita GDP

¹⁴ *European business: Overcoming uncertainty; strengthening recovery*, McKinsey Global Institute, May 2017.

¹⁵ "Industry 4.0 after the initial hype: Where manufacturers are finding value and how they can best capture it", Digital McKinsey, 2016.

¹⁶ German Federal Ministry for Economic Affairs and Energy.

¹⁷ "The Spark", *Handelsblatt*, <http://award.handelsblatt.com/the-spark/>.

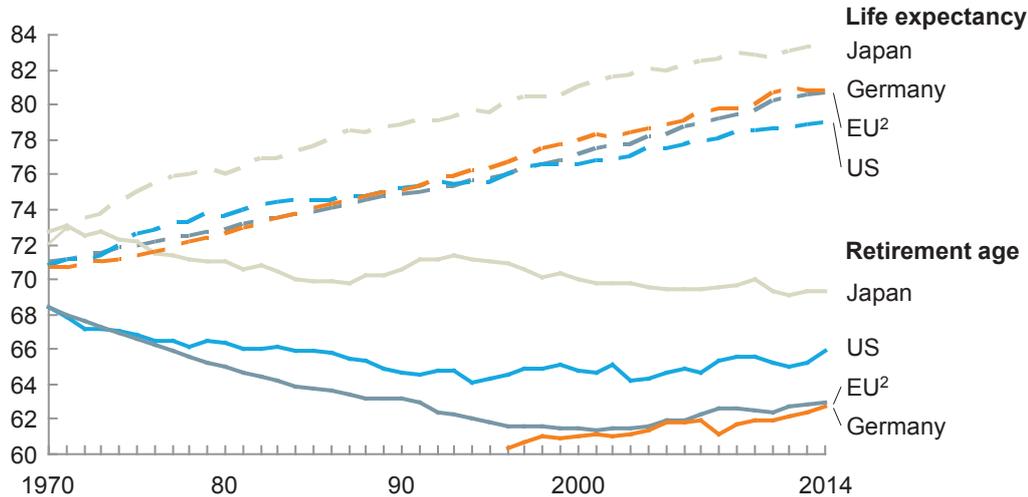
to 1.28 non-working Germans for each FTE, up from 1.06 today.¹⁸ Germany has one of the world's highest average life expectancies and, despite efforts to change, still a comparatively low effective average retirement age (Exhibit 3).

Exhibit 3

Growing dependency on a shrinking workforce

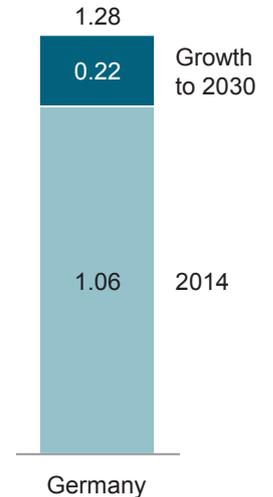
Effective retirement age and life expectancy¹

Age (years)



Dependency ratios³

Ratio of dependent non-working citizens per FTE



1 Average effective male retirement age and total average life expectancy at birth.

2 Not including Croatia due to absence of historical data.

3 Dependency ratios are calculated as the total size of the non-working population (including children, the elderly and non-workers) per FTE.

SOURCE: UN Population Database; OECD; McKinsey Global Institute analysis

**UP TO
2.4pp**
boost from
automation on
per-capita GDP

Automation **could compensate for the impact of ageing on economic growth** by significantly driving up productivity, according to MGI research. Under an early adoption scenario, automation-enabled labour substitution could **boost per capita GDP by up to 2.4 percentage points per year in Germany** until 2030 (assuming that displaced labour is redeployed to another profession where it has equal productivity), versus 0.2 percentage points in a late automation adoption scenario (Exhibit 4). By 2030, that could translate to as much as €15,750 additional GDP per person.^{19,20}

Additional productivity growth from other effects (such as capital deepening with greater infrastructure investment) could keep overall per capita GDP growth in line with historical levels: between 1964 and 2014, German per capita GDP growth averaged 2.1 percent per year.²¹

To put these scenario projections in perspective, past research has shown that robots boosted annual GDP growth across 17 countries by an extra 0.37 percentage points a year from 1993 to 2007.²² Others estimate that a 1 percent increase in robotics investment created a 0.03 percent increase in GDP from 1993 to 2015, with far greater growth after

¹⁸ *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; The Conference Board; UN Population Division.

¹⁹ Assumes an exchange rate of 1 USD to 0.84 EUR, the approximate average from 2012 to 2017 (Oanda).

²⁰ *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; The Conference Board; UN Population Division.

²¹ Ibid.

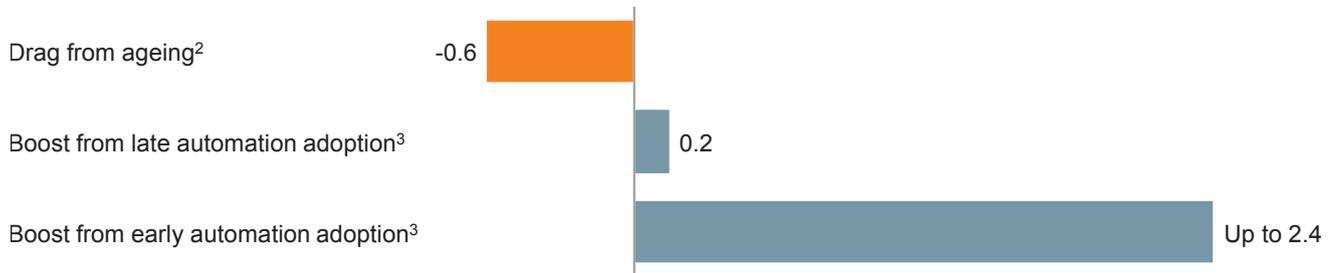
²² Georg Graetz and Guy Michaels, "Robots at Work" Centre for Economic Performance, London School of Economics, March 2015.

2011.²³ Similarly, the steam engine alone drove 0.3 percent annual GDP growth from 1850 to 1910.²⁴

Exhibit 4

An answer to the ageing workforce

Component contributions to projected GDP per capita for Germany (2014-30)¹
CAGR (percentage points of growth per year)



1 Assumes the total population will decline from 82.6 million in 2014 to 79.6 million in 2030. Assumes the working population will fall from 40.1 million in 2014 to 34.9 million in 2030.

2 Calculated change to GDP per capita assuming a constant 2014 productivity rate and a declining working population.

3 Considers the benefits of labour substitution only and assumes that all FTE hours displaced by automation will be re-allocated to equally productive work. Shows the difference in per capita income growth under a scenario with automation and one without.

SOURCE: The Conference Board Total Economy database; UNPopulation Division; McKinsey Global Institute analysis

Even beyond the productivity benefits from labour force substitution, automation can help German companies—like all others—**increase the value and quality of their outputs**. For example, AI processes can improve manufacturing yield, reducing scrap rates by up to 30 percent. Automated quality testing can increase defect detection rates by up to 90 percent—compared with human testing—at the same time that machine-learning systems can continually improve processes to further reduce defect rates.²⁵ This can help German companies to maintain their lead even as new competition emerges from developing economies.

...

Germany's globally competitive and connected economy is performing strongly and the country is already taking the necessary first steps to succeed in the new competitive environments that big data and digitisation are opening. Continuing to capture the value associated with digitisation and automation has substantial upside potential for Germany as its population ages and other global trends emerge; just the labour substitution benefits from automation could help boost per capita GDP enough to more than counterbalance the drag on economic growth from ageing.

²³ "The impact of automation", CEBR, January 2017.

²⁴ Nicholas Crafts, "Steam as a general purpose technology: A growth accounting perspective" Economic Journal, volume 114, issue 495, April 2004.

²⁵ "Smartening up with Artificial Intelligence: What's in it for Germany and its industrial sector?" Digital McKinsey, April 2017.





BUSINESSES NEED TO ACCELERATE THEIR DIGITAL TRANSITION, AND POLICY MAKERS CAN HELP

Despite its strong economy, Germany is not yet as fully transitioned into the digital age as its peers. That is partly due to the fact that many of the sectors where Germany excels—automotive, machine tools, chemicals, and pharmaceuticals—have not digitised as readily as the retail and consumer-facing companies that are more common in the United States and elsewhere. Yet as advances in data collection and computer power promise to change those industries, too, German business leaders and government officials need to start taking bolder steps to push the country faster and further into the new digital era.

GERMANY IS NOT YET AS DIGITISED AS SCANDINAVIA OR THE US

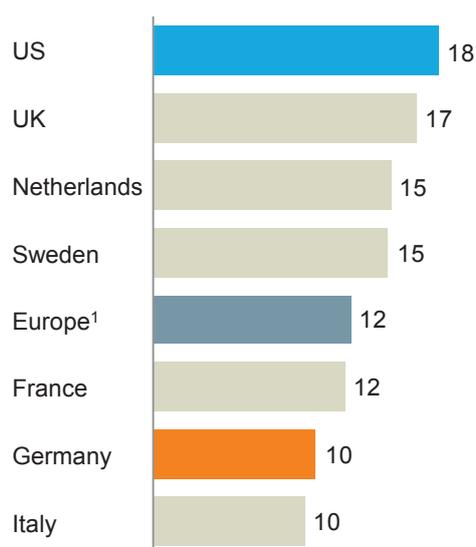
Germany today has captured just 10 percent of the potential marked by the global digital frontier—well behind the United States (18 percent) as well as the United Kingdom, the Netherlands, and Sweden (Exhibit 5). It also maintains a digital trade deficit with the United States (valued at 4.2 percent of total services trade). Measurement of digital potential is based on the **MGI Industry Digitisation Index**, which maps digitisation at a sector level, based on the level of digital spending, the share of the workforce in digital occupations, and other measures in each industry. For each country, an aggregate digitisation score is calculated, based on its internal company mix.²⁶

10%
of the potential marked by the global digital frontier captured in Europe

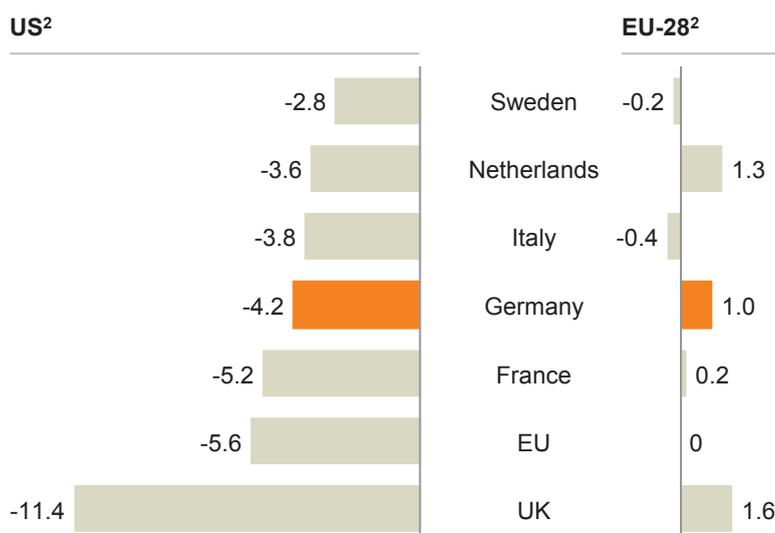
Exhibit 5

Germany's unrealised digital potential

Captured digital potential by country
Percent



Digital trade balance
Percent of services trade



1 Europe is the weighted average of the 6 countries shown here, which make up 60% of the population and 72% of GDP in the EU-28 grouping.

2 Trade within digital economy – examples include digital services commerce platforms, content services and software services.

SOURCE: Eurostat; OECD; International Trade Centre; European Commission Joint Research Centre; CSIMarket; McKinsey Global Institute analysis

²⁶ *Digital Europe: Pushing the frontier, capturing the benefits*, McKinsey Global Institute, June 2016.

Two-thirds of the variations in countries' scores are due to sector mix differences.²⁷

Because some industries—like ICT, media, and finance—are much more digitised than others, the “frontier” for each country’s digitisation level is highly dependent on its industry mix. Germany’s largely asset-heavy sector mix drags down its digitisation potential relative to the other countries considered, like the UK with its strong financial services sector.

That said, the **MGI Industry Digitisation Index** shows that several of Germany’s industries are still less digitised than the same sectors in other European countries or the United States (Exhibit 6).²⁸

Most notably, Germany’s **public services are overwhelmingly analogue**. For example, just 17 percent of individuals used the internet to submit a completed form to a public authority in 2013, and the EU ranked Germany as “insufficient” or “moderate” on nearly half of its e-government indicators in 2014.²⁹

Exhibit 6

Digitisation comparison by sector



MGI Industry Digitisation Index, US vs. European nations¹
Selected sectors²

Sector	Germany	US	UK	France	Netherlands	Italy	Sweden
ICT	Green	Dark Green	Green	Green	Green	Green	Green
Professional services	Light Green						
Media	Light Green	Light Green	Green	Light Green	Light Green	Light Green	Light Green
Finance and insurance	Light Green						
Wholesale trade	Light Green	Yellow	Light Green				
Retail trade	Light Green	Yellow	Light Green	Orange	Yellow	Orange	Light Green
Advanced manufacturing	Yellow	Light Green	Light Green	Light Green	Light Green	Yellow	Light Green
Basic goods manufacturing	Yellow	Orange	Light Green	Yellow	Yellow	Yellow	Light Green
Healthcare	Yellow	Orange	Orange	Orange	Yellow	Yellow	Yellow
Construction	Yellow	Red	Yellow	Yellow	Yellow	Orange	Orange
Real estate	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Government	Orange	Yellow	Yellow	Yellow	Yellow	Yellow	Orange

1 Index is based only on asset and labour components and thus may not align with heat maps displayed elsewhere.
2 Due to accounting differences between the US and Europe, not all sectors can be fairly compared.

SOURCE: McKinsey Global Institute analysis

Construction is another example where a step-up is feasible. In Germany, the sector invested only 0.7 percent of its gross value added (GVA) between 1991 and 2007 in digital assets annually, compared with 1.5 percent in the United States.³⁰ In **financial services**, digitisation has progressed far in Germany, and leading companies can compete at a global level and engage in cross-border financial deals with equally digitised foreign partners. Yet while advanced digital functionalities have been developed by savings banks’ central IT organisations, overall adaptation of business models is progressing more slowly than in other markets. In 2016, just 58 percent of German individuals used the internet for online

²⁷ Ibid.
²⁸ Ibid.
²⁹ *eGovernment in Germany*, European Commission, edition 18.0, February 2016.
³⁰ *Reinventing construction through a productivity revolution*, McKinsey Global Institute, February 2017.

banking, well behind digital frontrunners like Finland (93 percent) and the Netherlands (91 percent).³¹ Also notably less digitised is Germany's **manufacturing** sector, which tends to be stronger in automotive, machinery, and chemicals than in "digital industries" like computers or mobile phone.

New McKinsey research suggests that **AI is turbocharging digital transformation**, yet businesses in Germany and Europe more broadly are lagging behind competitors in China and the US.³² Only 18 percent of German businesses adopted at least one AI technology at scale or in a core part of their business, less than half as many as in China or the US.^{33, 34} Firms that have begun to adopt AI seriously with proactive strategies are already seeing real-life benefits and report current profit margins that are 3 to 15 percentage points higher than the industry average in most sectors.³⁵ These firms also expect this advantage to grow as their AI investments mature. In the next three years, these AI adopters expect their margins to increase by 5 percentage points more than the industry average.³⁶ German firms urgently need to accelerate their digital transformations in order to maintain their competitiveness particularly because AI adoption is highest in sectors such as automotive and assembly where German firms have traditionally been world leaders.³⁷

Germany has **not built out consumer tech companies** on the same scale as global leaders like the United States and China, partly because it has never been as active in the consumer and retail space that is currently driving digital transformations. As of May 2017, the largest publicly traded German tech company, SAP, had a market capitalisation of \$128 billion and ranked 15th in size globally, compared with top-ranked Apple in the United States with a market cap of \$802 billion.³⁸ Without a strong consumer tech industry, **Germany is at some disadvantage** as digital and automation technologies become bigger drivers of competition in the industrial and B2B spaces. While Facebook, Google, Tencent, and other digital-native titans have cultivated digital talent in the United States and China, Germany's top talent is still drawn to traditional engineering field.

Partly because Germany lacks massive tech titans on the scale of Apple or Alphabet, it has also not seen the same **concentrated venture capital activity** in tech that the United States and China are experiencing. That has left some German companies vulnerable to foreign buyouts. For example, the Chinese Midea group in 2016 purchased the German robotics manufacturer Kuka for €3.7 billion. In 2015, Apple bought Metaio, an augmented reality firm. While these acquisitions may help these German companies scale faster and expand German jobs and impact, there is concern that foreign purchases could simply shift German ideas and talent elsewhere.

BUSINESSES NEED TO INCREASE THE PACE AND SCOPE OF DIGITISATION ACROSS THEIR VALUE CHAINS AND OUTSIDE TRADITIONAL BOUNDARIES

Though German businesses are already taking the first important steps to capture the potential of the digital age, they **need to be bolder**. Digitisation can open up new competition that puts substantial pressure on revenue and profits. According to recent McKinsey research, current digitisation levels have already put pressure on revenue and profit growth across industries.³⁹ **Performance diverges sharply** across industries and companies,

3-15%
higher current
profit margins for
companies
adopting AI

³¹ Eurostat.

³² *Artificial intelligence: The next digital frontier?* McKinsey Global Institute, June 2017.

³³ Results are weighted by firm size. 'Eighteen percent of firms' indicates firms representing 18 percent of the workforce in Germany.

³⁴ *Artificial intelligence: The next digital frontier?* McKinsey Global Institute, June 2017.

³⁵ Ibid.

³⁶ Ibid.

³⁷ Ibid.

³⁸ S&P Capital IQ.

³⁹ Jacques Bughin, Laura LaBerge, and Anette Mellbye, "The Case for Digital Reinvention," McKinsey Quarterly, February 2017.

however, and the best-performing companies can actually thrive in this environment. Companies with winning strategies and strong execution could expect superior revenue growth despite the drag on industry revenue from digitisation. This disparity in performance creates winner-take-all dynamics in highly digitised industries, such as platform-based markets.⁴⁰

Businesses and industries that are far ahead on the digital frontier have already built out digital capabilities in the form of seamless data sets, agile organisations, and digital talent pools. As a result, they have a **natural advantage** in harnessing the upcoming waves of digital disruption, including machine learning and artificial intelligence. These digital-frontier firms are early and aggressive adopters of artificial intelligence technologies in their core business.⁴¹ This makes it all the more urgent for German firms to embark on their digital transformation journey.

Businesses need to be **proactive in identifying opportunities offered by digitisation** and automation—even well outside their traditional boundaries—by creating new products, services, or even markets in which they can become leaders.⁴² For example, utilities, construction companies, and other companies with newfound access to IoT data should consider what new products and services could be offered based on those data. This will require businesses to identify gaps in the existing market, recognise their competitive advantages, and build new digital platforms to serve new and existing customers.

Accelerating the adoption of digital across all elements of their value chains will let businesses capture the full opportunity available to them. Companies that assertively digitise across multiple dimensions—for example, in marketing and distribution, supply chains, and products themselves—see substantially more benefit than those that attack just one or two, which usually lose revenue to other companies that start faster.⁴³

Businesses need to take advantage of **digital innovation models** to generate new ideas and customers, fast. Nearly half of all digital initiatives generate lower returns than the cost of capital, according to a survey of 2,000 businesses across B2B and B2C industries, so it will be critical to take an agile approach to developing, piloting, and refining solutions to “fail fast” and reprioritise digital spending quickly.⁴⁴ This will enable businesses to minimise the risk inherent to investments in new technologies, while also ensuring speedy entry to new markets. To that end, companies can consider ways that they can use digital technologies to reduce expenses in one part of their business, which they can then immediately reinvest in transforming other aspects or expanding into new markets.

Implementing these business model changes will require **wholesale changes to culture and behaviour**. Companies that have thrived in the digital era keep their corporate and digital strategies tightly aligned, build a common culture across business units, and constantly maintain a customer viewpoint.⁴⁵ They also develop winning strategies for digitisation, and have excellent execution as they roll them out.⁴⁶ They further **make digitisation a true priority** for CEOs or other C-suite executives to ensure full integration with the broader business strategy and to ensure adequate support for the effort. Simultaneously, German companies will need to shift from a traditional—and often hierarchical—engineering culture to a more **flat, agile mode of working** that emphasises

⁴⁰ Ibid.

⁴¹ *Artificial Intelligence: The next digital frontier?* McKinsey Global Institute, June 2017.

⁴² Ibid.

⁴³ Jacques Bughin, Laura LaBerge, and Anette Mellbye, “The Case for Digital Reinvention”, *McKinsey Quarterly*, February 2017; *Smartening up with Artificial Intelligence: What’s in it for Germany and its industrial sector?* Digital McKinsey, April 2017.

⁴⁴ Ibid.

⁴⁵ Ibid.

⁴⁶ Ibid.

autonomous teams and close integration of customer feedback. More agile, autonomous, and collaborative environments are best able to drive digitisation. This may require relocating some operations or innovation centres to digital hubs such as Berlin to benefit from access to talent, ideas, and business cultures.

In many ways, this wholesale adoption of digital will be uncomfortable for German businesses—the traditional working culture in Germany emphasises a more moderate approach to change. However, staying successful in the new digital era will **require constant (r)evolution.**

POLICYMAKERS MUST ASK HOW THEY CAN BETTER HELP GERMAN BUSINESSES THRIVE IN THE DIGITAL AGE

By driving **its own digital transformation, the German government** can spur new demand for digital services, build necessary infrastructure, and set an example for private sector leaders to emulate. Germany has taken the first steps to address its low public sector digitisation levels by driving digital transformations at scale in the Federal Employment Agency and Federal Office for Migration and Refugees, and by implementing e-government services, including rolling out an electronic tax declaration system (known by its German acronym, ELSTER) and electronic court files in the justice system with the aim of achieving a fully paperless court.⁴⁷ German local, state and federal governments also plan initiatives to digitise city administrations, modernise registrations, and create a central citizen portal. Yet the German government can consider pushing further to digitise thousands of other services and drive digitisation and automation throughout the economy (see Box 2, “Estonia’s digital transformation”), and needs to ask whether it is doing everything it can to build the right digital ecosystems and support for Germany’s companies.

Digitising additional government services could help Germany to reduce its administrative spending and provide government services more efficiently. The UK government adopted a “digital by default” standard in 2011, shifting 800 government services online, that has reduced government service costs by up to \$2.3 billion annually across eight major departments.⁴⁸ While the cost savings of digitisation are the easiest

\$2.3BN
annual savings
from digitisation for
the UK government

⁴⁷ McKinsey & Company, “Behind the German jobs miracle”, October 2012; “Digitisation agenda 2020 — The BAMF’s IT strategy”, Federal Office for Migration and Refugees, November 2016; “Statistische Auswertungen zur elektronischen Steuererklärung”, ElsterOnline, https://www.elster.de/elster_stat_nw.php/; “E-Justice-Rat” Justizportal des Bundes und der Länder, <http://www.justiz.de>

⁴⁸ “GDS business plan April 2014 to March 2015”, Government Digital Service, July 2014

Box 2. Estonia’s digital transformation

Estonia is frequently cited as the vanguard example of a country that has gone **“all in” on digital governance.** In the early 2000s, Estonia had relatively few internet users, limited access to computers, and a lack of digital skills and motivation to use computers. By introducing online public services and digital ID cards—and otherwise driving digitisation through the public sector—the Estonian government helped to transform a country emerging from behind the Iron Curtain into a **world leader in technology.** The high-tech sector now accounts for

7 percent of GDP and 9.3 percent of employment, and includes companies such as Skype among its notable startups.¹ The Estonian government estimates that paperless government saved the country 2 percent of GDP in reduced government service costs.² The government further estimates its digital infrastructure and e-identity system saved upwards of 3,225 years of combined time for its 1.3 million citizens in 2014 alone, freeing up their time for more productive use than waiting in line for government services in person.³

¹ “Facts”, e-Estonia.com, <https://e-estonia.com/facts/>; “How did Estonia become a leader in technology?” *The Economist*, July 30, 2013.

² “Facts”, e-Estonia.com, <https://e-estonia.com/facts/>.

³ Kristjan Vassil, “Estonian e-Government Ecosystem: Foundation, Applications, Outcomes”, *World Development Report 2016*, Background Paper: Digital Dividends, June 2015.

to quantify, governments can also improve outputs and productivity through digitisation for both citizens and the public sector. For example, New Zealand is using advanced analytics and big data to track social sector spending's impact on individuals, helping to identify which housing, health, and welfare programmes have the greatest impact on citizen outcomes, so that government investment can become more effective over time.⁴⁹ Doing this in Germany may require establishing a clear leader for digitisation efforts within the government, responsible for setting tangible goals and connecting efforts across the federal system.

Germany's government can help business digitisation in other ways. One is to **give citizens stronger assurance** that companies will protect their security and data in the new digital economy. A Eurostat survey found that 82 percent of Germans are concerned about their online activities being recorded to provide them with tailored advertising.⁵⁰ Another is to expand programmes to help companies **access the foreign human talent** they need to drive the digital economy. The government has made important first steps here, including offering entire degrees in English at public universities to attract foreign students, and streamlining visa access for non-EU citizens with technology skill sets.⁵¹ Though questions about Germany's immigration policies are becoming an increasing component of political discussions domestically and abroad, it will be important for Germany to maintain its pipeline of foreign talent.

Government can also leverage **public procurement** and **insist that contractors and suppliers take advantage of digital tools**. For example, the government has announced that transportation projects will be required to use BIM (Building Information Modelling) by 2020, to enable more efficient planning, design, construction, and management of buildings and infrastructure. Policymakers could expand this requirement to all public works and upgrade to 5D BIM and other more advanced technologies.

Over the longer term, the government could invest more in **preparing young Germans** for the roles they will likely take on in the future. Though Germany's education system is known for creating world-class engineers and professionals, policymakers will need to consider how it will have to transform to also produce data scientists and software developers. In 2016, ICT specialists made up just 3.7 percent of the German workforce, compared with 6.6 percent in Finland and 6.3 percent in Sweden.⁵² To produce these tech specialists, Germany will need to prioritise teaching software programming. It can also increase its focus on IT skills across all levels of education to create digitally-savvy professionals who know how to work alongside automated technology, even if they are not necessarily coding and building tech systems themselves.

Finally, governments can help to **build the physical infrastructure and ecosystems** underpinning the digital economy. For example, in the first quarter of 2017, just 33 percent of German internet connections had average speeds above 15 Mbps, well behind leaders like South Korea (69 percent), Switzerland (56 percent), and Norway (54 percent).⁵³ To harness the full potential of the IoT and other digital opportunities, Germany will likely need more high-performance broadband networks across the country, including in rural areas that may not be profitable for companies to service without government subsidies.⁵⁴ Policymakers can consider how they can be more supportive in this space. Germany can also help to drive the EU digital single market, to help businesses scale across Europe and compete with the US and China. Further, they can help create the ecosystems needed for digital success;

⁴⁹ Bill English, "Social Investments Analytics Layer launch", Beehive.govt.nz, September 28, 2016.

⁵⁰ Eurostat, "Privacy and protection of personal information", 2016.

⁵¹ "Blue Card", Federal Ministry for Economic Affairs and Energy, n.d.

⁵² Eurostat, 2016. Employed ICT specialists as a percentage of total employment.

⁵³ State of the Internet Report Q1 2017, Akamai, February 2017.

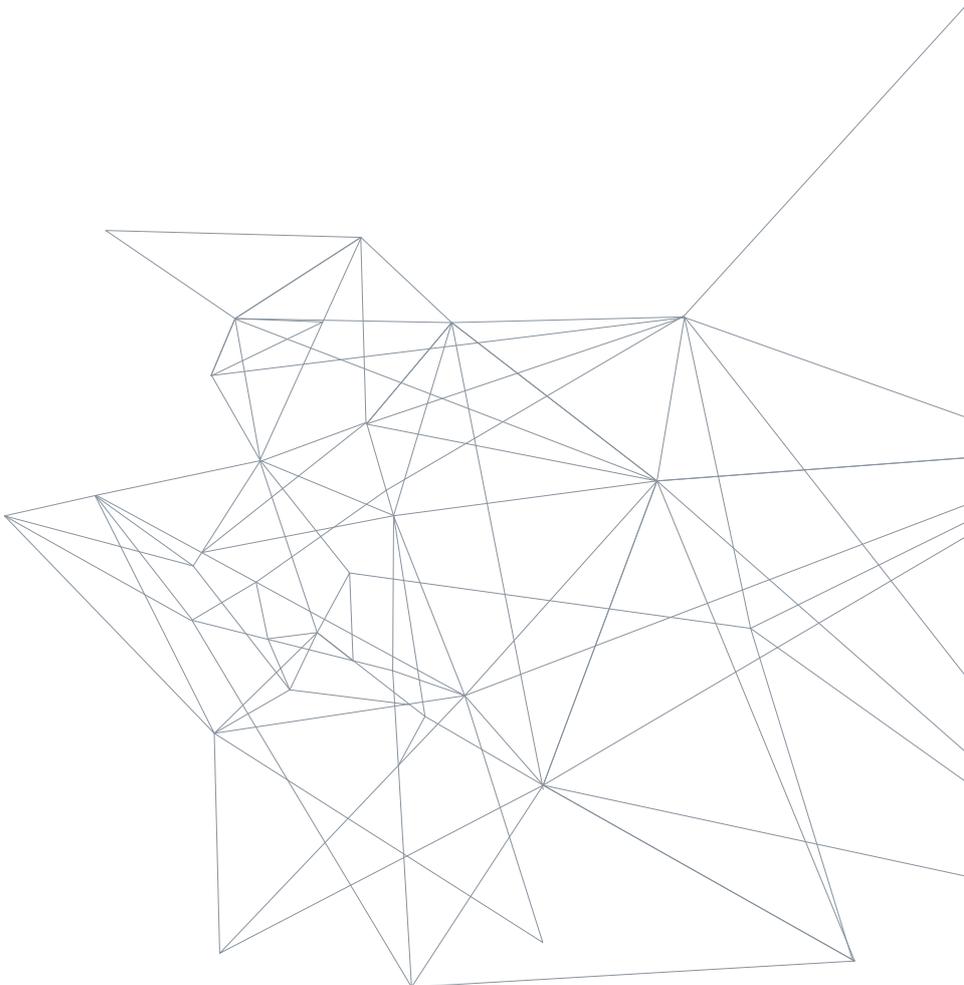
⁵⁴ Digital Strategy 2025, Federal Ministry for Economic Affairs and Energy, March 2016.

for example, they can continue to make regulation around automation and digitisation more effective.

This is an opportune time for increasing public investment as businesses say they support it and may even join in. Thirty-two percent of German companies in the recent McKinsey European Business Survey said they could see a case for increased EU public investment, even if it meant higher taxes. Another 45 percent would support increased investment, as long as tax levels were not affected. Only 23 percent could see no case for increased investment. Of those who supported any investment, 42 percent could see a case for investment in information and communication technology infrastructure and 33 percent for R&D. Seventy-four percent of the German executives who could see a case for public investment said they would be willing to co-invest, a greater portion than for survey participants from any of the other countries surveyed besides Spain and Italy.⁵⁵

...

Despite their economic strengths and early action to digitise, Germany's companies and policymakers will need to take bold action to thrive in the digital age. German companies will need to **change many aspects of their operating models** and look for new opportunities and value outside of their traditional spheres. While most of the burden will fall on businesses to innovate, **policymakers may also be able to play a role** by incentivising the private sector to digitise more quickly, by moving public services and public demand into the digital age as well as set up the infrastructure for businesses to digitise.



⁵⁵ *European business: Overcoming uncertainty, strengthening recovery*, McKinsey Global Institute, May 2017.



AS GERMANY ENTERS THE DIGITAL AGE, LABOUR MARKET IMPACT NEEDS TO BE MANAGED

Data-fuelled automation—whether in the form of a frame-welding robot in an automobile factory or a securities-trading algorithm at an investment firm—offers **significant upside** for the overall economy. Yet there is a risk that these **benefits could disproportionately accrue to already wealthy socioeconomic strata** and exacerbate income inequality. Business leaders and public policy makers need to proactively address these issues and deliver equitable resolutions.

CONCERNS ABOUT A “HOLLOWING OUT” OF THE GERMAN LABOUR MARKET NEED TO BE ADDRESSED

Because Germany’s ageing demographics will reduce the overall size of the workforce, **the impact of automation on overall job creation and employment levels should be less of a concern than wages and inequality**. Rather than seeing unemployment as automated processes displace human workers, Germany may actually struggle to fill all of the job posts opened up by the digital era. However, digitisation could reduce demand for middle- and low-skilled jobs.⁵⁶

With today’s technology, **48 percent of German activity hours are automatable** using currently demonstrated technology (Exhibit 7). This does not mean that 48 percent of jobs in Germany will be replaced by robots. Indeed, very few occupations are fully automatable (just 2 percent of those in Germany), but most have at least some activities that would be automatable by adopting today’s demonstrated technology; 62 percent of occupations in Germany have at least 30 percent of their activities that are automatable.⁵⁷

Work activities in three categories—**data collection, data processing, and predictable physical tasks**—have the highest automation potential today, given the current state of technology. These activities represent 54 percent of hours worked in Germany, higher than the global average (47 percent of hours worked), as German labour has a larger focus on data collection and processing than most other countries do.⁵⁸

Due to the different nature of work in each sector in Germany, these differences add up to create strong **variance in automation potential by sector**. Accommodation and food services (72 percent) and transportation and warehousing (64 percent) have the highest automation potential in Germany, compared to just 32 percent of hours in educational services, 34 percent in professional, scientific, and technical services, and 36 percent in healthcare and social care. Germany’s largest sector—manufacturing—has a 55 percent automation potential.⁵⁹

48%
automation
potential in
Germany in 2016

⁵⁶ Mark Muro and Scott Andes, “Robots seem to be improving productivity, not costing jobs”, Harvard Business Review, June 2015.

⁵⁷ *A future that works: Automation, employment, and productivity*, McKinsey Global Institute, January 2017; The Conference Board; UN Population Division.

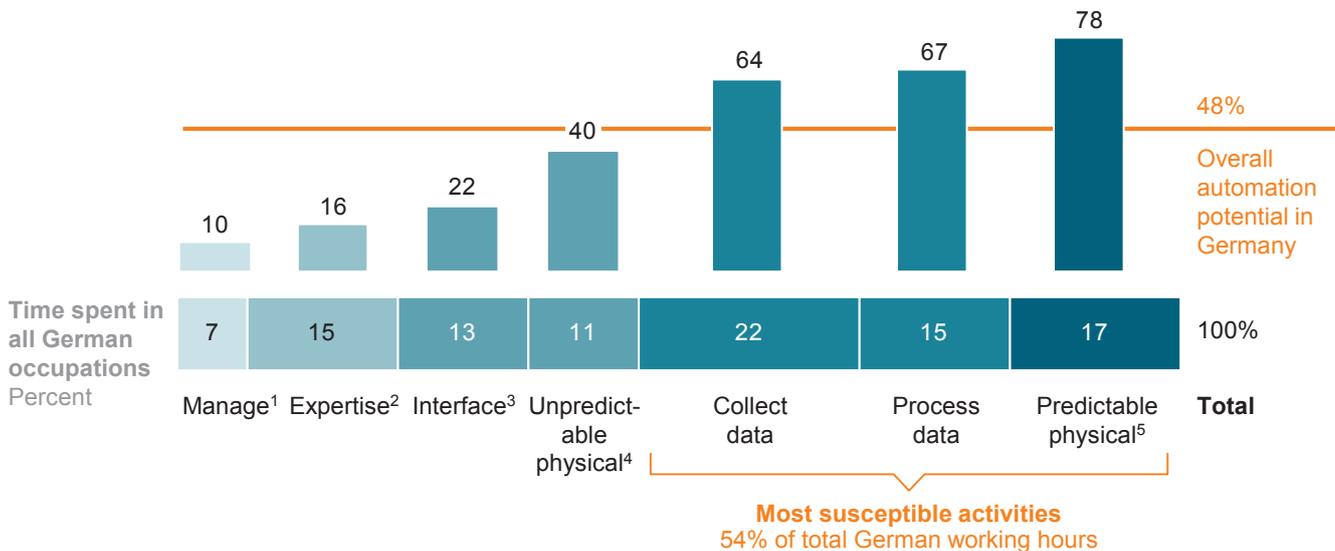
⁵⁸ Ibid.

⁵⁹ Ibid.

Exhibit 7

Automation potential by activity

Time spent on activities in Germany that can be automated by adapting currently demonstrated technology
Percent



- 1 Managing and developing people.
 - 2 Applying expertise to decision making, planning, and creative tasks.
 - 3 Interfacing with stakeholders.
 - 4 Performing physical activities and operating machinery in unpredictable environments.
 - 5 Performing physical activities and operating machinery in predictable environments.
- NOTE: Numbers may not sum due to rounding.

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

62-77%
automation
potential for the
two lowest skill
categories

Automation will have **greater impact on lower- and middle-skilled workers**. The automation potential of work is much higher for lower- and middle-skill categories—77 percent of 2014 hours worked in the lowest skill category, 62 percent in the second-lowest category, which generally requires a high school diploma, and 46 percent in the middle of the five categories, which requires some post-high school education. This compares with just 18 percent in the highest category, where jobs usually require advanced university degrees, and 25 percent in the second-highest, requiring bachelor degrees.⁶⁰ Again, this does not mean that all low- or middle-skilled jobs will disappear, but rather that they are likely to change form as automation and digitisation take hold, and demand for some activities is reduced.

Work content in Germany is currently **higher skilled** than in most other countries. Just 45 percent of Germany's 2014 FTE hours were in the two lowest job categories (requiring a high school diploma or less) compared with 51 percent in the US and 71 percent globally.⁶¹

Accompanying the huge potential of automation in Germany are therefore **concerns about societal equality and welfare**, particularly because the country is already experiencing rising income inequality. Between 2005 and 2015, household disposable income after taxes and transfers for Germany's highest-income groups grew more quickly than for its lowest ones (Exhibit 8). This disparity was much greater for Germany than it was for the United Kingdom or France.⁶² Wealth is even more unequal than income, and Germany has one of the highest concentrations of wealth amongst its top 10 percent in Europe.⁶³ Even business

⁶⁰ Ibid.

⁶¹ Ibid.

⁶² Eurostat (Household Budget Survey; EU SILC Survey).

⁶³ OECD, "Understanding the socioeconomic divide in Europe", January 2017.

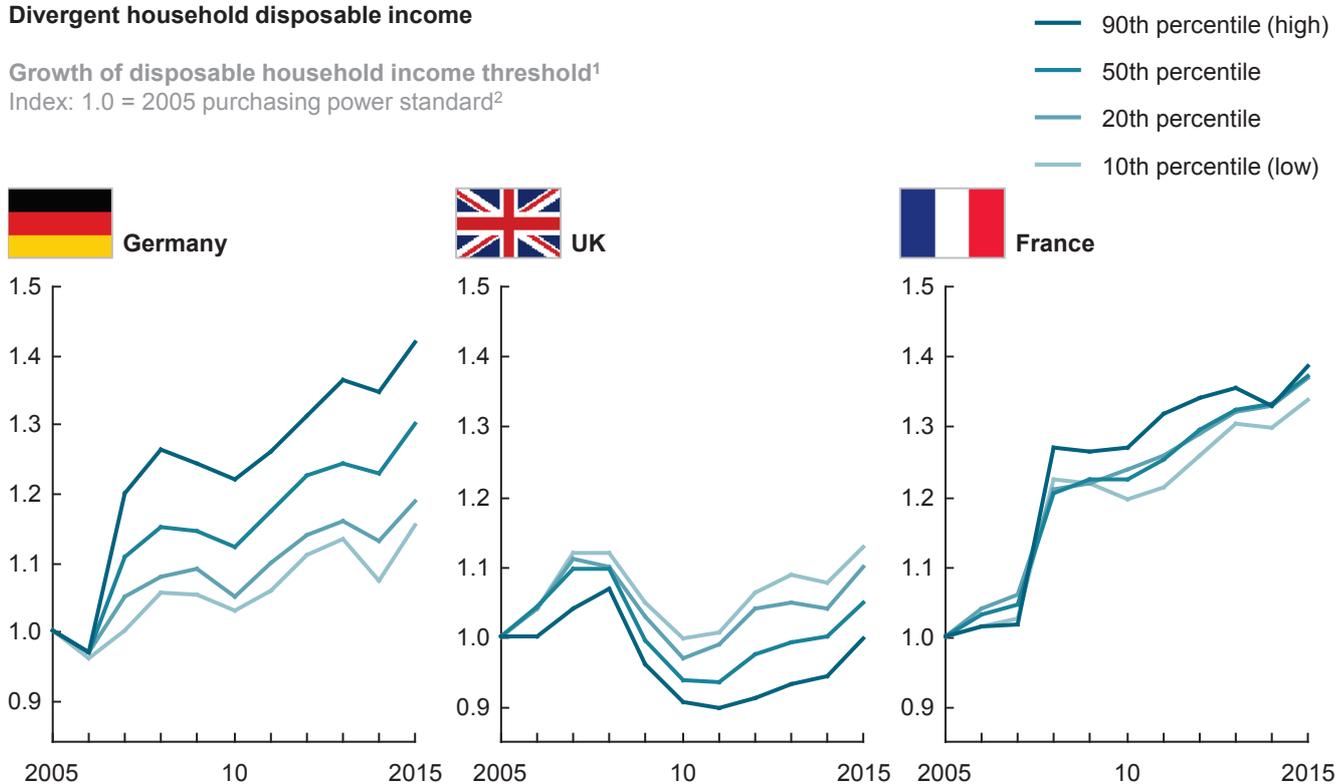
leaders are concerned about income inequality. In our survey, 40 percent of German firms indicated they thought rising inequality would have a negative impact on their business in the future.⁶⁴

Exhibit 8

Divergent household disposable income

Growth of disposable household income threshold¹

Index: 1.0 = 2005 purchasing power standard²



1 Disposable income level corresponding to the decile cutoff level (as average income by decile not available in consumption survey). Considers income post taxes and transfers.

2 Purchasing power parity (PPP) adjusted.

SOURCE: Eurostat (Household Budget Survey; EU SILC Survey); McKinsey Global Institute analysis

RESHAPING WORKER TRAINING, WELFARE SYSTEMS, AND LABOUR MARKET INSTITUTIONS CAN SPREAD THE BENEFITS OF THE DIGITAL ECONOMY

Germany has ample experience in responding to economic changes that threaten equal employment and welfare, and it can learn from its historical examples as it develops new strategies to handle the faster pace and broader extent of digitisation for its workforce today.

Germany has a **long history of using innovative welfare policies and investment schemes** to manage the adverse consequences of rapid economic change on citizen well-being. As early as the 1880s, Germany introduced a comprehensive social insurance system for workers under Otto von Bismarck.⁶⁵ German reunification at the end of the Cold War provides a more contemporary example. Between 1991 and 2014, companies, municipalities, and private builders invested €1.6 trillion to help bring the eastern German economy in line with western European standards, helping to halve the GDP per capita gap between eastern and western Germany in two decades. In 1991, eastern German GDP per capita was just 33 percent of western Germany's, rising to 67 percent of western Germany's

⁶⁴ *European business: Overcoming uncertainty, strengthening recovery*, McKinsey Global Institute, May 2017.

⁶⁵ "From Bismarck to Beveridge: Social security for all", International Labour Organisation, World of Work, issue 67, December 2009.

per capita GDP in 2013. Germany now has lower regional differences in per capita GDP than the G7 average.⁶⁶

Despite these successes, the **pace of Germany's past social programmes may not be able to keep up with the changes brought on by the digital age.** For example, the phasing out of the German hard coal industry with its 600,000 workers in 1950 required \$538 billion of subsidies between 1970 and 2014.⁶⁷ Germany extended its subsidies into 2018 and introduced new subsidies for the industry as recently as 2015.⁶⁸ In a world where nearly half of all the work done in Germany today could be automated, scores of German workers will need to be supported to quickly transition into roles that may not exist today. Policymakers need to question whether they are doing enough now to ensure the growth and continued well-being of communities in the midst of this transition.

Worker training will likely need to help current workers in lower and middle skill and income brackets—particularly any with jobs displaced by automation—better adapt to the new world of work. This could happen in partnership with private sector organisations, which themselves will need to develop better digital talent in order to succeed. Germany's renowned “dual system” Vocational Education Training programme is a good platform to build off. These programmes place students in two- to three-year training programmes with both classroom instruction in trade schools and on-the-job training at participating companies, where they usually receive a training allowance.⁶⁹ Policymakers could put a particular focus on helping young women and girls and the children of asylum seekers develop the skill sets to succeed in emerging work environments.

Welfare systems may also need to eventually evolve to more effectively address potential further increases in inequality and support displaced workers. Options range from already broadly established tools like minimum wages or low income tax credits to bolder, more controversial, and more experimental schemes like universal basic incomes. Universal basic income is already being piloted in Finland and planned for testing in the Canadian province of Ontario in order to guarantee citizens a basic standard of living without the complexity of managing interconnected welfare systems.⁷⁰ However, providing an unconditional living wage would require a substantially higher tax intake. Moreover, if vulnerable groups currently receiving support see their benefits erode in order to support a universal scheme that also supports wealthier groups, it may not be an effective poverty alleviation tool, even if it helps to share the benefits of globalisation and technological progress.⁷¹

Policymakers should also question whether labour market institutions could **better address the changing nature of work** offered by the so-called gig economy, in which permanent employment is changed to short-term contract jobs or freelance work. These changes create knock-on effects when social protection entitlements, unemployment benefits, and other institutions traditionally tied to employment status are considered.⁷² Previous MGI surveys suggest that there are approximately 21 million independent workers in Germany, including gig economy workers on digital platforms like Airbnb. Most of them choose to work independently—42 percent as a supplemental source of income and 29 percent as a primary source. That number could grow as digitisation blurs the traditional boundaries of

⁶⁶ Klaus Borger and Martin Buller, “Arrived at normality: Germany 25 years after the fall of the Berlin Wall”, KfW Economic Research, number 70, September 30, 2014.

⁶⁷ Laurie van der Burg and Sam Pickard, “G20 subsidies to oil, gas and coal production: Germany”, Overseas Development Institute, November 2015; “The rise and fall of Germany's coal mining industry”, Deutsche Welle, January 2007.

⁶⁸ Laurie van der Burg, “Cutting Europe's lifelines to coal: Tracking subsidies in 10 countries”, Overseas Development Institute, 2017.

⁶⁹ Federal Institute for Vocational Education and Training (BIBB).

⁷⁰ “Policy brief on the Future of Work: Basic income as a policy option: Can it add up?” OECD, May 2017.

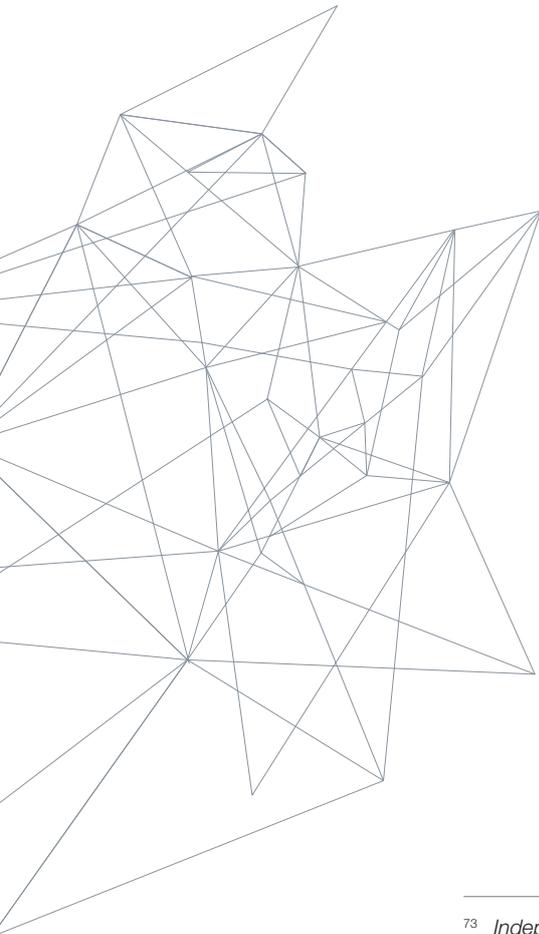
⁷¹ Ibid.

⁷² Ibid.

companies. The remainder, about 30 percent, do so out of necessity, and require help in finding better jobs or specific protection.⁷³ Germany could transform its labour institutions to help these temporary and gig workers gain access to the kind of benefits that normally accompany full-time, standard work, and allow the labour market to become more fluid. One example is a “portable” benefits programme being considered in New York State, in which companies contribute to funds that cover at least part of the cost of health insurance or other benefits for gig workers based on the fee associated with each individual paid task.⁷⁴ In terms of fluidity, Denmark’s “flexicurity” model enables 25 percent of Danish private sector workers to change jobs each year based on three pillars: flexibility in hiring and firing, an active labour market policy, and a generous social welfare scheme.⁷⁵



Automation and digitisation offer substantial upside for Germany’s economy and the boost automation can give to GDP growth can more than offset the drag its ageing economy will provide. Germany also comes from a position of strength to capture those benefits; its competitive, connected economy and strong early steps to digitise give it many of the tools it needs to more fully transform business operations and transition into a digital age. At the same time, Germany’s policy makers have an opportunity to proactively manage some of the side effects of automation and digitisation. The pace of digitisation and its all-encompassing—and unequal—impact on workers and society may require new approaches to worker training, welfare systems, and labour market institutions, and policymakers need to start asking themselves how they can manage the transition. Successfully implementing new approaches may enable Germany to share the gains from automation and digitisation more equitably across society, helping to ensure that all citizens benefit from its promise.



⁷³ *Independent work: Choice, necessity, and the gig economy*, McKinsey Global Institute, October 2016.

⁷⁴ Quinton, Sophie, “With growth of the gig economy, states rethink how workers get benefits”, Pew Stateline, February 2017.

⁷⁵ Ministry of Foreign Affairs of Denmark; “Realising human potential in the fourth industrial revolution: An agenda for leaders to shape the future of education, gender and work”, World Economic Forum white paper, January 2017.

BIBLIOGRAPHY

A

Akamai, “State of the Internet Report Q1 2017”, February 2017.

B

“Blue Card”, Federal Ministry for Economic Affairs and Energy, n.d.

Borger, Klaus, and Martin Buller, “Arrived at normality: Germany 25 years after the fall of the Berlin Wall”, KfW Economic Research, number 70, September 30, 2014.

Bughin, Jacques, Laura LaBerge, and Anette Mellbye, “The Case for Digital Reinvention”, *McKinsey Quarterly*, February 2017.

C

CEBR, “The impact of automation”, January 2017.

Chefsache, “Flexibles Arbeiten in Führungspositionen: Ein Handlungsleitfaden für Chefetagen”, May 2017.

Crafts, Nicholas, “Steam as a general purpose technology: A growth accounting perspective”, *Economic Journal*, volume 114, issue 495, April 2004.

D

Digital McKinsey, “Digital manufacturing: Capturing sustainable impact at scale”, June 2017.

Digital McKinsey, “Industry 4.0 after the initial hype: Where manufacturers are finding value and how they can best capture it”, April 2016.

Digital McKinsey, “Smartening up with Artificial Intelligence (AI): What’s in it for Germany and its industrial sector?” April 2017.

E

English, Bill, “Social Investments Analytics Layer launch”, Beehive.govt.nz, September 28, 2016.

European Commission, “eGovernment in Germany”, edition 18.0, February 2016.

F

Federal Ministry for Economic Affairs and Energy, “Digital Strategy 2025”, March 2016.

Federal Office for Migration and Refugees, “Digitisation agenda 2020—The BAMF’s IT strategy” November 2016.

G

“Germany to scale back mandatory civilian service”, *Der Spiegel*, May 21, 2010.

Government Digital Service, “GDS business plan April 2014 to March 2015”, July 2014.

Graetz, Georg, and Guy Michaels, “Robots at Work”, Centre for Economic Performance, London School of Economics, March 2015.

H

“How did Estonia become a leader in technology?” *The Economist*, July 30, 2013.

I

International Labour Organisation, “From Bismarck to Beveridge: Social security for all”, *World of Work*, issue 67, December 2009.

M

Muro, Mark and Scott Andes, “Robots seem to be improving productivity, not costing jobs”, *Harvard Business Review*, June 2015

McKinsey & Company, “Behind the German jobs miracle”, October 2012.

McKinsey Centre for Government, “The opportunity in government productivity”, April 2017.

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

McKinsey Global Institute, *Artificial Intelligence: The next digital frontier?* June 2017.

McKinsey Global Institute, *Digital Europe: Pushing the frontier: Capturing the benefits*, June 2016.

McKinsey Global Institute, *Digital globalization: The new era of global flows*, March 2016.

McKinsey Global Institute, *European business: Overcoming uncertainty, strengthening recovery*, May 2017.

McKinsey Global Institute, *Independent work: Choice, necessity, and the gig economy*, October 2016.

McKinsey Global Institute, *Reinventing construction through a productivity revolution*, February 2017.

McKinsey Global Institute, *Rome redux: New priorities for the European Union at 60*, March 2017.

O

OECD, "Automation and independent work in a digital economy", May 2016.

OECD, "Policy brief on the Future of Work: Basic income as a policy option: Can it add up?" May 2017.

OECD, "Understanding the socioeconomic divide in Europe", January 2017.

S

Seelaib-Kaiser, Martin, "The end of the conservative German welfare state model", *Social Policy & Administration*, volume 50, issue 2, February 2016.

Steinmetz, George, "The working class and the welfare state", *International Labour and Working-Class History*, number 40, Fall 1991.

Stifterverband and McKinsey & Company, "Hochschulbildung für die Arbeitswelt 4.0", January 2016.

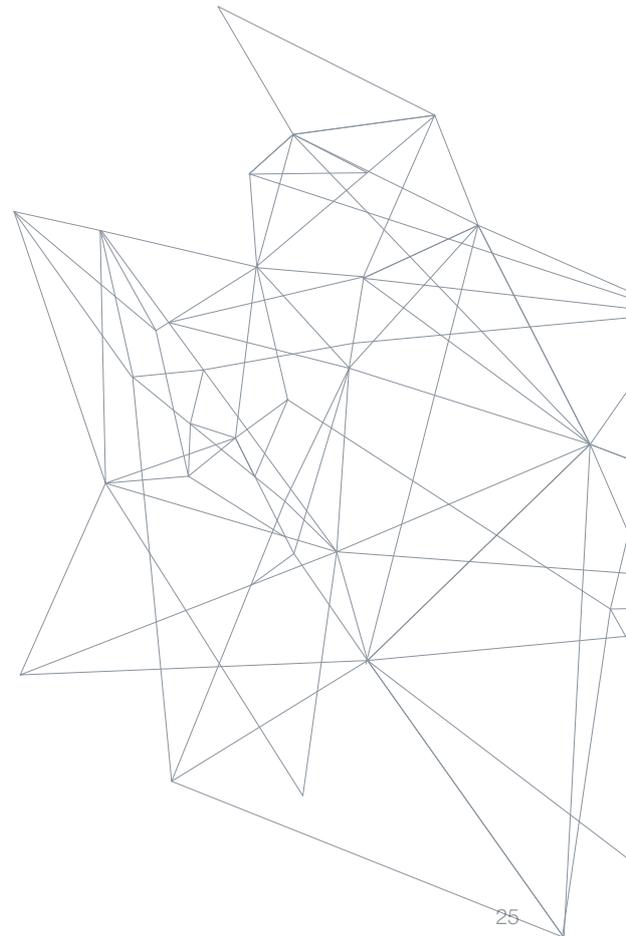
V

Van der Burg, Laurie, "Cutting Europe's lifelines to coal: Tracking subsidies in 10 countries", Overseas Development Institute, 2017.

Vassil, Kristjan, "Estonian e-Government ecosystem: Foundation, applications, outcomes", *World Development Report 2016*, background paper: digital dividends, June 2015.

W

World Economic Forum, "Realising human potential in the fourth industrial revolution: An agenda for leaders to shape the future of education, gender and work", January 2017.



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