Solving the productivity puzzle: The role of demand and digital

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ABSTRACT

While labor productivity growth has been declining across the United States and Western Europe since a boom in the 1960s, it has decelerated further since the mid-2000s to historic lows. To understand what is behind exceptionally weak productivity growth, we analyze seven countries (US, Germany, France, UK, Italy, Spain, and Sweden) across six sectors (automotive, technology, retail, electric power, tourism, and finance) and examine supply and demand factors in the period from 2010 to 2014 compared to 2000 to 2004.[2] For each sector, we combine economic analyses using KLEMS sector productivity data among other sources with McKinsey's industry expertise to shed light on the microeconomic causes behind industry productivity performance, and synthesize across sectors to draw aggregate implications. Aggregate productivity growth does not occur in unison across sectors but is the result of sectors accelerating and decelerating at different times. As a result, industry analysis is key to understanding aggregate productivity data and in this paper we focus on our sector findings.

During the 2010 to 2014 period compared with a decade earlier, a broad-based slowdown occurred across sectors but the extent varies across countries. We find three waves collided to produce a productivity-weak but job-rich recovery: the waning of a productivity boom that began in the 1990s, financial crisis aftereffects, including weak demand and uncertainty, and digitization. Looking ahead, two features stand out from our sector analysis as key drivers for future productivity growth. These include sustained demand growth and enhanced digital diffusion.

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[2] *Solving the productivity puzzle: The role of demand and the promise of digitization,* McKinsey Global Institute, February 2018.

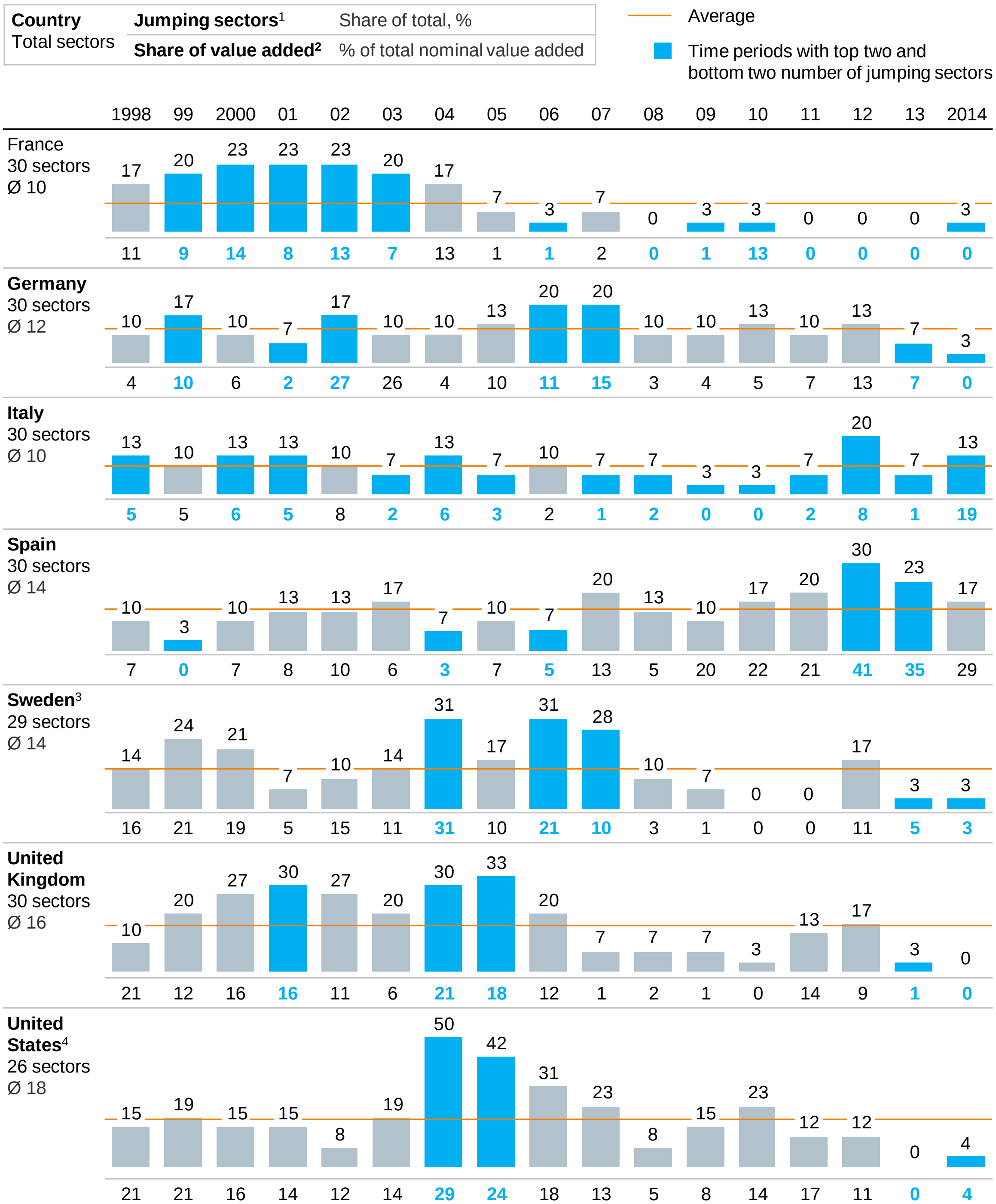
INTRODUCTION

Despite some improvement in productivity growth rates in the United States and Western Europe recently, they remain below historic norms with many countries in our sample seeing productivity growth of around 1 percent or less. To understand what is behind the slowdown, we examine micro patterns as the productivity performance of businesses and sectors does not slow down or speed up in unison. Rather, shifts in aggregate productivity growth are the result of individual sectors accelerating and decelerating at different times. For example, in the United States, the productivity boom of 1995 to 2000 was characterized by an exceptional combination of sectors experiencing a productivity acceleration: large-employment sectors such as retail and wholesale experienced accelerating productivity at the same time that rapid productivity growth was occurring in smaller sectors such as computer and electronic products. Together, these large and rapid growth sectors drove the productivity boom. The same trend can be found in Europe. For example, finance and insurance in Spain and the United Kingdom grew strongly, as did retail and wholesale trade in Sweden, contributing to a large share of jumping sectors in the mid-2000s. Today, the picture is very different in Europe and the United States, with exceptionally few jumping sectors, and accelerating sectors that are too small to have a major impact on aggregate productivity growth (Exhibit 1).[3]

[3] Our findings suggest that the reason productivity growth is so hard to predict is that it is by nature "jumpy" and dependent on underlying sector dynamics and technologies. Research by others shows that past productivity performance has been a poor predictor of future performance. See Erik Brynjolfsson, Daniel Rock, and Chad Syverson, *Artificial intelligence and the modern productivity paradox: A clash of expectations and statistics*, NBER working paper number 24001, November 2017.

Exhibit 1

Shifts in aggregate productivity growth are the result of individual sectors accelerating and decelerating at different times



1 A sector is classified as "jumping" in year Y if its compound annual growth rate of productivity for years Y-3 through Y is at least 3 percentage points higher than it was for 1995–2014 as a whole.
2 Based on share in Year Y.
3 Real productivity data are missing for the chemicals and chemical products sector for Sweden in the EU KLEMS 2016 release.
4 US data are for the private business sector only; Europe data are for the total economy.

SOURCE: EU KLEMS (2016 release); BLS Multifactor Productivity database (2016 release); McKinsey Global Institute analysis

We identify a broad-based productivity growth slowdown across sectors and countries with three main factors in common. The first two, the waning of a productivity boom that began in the 1990s and financial crisis aftereffects, including weak demand and uncertainty, have dragged down productivity growth by 1.9 percentage points on average across countries since the mid-2000s, from 2.4 percent to 0.5 percent. In particular, financial crisis aftereffects include weak demand, uncertainty, excess capacity, contraction and expansion of hours, and, in some sectors, a boom-bust cycle. The third, digitization, is fundamentally different from the first two because it contains the potential to reignite productivity growth but the benefits have not yet materialized at scale. This is due to adoption barriers and lag effects as well as transition costs.

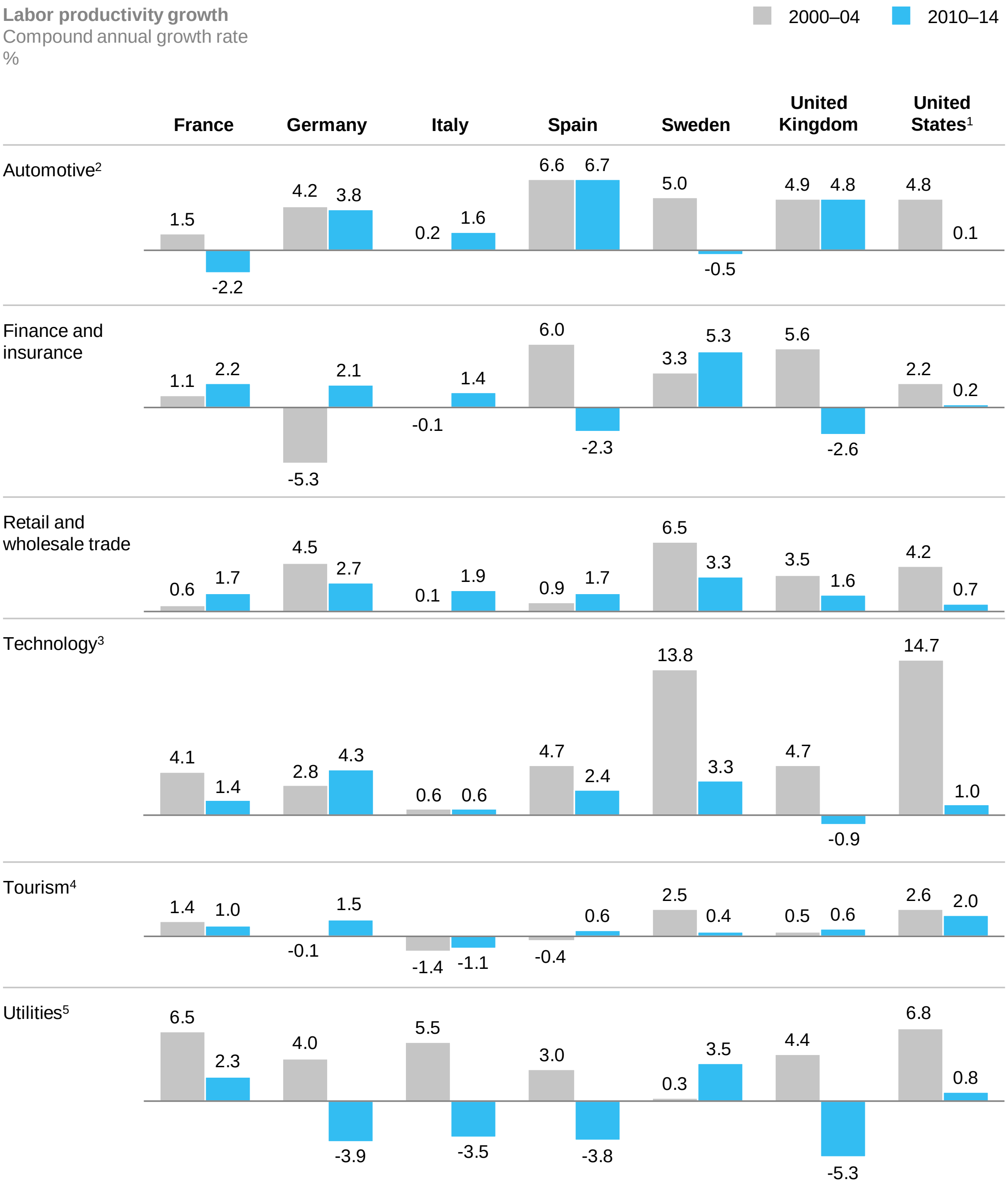
SECTOR ANALYSIS

In each sector, we analyze productivity growth since 2000, identify the factors that may fuel growth in the future, and outline the potential constraints to that growth. During the most recent productivity-growth slowdown, we find most sectors experienced weaker productivity growth, but the extent varies across countries (Exhibit 2). The tech sector, for instance, experienced the most dramatic drop across our sample, especially in Sweden and the United States, while tourism performance has differed by country, with average productivity gains remaining at a slow but steady level. For auto and finance, we find much more of a divergence in the productivity performance across countries.

Common trends emerge from our sector analysis that help to explain the recent aggregate productivity-growth slowdown: the waning of an ICT-enabled productivity boom that began in the 1990s, financial crisis aftereffects, and digitization. Retail most clearly illustrates how this perfect storm occurred across countries. In addition, the utilities sector, with a long-term trend of increasing energy efficiency that is reducing demand for electricity, provides a good case study in how demand impacts productivity. Finally, two factors stand out across our sample of sectors as critical in determining productivity growth in the future: demand and digitization.

Exhibit 2

Most sectors and countries have seen a decline in productivity growth



1 US data are for the private business sector only for all sectors except tourism; Europe and tourism data are for the total economy.
2 Automotive defined as “Transport equipment” for EU countries and “Transportation equipment” for the United States.
3 Technology defined as “Electrical and optical equipment” and “IT and information services” for EU countries and “Computer and electronic products,” “Data processing, internet publishing, and other information services,” “Computer systems design and related services,” and “Publishing industries, excluding internet (includes software)” for the United States.
4 Number of jobs used in lieu of hours worked due to data availability.
5 Utilities defined as “Electricity, gas, steam, and A/C supply” for EU countries and “Utilities” for the United States.

SOURCE: BLS Multifactor Productivity database (2016 release), Eurostat (June 2017 release), EU KLEMS (2016 release), WTTC; McKinsey Global Institute analysis

Automotive sector

In the aftermath of the crisis, the performance of automakers diverged. Germany, Spain, and the United Kingdom experienced flat or only slightly lower productivity growth compared with 2000–04, and Italy even saw an increase in productivity growth. France, Sweden, and the United States experienced a more severe slowdown. Looking more closely at two of the world's leading auto manufacturing nations, Germany and the United States, we find that the extent of the demand shock and the response to the financial crisis explain much of the variation. We also find that this sector continues to experience strong competitive intensity, with significant potential for digital disruption.

Germany and the United States both experienced stronger productivity growth in the early 2000s. This boom was due to a convergence of many factors: growth in more productive large and premium vehicles (which boosted productivity growth by about 0.5 percentage point in each country); an acceleration and expansion of vehicle content driven by regulations, safety standards, and fuel economy improvements, but also discretionary features, as OEMs sought to differentiate themselves and attract customers; and restructuring through a shifting of labor-intensive activities to low-cost locations, as well as automation and process improvements.

The rise of online vehicle comparison platforms increased the transparency of vehicle content while significant competition increased pressure on companies to add features to differentiate themselves and achieve operational productivity improvements. Emissions and safety regulation also played a role in feature enhancements. As an example, between 2000 and 2010, the market price of a Toyota Camry in the United States declined 1 percent a year while $1,400 of content was added and fuel efficiency improved. OEMs sought to reduce their own costs and in turn put significant pressure on suppliers to achieve 3 to 4 percent cost improvements each year to deliver additional content to consumers without increasing price. In the United States, a significant increase in competition from foreign OEMs intensified pressure on domestic automakers. Foreign OEMs in the United States scaled production, and domestic OEMs saw their share of domestic vehicle production fall.

Then came the financial crisis. In Germany, the impact on production was moderate and short, while in the United States it was severe and prolonged. Partly that was because Germany had a higher share of production from premium vehicles and exports (including, specifically, the export of premium vehicles to China). These markets proved more stable, and Germany was able to sustain more production, capacity utilization, and investment than the United States. US light-vehicle production fell by 47 percent during this time, from

10.5 million in 2007 to 5.6 million in 2009, while in Germany it fell by only 15 percent.[4] In Germany, capacity utilization for light-vehicle production dropped by 11 percentage points between 2008 and 2009 but rebounded immediately in 2010, while in the United States, it began a significant drop in 2007 and fell 32 percentage points between 2007 and 2009.[5] From 2009–10, US capacity utilization rates went up 20 percentage points, then 9 percentage points from 2010–11 (thus returning close to 2007 levels), and another 10 percentage points from 2011–12. Differences in excess capacity during and soon after the crisis, as well as a reduction in profits for OEMs as demand fell, meant the United States also had a much steeper decline in investment than Germany. Real investment in the United States dropped 5.4 percent per year from 2007 to 2010, while Germany maintained low but positive growth of 0.9 percent per year. R&D investment stayed relatively stronger during the crisis compared with equipment and structures.[6] Finally, hours worked dropped by a third in the United States and about a tenth in Germany in the crisis years (Exhibit 3). German OEMs focused on shift reduction and enhancing the skills of employees; in contrast, there were a large number of plant closures in the United States. When production returned to more normal levels, US automakers had to hire back workers in greater numbers than their German counterparts, slowing down productivity gains as OEMs focused on meeting new demand and workers needed to be trained.

Looking ahead, we find significant potential for higher productivity growth in autos from new value added per vehicle opportunities through digitization and technology trends. Competitive intensity remains high, with new players like Tesla entering the OEM market as well as tech companies like Apple and Google, and mobility providers like Uber focused on innovations such as autonomous driving. OEMs are focused on the digitization of vehicle content, increasing connectivity and adding infotainment features, as well as the evolution toward autonomous vehicles. Yet these digital trends remain subscale. Highly or fully autonomous cars are not yet commercially available. In 2016, only about 1 percent of vehicles sold were equipped with basic partial-autonomous-driving technology. But today, 80 percent of the top ten OEMs have announced plans for highly autonomous technology to be ready by 2025.[7] If technology and

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[4] Based on data from IHS Markit, 2017, data for light-vehicle production in the United States and Germany.

[5] Capacity utilization based on straight-time capacity at a one-, two-, or three-shift/three-crew structure dependent on the shift structure in a plant in a given year. This is calculated without overtime. Based on data from IHS Markit, 2017, for light-vehicle production capacity.

[6] Long product development cycles of five to seven years from design to production mean maintaining R&D during a downturn is critical for having new models available immediately after a crisis when demand returns. Firms delayed investment in equipment, particularly for maintenance and replacement, while spend on equipment for new models and innovation was less impacted.

[7] *The automotive revolution is speeding up*, McKinsey & Company, September 2017.

regulatory hurdles are overcome, McKinsey estimates that up to 15 percent of new cars sold in 2030 could be highly autonomous.[8] Software content rose from 7 percent of total vehicle content in 2010 to 10 percent in 2016 and could reach 30 percent by 2030.[9] Vehicle electrification could simplify production and reduce hours worked per vehicle, because electric vehicles have fewer components than those based on internal combustion engines. Automation, with tools such as collaborative robots, and Industry 4.0, which focuses on the use of data, analytics, and connectivity, should also help. However, OEMs are still learning how to make the most of new technologies. In a recent survey of manufacturers, only 16 percent said they had an overall Industry 4.0 strategy in place.[10] Finally, manufacturers are often as focused on agility as on efficiency: with significant uncertainty, the ability to scale production up and down as well as switch between models and locations becomes critical.

Yet uncertainties exist that may hold back the productivity-growth potential of the sector. The rise of protectionism threatens to reverse the globalization benefits of efficient supply chains, consumer adoption and government regulation of autonomous software could be slow, and some degree of value added could be transferred from the auto sector to other sectors, notably in terms of software for autonomous driving and batteries.[11] Overall demand for vehicles could peak and then decline in the United States and Europe as household formation rates drop, population growth slows, and demand for shared mobility increases.

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8 *Automotive revolution—perspective towards 2030*, McKinsey & Company Advanced Industries Practice, January 2016. For a review of autonomous technology and the innovations needed, also see *Self-driving car technology: When will the robots hit the road?* McKinsey & Company, May 2017.

9 Facing digital disruption in mobility as a traditional auto player, McKinsey & Company, December 2017.

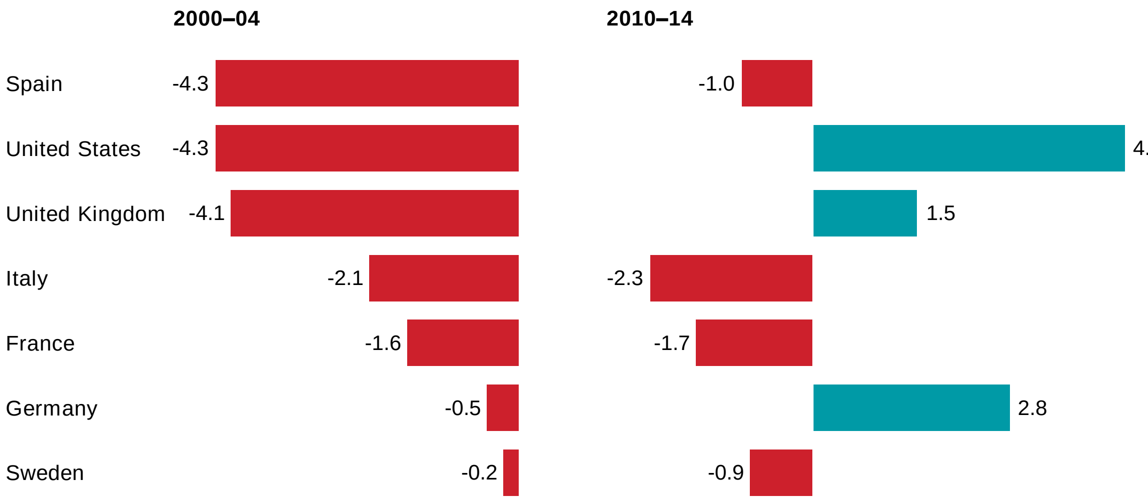
10 *Industry 4.0 after the initial hype. Where manufacturers are finding value and how they can best capture it*, McKinsey & Company, McKinsey Digital, 2016.

11 Electrification of the power train could result in a simpler power train with fewer components, which could drive down hours worked in assembly. However, the broader impact on the sector when accounting for internal combustion engine production is less clear for two reasons. First, most OEMs source batteries from battery-specific suppliers, such as Panasonic, which are not “measured” as part of the automotive industry; whether this will have a larger impact on value added or hours worked and therefore productivity is unclear. Second, a reduction in emissions via vehicle electrification could increase value added, provided the benefits from reduced emissions are factored into quality adjustments for price deflators to convert nominal to real value added.

Exhibit 3

Automotive sector

Hours worked
Average annual growth, %



SOURCE: BLS Multifactor Productivity database (2016 release); EU KLEMS (2016 release); McKinsey Global Institute analysis

Finance sector

A striking feature of the aftermath of the financial crisis is the diverging productivity performance of the finance sector itself.[12] Some countries, such as France, Germany, Italy, and Sweden, increased productivity growth, while Spain, the United Kingdom, and the United States experienced a sharp deterioration. The extent of the financial boom and the bust that followed explains much of this divergence.

The financial boom ahead of the crisis was more extreme in Spain, the United Kingdom, and the United States. High economic growth boosted demand for credit from 1995 to 2005 across countries, except for some specific years and countries (for example, Germany during a downturn in the early 2000s).

12 The measurement of productivity in finance is heavily debated. For example, the Bank of England found: "The period just before the financial crisis was characterized by growth in money and credit in excess of final output price inflation. There is, therefore, a risk that some of the growth in balance sheets was reflected in higher estimates of real service provision (on both lending and deposits), when it might have been better treated as an increase in prices. For example, the number of mortgage approvals made might be one alternative (quantity) measure of some of the services provided to borrowers by banks. The total number of approvals was relatively stable between 2002 and 2007, suggesting little change in output, but the stock of mortgage lending deflated by the GDP deflator rose by almost 60 percent." For further details, see Stephen Burgess, "Measuring financial sector output and its contribution to UK GDP," *Bank of England Quarterly Bulletin*, Bank of England, volume 51, number 3, 2011.

Loosening regulation encouraged large increases in leverage ratios, and relatively low interest rates drove high growth in lending (Exhibit 4). At the same time, the ICT revolution improved ease of access to financial services as well as process efficiency, increasing gross output and reducing costs.

The impact of the crisis on financial services firms in Spain, the United Kingdom, and the United States was significant. Many were threatened with insolvency due to a significant increase in defaults on loans and a stock market crash. In Spain, the United Kingdom, and the United States, profits dropped across the three countries in total by 90 percent between 2007 and 2010.[13] In the aftermath of the crisis, these countries experienced the sharpest productivity-growth decline, associated with a decline in value-added growth. Across all three countries, growth in the volume of loans and deposits has been slower or even negative during a post crisis period of deleveraging as banks sought to restore balance sheet health. Slower macroeconomic growth and demand for debt, stricter regulation, and more cautious lending practices put pressure on deposits and lending volumes.[14] Regulatory changes and settlements further dampened value-added growth and occupied management attention. Banks cut businesses such as proprietary trading and shouldered more than $165 billion in fines and settlements from 2010 to 2014.[15] In this environment, the sector also saw a decline in investment in structures and equipment as a share of GDP, though investment in intellectual property products (software and R&D) remained relatively robust across countries. At the same time, banks could not readily cut staff in line with the much deeper decline in value added and credit because of large IT infrastructure and fixed costs.[16]

In contrast, Sweden maintained high productivity growth from 2010 to 2014 due to much stronger demand thanks to a smaller shock from the crisis and a high

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13 Based on weighted average of data on profits after taxes in USD from McKinsey Panorama.

14 Interestingly, the United States has seen a recovery and strong growth in profits and nominal value added during this period. This is likely due to a large reduction in risk costs (from bad loans) between 2010 and 2014 of 27 percent per annum, with risk costs currently slightly below pre-crisis levels at 9 percent of revenue. By contrast, the United Kingdom and Spain still faced large risk costs in 2014 at 20 percent and 40 percent of revenues respectively, compared to 10 percent and 16 percent respectively in 2004 (based on data from McKinsey Panorama). However, these improvements in the United States did not translate into real value-added growth given real measures of output are driven to a large extent by the volume of activity, e.g. the number of loans, rather than their quality. A declining number of bad loans could then increase profitability and nominal value added but dampen real value-added growth to some extent.

15 *The road back: McKinsey global banking annual review 2014*, McKinsey & Company, December 2014.

16 However, there was some contraction of the jobs in the industry. Based on data from the BLS, the finance and insurance sector contracted by 8 percent between 2007 and 2010. By 2014, some jobs had been added back, but the sector was still 6 percent below the 2007 level. Office and administrative support occupations' share of the finance and insurance sector's employment has consistently decreased over the last decade and a half, while the share of business and financial occupations, as well as sales occupations, has been increasing.

and sustained pace of digital transformation. Sweden also went through significant restructuring and regulation setting following an earlier financial crisis, and its banking system was more resilient to external shocks. Sweden is at the forefront of some digital trends in this sector; for example, only about 30 percent of cash deposits and withdrawals in the country are teller-based, compared with up to 85 percent of deposits and 75 percent of withdrawals in Spain. France, Germany, Italy, and Sweden experienced less of a financial-sector boom-bust and leveraging-deleveraging cycle.

Looking ahead, we find two main factors that will drive productivity growth in the future: a renewed focus on growth as demand for financial products returns, and digital transformation. We expect higher growth in demand for both loans and deposits in the next ten or so years compared with 2010–14.[17] Current forecasts call for on average of 3 percent growth in deposits between 2014 and 2020, and 1.9 percent growth in loan volumes in that same period. This is mainly due to improvements in the macroeconomic environment, with confidence and demand for loans returning.

Digitization, advanced analytics, and automation can continue to raise value added and reduce labor costs along four fronts: digital customer interaction, IT modernization and process automation, and AI and big data. First, opportunities to digitize customer interaction are significant: branch networks, call centers, and monthly paper statements typically represent between 40 and 60 percent of total costs in retail and commercial banking.[18] Banks' current digital offerings lag significantly behind demand; only 13 percent of North American customers currently obtain an account online but 56 percent are willing to do so.[19] Second, banks can modernize IT through better data management and analytics to allow for a single view of the customer and adopt cloud infrastructure to drive down costs through automation and superior asset utilization. Other examples of opportunities include: robotic process automation that reduces resources needed for trading-risk calculation by 95 percent; a new algorithm for credit-card fraud detection that improves predictability by 80 percent, in 50 percent

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[17] Based on a simple average of growth in local currency units for France, Germany, Spain, Sweden, United Kingdom, and United States from McKinsey Panorama. There are some exceptions to this, for example, for deposits in the United States, where the 2010–14 period was one of unusual growth in deposits because demand was much less affected due to the rapid deleveraging and bailouts that occurred immediately after the crisis. However, looking forward in the United States, with the announcement of the end of quantitative easing and strong stock market returns, deposits post-2014 are beginning to shift back into investment.

[18] *A brave new world for global banking: McKinsey global banking annual review 2016*, McKinsey & Company, January 2017.

[19] McKinsey Retail Banking Consumer Survey 2016.

less time; and digitizing mortgage underwriting.[20] Third, security and authentication is a major trend, and blockchain is emerging as a technology that may significantly reshape efficiency. Finally, banks are finding new ways to use big data and machine learning to acquire new customers, cross-sell, and prevent fraud. For example, machine learning allows loan portfolio monitoring through early warning systems based on transactional data.

Most major banks have embarked on transformational agendas but have not yet reaped the full benefits. Factors influencing the pace of digital adoption and transformation include consumer preferences, the level of competition from new digital entrants, and internal barriers like the pace of retraining and redeploying staff or acquiring external talent. Continued digital transformation will help reduce costs, but in the interim it may put price pressure on incumbents as they restructure and industry revenues stumble via cannibalization and competition from new digital attackers. Estimates suggest that price pressure, and an environment of low interest rates and slow growth, could dampen total bank income, particularly in the Eurozone, by as much as 13 percent by 2020, 11 percent in the United Kingdom, and 9 percent in the United States.[21]

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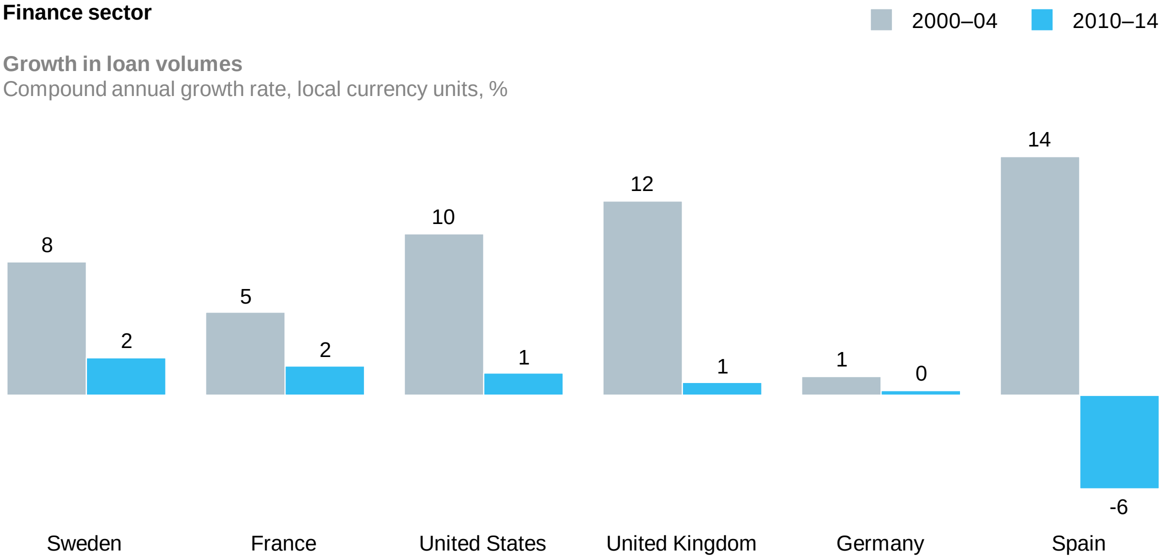
[20] *The phoenix rises: Remaking the bank for an ecosystem world: McKinsey global banking annual review 2017*, McKinsey & Company, October 2017.

[21] *A brave new world for global banking: McKinsey global banking annual review 2016*, McKinsey & Company, January 2017.

Exhibit 4

Finance sector

Growth in loan volumes
Compound annual growth rate, local currency units, %



SOURCE: McKinsey Panorama; McKinsey Global Institute analysis

Retail sector

Few industries capture all three waves that have driven productivity growth since the early 2000s as well as the retail sector: a waning productivity boom that began in the mid-1990s, financial crisis aftereffects, and digitization.

By the time the crisis hit in 2007, the retail sector was at the tail end of a productivity boom that began around 1995. This boom occurred as companies learned to use technology to transform supply chains and improve managerial and operational processes that enabled them to deliver the right products to the right stores more efficiently and accurately.[22] Large-format retailers such as Walmart, Tesco, and Carrefour were at the forefront of this supply-chain transformation, which led to changes in their wholesale and supplier networks, too. Vendor coordination systems, warehouse management systems, and new forecasting tools to align staffing with demand were just some of the IT solutions retailers employed. Much of this boom resulted from the diffusion of best practices from leading companies to other retailers, enabled by a strongly competitive environment and robust consumer spending in the late 1990s,

[22] For more details on the boom in retail productivity growth in the US, see *US productivity growth, 1995–2000*, McKinsey Global Institute, October 2001, and *How IT enables productivity growth: The US experience across three sectors in the 1990s*, McKinsey Global Institute, November 2002.

particularly in high-value goods. By the mid-2000s, many benefits had been captured.

After 2010, weak demand in the recovery from the financial crisis made matters worse. The demand momentum shifted as sales growth dropped and many consumers switched to lower-value products. Overall sales growth slowed down dramatically. In 2010–14 compared with 2000–04, retail sales growth fell by three percentage points on average across countries in our sample.[23] Some portion of store labor is fixed; therefore declining sales growth impacts productivity as labor cannot correspondingly be reduced. Similarly, in retail, we estimate that consumers shifting to higher-value goods, for example higher-value wines or premium yogurts, contributed 45 percent to the 1995–2000 retail productivity growth increase in the United States.[24] This subsequently waned, and even reversed during the recession, dragging down productivity growth.

As demand began to slowly recover, retailers hired workers, which impacted the pace of productivity improvements. In the United States, hiring was helped by low retail wage growth.[25] For example, annual retail wages per full-time equivalent employee in the United States grew by 6 percent per year between 2000 and 2004, a time when retail productivity growth was also booming. In such boom times, even low wage sectors like retail saw healthy wage growth, supporting demand in the economy more broadly, as well as capital deepening in the retail sector. That faded in the mid-2000s, and has remained low since then. Between 2010 and 2015, wage growth was much slower, at 2 percent per year. Had wages in retail grown since 2010 as they did between 2000–04, they would be $7,500 p.a. higher today. Assuming that retail wages in the United States had kept pace with total economy wage growth since 1948, the average retail full-time equivalent employee would be making $18,000 more per year, or about 50 percent more than they make today.[26] Interestingly, while many of the new jobs added back have been in sales occupations (which also saw the largest job losses in the crisis years), others have been in occupations like food preparation and serving, and health care, indicating that retailers are looking to expand the breadth of customer experiences. Real investment in equipment and structures fell in many countries during the crisis, and recovered slowly.

A final factor at play today in the retail sector is the ongoing digital disruption from e-commerce, the potential for continued automation (for example new

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[23] Based on data of real gross output.

[24] *US productivity growth, 1995–2000*, McKinsey Global Institute, October 2001.

[25] Furthermore, some US retailers came out of the boom with higher store density and longer-term contracts than was optimal in the postrecession environment and still had overcapacity.

[26] Calculated based on wage data from the Bureau of Economic Analysis.

forms of self-checkout), and the use of customer data and analytics, for example, to target sales or for automated ordering. In the middle of this slow recovery and challenging demand environment, the rise of Amazon and other online retailers and the wave of digital disruption hitting the retail industry created urgency for traditional retailers to build an online presence, resulting in transition costs and duplicative capacity.

While e-commerce has reached about 10 percent share of sales across countries, up from 2 percent in 2005, and growing rapidly, it remains a small share of total retail (Exhibit 5).[27] Pure play e-commerce can be as much as two times more productive than store-based retail as fulfillment centers allow for high employee utilization and efficient stocking and picking compared with traditional retail formats. Productivity could increase with the rising share of more productive e-commerce retailers as well as the competitive pressure they put on store-based retailers. Over the next ten years, we calculate that the growth of e-commerce could represent a one percentage point per year productivity boost in the United States as it continues to grow and companies find the right balance between online and in-store operations, something both incumbents and online retailers are still trying to figure out.[28]

Automation offers another productivity opportunity. The price advantage of e-commerce is putting pressure on retail margins, which is leading retailers to look more aggressively at improving operational efficiency. This could result in the adoption of automated technologies to streamline costs. Checkout and stocking are some areas where automation could have a positive impact on labor productivity growth. Checkout consists of over 10 percent of time in retail. Self-checkouts are already prominent in convenience channels, but new self-checkout solutions—for example, the Panasonic automated checkout and Amazon Go—require less assistance and increase checkout speed. For stocking, Tally, a stock-taking robot, can identify products to set stocking needs, while Swisslog has developed guided vehicles for material transport to help in physical stocking (with employees doing the final stocking). Similarly, in inventory stock taking, Zara has begun using RFID chips to eliminate stock taking and lost products. The speed of adoption is likely to be faster in regions with higher retail wages, and we have already seen more investment in self-checkout in Europe than in the United States.

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[27] Based on data across France, Germany, Italy, Spain, Sweden, United Kingdom, and United States from Euromonitor International, Retailing data (2018 edition).

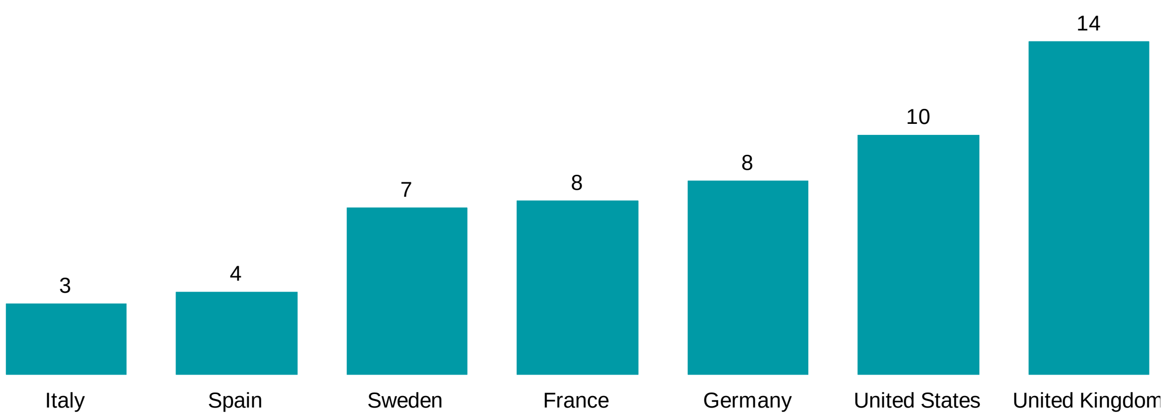
[28] Impact on retail productivity growth calculated based on the expected mix shift between online and offline retail, assuming today's level of relative productivity between the two segments. Based on data from Euromonitor International, Retailing data (2018 edition) and S&P Capital IQ.

How much of these productivity opportunities are captured will depend on the evolution of mix between brick-and-mortar and e-commerce channels, where most traditional retailers are still exploring the right “Goldilocks” balance. Consumer preferences will help shape the mix, for instance even between things like home delivery vs. store pickup of e-commerce purchases, and such preferences may well vary across countries. Another factor determining productivity growth will be the extent retailers shift freed up labor from automation to improving customer experience. For example, McDonald’s introduced self-ordering kiosks and yet retained staff to greet customers and provide service to tables in some locations. Or consider, for example, the Apple store, which is highly automated but also has a surplus of employees designed to build brand image, and service customers. The degree to which these changes happen will influence the nature of employment going forward in these sectors.

Exhibit 5

Retail sector

Share of online sales[1]
% of total retail sales (excluding sales tax)



1 Euromonitor International, Retailing data (2018 edition).

SOURCE: Euromonitor International, Retailing data (2018 edition); McKinsey Global Institute analysis

Technology sector

The technology sector, including electronics manufacturing, packaged software, and software services, plays an outsized role in productivity growth due to its own rapid rate of improvement and because it acts as a catalyst for innovation and the diffusion of tech talent. Yet it experienced the sharpest productivity-growth slowdown among our focus industries in many countries.

Our analysis mostly focuses on the United States as it represents about 60 percent of value added and about 50 percent of the employment of the industry.[29] Since 2000, the tech industry has changed in composition of value added as the share of manufacturing has declined from 47 percent to 29 percent and software services has grown from 28 percent to 43 percent in that time. The productivity dynamics in these segments are very different. Tech manufacturing is R&D- and capital-intensive and has fast technology upgrade cycles and large economies of scale, reflected in its potential for very rapid productivity improvements when quality improvements are accounted for. Software services are intensive in skilled labor working to develop customized software, a less scalable business in which productivity gains have been slower. This mix shift dragged down tech productivity growth by roughly 1 percent a year between 2000 and 2014; however, since the shift has been continuous, it has not contributed to the industry slowdown.

The decline in productivity growth was most pronounced in the tech manufacturing subsector. In the United States, tech manufacturing productivity grew about 18 percent per year from 2000 to 2004 and has declined steadily since then to 15 percent between 2004 and 2007, and to zero growth in 2010–14. In contrast, productivity growth in tech services and software was relatively robust; services grew at 2 percent a year from 2010 to 2014 and software 3.4 percent, roughly in line with long-term trends.

Two factors explain the slowdown in measured productivity growth in tech manufacturing. First, as the industry has expanded and matured, we have witnessed rising complexity of innovation. The late 1990s and early 2000s were characterized by rapid performance improvements in the core semiconductor and computer electronics products. The industry faced an ideal environment for rapid productivity gains: fierce competition between chip manufacturers Intel, AMD, and emerging South Korean suppliers, and robust demand from companies investing in ICT to enhance their business processes and prepare for Y2K.[30] This spurred innovation in the sector, manifested in increasing speed and decreasing costs (average per-bit price declines of 30 to 35 percent per year in dynamic random-access memory for several decades). Since then, tech manufacturing in the United States has evolved. For example, the share of hours worked in computer and peripheral equipment, semiconductor, and communications equipment manufacturing fell by eight percentage points

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29 Across our sample of seven countries.

30 The competition between Intel and AMD was focused on microprocessors, while Korean players added capacity and competitive pressure especially in the DRAM space. For a detailed description of the semiconductor industry dynamics at this time, see *US productivity growth 1995–2000*, McKinsey Global Institute, October 2001, and *Productivity led growth for Korea*, McKinsey Global Institute, March 1998.

between 2000 and 2014, while the share of equipment like navigation and measuring instruments increased by 11 percentage points in that time. While competitive intensity remains fierce, sustaining the pace of innovation has become more fragmented and complex as the proliferation of electronic devices and applications has broadened the demands on performance. The shift in demand toward smartphones (which make up 48 percent of United States spending on devices today compared with 4 percent in the mid-2000s) requires managing sometimes dozens of sensors from fingerprint recognition and GPS to multiple cameras, all requiring efficient power consumption to save battery time.[31] Virtual world gaming, artificial intelligence, and autonomous driving have dramatically expanded the performance demands on GPUs. Bitcoin mining has evolved with innovations in FPGAs; and dedicated ASIC arrays and dramatic improvements in power semiconductors have enabled an expanding range of electric vehicles. The breadth and depth of innovation is vast, yet the scale in many specialized chips lower and thus cost declines slower, making it harder to achieve the pace of improvements driven by increases in processor speed that characterized the past.[32] This may also have made it harder to accurately measure improvements.[33]

Second, the end of an offshoring and restructuring boom in tech manufacturing after the dot-com bust explains part of the decline. The 2001 downturn led to a wave of restructuring and offshoring. For example, the total number of jobs fell in the computer and peripheral manufacturing industry by about 20,000 between 2002 and 2004, reflecting both the rise of Asian hubs in global

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31 Smartphone data based on data from IDC Worldwide Back Book Standard Edition, 2017.

32 Researchers have also assessed whether Moore's law itself might no longer hold, or takes more effort. See, for example, Kenneth Flamm, "Has Moore's law been repealed? An economist's perspective," *Computing in Science and Engineering*, IEEE, 2017; Nicholas Bloom et al., *A*re ideas getting harder to find? NBER working paper number 23782, September 2017; and *Moore's law: Repeal or renewal?* McKinsey & Company, 2013.

33 The way output of tech manufacturing has been measured creates additional challenges for interpreting productivity-growth slowdown. Because of rapid improvements in performance of new generations of products sold at similar or lower prices, US BEA has used quality-adjusted price deflators that adjust for, say, faster processor capacity of each generation of personal computers. However, the capacity to keep up with the data requirements to assess those improvements has become even harder, in particular as the tech device and application pool has broadened, value chains have globalized (with domestic production transitioning to domestic R&D), and the market share of multinationals has risen. This has led researchers to assess whether mismeasurement could explain the decline. See for example, David Byrne, Stephen Oliner, and Daniel Sichel, *Prices of high-tech products, mismeasurement, and pace of innovation*, NBER working paper number 23360, April 2017; David Byrne and Carol Corrado, *ICT asset prices: Marshaling evidence into new measures*, Finance and Economics discussion series, Washington Board of Governors of the Federal Reserve System, 2017; David Byrne, Stephen Oliner, and Daniel Sichel, *How fast are semiconductor prices falling?* NBER working paper number 21074, April 2015; Hal Varian, "A microeconomist looks at productivity: A view from the valley," presentation to the Brookings Institution, September 2016; Fatih Guvenen et al., *Offshore profit shifting and domestic productivity measurement*, NBER working paper number 23324, 2017; and Susan N. Houseman and Michael J. Mandel, *Measuring globalization: Better trade statistics for better policy*, Upjohn Press, 2015.

semiconductor and computer electronics production and assembly shifting to Mexico, Eastern Europe, and other lower-cost nearshore locations (Exhibit 6).[34] This transformation slowed in the mid-2000s before the Great Recession, and the number of jobs in this subsector has slowly increased by roughly 11,000 jobs between 2010 and 2016.

Looking ahead, productivity growth in tech manufacturing should remain above national averages. Demand for new technology is likely to continue to encourage rapid innovation across a range of applications. However, this is a sector in which our capacity to track improvements is challenging as products and their performance dimensions have proliferated and global value chains evolved. The tech industry in developed economies has already shifted toward services and software, where productivity growth could remain robust but not in the double-digit range that characterized the past wave and this should continue. Demand for high-productivity software and cloud services continues to rise: software represented an average of 27 percent of total IT spending in the United States from 2010 to 2014, and this is expected to rise to an average of 36 percent from 2018 to 2021.[35] As packaged software has almost zero marginal cost, this increased demand should translate into productivity increases. The rise of cloud services is also reducing barriers to entry for technology companies and allowing for capital-light business models, including in other industries. Finally, the advent of AI and machine learning will propel further advances in productivity.

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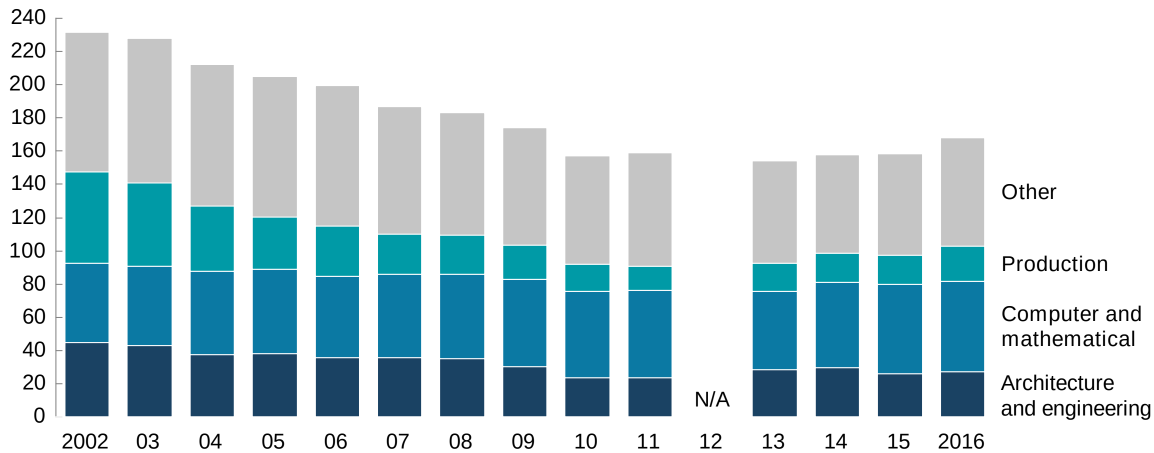
[34] See *New horizons: Multinational company investment in developing economies*, McKinsey Global Institute, October 2003.

[35] Based on data from IDC Worldwide Black Book Standard Edition, 2017.

Exhibit 6

Technology sector

Number of jobs by occupation, computer and peripheral equipment manufacturing, US example (thousand)



SOURCE: BLS occupational data; McKinsey Global Institute analysis

Tourism sector

Across our sectors, tourism stands out, with slow but sustained productivity growth since 2000 and without a clear decline from 2010 to 2014. What explains this trend? The tourism industry is a diverse, highly labor-intensive industry that comprises transportation, accommodation, food services, and arts, entertainment, and recreation. Across many of these categories, labor productivity levels are among the lowest in the economy, even slightly below that of other service industries such as retail and education in some countries. We find that its slow but relatively steady productivity evolution since the turn of the century is explained by shifts in demand and the adoption of digital solutions.

Demand for tourism can be volatile, and since the turn of the century, there have been two major demand shocks: the 9/11 attacks in the United States, and the financial crisis. These shocks led to quick and severe drops in travel and left many airlines and hotels with excess capacity. While some of the staffing needs, such as hotel cleaning, can be adjusted, many others require constant attendance despite the lower volume of visitors, leading to weaker labor productivity growth. After the financial crisis hit, for example, productivity growth fell from 0.7 percent in 2000–04 to minus 0.6 percent on average in the sector as value added contracted faster than jobs, for example, in France and the United States. Yet these shocks masked a longer-term robust demand momentum, fueled by both income and demographics, that has helped the industry to bounce back from the downturn, a trend we expect to continue.

Innovations and operational improvement within the industry have also contributed to the sustained growth trend since 2000, starting with performance pressure during the post-9/11 demand decline. Airlines, for instance, reduced direct labor inputs substantially through the centralization of back-end resources, using technology to automate front-end processes such as check-in, along with an increasing trend of offshoring jobs related to IT services and administrative processes. This is reflected in the decline in labor share, from 35 percent of revenue in 2000 to 24 percent in 2014. Consolidation across airlines, particularly in the United States, led to restructuring and efficiency gains from greater economies of scale.[36] As another illustration, the number of retail travel agency outlets has decreased significantly since the early 2000s due to increased productivity and the rise of online channels (Exhibit 7).

The tourism sector has been in many ways a pioneer of digital transformations, starting with online air travel and hotel booking. Online transactions for airlines in the United States, for example, increased from 14 percent of all transactions in 2001 to 34 percent in 2005, dramatically reducing labor inputs needed for the same number of bookings.[37] Online aggregators such as Booking.com increased price transparency and provided customers with more choice and convenience, while the entry of low-cost airlines helped drive productivity gains by increasing competitive pressures. We have seen the rise of new business models, with Airbnb starting operations in 2008 and growing, but still makes up less than a 5 percent market share of demand for rooms.[38] While the speed of technological adoption varies between subsectors of the tourism industry and types of players, the productivity of the industry overall has benefited from digitization.

Looking ahead, we find further productivity-growth potential as digitization continues across the tourism sector. Large opportunities to both improve internal operations and enhance the customer experience remain. There is room for greater labor cost savings with the introduction of technologies such as facial

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[36] Industry dynamics vary for airlines and hotels. The airline industry is relatively concentrated, with the top three US airlines, for example, having roughly 65 percent market share, based on data from the US Department of Transportation. Consolidation was driven by losses in the industry and an imperative for restructuring. Consolidation has also been occurring in the hotel industry, but it has been driven primarily by the large chains seeking to add more brands to their portfolios to serve a broad array of customer segments and to expand in new geographies. This part of the tourism industry remains relatively less concentrated, though, with the top three players in the United States having roughly 45 percent market share by revenue and 35 percent of inventory, based on data from Euromonitor International Travel (2018 edition).

[37] Based on data from Phocuswright, US Online Travel Overview Sixteenth Edition, 2017.

[38] "Airbnb and hotel performance: An analysis of proprietary data in 13 global markets," *STR*, 2017.

recognition at airports, predictive maintenance, and automation.[39] For example, online transaction volumes still remain at 40 percent for hotels in the United States, and 48 percent in Europe.[40] Better revenue optimization through targeted marketing of new custom products using big data to predict demand and set pricing to help fill capacity is just at the beginning.

We also expect increasing experimentation with online and shared-economy business models. In the hotel industry, digital players have entered as information providers, sales channels, tour operators, and providers of rooms. They can help personalize travel, increase customer choice, and add to supply. For example, Airbnb now has listings of more than 3 million units worldwide.[41] A variety of other digital players have entered this space. Websites like Booking.com and Expedia are growing at double-digit rates, with higher margins compared to traditional players. New entrants include Google Trips. Online players are helping to create price transparency in the industry and, with their mechanisms to highlight customer feedback and ratings, are increasing pressure on companies to improve the quality of their offerings. Finally, these business models are not only taking a higher share of consumer spending but are also contributing to increasing the overall size of the market, with more people willing to travel given increased transparency and lower prices.

Tourism should also benefit from ongoing demand growth that will continue momentum for productivity growth. External forecasts suggest that demand for tourism is expected to grow at 4.2 percent a year between 2014 and 2020, on par with historical growth rates.[42] Growing numbers of people are traveling worldwide, and the expansion and diversification of service offerings is boosting spending per traveler. Aging baby boomers across developed economies are the largest consumer group fueling global demand, contributing 20 percent of global consumption growth in the period to 2030.[43] As they retire, they have more time to travel. In addition, demand will be fueled by an appetite to travel from millennials and the growing middle class in emerging regions such as China. The industry also has the potential for value-added growth as an increasingly diverse

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[39] Wage growth in the sector has remained moderate, putting limited pressure on companies to emphasize automation. However, going forward, if wages rise, we could see industries turning to automation much faster than expected.

[40] Based on data for 2016 from Phocuswright, *US Online Travel Overview Sixteenth Edition*, 2017, and Phocuswright, *European Online Travel Overview Twelfth Edition*, 2016.

[41] "Airbnb and hotel performance: An analysis of proprietary data in 13 global markets," *STR*, 2017.

[42] Based on data from WTTC on travel and tourism consumption, and is a simple average of consumption growth in local currency units across France, Germany, Spain, Sweden, United Kingdom and the United States.

[43] For a detailed look at aging consumers' spending and consumption patterns, see *Urban world: Global consumers to watch*, McKinsey Global Institute, April 2016.

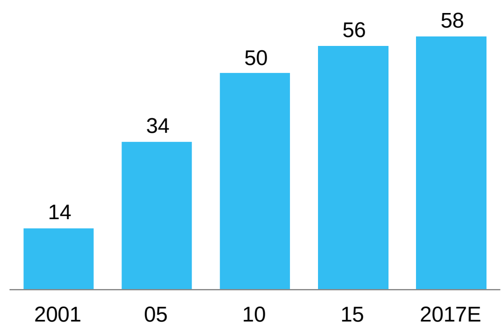
population of tourists is an opportunity for companies to provide differentiated offerings to each customer segment. While the industry has had separate offerings for mass and luxury segments for a long time, better use of customer data enables companies to target and tailor offerings to increasingly small niche segments. Some examples of customized offerings already in the market range from active hiking and biking tours and food or medical tourism to tours designed for international visitors. Strong demand growth can help keep capacity utilization in the industry healthy and fuel new investment and innovations.

Yet we also identify headwinds that could hold back productivity growth in tourism. Some of the new business models described above push the boundaries of existing regulations and lead to regulatory uncertainty and possible direct restrictions on their operations. Potential visa and other policy restrictions for cross-border travel may limit the expansion of the number of travelers. And given the volatility of tourism demand, unforeseen events, such as rising terrorism, crime, or war, or simply another recession, could dampen demand growth.

Exhibit 7

Tourism sector

US airlines online booking transactions
%



SOURCE: Phocuswright; McKinsey Global Institute analysis

Utilities sector

The utilities sector provides another case study in how demand—and regulation shaping that demand—impacts productivity growth, alongside technological disruption. The sector stands out as having the most consistent decline in productivity growth across countries, even negative levels in many cases, due to a sharp decrease in value-added growth accompanied by an increase in hours worked growth. The factors at play are the waning of a liberalization wave, declining demand from energy efficiency measures and other factors, and technological disruption from digital and renewables that will eventually boost productivity but come with a protracted transition.

During the 1990s and 2000s, a wave of deregulation occurred in the United States and Europe, opening utilities up for competition.[44] This included generation, where many suppliers could provide power to a grid, and resellers who could sell electricity to consumers. In the United States, deregulation began in the late 1990s to varying degrees by state. This meant that the value chain around the electricity distribution networks, still owned by a regulated monopoly, was rapidly transforming. The competition in generation and reselling also helped drive operational efficiency gains.[45] The electricity transmission and distribution networks were in turn encouraged to focus on operational efficiency gains through the use of performance-based ratings schemes, particularly in Europe, where revenues were dependent on achieving such gains. This also helped drive productivity improvements in the sector. For example, companies focused on operational efficiency gains like maximizing time for personnel in the field and reducing travel time with route optimization, bundling inspections, and so forth. However, some of these factors ended by the mid-2000s. For example, in the United Kingdom, the period from 2000 to 2005 saw regulators requiring efficiency improvements of 3 percent per year, but by 2010, there was no such requirement. Particularly in the United States, there is room to further liberalize the sector in generation and sales, boosting productivity growth; only 20 states allow some degree of competition in reselling choice, for example.

At the same time, the industry has faced a trend of declining demand for electricity since the mid-2000s, slowing productivity growth in a given grid network (Exhibit 8). Energy efficiency technologies such as LED lights and more efficient air conditioning systems, together with demand-side factors, drove down total consumption as well as consumption per capita of electricity across countries. In Europe, consumption fell by 1.7 percent per year between 2010 and 2014, compared with growth of 2.1 percent between 2000 and 2004, while in the

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[44] Deregulation typically occurs in the electricity generation and retail/reselling subsectors of utilities, while transmission and distribution represents a regulated natural monopoly.

[45] On the retail side, there is debate about the final effect of deregulation on productivity, as multiple factors come to bear. Deregulation could result in multiple providers duplicating functions of customer service, marketing, billing, and so forth, which could drag down productivity growth. Meanwhile, retail choice allows new entrants to innovate in new value-added offerings beyond just the core energy commodity (for example, providing customers with dynamic price packages, and bundling electricity consumption with other services like security systems). To what extent the deregulated retail market increases value added and changes the amount of labor will ultimately determine productivity gains.

United States, it fell to 0.1 percent after growth of 0.9 percent.[46] Government regulation has played a critical role in shaping consumer preferences and reducing demand for electricity. For example, Europe set energy and emission targets for 2020: a 20 percent reduction in greenhouse gases, a 20 percent increase in savings from energy efficiency, and 20 percent of energy consumption from renewables. While demand has declined in utilities, labor has not been correspondingly cut back because of two factors. First, many of the easier operational improvements and labor cuts had already taken place during earlier efficiency improvement efforts. Second, the transmission and distribution subsector, which makes up a significant portion of employment (as much as 60 percent, for example, in the United States), is mainly driven by the number of customers rather than by per capita demand.

Demand may continue to play a limiting role for productivity growth in the sector. McKinsey's Energy Insights, Power IQ models, and past MGI research suggest that electricity consumption in the United States and Western Europe could remain flat or grow slowly as energy efficiency improvements continue and generation for own use on the part of households (so-called distributed generation) picks up. Flattening consumption could limit the benefits of other productivity drivers unless labor and capacity are reduced accordingly. However, there is the potential for upside from electrification (for example due to the advent of electric vehicles), which could keep demand for utilities robust.

Like other sectors, utilities are in the middle of a digital transition that takes time and comes with transition costs. The digital utility of the future will innovate across the entire value chain, with many opportunities to reduce labor and increase productivity from things like big data–driven supply and demand matching, predictive maintenance, smart-grid infrastructure, and automation of billing and processing. Some estimates suggest that the use of smart meters and grids, digital productivity tools for employees, and automation of back-office process could boost profitability by as much as 20 to 30 percent.[47] GPS and traffic information could be added to conventional route planning, which could help increase productive hours by 15 percent. In addition, the digital utility will reinvent the user experience via mobile solutions and apps, and price-comparison websites, which will continue to increase transparency in the retail market. However, utility providers are still in the process of making these investments, and a learning curve continues to be associated with many of them. As with other digital disruptions, making the most of these technologies is not just about making the investment but about corresponding business process and

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[46] Based on a simple average of growth in France, Germany, Spain, Sweden, and the United Kingdom for Europe. Based on data from Eurostat and EIA.

[47] *The digital utility: New opportunities and challenges*, McKinsey & Company, 2016.

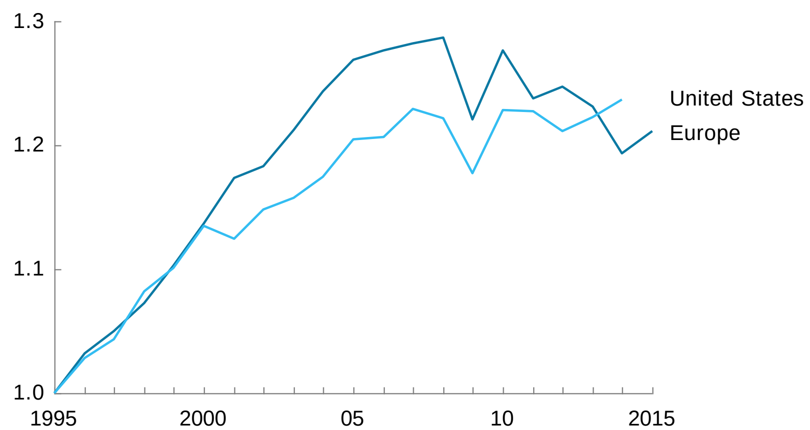
organizational changes. For example, the productivity gains from smart meter technologies are not just from ease of meter readings and billings but come when the data can be used for analysis to identify which customers need help to avoid defaults on their bills, use of data for predictive maintenance and enabling better asset health, and helping utilities understand and manage patterns in demand.[48]

The shift to renewables will be a boon to labor productivity in the long run. The energy mix shift will continue due to targets for renewables set in Europe, the falling price of renewable energy, and legacy technologies that may become less attractive over time. Renewables still make up less than 10 percent of power generation in the United States and less than 20 percent in Europe, and as costs decline further they will be more competitive with fossil fuels.[49] The advent of electricity storage could also make renewables far more attractive compared with fossil fuels.[50]

Exhibit 8

Utilities sector

Energy consumption (MWh)[1]
Index: 1 = 1995



1 Based on data from EIA and Eurostat. Europe is simple average of France, Germany, Spain, Sweden, and the United Kingdom.

SOURCE: EIA; Eurostat; McKinsey Energy Insights, Global Energy Perspective; McKinsey Global Institute analysis

48 Ibid.

49 *Beyond the supercycle: How technology is reshaping resources*, McKinsey Global Institute, February 2017.

50 Thus far, it has not been possible to store electricity economically. This means that the industry must maintain more generation capacity than will be used (reserve capacity) to ensure that demand does not exceed supply. This is particularly exacerbated in the case of the use of renewables, which have lower utilization than legacy plants because they often depend on weather conditions to produce energy.

CONCLUSION

As financial crisis aftereffects dissipate and the digital transformation of industries continues, we expect productivity growth to recover from current lows across sectors and countries. We are seeing an uptick today in economic variables like productivity and GDP growth in many countries. Our sector deep dives reveal significant potential to boost productivity growth from opportunities such as traditional operational efficiency gains as well as new avenues enabled by digital technologies. The opportunities we have identified range from those within companies—to boost efficiency, reduce costs, streamline labor requirements, and enhance innovation—to opportunities that are reshaping entire business models and industries and changing barriers to entry. In addition, external factors such as regulation can positively influence industry behavior and company action that boosts productivity growth. We estimate that productivity-boosting opportunities could amount to at least 2 percent per year productivity growth over the next ten years, with more than half of that coming from the latest wave of digital opportunities. However, there is no guarantee that the productivity-growth potential we identify will be realized. Two factors stand out that may keep productivity growth below potential. First, changing demographics, rising income inequality, decreasing labor share of income, and a decline in investment relative to earnings could create chronic drags on the demand for products and services. Second, the nature of digital technologies is reshaping industry structures and economics in a way that raises questions about incentives to invest and innovate, and could further amplify demand drags. As a result, traditional supply-side approaches alone to boost productivity growth may prove inadequate. Addressing bottlenecks in both demand and digital diffusion may be required to capture the productivity-growth potential of advanced economies.