UNIVERSITY OF CAMBRIDGE

Cambridge Industrial Innovation Policy

Understanding sectoral sources of aggregate productivity growth: A cross-country analysis

Summary report

About this report

This summary report analyses the sectoral sources of labour productivity growth in a sample of economies at different stages of development over the last 20 years. In addition to this summary report, a full report and eight economy-specific studies have been produced for China, France, Germany, Korea, Taiwan, Singapore, the United Kingdom and the United States. Together, they seek to inform policies aimed at boosting productivity by improving the understanding of how sectors account for aggregate productivity gains and losses and how this differs across economies.

Contributors

The authors of this report are Jennifer Castañeda-Navarrete and Carlos López-Gómez.

Ana Rincon-Aznar, Principal Economist at the National Institute of Economic and Social Research (NIESR), provided scientific advice.

Design by Ella Whellams, IfM Engage, University of Cambridge.

Copy-editing by Jason Naselli and Elizabeth Tofaris, IfM Engage, University of Cambridge; and Amanda George, Perfect Words.

Acknowledgements

This report has been made possible by core funding from the Gatsby Charitable Foundation.

Disclaimer

Cambridge, United Kingdom | 2022

Summary report

Since the global financial crisis of 2008, aggregate productivity growth has been sluggish in many developed and developing countries; however, there are stark differences across economies. Understanding the reasons behind these differences is essential for policy-makers. This report draws from a cross-country data set to investigate the extent to which sectoral structures and dynamics explain the diversity in labour productivity gains and losses during the period from 1998 to 2017. The report looks at sector-level data in a sample of eight economies, at different stages of development, which account for over half of the world's economic output: China, France, Germany, Korea, Taiwan, Singapore, the United Kingdom and the United States.

Six takeaway messages emerge from this report:

1. **Sectors contribute differently to productivity growth.** Across the eight economies examined, some sectors tend to be more productive and to grow faster than others. While some variations across economies exist, sectors such as finance, mining and quarrying,[1] information and communication, and manufacturing tend to have above-average levels of productivity and to experience faster productivity growth.
2. **Structural change has had a significant effect in the UK's productivity performance over the last two decades.** For the market economy – that is, excluding sectors such as real estate, education, and public administration – the growth of the participation of sectors with lower productivity levels, at the expense of high productivity sectors, has more than halved the UK's overall productivity growth.
3. **Countries that have maintained a high share of manufacturing have benefited from a productivity premium.** The manufacturing sector has been the main driver of productivity growth in economies where it accounts for more than 20% of GDP. Conversely, the loss of manufacturing has imposed a severe penalty on productivity growth, particularly in the UK. We estimate that the decline of manufacturing in the UK is responsible for an annual reduction in productivity growth of three-quarters of a percentage point, on average, in the last two decades.
4. **The contribution of services to productivity growth varies widely among subsectors.** Service activities whose contribution to aggregate productivity growth has increased over the last two decades include both activities with productivity levels that are above average, such as financial and insurance activities and professional, scientific and technical activities, and more labour-intensive activities with below-average productivity levels, such as wholesale and retail trade, human health and social work activities, and administrative and support services.
5. **National productivity strategies need to be grounded in sector-specific analyses.** Policies aimed at improving national productivity need to be grounded in a sound understanding of how productivity varies across sectors, the drivers of competitive advantage in each sector, and how differences in sector performance help to explain aggregate productivity gains and losses.
6. **Productivity measures have important limitations.** Because productivity measures are based on value added measures, they have important limitations and should not be confused with efficiency metrics. The relevance of productivity measures to monitor the performance of predominantly non-market sectors, such as healthcare, should be questioned.

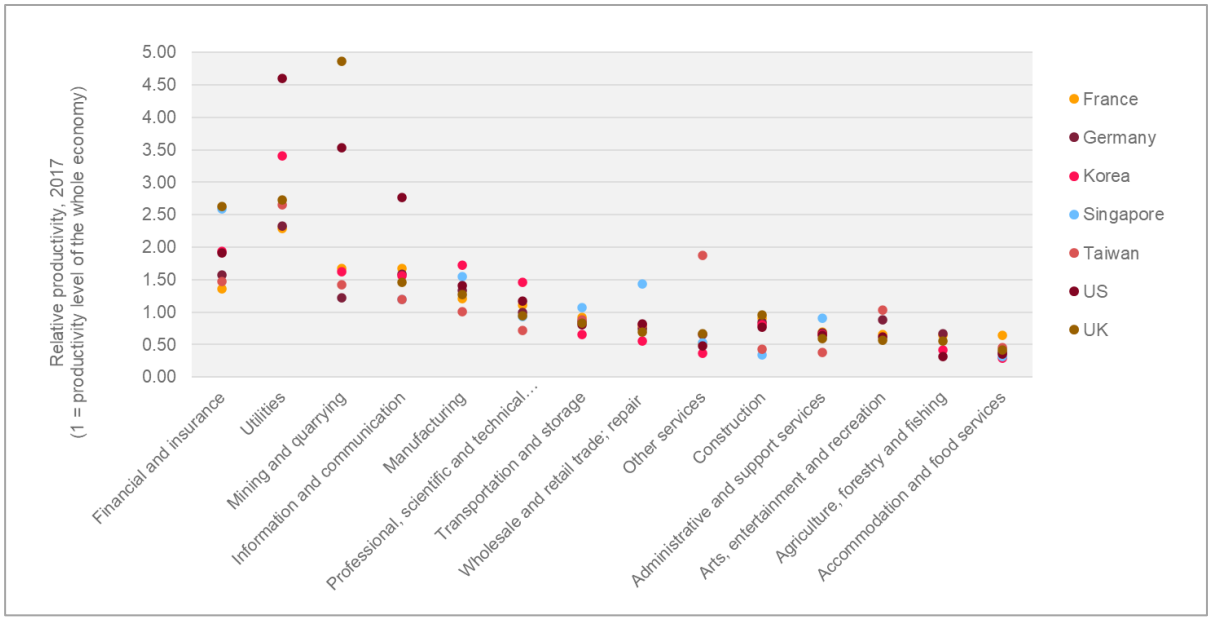
[1] Extraction of crude petroleum and natural gas represents around 80% of the gross value added of mining and quarrying.

1. Some sectors tend to be more productive and to grow faster than others.

Across the economies examined, some sectors tend to be more productive and to experience faster productivity growth than others. Figure 1 shows that, while some variations across economies exist, sectors such as financial and insurance activities, mining and quarrying, information and communication, and manufacturing tend to have above-average levels of productivity across the economies examined. In contrast, productivity tends to be below-average in sectors such as accommodation and food services, agriculture, and administrative and support services.

This basic, often overlooked, point has important implications for the way in which we analyse productivity growth. The rate at which national productivity grows is determined by the combined performance of individual sectors of the economy. An economy's productivity grows not only when its sectors become more productive but also when the participation of sectors with above-average levels of productivity increases. Conversely, aggregate productivity growth slows down when the share of sectors with below-average levels of productivity increases.

FIGURE 1: SECTORAL PRODUCTIVITY LEVELS (RATIO RELATIVE TO THE WHOLE ECONOMY), 2017 "MARKET" SECTORS



Note: Labour productivity measured as output per worker, current prices. China was excluded from this analysis because of the large variation in the productivity levels of sectors.

Source: Authors' computation, based on data from: OECD STAN Industrial Analysis (2020 ed.); Singapore Department of Statistics; Singapore Ministry of Trade and Industry; Manpower Research & Statistics Department; Taiwan Statistical Bureau UK Office for National Statistics; US Bureau of Economic Analysis; and US Bureau of Labor Statistics.

2. The rise in the share of sectors with below-average levels of labour productivity, at the expense of sectors with above-average productivity, has slowed overall productivity growth, particularly in the UK.

To understand how the performance of individual sectors influences recent trends in national labour productivity growth across our sample of economies, we decomposed aggregate labour productivity growth rates into two main sub-components: an *intra-industry growth (within) effect*; and an *allocation (between) effect*.

- The *intra-industry growth effect* captures the contribution of each sector given by its productivity growth rate. It is positive when an industry experiences positive labour productivity growth and negative when an industry experiences negative labour productivity growth. The size of the effect is proportional to the size of the sector and productivity growth rates.
- The *allocation effect* captures the contribution of each sector due to changes in its relative size over time. It is positive when an industry grows and negative when an industry shrinks. The size of the effect is proportional to its relative productivity level.
- The total contribution of a sector to aggregate national productivity growth is the sum of the intra-industry and the allocation effects.

For the eight economies analysed, aggregate labour productivity growth is largely explained by the intra-industry effect during the 1998–2017 period, as shown in Table 1. However, we also find substantial changes in aggregate productivity growth as a result of the allocation effect during this period.

Crucially, the allocation effect becomes even more substantial when only looking at those sectors where most of the transactions occur in the market, that is, excluding sectors such as real estate, education, public administration and healthcare. This is particularly true in Korea, the US and the UK.

In the UK the allocation effect (-1.04 percentage points) is even larger than the aggregate productivity growth experienced by the market economy in the 1998–2017 period (0.75 percentage points). This means that the growth of sectors with below-average labour productivity levels, at the expense of above-average productivity sectors, has more than halved overall productivity growth.

TABLE 1: DECOMPOSITION OF PRODUCTIVITY GROWTH, WHOLE ECONOMY AND MARKET ECONOMY, 1998–2017

Whole economy, 1998–2017

Economy	Intra-industry growth effect	Allocation effect	Total aggregate productivity growth
China	7.56	1.34	8.90
France	2.38	-0.21	2.17
Germany	1.9	-0.18	1.72
Korea	4.88	-0.17	5.06
Taiwan	3.03	-0.53	2.68
US	1.74	-0.19	1.55
UK	1.02	0.06	1.08

Market economy, 1998–2017

Economy	Intra-industry growth effect	Allocation effect	Total aggregate productivity growth
China[1/]	7.66	0.93	8.59
France	2.15	-0.19	1.96
Germany	2.01	-0.16	1.86
Korea	5.49	-0.45	5.25
Taiwan	3.62	-0.32	3.30
US	2.22	-0.44	1.77
UK	1.79	-1.04	0.75

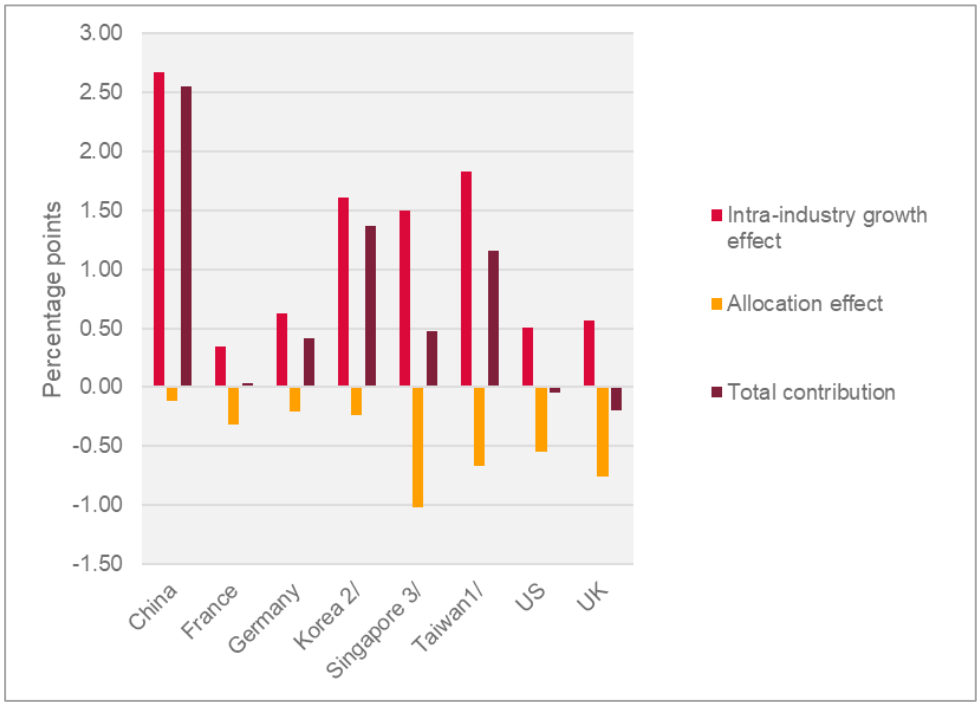
Source: Authors' computation, based on data from: APO Productivity Database 2020 Ver.1 (5 August 2020); OECD STAN Industrial Analysis (2020 ed.); Korea Productivity Center; Singapore Department of Statistics; Singapore Ministry of Trade and Industry; Manpower Research & Statistics Department; Taiwan Statistical Bureau; UK Office for National Statistics; US Bureau of Economic Analysis; and US Bureau of Labor Statistics. [1/] Only real estate excluded.

3. The manufacturing sector has been the main driver of productivity growth in economies where it accounts for more than 20% of GDP. Conversely, the loss of manufacturing has imposed a severe penalty on productivity growth, particularly in the UK.

Manufacturing is one of the sectors with the fastest labour productivity growth among the economies analysed, with growth rates ranging from 2.5% in France to 8.3% in China during the 1998–2017 period. In principle, this means that manufacturing offers the potential to push up aggregate productivity growth. However, this potential has not been fully realised because of the deindustrialisation (that is, the reduction in the share of manufacturing value added and employment in the economy) experienced by these economies during the period of analysis.

On the one hand, the manufacturing sector has made a significant contribution to aggregate national productivity growth in all of the economies analysed, thanks to its fast productivity growth and above-average productivity levels (through the intra-industry effect). On the other hand, the shrinking of the manufacturing sector's share in the economy has led to a negative manufacturing contribution to aggregate productivity growth (through the allocation effect) (Figure 2).

FIGURE 2: DECOMPOSITION OF MANUFACTURING'S CONTRIBUTION TO AGGREGATE PRODUCTIVITY GROWTH, 1998–2017



Note: Decomposition based on output per worker. 1/ Taiwan's decomposition of productivity growth excludes agriculture, forestry and fishing, and public administration and defence, because of the unavailability of data. 2/For Korea, the 2005–17 annual average is computed. 3/For Singapore, the 2010–17 annual average is computed.

Source: Authors' computation, based on data from: APO Productivity Database 2020 Ver.1 (5 August 2020); OECD STAN Industrial Analysis (2020 ed.); Singapore Department of Statistics; Singapore Ministry of Trade and Industry; Manpower Research & Statistics Department; Taiwan Statistical Bureau; UK Office for National Statistics; US Bureau of Economic Analysis; and US Bureau of Labor Statistics.

The overall contribution of the manufacturing sector (the sum of the intra-industry effect and the allocation effect) varies significantly among the economies examined:

- Manufacturing represents the main driver of aggregate productivity growth in the economies where manufacturing sustains output shares over 20% of the total economy. In Taiwan manufacturing contributed to almost half of the aggregate productivity growth experienced between 1998 and 2017. In Korea and China the sector contributed to roughly a third, and in Germany it contributed a quarter of the aggregate productivity growth experienced in the same period.
- Manufacturing made a negligible contribution to aggregate productivity growth in France, where the manufacturing output share in the economy was 11.2% in 2017.
- Manufacturing made a negative contribution to aggregate productivity growth during the period of analysis in the UK and the US, where manufacturing output shares accounted for around 10% and 11% of total output in 2017, respectively. Notably, the loss of manufacturing has imposed a penalty on UK productivity growth of three-quarters of a percentage point, on average, each year for the last two decades (Table 2).

TABLE 2: CONTRIBUTION OF MANUFACTURING TO AGGREGATE PRODUCTIVITY GROWTH, 1998–2017

Economy	% of aggregate productivity growth (1998–2017)	Percentage points (1998–2017)	Output shares (2017)	Rank (at 2-digit level of ISIC or equivalent codes)
China	28.6%	2.54	29.3%	1
France	1.6%	0.03	11.2%	14
Germany	24.4%	0.42	22.8%	1
Korea[1/]	32.1%	1.37	29.5%	1
Singapore[2/]	15.4%	0.48	20.6%	5
Taiwan	47.5%	1.15	33.5%	1
US	-2.7%	-0.04	11.2%	20
UK	-17.7%	-0.19	10.0%	20

Note: [1/] For Korea, the 2005–17 annual average is computed. [2/] For Singapore, the 2010–17 annual average is computed.
Source: Authors' computation, based on data from: APO Productivity Database 2020 Ver.1 (5 August 2020); OECD STAN Industrial Analysis (2020 ed.); Singapore Department of Statistics; Singapore Ministry of Trade and Industry; Manpower Research & Statistics Department; Taiwan Statistical Bureau; UK Office for National Statistics; US Bureau of Economic Analysis; and US Bureau of Labor Statistics.

4. Services have contributed to productivity growth through their increasing size and productivity dynamism, but this is not equal across all service activities and economies.

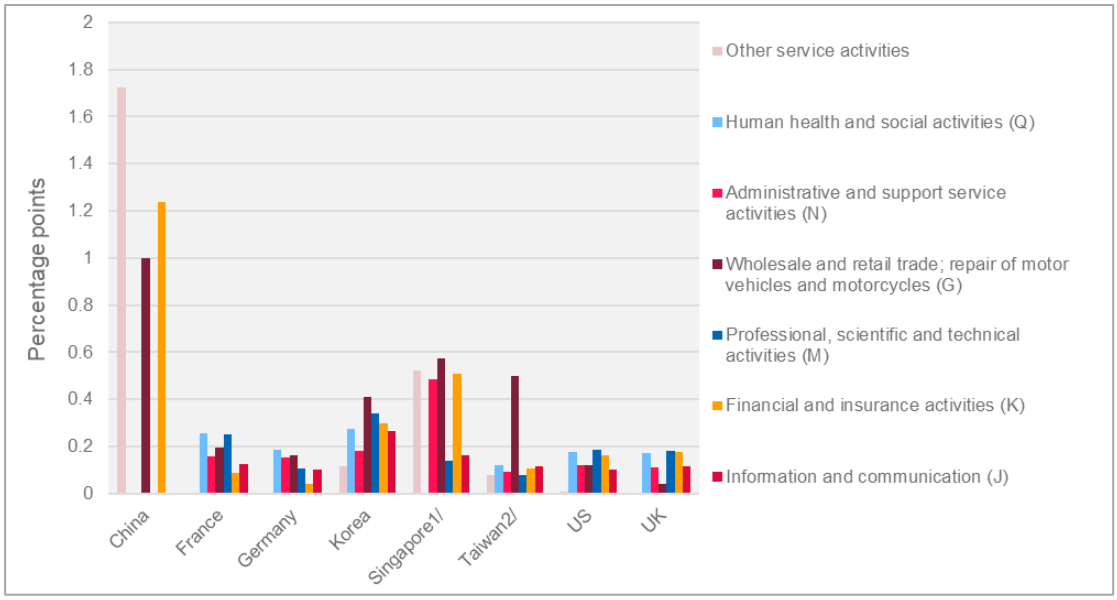
The shrinking of manufacturing has gone hand in hand with the expansion of service activities. Productivity levels in services are wide-ranging. Information and communication and financial activities are consistently more productive than the rest of the service activities. This ranges from 1.5 to 2 times more productive than the total economy. In contrast, the accommodation and food services and administrative and support services sectors are uniformly less productive relative to the whole economy.

Sectors whose contribution to aggregate productivity growth has increased include both activities with productivity levels that are above average, such as financial and insurance activities and professional, scientific and technical activities, and more labour-intensive sectors with below-average productivity levels, but whose productivity has been growing fast, such as wholesale and retail trade, or has been expanding, such as human health and social work activities (Figure 3).

Services where a large proportion of the output is derived from non-market transactions, and which are usually regarded as low-productivity activities, such as public administration and human health, continue to make a substantial contribution to aggregate productivity growth across the economies examined. The contributions of these sectors were particularly large during the global financial crisis of 2008 and in those economies severely hit by the crisis, such as France, Germany, the UK and the US.

The contribution of human health and social work activities showed a steady increase in the 1998–2017 period. Considering population ageing trends, it is expected that this sector will continue to grow (and potentially increase its contribution to aggregate productivity growth) in the coming decades.

FIGURE 3: CONTRIBUTION OF SELECTED SERVICE ACTIVITIES TO AGGREGATE PRODUCTIVITY GROWTH, 1998–2017



Note: Decomposition based on output per worker. 1/ For Singapore, the 2010–17 annual average is computed. 2/ Taiwan's decomposition of productivity growth excludes agriculture, forestry and fishing, and public administration and defence, because of the unavailability of data. For China, the data for financial and insurance activities refers to financial intermediation, real estate, renting and business activities; and data for other service activities refers to community, social and personal services.

Source: Authors' computation, based on data from: APO Productivity Database 2020 Ver.1 (5 August 2020); OECD STAN Industrial Analysis (2020 ed.); Singapore Department of Statistics; Singapore Ministry of Trade and Industry; Manpower Research & Statistics Department; Taiwan Statistical Bureau; UK Office for National Statistics; US Bureau of Economic Analysis; and US Bureau of Labor Statistics.

5. Policies aimed at improving national productivity need to be grounded in a sound understanding of how productivity varies across sectors, the drivers of competitive advantage in each sector, and how differences in sector performance help to explain aggregate productivity gains and losses.

Productivity is widely considered to be one of the major determinants of prosperity and is high on the agenda of many countries. Yet, most policy discussions are still focused on national measures of productivity, with little attention given to sector-level productivity performance. As evidenced by this report, an excessive focus on aggregate productivity growth across the whole economy risks overlooking the heterogeneity of sectors within national economies and restricting the evidence available to policy-makers.

To be effective, productivity strategies must be based on granular knowledge of sector-specific opportunities and constraints. Understanding the drivers of competitive advantage that enable sectors to command higher levels of value-added is, therefore, critical to effective policy design. This involves a thorough understanding of sector characteristics, including global dynamics that affect a sector's international competitive position, the impact of technological change, skills dynamics, and interdependencies across sectors.[1]

Policy-makers need to recognise that productivity does not grow at the same pace across all sectors, and thus, the role and potential of policies to boost productivity varies across sectors. For example, productivity in some tradable sectors exposed to competition tend to grow faster.[2] In sectors with little competition, policy action may be needed to help consumers access information to increase the pressure on firms to compete and raise productivity.[3] The responses required might be very different for sectors that are mainly operating domestically, such as education and construction.

Traditionally, international productivity comparisons have focused on national averages. However, sector-level international comparisons of productivity can provide valuable insights to policy-makers. By generating information on the relative performance of different parts of the economy, they can help to identify areas with potential for improvement.

Our economy-specific studies conducted as part of this analysis have found that some governments have productivity strategies and targets that are focused on specific sectors. For example, given its high productivity growth, increasing the participation of the manufacturing sector in the national economy has been set as a policy target in some economies and regions. Singapore's 10-year "Manufacturing 2030" plan has the goal to grow manufacturing value added by 50% while maintaining a share of around 20% of the gross domestic product.[4] Similarly, in 2012 the European Commission set the target of increasing the manufacturing output share to 20% of the total economy by 2020,[5] although this goal has not yet been achieved.[6]

6. Productivity measures have important limitations and should not be confused with efficiency metrics, particularly in predominantly non-market sectors, such as healthcare.

Because productivity measures are based on value added measures, they suffer from similar limitations to those found in the measurement of gross domestic product (GDP). Such limitations have been discussed extensively in the academic literature in the last couple of decades, from how value added is mainly determined by market transactions, and the related undervaluing of non-market activities (such as unpaid domestic work and public services), to the failure to account for the environmental and social costs of economic activity.[7]

In real estate, imputed rents from owner-occupied dwellings tend to be included in the value added of the sector and this boosts labour productivity measures above those observed in other sectors. Cross-country comparisons of non-market services are also challenging and should be interpreted with caution because methods to estimate the input and output of non-market services and the mix of public and private provision of service activities, such as healthcare, differs across countries.[8]

Improving the measurement of public-sector productivity is a long-standing and complex challenge for national statistical offices. Although different methods have been developed to adjust the productivity measures of non-market services to quality, these are far from perfect and tend to underestimate the non-market value of the contribution of these sectors to society.[9] Policy-makers should therefore exercise caution when using productivity measures to monitor the performance of predominantly non-market sectors such as public administration and healthcare.

Beyond measurement issues, productivity should not be confused with the efficiency with which these services are provided, as this could lead to drawing the wrong conclusions about, for example, the optimal size of a sector or the adequate wage levels.

The organisation of data according to economic activities has also shown limitations in capturing the blurred boundaries between industries.[10] The decrease in the share of manufacturing in advanced economies, for example, is the result of less production and changes in the classification systems. There has been an increase in the number of “services” categories, including the movement of manufacturing-related services out of manufacturing categories. In addition, some manufacturing companies have been reclassified as service firms, since the manufacturing share in their total output is falling.[11] A government report estimated that up to 10% of the fall in manufacturing employment in the UK between 1998 and 2006 may be due to this reclassification effect.[12] Although some manufacturing has been lost due to the reclassification effect, the loss in the UK and US is still more significant than in other countries.

Economy-specific highlights

China

- China stands out with the fastest labour productivity growth rates among the economies analysed, at 8.3% on average, in the 1998–2017 period.
- Despite this fast growth, productivity levels in China are still a fraction of those observed in developed economies, a third of those observed in the United Kingdom and Korea and less than a fifth of those seen in Singapore. Nonetheless, because of its large workforce and fast productivity growth, China is now the second-largest economy in the world after the United States.
- Manufacturing is the main sector driving productivity growth in China, accounting for almost one-third of overall productivity growth in 1998–2007. However, its decline in size implies a reduction in its contribution to aggregate productivity growth in this period.
- Nevertheless, it is in the decline of agriculture that we observe the main manifestation of structural change, where approximately 140 million workers moved to the manufacturing and services (to a larger extent) sectors between 1998 and 2017.

France

- During the global financial crisis of 2008 France's productivity did not deteriorate as much as other European advanced economies, such as Germany and the UK. In the following decade, however, France's productivity did slow down, but more moderately than other large developed countries, such as the US and the UK.
- Professional, scientific and technical activities make up the market sector that has made the largest contribution to aggregate productivity growth in France, accounting for 10.9% of the overall growth observed between 1998 and 2017. This sector, with productivity levels above the national average, has seen a sizeable expansion during the period analysed.
- Manufacturing is the market sector with the fastest productivity growth. Although France's manufacturing has seen a contraction in size, it is the only sector that has seen its contribution to aggregate productivity growth increase since the financial crisis.

Germany

- Germany's labour productivity growth deteriorated sharply in the aftermath of the global financial crisis of 2008, with only the UK faring worse.
- However, Germany was the only economy, from the sample studied, that experienced faster productivity growth in the post-crisis period compared to the decade before the crisis.
- Manufacturing was the main sectoral source of productivity growth in Germany (24.4% of aggregate productivity growth in 1998–2017). This is largely driven by the strong productivity growth and relatively large size of the automotive industry.
- Although manufacturing continues to be a key driver of Germany's productivity growth, it has experienced a significant contraction in the last two decades, particularly between 1998 and 2010.

Korea

- Korea's labour productivity growth has been remarkable, with the second-highest growth rate (5.1%) from the sample of economies studied, behind only China.
- In 1998 Korea's level of labour productivity (in terms of output per worker) was approximately half of that observed in the UK; by 2017 it had surpassed the UK.
- Manufacturing is the sector that makes the largest contribution to Korea's aggregate productivity growth, accounting for one-third of the overall growth rate achieved in 1998–2017. This contribution is largely driven by the positive performance and relatively large size of the manufacturing of computer, electronic and optical products sector.
- However, Korea's manufacturing contribution to aggregate productivity growth has reduced over time, driven by a major slowdown in productivity growth and a contraction in the sector size.

Singapore

- From the sample of economies analysed in this report, Singapore stands out, with the highest output per worker in 2017 (Figure E.1).
- Financial and insurance activities and manufacturing are the two main sectors driving Singapore's aggregate productivity gains; together, they account for around 40% of the national productivity growth experienced between 2010 and 2019.
- Although Singapore experienced among the largest contractions in manufacturing shares, it has managed to revert this trend in recent years and to sustain manufacturing output shares above 20%, similar to those observed in Germany.
- This is likely to be linked to an explicit commitment of the government to prioritise manufacturing as an engine of Singapore's economy. In the 10-year "Manufacturing 2030" plan, announced in 2021, Singapore's government set the goal to grow manufacturing value added by 50% while maintaining a share of around 20% of the gross domestic product.
- We estimate that the contraction of manufacturing has lowered Singapore's aggregate productivity growth by 1 percentage point, on average, per year, during the 2010–17 period.

Taiwan

- Taiwan has the third-highest labour productivity level, from the sample of economies studied in 2017, behind that observed in Singapore and the United States.
- Taiwan has also experienced steady labour productivity growth, at 2.7% on average, each year between 1998 and 2017.
- Similar to the rest of the economies examined in this report, the rate of productivity growth in Taiwan fell in the years following 2007.
- Manufacturing is the sector that makes the largest contribution to Taiwan's overall productivity growth, accounting for almost half in 1998–2017. The manufacture of electronic parts and components, and of computers, electronic and optical products, accounts for a large part of these gains.
- The electronics industry plays a key role in the Taiwanese and world economy. In 2019 the semiconductor industry accounted for 28% of the total valued added of Taiwan's economy, as well as 30% of the world's semiconductor industry output. This market share is even larger in specific segments, such as semiconductor foundries (more than 70%) and integrated circuits (more than 50%).

The United Kingdom

- The United Kingdom has the second-lowest labour productivity level in this sample of economies (measured in 2017) and the lowest labour productivity growth rate, on average, during 1998–2017, from the sample of economies studied.
- UK productivity was hit the hardest during the financial crisis of 2008, and it has struggled to recover its dynamism more than any of the other economies studied in this report.
- The slowdown of productivity growth since the financial crisis, which to many constitutes a "puzzle", is a widespread phenomenon across most sectors of the economy.
- The shrinking of the manufacturing sector, a trend largely observed between 1998 and 2007, has been a major development affecting the UK's economy structure in the last few decades. This structural change helps to explain part of the overall productivity shortfall. On average, we estimate that the shrinking of manufacturing has accounted for an annual decline in productivity growth of 0.76 percentage points during the 1998–2017 period.
- A decline in the size of other sectors, such as information and communication (which has seen a decline in relative output prices), mining and quarrying, and public administration and defence, has also made a negative contribution to overall UK productivity growth.

The United States

- The United States has the second-highest labour productivity level in our sample of economies, after Singapore.
- However, US productivity has also experienced the second-slowest growth rate, after only the UK, with an annual average growth rate of 1.6% (output per worker) during the 1998–2017 period.
- Professional, scientific and technical activities, and financial and insurance activities, are among the main market sectors contributing to aggregate productivity growth. This is explained mainly by their high productivity growth rates. In addition, professional, scientific and technical activities make up a sector that has expanded in the last two decades.
- The US manufacturing sector has seen a decline in its size, resulting in a negative impact on aggregate productivity growth, particularly between 1998 and 2010. This structural change resulted in a reduction of 0.55 percentage points in the overall growth rate, a third of the overall productivity growth experienced in 1998–2019.
- Other sectors that saw relatively large declines in their employment shares and made negative contributions to aggregate productivity growth include information and communication (mainly explained by reductions in relative output prices) and administration and defence.

[1] Atkinson, R. (2021). Sectoral Policies to Drive Productivity Growth.
[2] Aubrey, T. (2021). Will boosting aggregate demand increase UK productivity growth? The Productivity Institute.
[3] Atkinson, R. (2021). Sectoral Policies to Drive Productivity Growth.
[4] Singapore Economic Development Board (2021). Singapore seeking frontier firms for 'Manufacturing 2030'.
[5] European Commission (2012). A Stronger European Industry for Growth and Economic Recovery. Industrial Policy Communication Update.
[6] World Bank (2022). World Bank national accounts data. Manufacturing, value added (% of GDP) – European Union.
[7] See, for example: Mazzucato, M. (2018). The value of everything: Making and taking in the global economy. Hachette UK; Raworth, K. (2017). *Doughnut economics: seven ways to think like a 21st-century economist.* Chelsea Green Publishing; Stiglitz, J.E., Sen, A. and Fitoussi, J.P. (2010). *Mismeasuring our lives: Why GDP doesn't add up*. The New Press.
[8] Coyle, D., Dreesbeimdieck, K. and Manley, A. (2021). *Productivity in UK healthcare during and after the Covid-19 pandemic.* The Productivity Institute working paper No.002.
[9] Esquivel, V. (2019). Gender impacts of structural transformation. International Labour Organization. Technical Brief No. 2.
[10] López-Gómez, C. et al. (2017). *New industrial capabilities for new economic growth: a review of international policy approaches to strengthening value chain capabilities*. Report commissioned by the Department for Business, Energy and Industrial Strategy (BEIS).
[11] Hauge, J. and O'Sullivan, E. (2019). *Inside the black box of manufacturing: Conceptualising and counting manufacturing in the Economy.* Report prepared for the UK Department for Business, Energy and Industrial Strategy. Centre for Science, Technology and Innovation Policy.
[12] Chang (2014), cited in Hauge, J. and O'Sullivan, E. (2019). *Op. cit.*

UNIVERSITY OF CAMBRIDGE
Department of Engineering

IfM MANAGEMENT TECHNOLOGY POLICY

Cambridge Industrial Innovation Policy is based at the Institute for Manufacturing (IfM), a division of the University of Cambridge's Department of Engineering. CIIP brings together the Centre for Science, Technology & Innovation Policy at the Institute for Manufacturing, the Policy Links Unit from IfM Engage, and the Babbage Policy Forum.

Cambridge Industrial Innovation Policy, 17 Charles Babbage Road, Cambridge, CB3 0FS, United Kingdom

ciip.group.cam.ac.uk