UNIVERSITY OF CAMBRIDGE

Cambridge Industrial Innovation Policy

Insights from Korea

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

About this report

This report analyses sectoral sources of labour productivity growth in Korea during the 1998–2018 period. The overall project includes an overview report of eight economies, a summary report and eight economy-specific studies for China, France, Germany, the Republic of 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

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Insights from Korea

Key messages

How does Korea's productivity performance compare with that observed in other economies?

- Korea's productivity has experienced high growth rates, unlike most of the economies examined in this report. In 1998 Korea's output per worker was around half of that observed in the UK, but in 2017 Korea's labour productivity was US$74,431, which is 2% higher than the UK. Between 1998 and 2017 Korea observed the second-highest productivity growth rate (5.1% annual average, measured as output per worker), behind only China.

Which sectors are the main sources of Korea's aggregate labour productivity growth?

- The sectors that made the largest contributions to Korea's labour aggregate productivity in 1998–2018 include: manufacturing (30.6%); wholesale and retail trade (8.1%); real estate activities (7.4%); public administration and defence (7.0%); and professional, scientific and technical activities (6.5%).
- During the crisis and in its aftermath (2008–10), in addition to manufacturing (43.6%) and wholesale and retail trade (9.1%), other market and non-market services also made large contributions to aggregate productivity growth, including: professional, scientific and technical activities (7.9%); public administration and defence (6.1%); and human health and social work activities (5.5%).
- In the post-crisis period (2011–18) manufacturing experienced the deepest decline in its contributions to aggregate productivity growth (-0.5 percentage points, compared with 1998-2007 period). In comparison, construction increased its contribution by 0.22 percentage points, accounting for 7.2% of the aggregate productivity growth observed in that period (5.3%).

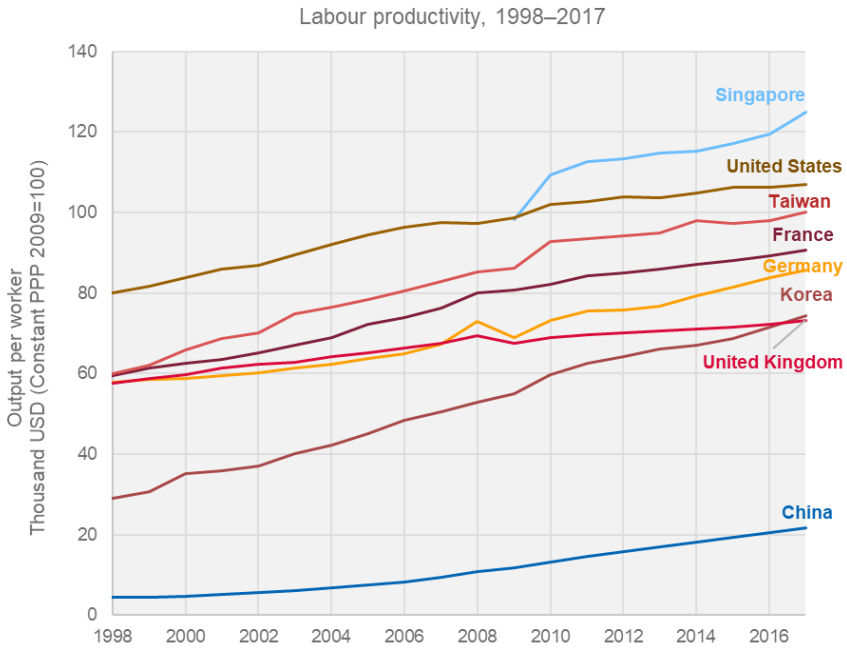
How do sectoral dynamics explain recent trends in aggregate productivity growth?

- The contribution of manufacturing to Korea's aggregate labour productivity growth is explained by productivity levels above the national average, high productivity growth and the relatively large size of the sector (29.1% output shares and 16.8% employment shares in 2018).
- Within manufacturing, the manufacture of computer, electronic and optical products is the sub-sector with the largest contribution to aggregate productivity growth, at 10.2% in 1998–2018. This industry represents around a third of Korea's manufacturing value added.
- Korea's manufacturing contribution to aggregate productivity growth has been affected by a major slowdown in its productivity growth and a contraction in the size of the sector. Manufacturing experienced a decline in its employment shares from 19.5% in 1998 to 16.8% in 2018, which was amplified by reductions in relative output prices of -6.6 percentage points between 1998 and 2018. We estimate that the shrinking of manufacturing reduced Korea's aggregate productivity growth by -0.5 percentage points, on average, between 1998 and 2018 (allocation effect).
- The contribution of professional, scientific and technical activities to aggregate productivity growth is explained by the expansion of this sector, which shows productivity levels above the average and relatively large productivity growth rates (4.8% in 1998–2018).
- The growing contribution of construction in the post-crisis period is the result of an expansion of this sector, in combination with high productivity growth rates (5.8%, on average, in 2011–18). The Korean government supported the recovery of the construction industry after the global financial crisis, investing in infrastructure projects and creating a housing renting scheme that boosted private investment in housing. Productivity increase has also been supported by investments in skills development and the establishment of a national roadmap for the adoption of smart technologies in construction.

1. How does Korea's productivity performance compare with that observed in other economies?

Korea's productivity has experienced high growth rates, unlike most of the economies examined in this study.[1] In 1998 Korea's output per worker was around half of that observed in the UK, but by 2017 it had surpassed the UK by 2%. Between 1998 and 2017 Korea observed the second-highest productivity growth rate (5.1% annual average, measured as output per worker), behind only China (Figure 1).

FIGURE 1: WHOLE ECONOMY LABOUR PRODUCTIVITY GROWTH, 1998–2017, SELECTED ECONOMIES



Economy	Output per worker in 2017 (thousand USD, constant PPP, 2009 = 100)
Singapore	124,967
United States	107,075
Taiwan	100,075
France	90,791
Germany	85,815
Korea	74,431
United Kingdom	73,258
China	21,706

Economy	Growth rate, 1998–2017 (annual average)
China	8.9%
Korea	5.1%
Singapore[1/]	3.1%
Taiwan	2.7%
France	2.2%
Germany	1.7%
US	1.6%
UK	1.1%

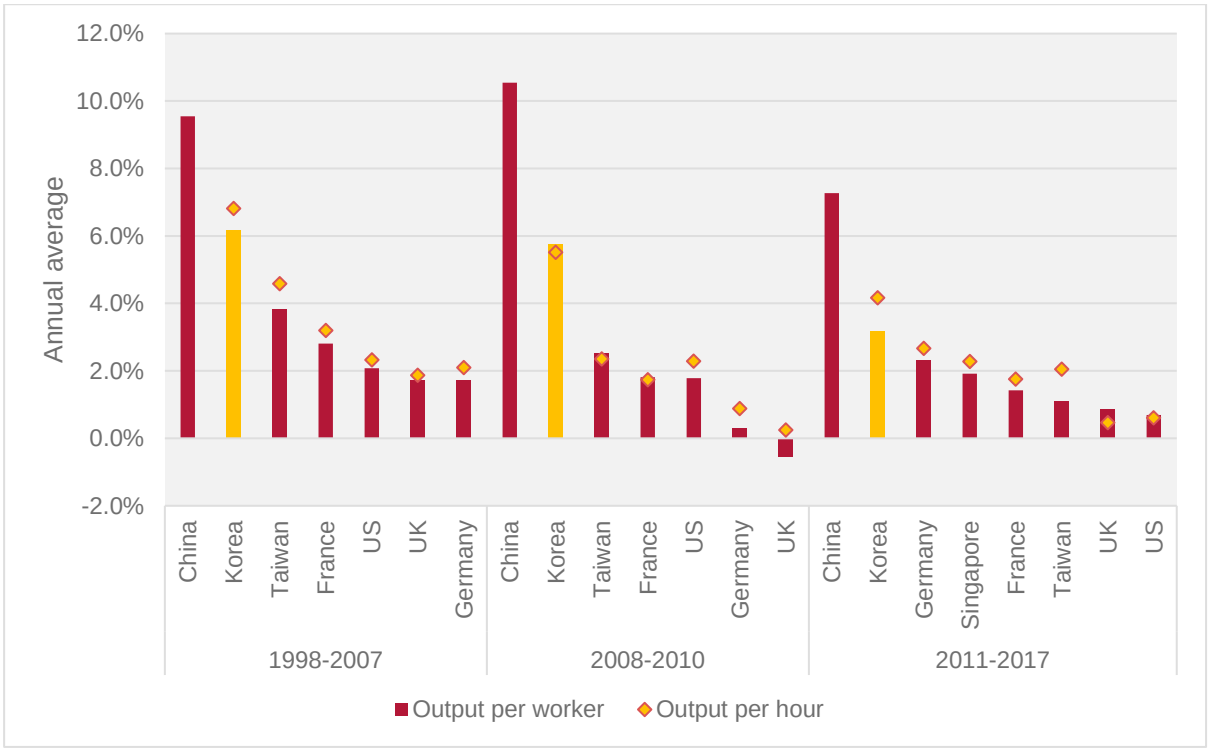
Note: [1/] The 2010–17 period for Singapore.

Source: Authors' computation, based on data from Asian Productivity Organization (APO) Productivity Database 2020 Ver.1 (5 August 2020); OECD Structural Analysis Database (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.

Similar to the rest of the economies examined in this report, productivity growth slowed down in Korea in the last decade, from 6.8% in 1998–2007 to 5.3% in 2011–18. A decline in global trade after the global financial crisis partly explains the lower productivity growth.[2]

[1] China, France, Germany, Korea, Taiwan, Singapore, the United Kingdom and the United States.
[2] Asian Productivity Organization (2022). APO Productivity Outlook 2022. Manufacturing Labor Productivity: Trends and Linkages. Tokyo: Asian Productivity Organization.

FIGURE 2: WHOLE ECONOMY LABOUR PRODUCTIVITY GROWTH, 1998–2017, SELECTED ECONOMIES



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.

2. Which sectors are the main sources of Korea's aggregate labour productivity growth?

The sectors that made the largest contributions to Korea's labour aggregate productivity in 1998–2018 include: manufacturing (30.6%); wholesale and retail trade (8.1%); real estate activities (7.4%); public administration and defence (7.0%); and professional, scientific and technical activities (6.5%) (Figure 3, Table 6).

In the pre-crisis period (1998–2007) the top five sectors driving productivity growth were: manufacturing (28.9%); wholesale and retail trade (8.7%); real estate activities (7.8%); financial and insurance activities (7.4%); and information and communication (6.8%) (Figure 3, Table 3).

During the crisis and its aftermath (2008–10), in addition to manufacturing (43.6%) and wholesale and retail trade (9.1%), market and non-market services made large contributions to aggregate productivity growth, including: professional, scientific and technical activities (7.9%); public administration and defence (6.1%); and human health and social work activities (5.5%) (Figure 3, Table 4).

In the decade that followed (2011–18), manufacturing experienced the deepest decline in its contributions to aggregate productivity growth (-0.48 percentage points, in comparison with the 1998–2007 period). Other sectors that experienced declines in their contributions include: financial and insurance activities (-0.3 percentage points); wholesale and retail trade (-0.2 percentage points); and information and communication (-0.2 percentage points). In comparison, construction increased its contribution by 0.22 percentage points, accounting for 7.2% of the aggregate productivity growth observed in that period (5.3%) (Figure 3, Table 5).

FIGURE 3: TOP FIVE SECTORS CONTRIBUTING TO KOREA'S AGGREGATE PRODUCTIVITY GROWTH (1998–2018)

Korea: top five sectors

(based on their contribution to aggregate productivity growth measured as output per hour)

Pre-crisis (1998–2007)

Aggregate productivity growth rate: 6.8%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	28.9	1.97
Wholesale and retail trade	8.7	0.59
Real estate activities	7.8	0.53
Financial and insurance activities	7.4	0.51
Information and communication	6.8	0.46

Crisis (2008–2010)

Aggregate productivity growth rate: 5.5%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	43.6	2.40
Wholesale and retail trade	9.1	0.50
Professional, scientific and technical activities	7.9	0.43
Public administration and defence	6.1	0.34
Human health and social work activities	5.5	0.30

Post-crisis (2011–2018)

Aggregate productivity growth rate: 5.3%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	28.3	1.49
Public administration and defence	8.0	0.42
Real estate activities	7.8	0.41
Professional, scientific and technical activities	7.2	0.38
Construction	7.2	0.38

Whole period (1998–2018)

Aggregate productivity growth rate: 6.0%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	30.6	1.85
Wholesale and retail trade	8.1	0.49
Real estate activities	7.4	0.44
Public administration and defence	7.0	0.42
Professional, scientific and technical activities	6.5	0.39

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

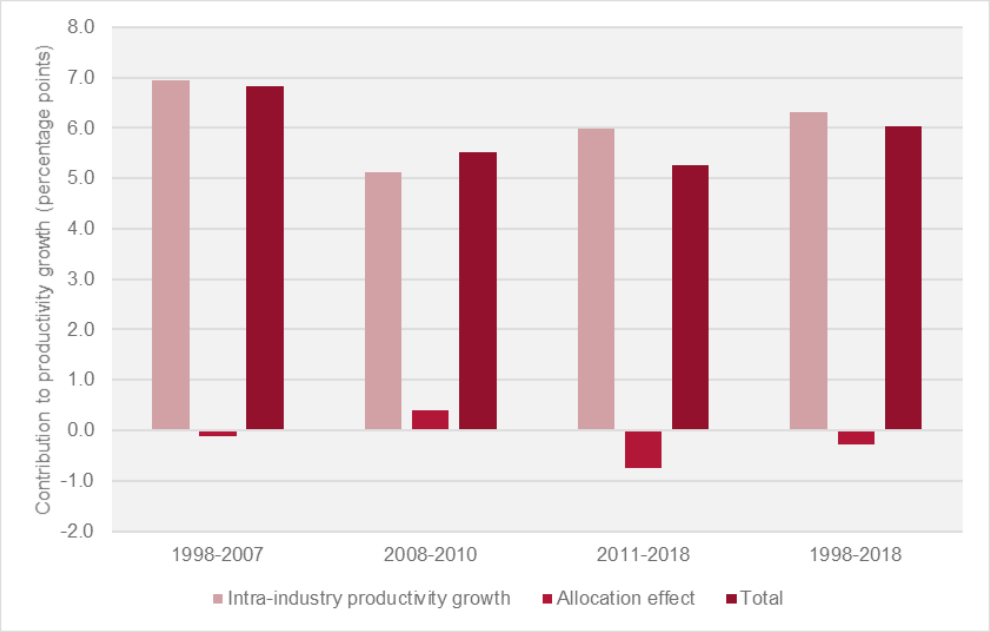
3. How do sectoral dynamics explain recent trends in aggregate productivity growth?

Overall labour productivity growth can be explained by an intra-industry productivity growth effect (or 'within' effect), which captures the productivity growth of each industrial sector and its relative weight in the overall economy; and by an allocation effect (or 'between-industries' effect), which captures the impacts on aggregate productivity growth because of the expansion or contraction of sectors with different levels of productivity.

In order to understand how different sectors have contributed to either aggregate productivity growth or slowdown, labour productivity (measured as output per worker) growth rates by sector were decomposed into these components using the Generalised Exactly Additive Decomposition (GEAD) methodology, as described in Tang and Wang.[3] Appendix II explains this decomposition in more detail.

Korea's aggregate productivity is largely explained by its intra-industry productivity growth, as shown in Figure 4. However, during the period 2011–18, Korea's economy experienced changes in its structure, leading to negative contributions to productivity growth. The allocation effect was negative during this period and represented 14.1% of aggregate productivity growth (5.3%). Negative allocation effects are also observed in the period 1998–2007, albeit smaller (1.9%).

FIGURE 4: DECOMPOSITION OF KOREA'S AGGREGATE PRODUCTIVITY GROWTH (1998–2018)



Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

The decomposition was also conducted excluding sectors that involve a large non-market component (real estate, public administration and defence, education, and human health activities and social work activities). Table 9 presents the results of this decomposition for the period of 1998–2018. Key highlights include: larger intra-industry productivity effects (6.8

[3] Tang, J. and Wang, W. (2004). Sources of aggregate labour productivity growth in Canada and the United States. *Canadian Journal of Economics*, Volume 37, Number 2.

percentage points), explained mostly by the manufacturing sector; and more negative allocation effects (-0.4 percentage points), mainly explained by the electricity, gas and water supply sector.

As discussed in Section 2, the economic sectors that contributed the most to Korea's aggregate productivity in 1998–2018 include: manufacturing; wholesale and retail trade; real estate activities; public administration and defence; and professional, scientific and technical activities.

Manufacturing contributes almost one-third of Korea's labour aggregate productivity growth. The contribution of manufacturing is explained by productivity levels above the average of Korea's economy, high productivity growth and the relatively large size of the sector (29.1% output shares and 16.8% employment shares in 2018).

The manufacturing sub-sectors that contributed the most to aggregate productivity in 1998–2018 include (in brackets relative contributions): the manufacture of computer, electronic and optical products (10.2%); chemical, rubber, plastics, fuel products and other non-metallic mineral products (5.6%); the manufacture of basic metals and fabricated metal products (4.3%); the manufacture of transport equipment (3.0%); and the manufacture of machinery and equipment (2.5%) (Table 7).

The manufacture of computer, electronic and optical products represents around a third of Korea's manufacturing value added. The industry dates back to the mid-1960s, when the government developed a strategy to diversify its manufacturing base. The government supported Korean firms to develop production and innovation capabilities while facilitating partnerships with foreign companies.[4] Public research and development organisations, including the Electronics and Telecommunications Research Institute (ETRI), established in 1976, and the Korea Electronics Technology Institute (KETI), established in 1991, have also played a key role in the development of the electronics industry in Korea.[5]

In the 1980s and early 1990s, the government shifted its focus from consumer electronics to information and communications technology (ICT), and Korean firms diversified their products and developed core components and materials by expanding their investments in research and development.[6]

Korea's main strengths in the electronics value chain are in integrated circuits (memory), led by Samsung and Hynix, displays (Samsung Display and LG Display) and mobile phones (Samsung, LG).[7] In 2015 Korea ranked fourth in the global ranking of the electronics industry in terms of output, behind China, the US and Japan.[8]

Korea's manufacturing contribution to aggregate productivity growth has been affected by a major slowdown in its productivity growth and a contraction in the size of the sector. Manufacturing experienced a decline in its employment shares from 19.5% in 1998 to 16.8% in 2018, which was amplified by reductions in relative output prices, namely, -6.6 percentage points between 1998 and

[4] Lim, W. (2016). The Development of Korea's Electronics Industry During Its Formative Years (1966-1979). Ministry of Strategy and Finance.
[5] Frederick, S. and Lee, J. (2017). Korea and the Electronics Global Value Chain. Korea Institute for Industrial Economics and Trade. Duke Global Value Chains Center.
[6] Lim, W. (2016). Op. cit.
[7] Frederick, S. and Lee, J. (2017). Op. cit.
[8] Lim, W. (2016). Op. cit.

2018. We estimate that the shrinking of manufacturing reduced Korea's aggregate productivity growth by -0.5 percentage points, on average, between 1998 and 2018 (allocation effect).

The sub-sectors that have contributed the most to this trend include: chemical, rubber, plastics, fuel products and other non-metallic mineral products; the manufacture of textiles, wearing apparel, leather and related products; and the manufacture of transport equipment (Table 7). These industries have experienced decreases in both employment shares and relative output prices. The largest decline in employment shares is observed in textiles, wearing apparel, leather and related products (-0.4 percentage points), while the largest decline in relative output prices is observed in the manufacture of transport equipment (-17.2 percentage points) (Table 8).

The contribution of professional, scientific and technical activities to aggregate productivity growth is explained by the expansion of this sector, which shows productivity levels above the average and relatively large productivity growth rates (4.8% in 1998–2018) (Table 6). Korea's spending on R&D as a proportion of its GDP is the second largest globally (4.6% in 2019), behind only Israel.[9] The government has been expanding funding for basic research in recent decades, with the aim of becoming a global leader in this area.[10]

The growing contribution of construction is the result of an expansion of this sector in the post-crisis period, a 1 percentage point increase in output shares and a 0.3 percentage point increase in employment shares in 2011–18, in combination with high productivity growth rates (5.8%, on average, in 2011–18) (Table 5). The Korean government supported the recovery of the construction industry after the global financial crisis, investing in four major river projects and creating a housing renting scheme that boosted private investment in housing. The productivity increase of the construction sector has also been supported by the development of technical and professional education programmes in subjects relevant to the industry and the establishment of a national roadmap for the adoption of smart technologies.[11]

Korea's manufacturing had one of the highest productivity growth rates across sectors (8.6% in 1998–2018), but it experienced a major slowdown from an annual growth rate of 11.4% in 1998–2007 to 5.6% in 2011–18. Despite showing productivity levels below the national average, the contribution of wholesale and retail trade to aggregate productivity growth is also explained by its high productivity growth (6.9% in 1998–2018). Factors that help to explain the high productivity of the wholesale and retail trade sector include: the entrance of new actors; the emergence of new (mainly online) retail channels, and sustained investments in digital technologies.[12] However, like manufacturing, its productivity growth slowed down, from 8.2% in 1998–2007 (Table 3) to 4.6% in 2011–18 (Table 5).

Other sectors that experienced significant slowdowns in their labour productivity from the pre-crisis to the post-crisis period include: financial and insurance activities (-4.7 percentage points) and information and communication (-3.3 percentage points) (Table 1).

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[9] Policy Links (2022). UK Innovation Report 2022. Benchmarking the UK's Industrial and Innovation Performance in a Global Context. IfM Engage. Institute for Manufacturing, University of Cambridge.
[10] Kim, S.Y. (2022). To boost basic science, look to values, not just budgets. *Nature*, Vol. 6.
[11] Lee, C. (2021). Construction Industry Progress of South Korea: 1995–2019. In: Anson, M., Chiang, Y.H., Lam, P. and Shen, J. (Eds). Construction Industry Advance and Change: Progress in Eight Asian Economies Since 1995, Emerald Publishing Limited, Bingley, pp. 137–161. https://doi.org/10.1108/978-1-80043-504-920211007
[12] Cho, J., Chun, H. and Lee, Y. (2022). Productivity dynamics in the retail trade sector: the roles of large modern retailers and small entrants. *Small Bus. Econ*. https://doi.org/10.1007/s11187-022-00632-7; Retail Insight Network (2021). South Korea plans to inject $267m to support retail digitalisation; USCS Korea (2021). Korea: retail industry.

While the manufacturing sector shrunk, service activities saw large expansions between 1998 and 2018, including (in brackets, changes in employment shares): human health and social work activities (5.8 percentage points.); arts, entertainment, recreation and other services (1.7 percentage points); education (1.0 percentage points); information and communication (0.6 percentage points); and transportation and storage (0.5 percentage points) (Table 6).

TABLE 1: KOREA: PRODUCTIVITY LEVELS AND GROWTH RATES BY SECTOR, 1998–2018

Economic sector	Output per hour (annual average)							
	1998–2007		2008–2010		2011–2018		1998–2018	
	Absolute value (thousand won[1/])	Average annual growth	Absolute value (thousand won[1/])	Average annual growth	Absolute value (thousand won[1/])	Average annual growth	Absolute value (thousand won[1/])	Average annual growth
Agriculture, forestry and fishing	5,514.2	5.3%	7,342.8	1.1%	10,806.4	6.8%	7,791.5	5.3%
Mining and quarrying	31,882.3	4.5%	34,721.0	3.6%	53,150.0	5.4%	40,389.8	4.7%
Manufacturing	20,449.5	11.4%	30,999.7	7.1%	42,091.1	5.6%	30,201.1	8.6%
Electricity, gas and water supply; sewerage, waste management and remediation activities	14,307.2	-1.0%	12,094.9	5.8%	52,578.0	38.0%	28,570.5	14.8%
Construction	11,844.9	5.2%	15,756.1	1.8%	20,026.6	5.8%	15,520.4	4.9%
Wholesale and retail trade; repair of motor vehicles and motorcycles	7,075.4	8.2%	11,523.8	8.9%	15,659.2	4.5%	10,980.9	6.9%
Transportation and storage	9,763.1	6.1%	13,001.7	-1.5%	17,384.3	8.3%	13,129.1	5.9%
Accommodation and food service activities	4,066.5	5.8%	6,287.1	14.4%	7,361.5	2.8%	5,639.0	5.9%
Information and communication	32,492.7	4.4%	43,944.7	7.3%	46,616.0	1.1%	39,509.0	3.5%
Financial and insurance activities	30,655.1	9.8%	45,235.0	1.3%	55,640.1	5.1%	42,256.0	6.8%
Real estate activities	52,294.5	3.3%	69,083.3	6.4%	93,511.8	5.5%	70,394.7	4.6%
Professional, scientific and technical activities	22,608.5	4.4%	31,856.8	2.7%	39,927.6	6.2%	30,527.4	4.9%
Administrative and support service activities	16,208.6	0.0%	16,438.8	4.5%	20,805.1	4.7%	17,992.6	2.5%
Public administration and defence; compulsory social security	22,362.5	6.9%	31,320.4	2.0%	44,726.5	6.1%	32,161.8	5.9%
Education	12,320.7	5.5%	17,137.6	2.9%	22,863.1	5.7%	17,025.0	5.2%
Human health and social work activities	15,791.1	4.0%	17,892.3	-4.2%	17,782.8	2.5%	16,850.0	2.3%
Arts, entertainment, recreation and other services	7,312.3	4.0%	10,352.9	10.3%	12,604.0	2.8%	9,762.6	4.5%
Whole economy	13,880.1	6.8%	20,254.7	5.5%	26,945.0	5.3%	19,767.9	6.0%

Note: Chained prices of the previous year.

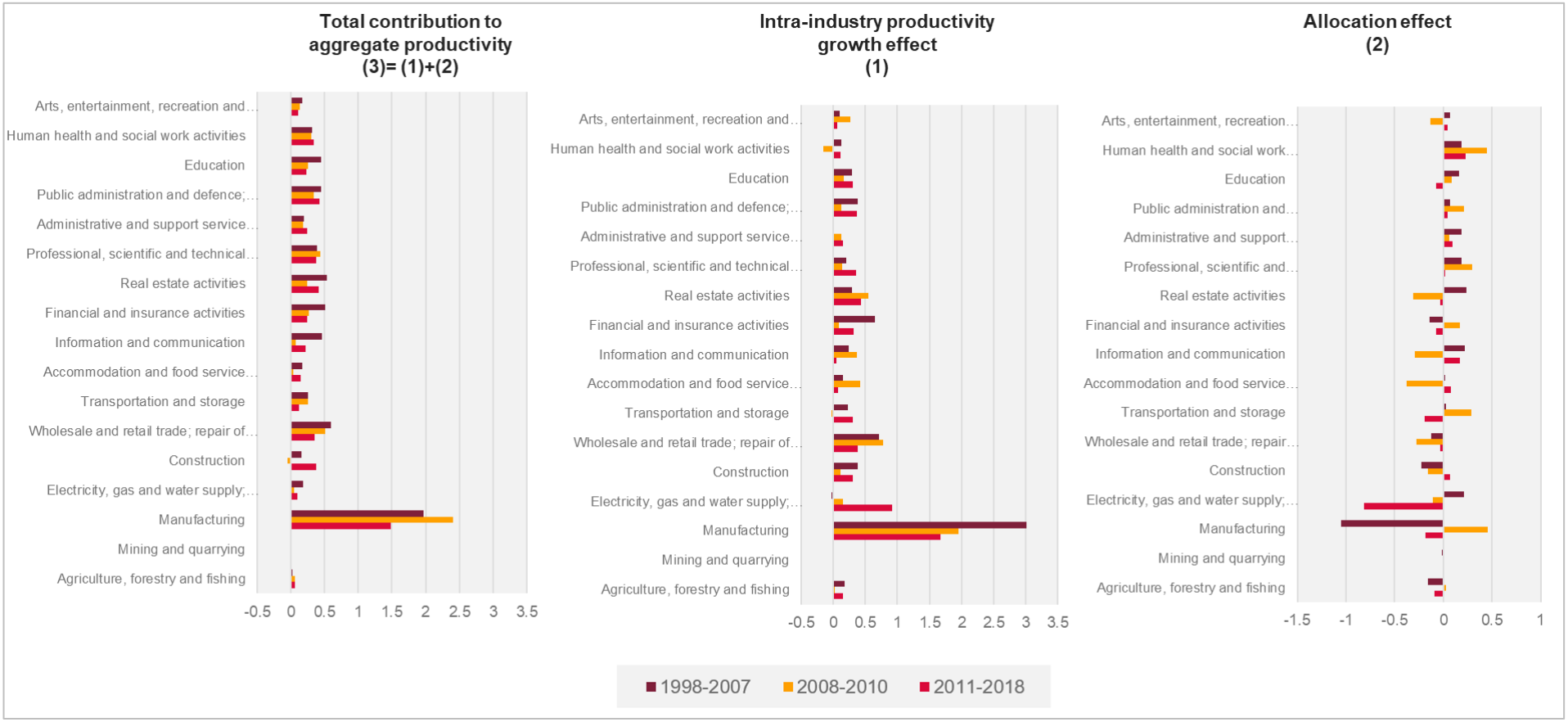
Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 2: KOREA: PRODUCTIVITY LEVELS AND GROWTH BY MANUFACTURING SUB-SECTORS, 1998–2018

Manufacturing sub-sector	Output per hour							
	1998–2007		2008–2010		2011–2018		1998–2018	
	Absolute value (thousand won[1/])	Average annual growth	Absolute value (thousand won[1/])	Average annual growth	Absolute value (thousand won[1/])	Average annual growth	Absolute value (thousand won[1/])	Average annual growth
Manufacture of food products, beverages and tobacco	15,604.7	7.0%	20,544.9	4.0%	26,907.7	3.8%	20,616.3	5.3%
Manufacture of textiles, wearing apparel, leather and related products	9,549.7	11.4%	17,731.9	6.9%	28,442.6	8.1%	17,915.9	9.5%
Manufacture of wood and paper products, and printing	16,908.6	5.6%	25,002.1	-1.6%	28,366.2	7.5%	22,429.6	5.3%
Manufacture of chemical, rubber, plastics, fuel products and other non-metallic mineral products	27,793.3	7.5%	42,066.9	6.0%	55,446.2	4.8%	40,366.9	6.3%
Manufacture of basic metals and fabricated metal products, except machinery and equipment	6,130.7	8.0%	9,618.7	13.3%	12,393.6	1.9%	9,014.9	6.4%
Manufacture of computer, electronic and optical products	27,307.6	9.9%	42,270.5	16.1%	56,866.7	7.6%	40,705.8	9.9%
Manufacture of electrical equipment	19,024.7	8.2%	31,980.5	13.6%	36,173.5	2.7%	27,408.4	6.9%
Manufacture of machinery and equipment n.e.c.	13,543.9	11.1%	20,447.6	14.5%	36,416.9	7.1%	23,243.7	10.1%
Manufacture of transport equipment	17,510.5	15.1%	30,171.4	-8.7%	34,203.3	8.3%	25,678.4	9.1%
Manufacture of furniture; other manufacturing; repair and installation of machinery and equipment	15,259.5	6.3%	24,493.4	7.2%	33,575.8	10.9%	23,556.2	8.2%
Total manufacturing	20,449.5	11.4%	30,999.7	7.1%	42,091.1	5.6%	30,201.1	8.6%

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

FIGURE 5: SECTORAL CONTRIBUTION TO KOREA'S AGGREGATE PRODUCTIVITY GROWTH, 1998–2018



Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 3: KOREA: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH,1998–2007

Economic sector	Output shares		Employment shares		Structural change (1998–2007, percentage points)			Contribution to productivity growth (1998–2007, average, percentage points)			Labour productivity growth (1998–2007)
	1998	2007	1998	2007	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Agriculture, forestry and fishing	4.4%	2.5%	11.8%	7.2%	-1.8	-4.6	-3.6	0.18	-0.16	0.02	5.28%
Mining and quarrying	0.3%	0.2%	0.1%	0.1%	-0.1	0.0	3.8	0.01	-0.01	0.00	4.54%
Manufacturing	26.5%	27.2%	19.5%	17.5%	0.7	-2.0	-6.2	3.02	-1.05	1.97	11.39%
Electricity, gas and water supply; sewerage, waste management and remediation activities	2.4%	2.3%	0.5%	0.6%	-0.1	0.1	-7.4	-0.03	0.21	0.18	-0.96%
Construction	7.8%	6.3%	7.9%	7.9%	-1.6	0.0	9.9	0.38	-0.23	0.15	5.21%
Wholesale and retail trade; repair of motor vehicles and motorcycles	8.1%	8.5%	19.0%	15.7%	0.4	-3.3	1.1	0.72	-0.12	0.59	8.20%
Transportation and storage	3.8%	3.6%	4.8%	5.3%	-0.2	0.5	-6.0	0.23	0.03	0.25	6.13%
Accommodation and food service activities	2.6%	2.7%	8.7%	8.7%	0.1	0.0	4.4	0.16	0.02	0.18	5.79%
Information and communication	4.7%	5.4%	2.5%	2.7%	0.7	0.2	2.0	0.24	0.22	0.46	4.36%
Financial and insurance activities	6.6%	6.9%	3.9%	3.5%	0.3	-0.4	-3.1	0.65	-0.14	0.51	9.78%
Real estate activities	10.5%	8.7%	N/A	1.9%	-1.9	N/A	5.6	0.30	0.23	0.53	3.30%
Professional, scientific and technical activities	4.1%	5.3%	N/A	3.0%	1.2	N/A	-2.2	0.20	0.19	0.39	4.43%
Administrative and support service activities	2.8%	2.9%	N/A	4.2%	0.0	N/A	3.4	0.01	0.19	0.19	0.04%
Public administration and defence; compulsory social security	5.5%	5.9%	3.7%	3.4%	0.4	-0.3	4.1	0.38	0.07	0.45	6.94%
Education	5.0%	5.8%	5.9%	7.4%	0.8	1.5	5.8	0.29	0.16	0.45	5.46%
Human health and social work activities	2.4%	3.4%	1.8%	3.2%	1.0	1.3	-4.4	0.13	0.19	0.32	3.97%
Arts, entertainment, recreation and other services	2.5%	2.5%	4.8%	7.6%	0.1	2.8	1.3	0.10	0.07	0.17	4.03%
Whole economy	100%	100%	95%	100%	N/A	N/A	N/A	6.95	-0.13	6.82	6.82%

Note: N/A, not available, not applicable.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 4: KOREA: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH, 2008–2010

Economic sector	Output shares		Employment shares		Structural change (2008–10, percentage points)			Contribution to productivity growth (2008–10, average, percentage points)			Labour productivity growth (2008–10)
	2008	2010	2008	2010	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Agriculture, forestry and fishing	2.3%	2.3%	7.0%	6.5%	0.0	-0.6	15.8	0.03	0.03	0.06	1.14%
Mining and quarrying	0.2%	0.2%	0.1%	0.1%	0.0	0.0	-3.7	0.01	0.00	0.01	3.58%
Manufacturing	27.7%	29.7%	17.1%	17.2%	2.0	0.1	-0.9	1.95	0.45	2.40	7.07%
Electricity, gas and water supply; sewerage, waste management and remediation activities	1.5%	2.1%	0.7%	0.6%	0.6	-0.1	46.1	0.15	-0.11	0.05	5.80%
Construction	5.9%	5.2%	7.7%	7.4%	-0.7	-0.3	-0.2	0.11	-0.15	-0.05	1.78%
Wholesale and retail trade; repair of motor vehicles and motorcycles	8.5%	8.6%	15.4%	15.0%	0.1	-0.4	-6.7	0.78	-0.27	0.50	8.90%
Transportation and storage	3.8%	3.8%	5.3%	5.4%	0.0	0.1	24.0	-0.03	0.29	0.26	-1.49%
Accommodation and food service activities	2.7%	2.4%	8.6%	7.9%	-0.3	-0.7	-19.1	0.42	-0.38	0.04	14.43%
Information and communication	5.1%	4.8%	2.7%	2.8%	-0.3	0.1	0.9	0.37	-0.29	0.08	7.30%
Financial and insurance activities	6.8%	6.6%	3.5%	3.4%	-0.3	-0.1	6.5	0.09	0.17	0.27	1.31%
Real estate activities	8.6%	8.0%	1.9%	1.9%	-0.6	0.1	-1.3	0.55	-0.31	0.25	6.40%
Professional, scientific and technical activities	5.6%	5.6%	3.2%	3.7%	0.0	0.5	-1.6	0.14	0.29	0.43	2.74%
Administrative and support service activities	3.0%	3.0%	4.3%	4.5%	0.0	0.2	-2.6	0.12	0.06	0.19	4.51%
Public administration and defence; compulsory social security	6.1%	5.9%	3.6%	4.0%	-0.2	0.5	-7.0	0.13	0.21	0.34	2.02%
Education	6.0%	5.6%	7.6%	7.6%	-0.4	0.0	-5.4	0.17	0.09	0.26	2.91%
Human health and social work activities	3.5%	3.7%	3.6%	4.8%	0.2	1.3	-3.0	-0.15	0.45	0.30	-4.17%
Arts, entertainment, recreation and other services	2.6%	2.5%	7.7%	7.1%	-0.1	-0.6	-3.2	0.27	-0.13	0.14	10.33%
Whole economy	100%	100%	100%	100%	N/A	N/A	N/A	5.11	0.40	5.52	5.52%

Note: N/A, not applicable.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 5: KOREA: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH, 2011–2018

Economic sector	Output shares		Employment shares		Structural change (2011–18, percentage points)			Contribution to productivity growth (2011–18, average, percentage points)			Labour productivity growth (2011–18)
	2011	2018	2011	2018	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Agriculture, forestry and fishing	2.4%	1.9%	6.3%	5.0%	-0.5	-1.3	-10.2	0.15	-0.09	0.06	6.78%
Mining and quarrying	0.2%	0.1%	0.1%	0.1%	0.0	0.0	-14.2	0.01	-0.01	0.00	5.44%
Manufacturing	30.3%	29.1%	17.2%	16.8%	-1.2	-0.4	-2.0	1.67	-0.19	1.49	5.64%
Electricity, gas and water supply; sewerage, waste management and remediation activities	1.8%	2.0%	0.6%	0.7%	0.2	0.1	-1.4	0.92	-0.82	0.10	37.96%
Construction	4.9%	5.9%	7.3%	7.6%	1.0	0.3	1.7	0.31	0.07	0.38	5.81%
Wholesale and retail trade; repair of motor vehicles and motorcycles	8.9%	7.9%	15.0%	13.9%	-1.0	-1.1	-2.3	0.38	-0.03	0.35	4.55%
Transportation and storage	3.4%	3.3%	5.5%	5.2%	-0.1	-0.3	6.8	0.31	-0.19	0.12	8.30%
Accommodation and food service activities	2.3%	2.5%	7.6%	8.4%	0.2	0.7	-1.3	0.07	0.08	0.15	2.79%
Information and communication	4.7%	4.6%	2.9%	3.1%	-0.1	0.2	2.8	0.05	0.17	0.22	1.10%
Financial and insurance activities	6.8%	6.0%	3.5%	3.1%	-0.8	-0.4	-2.7	0.32	-0.07	0.25	5.06%
Real estate activities	7.9%	8.0%	1.8%	2.0%	0.1	0.2	1.7	0.44	-0.03	0.41	5.52%
Professional, scientific and technical activities	5.7%	6.2%	4.0%	4.1%	0.5	0.1	2.6	0.36	0.02	0.38	6.18%
Administrative and support service activities	3.0%	3.5%	4.7%	4.9%	0.6	0.2	6.1	0.15	0.09	0.25	4.71%
Public administration and defence; compulsory social security	5.9%	6.6%	3.9%	4.1%	0.7	0.2	1.9	0.37	0.05	0.42	6.12%
Education	5.5%	5.2%	7.0%	6.9%	-0.3	-0.1	1.3	0.31	-0.08	0.23	5.66%
Human health and social work activities	3.7%	4.7%	5.4%	7.6%	0.9	2.2	3.0	0.11	0.23	0.34	2.52%
Arts, entertainment, recreation and other services	2.5%	2.4%	7.3%	6.5%	-0.1	-0.9	-1.6	0.07	0.05	0.11	2.77%
Whole economy	100%	100%	100%	100%	N/A	N/A	N/A	6.00	-0.74	5.25	5.25%

Note: N/A, not applicable.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 6: KOREA: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH, 1998–2018

Economic sector	Output shares		Employment shares		Structural change (1998–2018, percentage points)			Contribution to productivity growth (1998–2018, average, percentage points)			Labour productivity growth (1998–2018)
	1998	2018	1998	2018	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Agriculture, forestry and fishing	4.4%	1.9%	11.8%	5.0%	-2.5	-6.8	1.3	0.15	-0.11	0.04	5.26%
Mining and quarrying	0.3%	0.1%	0.1%	0.1%	-0.1	0.0	-3.9	0.01	-0.01	0.00	4.75%
Manufacturing	26.5%	29.1%	19.5%	16.8%	2.6	-2.7	-6.6	2.35	-0.50	1.85	8.58%
Electricity, gas and water supply; sewerage, waste management and remediation activities	2.4%	2.0%	0.5%	0.7%	-0.4	0.2	-16.3	0.36	-0.22	0.13	14.83%
Construction	7.8%	5.9%	7.9%	7.6%	-1.9	-0.4	13.5	0.31	-0.10	0.21	4.95%
Wholesale and retail trade; repair of motor vehicles and motorcycles	8.1%	7.9%	19.0%	13.9%	-0.2	-5.1	0.4	0.60	-0.11	0.49	6.91%
Transportation and storage	3.8%	3.3%	4.8%	5.2%	-0.5	0.5	-12.8	0.22	-0.02	0.20	5.87%
Accommodation and food service activities	2.6%	2.5%	8.7%	8.4%	-0.1	-0.3	5.1	0.16	-0.02	0.14	5.88%
Information and communication	4.7%	4.6%	2.5%	3.1%	-0.1	0.6	2.8	0.19	0.13	0.31	3.54%
Financial and insurance activities	6.6%	6.0%	3.9%	3.1%	-0.6	-0.8	0.2	0.44	-0.07	0.37	6.77%
Real estate activities	10.5%	8.0%	N/A	2.0%	-2.6	N/A	3.7	0.39	0.06	0.44	4.59%
Professional, scientific and technical activities	4.1%	6.2%	N/A	4.1%	2.0	N/A	-1.0	0.25	0.14	0.39	4.85%
Administrative and support service activities	2.8%	3.5%	N/A	4.9%	0.7	N/A	5.6	0.08	0.13	0.21	2.46%
Public administration and defence; compulsory social security	5.5%	6.6%	3.7%	4.1%	1.1	0.4	5.7	0.34	0.08	0.42	5.92%
Education	5.0%	5.2%	5.9%	6.9%	0.2	1.0	4.1	0.28	0.06	0.34	5.17%
Human health and social work activities	2.4%	4.7%	1.8%	7.6%	2.2	5.8	-6.7	0.08	0.24	0.32	2.26%
Arts, entertainment, recreation and other services	2.5%	2.4%	4.8%	6.5%	-0.1	1.7	3.2	0.11	0.03	0.14	4.45%
Whole economy	100%	100%	95%	100%	N/A	N/A	N/A	6.32	-0.29	6.04	6.04%

Note: N/A, not applicable.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 7: KOREA: CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH BY MANUFACTURING SUB-SECTORS, 1998–2018

Manufacturing sub-sector	1998–2007 (average, percentage points)			2008–2010 (average, percentage points)			2011–2018 (average, percentage points)			1998–2018 (average, percentage points)		
	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)
Manufacture of food products, beverages and tobacco	0.12	-0.04	0.08	0.02	0.03	0.05	0.06	0.02	0.08	0.08	-0.01	0.08
Manufacture of textiles, wearing apparel, leather and related products	0.18	-0.15	0.03	0.10	-0.03	0.07	0.11	-0.09	0.02	0.14	-0.11	0.03
Manufacture of wood and paper products, and printing	0.07	-0.03	0.05	0.07	-0.04	0.04	0.05	0.00	0.04	0.06	-0.02	0.04
Manufacture of chemical, rubber, plastics, fuel products and other non-metallic mineral products	0.61	-0.24	0.36	0.33	0.08	0.41	0.31	-0.04	0.27	0.46	-0.12	0.34
Manufacture of basic metals and fabricated metal products, except machinery and equipment	0.35	-0.01	0.34	0.28	0.07	0.35	0.14	-0.02	0.12	0.26	0.00	0.26
Manufacture of computer, electronic and optical products	0.59	-0.02	0.57	0.64	0.17	0.81	0.63	-0.02	0.61	0.61	0.01	0.62
Manufacture of electrical equipment	0.14	-0.03	0.12	0.26	-0.03	0.23	-0.01	0.09	0.08	0.10	0.02	0.12
Manufacture of machinery and equipment n.e.c.	0.17	-0.03	0.14	0.15	0.03	0.18	0.22	-0.07	0.16	0.18	-0.03	0.15
Manufacture of transport equipment	0.32	-0.06	0.26	0.37	-0.12	0.25	0.17	-0.11	0.06	0.27	-0.09	0.18
Manufacture of furniture; other manufacturing; repair and installation of machinery and equipment	0.06	-0.03	0.04	0.05	-0.04	0.01	0.04	0.00	0.04	0.05	-0.02	0.04
Total manufacturing	**3.02**	**-1.05**	**1.97**	**1.95**	**0.45**	**2.40**	**1.67**	**-0.19**	**1.49**	**2.35**	**-0.50**	**1.85**

Note: N/A, not applicable.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 8: KOREA: CHANGES IN RELATIVE SIZE OF MANUFACTURING SUB-SECTORS, 1998–2020

Manufacturing sub-sector	Change, 1998–2007, percentage points			Change, 2008–2010, percentage points			Change, 2011–2018, percentage points			Change, 1998–2018, percentage points		
	Output shares	Employment shares	Relative output prices	Output shares	Employment shares	Relative output prices	Output shares	Employment shares	Relative output prices	Output shares	Employment shares	Relative output prices
Food products, beverages and tobacco	-0.45	-0.42	-11.91	-0.01	-0.04	2.24	0.11	0.10	-1.57	-0.40	-0.38	-9.57
Textiles, wearing apparel, leather and related products	-0.87	-1.66	-10.92	0.05	-0.07	4.71	-0.35	-0.24	0.11	-1.18	-2.09	-3.91
Wood and paper products, and printing	-0.26	-0.10	-2.27	-0.02	-0.06	-0.19	0.00	0.01	6.78	-0.32	-0.23	6.75
Chemical, rubber, plastics, fuel products and other non-metallic mineral products	-1.29	-0.31	-7.49	-0.08	0.02	-6.36	-0.77	0.15	-8.16	-1.58	-0.21	-10.21
Basic metals and fabricated metal products, except machinery and equipment	0.75	0.23	-3.38	-0.24	0.09	-20.16	-0.93	-0.01	-2.57	0.23	0.23	-7.19
Manufacture of computer, electronic and optical products	1.25	N/A	-2.39	1.62	0.05	10.13	1.53	-0.42	1.34	4.29	N/A	2.75
Manufacture of electrical equipment	0.29	N/A	2.64	0.33	0.04	-7.86	-0.05	0.05	-1.87	0.63	N/A	2.77
Manufacture of machinery and equipment n.e.c.	0.60	0.15	-7.77	0.14	0.07	-2.04	0.17	0.08	-0.76	0.97	0.32	-7.23
Transport equipment	0.78	0.09	-9.59	0.23	0.01	10.86	-1.04	-0.20	-2.06	-0.01	-0.13	-17.17
Furniture; other manufacturing; repair and installation of machinery and equipment	-0.06	-0.21	-9.09	-0.02	-0.01	-2.57	0.11	0.09	8.89	-0.02	-0.16	-1.20
Total manufacturing	0.75	-2.04	-6.21	2.01	0.09	-0.89	-1.22	-0.39	-2.05	2.63	-2.69	-6.56

Note: N/A, not available.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

TABLE 9: KOREA: PRODUCTIVITY GROWTH DECOMPOSITION OF 'MARKET SECTORS', 1998–2018

Economic sector	All sectors			'Market' sectors		
	Contribution to productivity growth (1998–2018, average, percentage points)			Contribution to productivity growth (1998–2018, average, percentage points)		
	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)
Agriculture, forestry and fishing	0.15	-0.11	0.04	0.19	-0.11	0.08
Mining and quarrying	0.01	-0.01	0.00	0.01	-0.01	0.00
Manufacturing	2.35	-0.50	1.85	3.06	-0.45	2.61
Electricity, gas and water supply; sewerage, waste management and remediation activities	0.36	-0.22	0.13	0.47	-0.28	0.19
Construction	0.31	-0.10	0.21	0.41	-0.09	0.32
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.60	-0.11	0.49	0.78	-0.08	0.70
Transportation and storage	0.22	-0.02	0.20	0.29	0.00	0.29
Accommodation and food service activities	0.16	-0.02	0.14	0.21	0.00	0.21
Information and communication	0.19	0.13	0.31	0.24	0.20	0.44
Financial and insurance activities	0.44	-0.07	0.37	0.58	-0.05	0.53
Real estate activities	0.39	0.06	0.44	N/A	N/A	N/A
Professional, scientific and technical activities	0.25	0.14	0.39	0.33	0.22	0.55
Administrative and support service activities	0.08	0.13	0.21	0.10	0.19	0.30
Public administration and defence; compulsory social security	0.34	0.08	0.42	N/A	N/A	N/A
Education	0.28	0.06	0.34	N/A	N/A	N/A
Human health and social work activities	0.08	0.24	0.32	N/A	N/A	N/A
Arts, entertainment, recreation and other services	0.11	0.03	0.14	0.15	0.06	0.20
Whole economy	6.32	-0.29	6.04	6.82	-0.40	6.42

Note: N/A, not applicable.

Source: Authors' computation, based on data from OECD (2020). Structural Analysis Database (STAN) and Korea Productivity Center.

Appendix I. Definitions of variables and data sources

Variable	Measure, units	Source
Labour (hours)	Total working hours, million hours	Korea Productivity Center. Productivity Statistics
Labour (people)	Number of persons engaged (total employment) (EMPN) – persons, thousands	OECD (2020). STAN Industrial Analysis (2020 ed.)
Output (real values)	Value added, chained prices of the previous year, won, millions	
Output (nominal values)	Value added, current prices, won, millions	

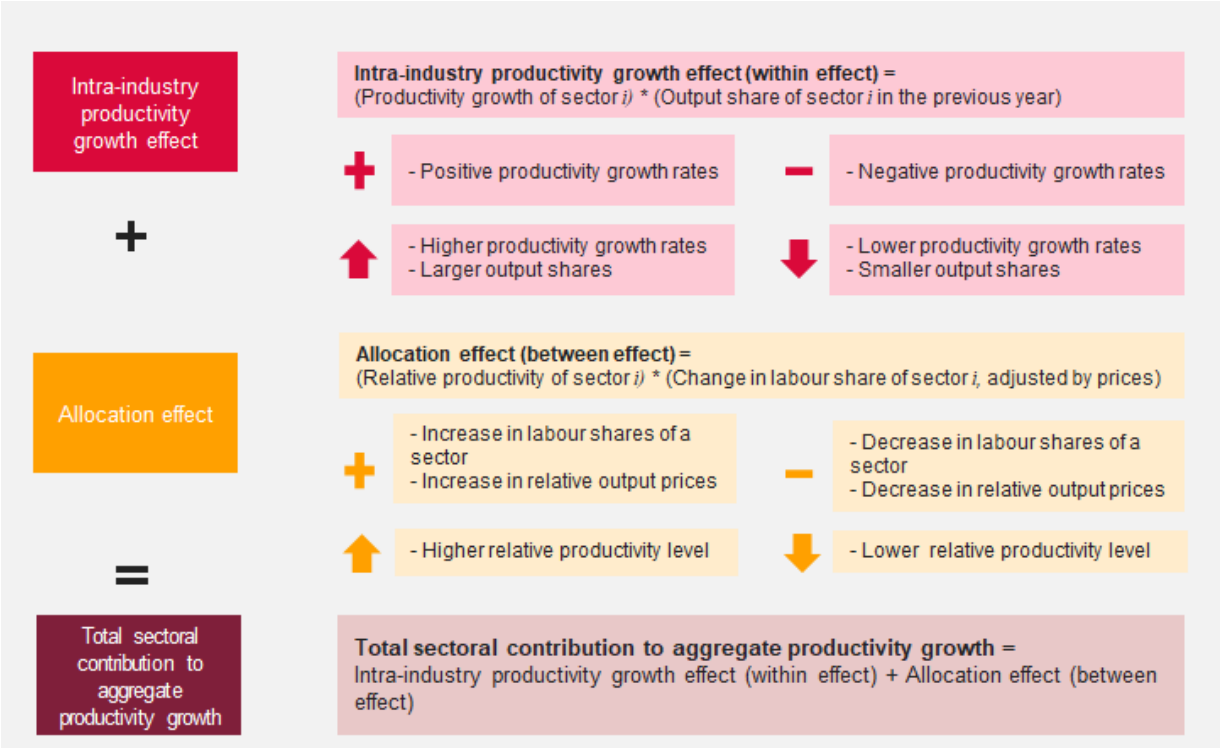
Appendix II. Decomposition of productivity growth

Economic sectors contribute disparately to aggregate productivity growth, depending on their productivity gains over time, as well as their weight in the total economy and relative productivity differences.

In order to understand the extent and nature of these contributions, we decompose the economy-wide labour productivity growth rates into sectoral contribution effects, as described in Tang and Wang:[13] (i) an intra-industry effect that captures the productivity growth of each economic sector given the relative importance in the economy (within effect); and (ii) an allocation effect (between-industries effect) that captures the effects of changes in the relative size of sectors.

The *intra-industry productivity growth effect* of a given sector i takes positive (negative) values whenever the sector shows positive (negative) productivity growth. Its magnitude depends on the productivity growth rate and how large the sector is in relation to other sectors in the economy. Assuming that a sector i shows a productivity level above the national average, then the *allocation effect* will take positive (negative) values if the sector increases (decreases) in size. The relative size is determined by changes in the labour shares and relative output prices of sector i. By changes in relative output prices, we mean how much output prices in sector i change in relation to changes in the output prices of the whole economy.

FIGURE A.1: DECOMPOSITION OF SECTORAL CONTRIBUTION TO AGGREGATE PRODUCTIVITY GROWTH



Source: Authors, based on Tang and Wang (2004).

[13] Tang, J. and Wang, W. (2004). Sources of aggregate labour productivity growth in Canada and the United States. *Canadian Journal of Economics*, Volume 37, Number 2.

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