UNIVERSITY OF CAMBRIDGE

Cambridge Industrial Innovation Policy

Insights from Taiwan

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

About this report

This report analyses sectoral sources of labour productivity growth in Taiwan during the 1998–2019 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

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

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

Design by Ella Whellams, IfM Engage, University of Cambridge. Cover image: Adobe Stock

Copy-editing by Amanda George, Perfect Words.

Acknowledgements

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

Disclaimer

Cambridge, United Kingdom | 2022

Insights from Taiwan

Key messages

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

- Taiwan had the third-highest labour productivity level, from the sample of economies studied, at US$100,075 output per worker in 2017, behind Singapore and the United States.
- Taiwan also experienced steady labour productivity growth, 2.7% on average per year between 1998 and 2017, the fourth largest, behind China, Korea and Singapore. However, like the rest of the economies examined in this report, it experienced a slowdown in its productivity growth in the years after 2007.

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

- The sectors that made the largest contributions to Taiwan's aggregate labour productivity growth in 1998–2019 include: manufacturing (41.1%); wholesale and retail trade (20%); real estate activities (8.7%); financial and insurance activities (5.2%); and human health and social work activities (4.7%).
- The manufacture of electronic parts and components and of computers, electronic and optical products are the manufacturing sub-sectors that contribute the most to aggregate productivity growth because of their high productivity. Together, these industries accounted for 28% of the aggregate productivity growth seen in 1998–2019. The electronics industry plays a key role in Taiwan and the world economy. Taiwan holds a 30% market share of the world's semiconductor industry, and its market participation is even larger in specific segments, such as semiconductor foundries (more than 70%) and integrated circuits (more than 50%).

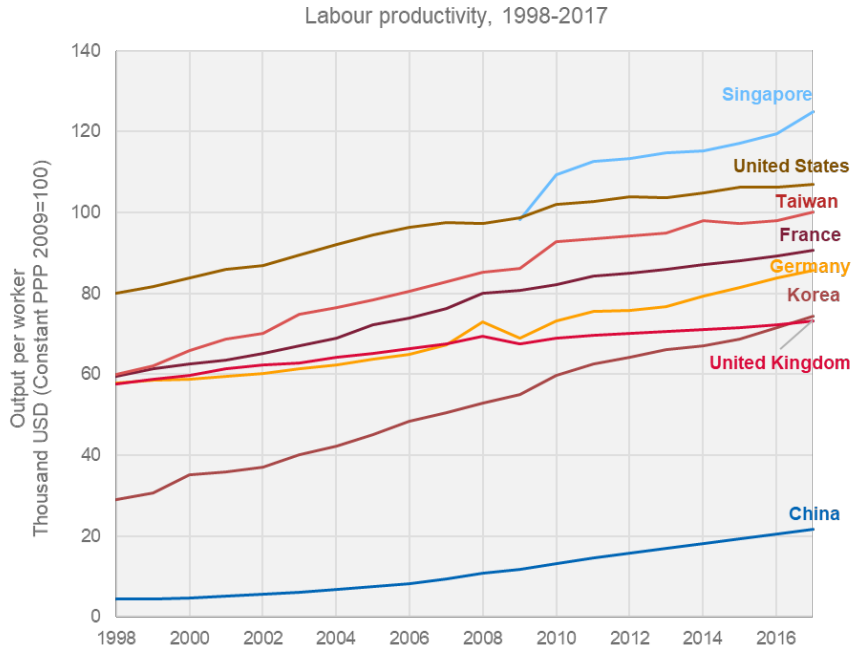
How do sectoral dynamics explain recent trends in aggregate productivity growth?

- The lower productivity growth experienced in Taiwan in the post-crisis period is mainly explained by slower growth across all sectors. However, changes in the structure of the economy have also slowed down aggregate productivity growth.
- Manufacturing is the sector that contributes the most to this trend. Because of the contraction of its employment shares (-6.05 percentage points) and relative output prices (-35 percentage points), the sector made a negative contribution to aggregate productivity growth of -0.7 percentage points per year, on average, between 1998 and 2019. The manufacture of electronic parts and components is the sub-sector that mainly contributes to this because of reductions in its relative output prices.
- Although the wholesale and retail trade sector has slower productivity growth and labour productivity levels, below the national average, its large size explains the sector's relatively large contributions to aggregate productivity growth.
- The shrinking of mining and quarrying, wholesale and retail trade, and information and communication (the latter because of reductions in relative output prices) have also slowed down aggregate productivity growth.
- In comparison, expansions of service activities with relatively higher productivity levels (e.g. professional, scientific and technical activities) or increases in relative output prices (e.g. human health and social work activities) have resulted in positive contributions to aggregate productivity growth.

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

Taiwan had the third-highest labour productivity level from the sample of economies studied,[1] at US$100,075 output per worker[2] in 2017, behind that observed in Singapore and the United States. Taiwan also experienced steady labour productivity growth, at 2.7%, on average, per year between 1998 and 2017, the fourth largest, behind China, Korea and Singapore (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%

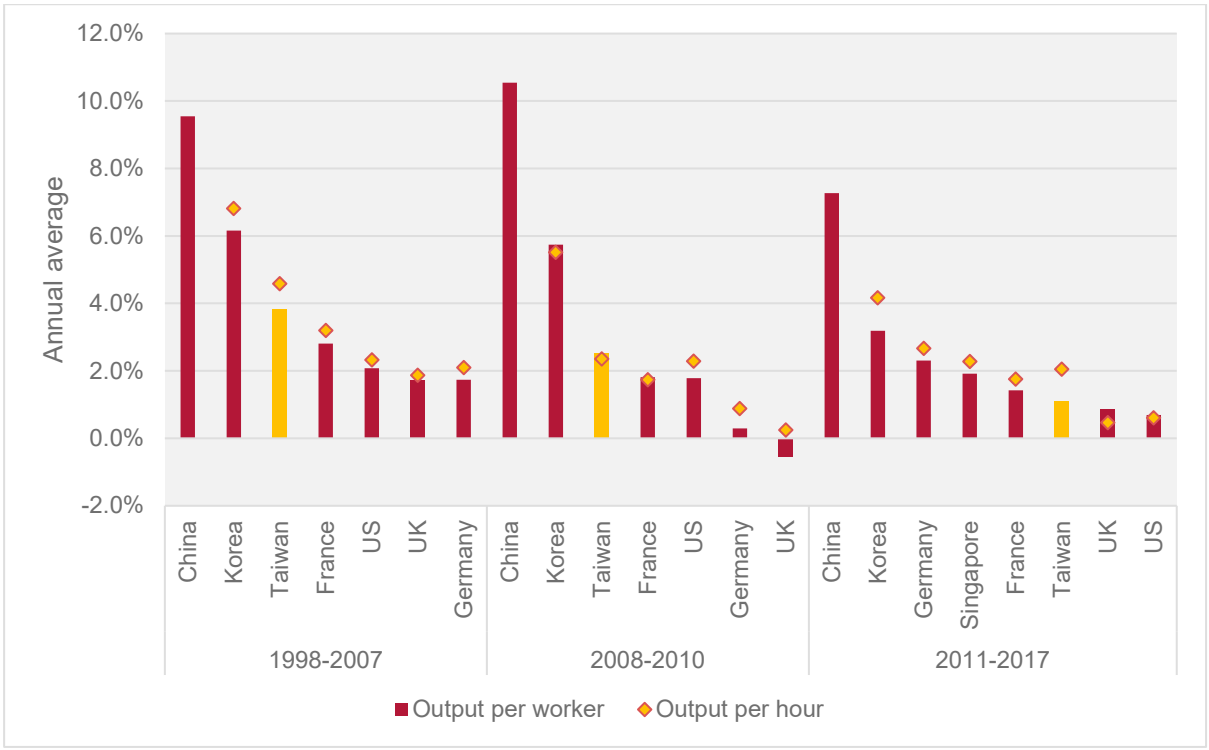
Note: [1/] The 2010–17 period for Singapore.

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.

Despite this sustained growth, Taiwan's labour productivity growth experienced a slowdown from a rate of 4.6% in 1998–2007 (measured as output per hour) to 2.1% in 2011–17 (Figure 2).

[1] China, France, Germany, Korea, Taiwan, Singapore, the United Kingdom and the United States.
[2] Constant purchasing power parity (PPP), 2009 = 100.

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 Taiwan's aggregate labour productivity growth?

The sectors that made the largest contributions to Taiwan's aggregate labour productivity growth in 1998–2019 include: manufacturing (41.1%); wholesale and retail trade (20%); real estate activities (8.7%); financial and insurance activities (5.2%); and human health and social work activities (4.7%).

In the decade before the global financial crisis (1998–2017) manufacturing (36.5%), wholesale and retail trade (25.9%), real estate activities (8.5%), information and communication (5.8%) and financial and insurance activities (5.1%) were the sectors that made the largest contributions to aggregate productivity growth.

During and in the aftermath of the crisis (2008–10) these sectors saw a reduction in their contributions in absolute terms (percentage points), and, in the case of wholesale and retail trade, information and communication, and financial and insurance activities, they also experienced a reduction in relative terms. In comparison, electricity, gas, steam and air conditioning supply (6.6%), and accommodation and food service activities (6.4%), increased their relevance in aggregate productivity growth.

In the post-crisis period (2011–19), manufacturing (48.6%) and financial and insurance activities (10.5%) increased their relative contributions to labour aggregate productivity, but in absolute terms, these are about half of those seen in the pre-crisis period (Figure 3).

FIGURE 3: TOP FIVE SECTORS CONTRIBUTING TO TAIWAN'S AGGREGATE PRODUCTIVITY GROWTH (1998–2019)

Taiwan: top five sectors
(based on their contribution to aggregate productivity growth measured as output per hour)

Pre-crisis (1998–2007)
Aggregate productivity growth rate: 4.2%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	36.5	1.55
Wholesale and retail trade	25.9	1.10
Real estate activities	8.5	0.36
Information and communication	5.8	0.25
Financial and insurance activities	5.1	0.22

Crisis (2008–2010)
Aggregate productivity growth rate: 2.2%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	46.8	1.05
Real estate activities	14.9	0.33
Wholesale and retail trade	10.9	0.24
Electricity, gas, steam and air conditioning supply	6.6	0.15
Accommodation and food service activities	6.4	0.14

Post-crisis (2011–2019)
Aggregate productivity growth rate: 1.8%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	48.6	0.87
Financial and insurance activities	10.5	0.19
Wholesale and retail trade	7.4	0.13
Accommodation and food service activities	7.0	0.13
Real estate activities	6.2	0.11

Whole period (1998–2019)
Aggregate productivity growth rate: 2.9%

Sector	% of aggregate productivity growth	Percentage points
Manufacturing	41.1	1.20
Wholesale and retail trade	20.0	0.59
Real estate activities	8.7	0.26
Financial and insurance activities	5.2	0.15
Human health and social work activities	4.7	0.14

Note: Because of the unavailability of data on employment, productivity growth decomposition excludes the following sectors: agriculture, forestry and fishing; public administration and defence; compulsory social security; and education (1998–2008).

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

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.

In Taiwan productivity growth is mostly explained by inter-industry productivity growth during the period of 1998–2019. Allocation effects during this period were negative, particularly during the sub-period 1998–2007, when these represented 20% of Taiwan's aggregate productivity growth. However, during the sub-period of 2011–19 allocation effects were positive, accounting for 6.9% (0.1 percentage points) of aggregate productivity growth (1.8%) (Figure 4).

FIGURE 4: DECOMPOSITION OF TAIWAN'S AGGREGATE PRODUCTIVITY GROWTH (1998–2019)

Note: Productivity growth decomposition does not add to the aggregate rate because of a lack of employment data for the education sector before 2009.

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

The productivity growth decomposition was also conducted, excluding sectors that traditionally involve a large non-market component (real estate, education, and human health and social activities). Table 9 presents the results of this decomposition for the period of 1998–2019. Key highlights include a larger aggregate intra-industry productivity growth effect (3.9 percentage

[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.

points) and less negative aggregate allocation effect (-0.28 percentage points), both largely explained by larger (or less negative) contributions from the manufacturing and the wholesale and retail trade sectors.

As mentioned in Section 2, the sectors that contributed the most to Taiwan's aggregate productivity growth in 1998–2019 include: manufacturing; wholesale and retail trade; real estate activities; financial and insurance activities; and human health and social work activities. With the exception of human health and social work activities, the contributions of these sectors are mainly explained by their high productivity growth, weighted by the size of the sectors (intra-industry productivity growth effect) (Table 6).

Manufacturing and information and communication are the economic sectors that experienced the fastest productivity growth (measured as output per hour) between 1998 and 2019. Manufacturing productivity observed an increase of 6.2% (annual average), while the labour productivity of information and communication activities increased by 5.5% (Table 1). However, these sectors observed among the largest slowdowns in their productivity growth in the years after 2007.

Within the manufacturing sector, the industries that experienced the fastest productivity growth include (productivity annual growth, 1998–2019): the manufacture of electronic parts and components (11.2%); the manufacture of computers, electronic and optical products (8.2%); the manufacture of chemicals (6.4%); the manufacture of basic metals (5.7%); the manufacture of other non-metallic mineral products (5.7%); and the manufacture of other chemical products (4.4%).

During the financial crisis of 2008 the sectors that were mainly impacted in their productivity growth include (in brackets, average annual growth of output per hour in 2008–10): construction (-3.3%); professional, scientific and technical activities (-3.3%); administrative and support service activities (-2.5%); and accommodation and food service activities (-2.5%) (Table 1).

In the subsequent decade (2011–19), further reductions were observed in the productivity growth of Taiwan's economy. The sectors that experienced the largest reductions in their productivity growth from 1998–2007 to 2011–19 include: other service activities; water supply; real estate; information and communication; manufacturing; and professional, scientific and technical activities (Table 1).

Within the manufacturing sector, the manufacture of electronic parts and components, the manufacture of chemicals, the manufacture of computers, electronic and optical products and the manufacture of other non-metallic mineral products are among the sub-sectors that showed the largest decline in productivity growth in the last decade (Table 2).

Changes in the structure of Taiwan's economy have had negative impacts on aggregate productivity growth, particularly during the sub-periods of analysis, 1998–2007 and 2008–10. Manufacturing is the sector that contributes the most to this trend. Because of the contraction in its employment shares (-6.05 percentage points) and relative output prices (-35 percentage points), the sector made a negative contribution to aggregate productivity growth of -0.7 percentage points per year, on average, between 1998 and 2019 (Figure 5 and Table 5).

Within manufacturing, the sub-sectors that contributed the most to these negative allocation effects include (in brackets, allocation effect, annual average 1998–2019): the manufacture of

electronic parts and components (-0.26 percentage points); the manufacture of computers, electronic and optical products (-0.13 percentage points); the manufacture of other non-metallic mineral products (-0.05 percentage points); the manufacture of coke and refined petroleum products (-0.04 percentage points); and the manufacture of chemicals (-0.04 percentage points).

In the case of the manufacture of electronic parts and components and of computers, electronic and optical products, the large negative effects are explained by reductions in relative output prices. However, these manufacturing sub-sectors contributed the most to aggregate productivity growth because of their high productivity growth. Together, these industries accounted for 28% of the aggregate productivity growth seen in 1998–2019.

The semiconductor industry plays a key role in the Taiwanese and the world economy. In 2019 the semiconductor industry accounted for 28% of the total valued added of Taiwan's economy. Taiwan holds a 30% market share of the world's semiconductor industry, and its market share is even larger in specific segments, such as semiconductor foundries (more than 70%) and integrated circuits (more than 50%). It is also ranked second, after the US, in chip design, with a global market share of more than 18%.[4]

Taiwan is home to the world's largest semiconductor foundry, the Taiwan Semiconductor Manufacturing Company (TSMC), and the largest integrated circuit packaging and testing firm, Advanced Semiconductor Engineering, Inc. (ASE). The semiconductors industry has been a priority in national development plans since the 1970s, when the Industrial Technology Research Institute of Taiwan (ITRI) was established. Since then, ITRI has led the development of the semiconductor industry and the creation of successful spin-off companies, such as TSMC. In the 1980s and the decades that followed, further government support was provided to this sector, including grants, subsidies, tax incentives and additional investments in research and industry infrastructure.[5]

In the aftermath of the global financial crisis and the decade that followed, mining and quarrying and wholesale and retail trade saw reductions in their size (output, employment and output prices), leading to negative impacts on aggregate productivity growth. Reductions in the relative output prices of the information and communication sector along the whole period of analysis (1998–2019) have also slowed down productivity growth.

In comparison, sectors that have expanded their employment shares include (in brackets, change in employment shares 1998–2019): accommodation and food service activities (3.40); administrative and support service activities (3.21); human health and social work activities (2.51); education (1.75); and professional, scientific and technical activities (0.87) (Table 6).

For service activities with relatively high productivity levels (e.g. professional, scientific and technical activities) or increases in relative output prices (e.g. human health and social work activities), these expansions in employment shares have resulted in positive contributions to aggregate productivity growth via allocation effects.

[4] Chang, M.F., Lin, C. and Shen, C.H. et al. (2021). The role of government policy in the building of a global semiconductor industry. *Nat. Electron.* 4, 230–233. https://doi.org/10.1038/s41928-021-00575-z
[5] Ibid.

TABLE 1: TAIWAN: PRODUCTIVITY LEVELS AND GROWTH RATES BY SECTOR, 1998–2019

Economic sector	Output per hour							
	1998–2007		2008–2010		2011–2019		1998–2019	
	Average absolute value (NT$, chained 2016)	Average annual growth	Average absolute value (NT$, chained 2016)	Average annual growth	Average absolute value (NT$, chained 2016)	Average annual growth	Average absolute value (NT$, chained 2016)	Average annual growth
Mining and quarrying	1,233.1	-0.2%	1,248.0	12.6%	1,568.2	1.0%	1,372.2	2.1%
Manufacturing	416.6	7.9%	668.5	7.4%	914.5	3.8%	654.6	6.2%
Electricity, gas, steam and air conditioning supply	3,261.0	3.5%	3,992.1	7.8%	4,521.8	0.3%	3,876.5	2.8%
Water supply; sewerage, waste management and remediation activities	1,241.0	6.2%	1,639.7	2.2%	1,595.3	-0.4%	1440.3	3.0%
Construction	477.7	2.1%	436.7	-3.3%	442.3	0.4%	457.6	0.7%
Wholesale and retail trade; repair of motor vehicles and motorcycles	623.6	4.4%	759.6	1.6%	825.1	1.6%	724.6	2.9%
Transportation and storage	643.2	5.5%	777.5	1.1%	847.4	1.6%	745.1	3.3%
Accommodation and food service activities	735.9	0.6%	579.7	-2.5%	520.4	-1.7%	626.5	-0.8%
Information and communication	863.1	8.9%	1,076.6	3.2%	1,247.5	2.4%	1,049.5	5.5%
Financial and insurance activities	1,063.8	2.6%	1,181.7	0.0%	1,459.7	3.3%	1,241.9	2.5%
Real estate activities	6,180.0	6.3%	6,567.1	0.1%	6,017.0	-0.4%	6,166.1	2.7%
Professional, scientific and technical activities	711.4	3.8%	715.4	-3.3%	716.5	-0.3%	714.0	1.1%
Administrative and support service activities	356.6	0.0%	288.1	-2.5%	336.8	3.4%	339.2	1.0%
Education	N/A	N/A	N/A	N/A	6,186.4	-4.7%	6,109.1	-3.8%
Human health and social work activities	884.9	-0.6%	764.0	-1.0%	726.4	-1.5%	803.6	-1.0%
Arts, entertainment and recreation	1,118.7	2.1%	1,011.9	1.7%	1,079.4	1.2%	1088.1	1.7%
Other service activities	1,519.9	6.3%	1,938.2	4.5%	1,894.5	-0.5%	1,730.2	3.3%
Whole economy (A and O sections excluded)	701.0	4.6%	856.7	2.4%	980.4	1.8%	836.6	3.1%

Note: N/A, not applicable.

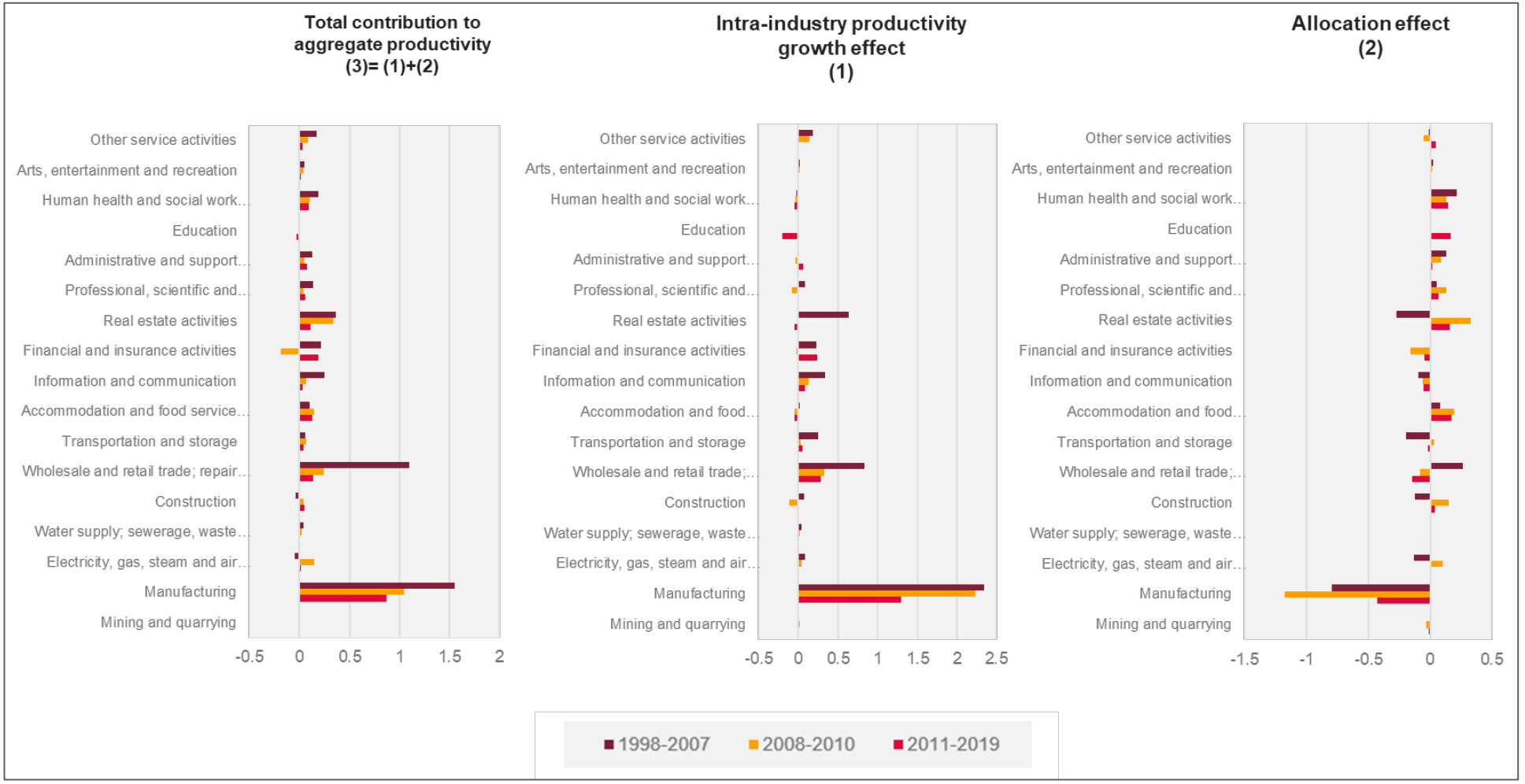
Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

TABLE 2: TAIWAN: PRODUCTIVITY LEVELS AND GROWTH BY MANUFACTURING SUB-SECTORS, 1998–2019

Manufacturing sub-sector	Output per hour							
	1998–2007		2008–2010		2011–2019		1998–2019	
	Average absolute value (NT$, chained 2016)	Average annual growth	Average absolute value (NT$, chained 2016)	Average annual growth	Average absolute value (NT$, chained 2016)	Average annual growth	Average absolute value (NT$, chained 2016)	Average annual growth
Manufacture of food products	460.0	3.5%	548.7	0.3%	526.9	-0.1%	499.5	1.6%
Manufacture of textiles	404.2	3.4%	468.6	2.6%	461.3	-0.6%	436.3	1.7%
Manufacture of wearing apparel	435.8	-3.1%	314.2	1.8%	415.0	3.5%	410.7	0.3%
Manufacture of leather and related products	304.2	3.2%	374.0	3.7%	384.7	-0.1%	346.6	1.9%
Manufacture of wood and of products of wood and cork	285.9	5.1%	309.8	-3.1%	335.7	1.0%	309.5	2.3%
Manufacture of paper and paper products	349.2	6.9%	428.0	-2.8%	467.4	2.1%	408.3	3.6%
Printing and reproduction of recorded media	242.8	7.8%	307.0	-1.1%	328.5	0.7%	286.6	3.7%
Manufacture of coke and refined petroleum products	10,002.1	9.8%	12,022.6	-2.0%	9,208.3	-4.2%	9,952.9	2.5%
Manufacture of chemicals	1,109.1	9.8%	1858.1	5.7%	2,462.7	2.8%	1,765.0	6.4%
Manufacture of other chemical products	446.8	4.9%	593.2	5.5%	837.6	3.4%	626.6	4.4%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	598.7	5.4%	829.0	-0.3%	730.3	-1.2%	683.9	1.9%
Manufacture of rubber products	541.7	3.2%	706.0	5.1%	604.3	-3.6%	589.7	0.7%
Manufacture of plastic products	335.0	1.8%	339.0	1.0%	465.3	3.8%	388.8	2.5%
Manufacture of other non-metallic mineral products	297.5	6.9%	557.6	13.2%	775.9	1.9%	528.7	5.7%
Manufacture of basic metals	490.5	4.9%	574.4	4.8%	962.4	7.0%	695.0	5.7%
Manufacture of fabricated metal products, except machinery and equipment	380.9	-0.3%	358.6	1.8%	450.4	2.6%	406.3	1.2%
Manufacture of electronic parts and components	370.9	14.4%	831.6	13.1%	1,418.6	7.2%	862.3	11.2%
Manufacture of computers, electronic and optical products	532.1	10.3%	1,007.9	11.6%	1,433.9	4.6%	965.9	8.2%
Manufacture of electrical equipment	590.0	2.0%	558.6	-1.8%	631.0	1.4%	602.5	1.2%
Manufacture of machinery and equipment n.e.c.	466.5	4.6%	596.9	5.7%	618.1	-0.8%	546.3	2.5%
Manufacture of motor vehicles, trailers and semi-trailers	803.7	3.5%	804.5	2.4%	821.9	-0.6%	811.3	1.7%
Manufacture of other transport equipment	554.0	4.3%	697.0	-2.0%	655.3	0.8%	614.9	2.0%
Manufacture of furniture	366.1	2.1%	421.8	3.2%	375.0	-2.5%	377.3	0.4%
Other manufacturing	545.4	4.8%	675.5	-0.1%	768.3	3.3%	654.3	3.5%
Total manufacturing	416.6	7.9%	668.5	7.4%	914.5	3.8%	654.6	6.2%

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

FIGURE 5: TAIWAN: SECTORAL CONTRIBUTION TO TAIWAN'S AGGREGATE PRODUCTIVITY GROWTH, SELECTED SECTORS 1998–2019



Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

TABLE 3: TAIWAN: 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)	
Mining and quarrying	0.35%	0.20%	0.20%	0.07%	-0.15	-0.12	100.88	0.00	0.00	0.00	-0.16%
Manufacturing	29.21%	31.59%	41.22%	38.95%	2.38	-2.26	-22.71	2.34	-0.79	1.55	7.91%
Electricity, gas, steam and air conditioning supply	2.59%	1.15%	0.49%	0.43%	-1.43	-0.07	-40.49	0.08	-0.13	-0.05	3.49%
Water supply; sewerage, waste management and remediation activities	0.58%	0.74%	0.41%	0.38%	0.16	-0.03	10.28	0.04	0.01	0.04	6.24%
Construction	4.56%	3.02%	8.21%	6.51%	-1.53	-1.70	6.13	0.08	-0.12	-0.04	2.08%
Wholesale and retail trade; repair of motor vehicles and motorcycles	18.04%	19.77%	22.31%	22.89%	1.73	0.58	8.34	0.83	0.27	1.10	4.39%
Transportation and storage	4.98%	3.54%	4.77%	4.03%	-1.44	-0.74	-25.38	0.25	-0.19	0.06	5.46%
Accommodation and food service activities	2.18%	2.11%	2.80%	3.92%	-0.08	1.12	6.31	0.01	0.08	0.10	0.58%
Information and communication	3.65%	3.82%	2.38%	2.55%	0.17	0.18	-45.26	0.34	-0.10	0.25	8.91%
Financial and insurance activities	9.53%	8.06%	5.93%	5.69%	-1.47	-0.24	-1.08	0.22	-0.01	0.22	2.58%
Real estate activities	9.99%	9.35%	1.64%	1.26%	-0.64	-0.39	5.11	0.63	-0.27	0.36	6.34%
Professional, scientific and technical activities	2.20%	2.52%	2.93%	2.98%	0.31	0.05	16.73	0.08	0.05	0.14	3.75%
Administrative and support service activities	0.91%	1.56%	1.76%	4.16%	0.65	2.40	8.61	-0.01	0.13	0.12	-0.04%
Education	4.64%	5.55%	N/A	N/A	0.91	N/A	23.26	N/A	N/A	N/A	N/A
Human health and social work activities	2.76%	3.11%	2.81%	4.00%	0.36	1.20	21.65	-0.02	0.21	0.19	-0.58%
Arts, entertainment and recreation	0.95%	0.93%	0.65%	0.84%	-0.02	0.20	2.25	0.02	0.03	0.05	2.07%
Other service activities	2.88%	2.98%	1.49%	1.33%	0.10	-0.17	9.35	0.18	-0.01	0.17	6.34%
Whole economy (A and O sectors excluded)	100%	100%	100%	100%	N/A	N/A	N/A	5.09	-0.84	4.24[1/]	4.58%

Note: N/A, not applicable. [1/] Productivity growth decomposition does not add to the aggregate rate because of a lack of employment data for the education sector before 2009. Sector 'A' corresponds to agriculture, forestry and fishing and sector 'O' corresponds to public administration and defence; compulsory social security. Sectors excluded because of a lack of data.

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

TABLE 4: TAIWAN: 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)	
Mining and quarrying	0.21%	0.15%	0.07%	0.06%	-0.05	-0.01	-79.79	0.02	-0.03	-0.01	12.57%
Manufacturing	30.59%	32.50%	38.56%	37.29%	1.91	-1.27	-3.60	2.23	-1.18	1.05	7.36%
Electricity, gas, steam and air conditioning supply	0.35%	1.48%	0.42%	0.43%	1.13	0.01	52.42	0.04	0.10	0.15	7.81%
Water supply; sewerage, waste management and remediation activities	0.76%	0.76%	0.39%	0.39%	0.00	0.00	4.15	0.02	0.01	0.03	2.21%
Construction	3.10%	2.95%	6.47%	6.52%	-0.15	0.05	2.78	-0.11	0.15	0.04	-3.30%
Wholesale and retail trade; repair of motor vehicles and motorcycles	20.31%	19.14%	22.65%	22.17%	-1.17	-0.48	-0.55	0.33	-0.08	0.24	1.63%
Transportation and storage	3.42%	3.50%	3.93%	3.84%	0.08	-0.10	9.10	0.03	0.03	0.07	1.08%
Accommodation and food service activities	2.25%	2.37%	4.14%	4.49%	0.12	0.34	4.71	-0.05	0.20	0.14	-2.50%
Information and communication	3.97%	3.76%	2.58%	2.60%	-0.22	0.02	-9.37	0.13	-0.06	0.07	3.25%
Financial and insurance activities	7.97%	7.01%	5.64%	5.33%	-0.96	-0.32	-3.51	-0.03	-0.16	-0.19	-0.01%
Real estate activities	9.73%	9.65%	1.27%	1.31%	-0.08	0.05	1.90	0.01	0.33	0.33	0.09%
Professional, scientific and technical activities	2.55%	2.47%	3.07%	3.25%	-0.08	0.18	1.33	-0.08	0.13	0.04	-3.31%
Administrative and support service activities	1.69%	1.59%	4.57%	4.79%	-0.09	0.23	-0.95	-0.04	0.09	0.05	-2.54%
Education	5.75%	5.49%	N/A	1.07%	-0.26	1.07	0.83	N/A	N/A	N/A	N/A
Human health and social work activities	3.25%	3.18%	4.11%	4.35%	-0.07	0.23	1.73	-0.03	0.13	0.10	-0.95%
Arts, entertainment and recreation	0.98%	0.97%	0.84%	0.86%	0.00	0.03	2.15	0.02	0.02	0.04	1.75%
Other service activities	3.12%	3.01%	1.29%	1.25%	-0.11	-0.03	0.77	0.14	-0.06	0.08	4.51%
Whole economy (A and O sections excluded)	100%	100%	100%	100%	N/A	N/A	N/A	2.62	-0.38	2.24[1/]	2.35%

Note: N/A, not applicable. [1/] Productivity growth decomposition does not add to the aggregate rate because of a lack of employment data for the education sector before 2009. Sector 'A' corresponds to agriculture, forestry and fishing and sector 'O' corresponds to public administration and defence; compulsory social security. Sectors excluded because of a lack of data.

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

TABLE 5: TAIWAN: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH, 2011–2019

Economic sector	Output shares		Employment shares		Structural change (2011–19, percentage points)			Contribution to productivity growth (2011–19, average, percentage points)			Labour productivity growth (2011–19)
	2011	2019	2011	2019	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Mining and quarrying	0.1%	0.1%	0.1%	0.04%	-0.07	-0.02	-29.79	0.00	-0.01	-0.01	1.04%
Manufacturing	32.1%	34.7%	37.5%	35.17%	2.59	-2.29	-1.37	1.30	-0.43	0.87	3.84%
Electricity, gas, steam and air conditioning supply	1.0%	1.3%	0.4%	0.40%	0.32	-0.02	24.04	0.01	0.00	0.01	0.29%
Water supply; sewerage, waste management and remediation activities	0.8%	0.7%	0.4%	0.41%	-0.12	0.03	-6.70	0.00	0.00	0.00	-0.44%
Construction	3.0%	3.0%	6.4%	5.79%	-0.08	-0.63	18.41	0.01	0.04	0.05	0.44%
Wholesale and retail trade; repair of motor vehicles and motorcycles	19.5%	17.4%	22.1%	21.00%	-2.04	-1.08	-4.46	0.28	-0.15	0.13	1.60%
Transportation and storage	3.2%	3.3%	3.8%	3.73%	0.10	-0.08	3.33	0.06	-0.01	0.04	1.64%
Accommodation and food service activities	2.6%	3.1%	4.7%	6.20%	0.43	1.54	21.01	-0.05	0.17	0.13	-1.71%
Information and communication	3.7%	3.5%	2.6%	2.87%	-0.21	0.27	-25.46	0.08	-0.05	0.03	2.39%
Financial and insurance activities	7.2%	7.5%	5.2%	4.80%	0.30	-0.43	-4.39	0.24	-0.05	0.19	3.28%
Real estate activities	9.7%	9.2%	1.4%	1.47%	-0.54	0.07	1.19	-0.05	0.16	0.11	-0.43%
Professional, scientific and technical activities	2.5%	2.6%	3.3%	3.80%	0.11	0.46	6.66	-0.01	0.07	0.06	-0.27%
Administrative and support service activities	1.6%	2.0%	4.8%	4.98%	0.38	0.20	3.55	0.06	0.02	0.08	3.40%
Education	5.5%	4.4%	1.0%	1.7%	-1.13	0.70	-2.12	-0.20	0.16	-0.03	-4.67%
Human health and social work activities	3.3%	3.5%	4.3%	5.3%	0.19	1.03	15.15	-0.05	0.14	0.09	-1.51%
Arts, entertainment and recreation	1.0%	1.0%	0.8%	0.9%	-0.02	0.05	5.96	0.01	0.00	0.02	1.17%
Other service activities	3.0%	2.8%	1.2%	1.4%	-0.21	0.19	3.73	-0.02	0.05	0.03	-0.54%
Whole economy (A and O sections excluded)	100%	100%	100%	100%	N/A	N/A	N/A	1.67	0.12	1.80	1.80%

Note: N/A, not applicable. Sector 'A' corresponds to agriculture, forestry and fishing and sector 'O' corresponds to public administration and defence; compulsory social security. Sectors excluded because of a lack of data.

Source: Authors' computation, based on data from Taiwan Statistical Bureau.

TABLE 6: TAIWAN: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH, 1998–2019

Economic sector	Output shares		Employment shares		Structural change (1998–19, percentage points)			Contribution to productivity growth (1998–2019, average, percentage points)			Labour productivity growth (1998–2019)
	1998	2019	1998	2019	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Mining and quarrying	0.35%	0.07%	0.20%	0.04%	-0.28	-0.16	19.04	0.00	-0.01	-0.01	2.07%
Manufacturing	29.21%	34.72%	41.22%	35.17%	5.52	-6.05	-35.04	1.90	-0.70	1.20	6.17%
Electricity, gas, steam and air conditioning supply	2.59%	1.32%	0.49%	0.40%	-1.26	-0.09	-33.20	0.05	-0.05	0.00	2.77%
Water supply; sewerage, waste management and remediation activities	0.58%	0.66%	0.41%	0.41%	0.08	0.00	14.23	0.02	0.01	0.02	2.96%
Construction	4.56%	2.96%	8.21%	5.79%	-1.60	-2.42	43.79	0.03	-0.02	0.01	0.68%
Wholesale and retail trade; repair of motor vehicles and motorcycles	18.04%	17.44%	22.31%	21.00%	-0.60	-1.31	7.98	0.54	0.05	0.59	2.87%
Transportation and storage	4.98%	3.34%	4.77%	3.73%	-1.64	-1.04	-21.17	0.14	-0.09	0.05	3.30%
Accommodation and food service activities	2.18%	3.06%	2.80%	6.20%	0.87	3.40	42.74	-0.02	0.14	0.12	-0.77%
Information and communication	3.65%	3.46%	2.38%	2.87%	-0.19	0.50	-80.92	0.21	-0.07	0.13	5.47%
Financial and insurance activities	9.53%	7.54%	5.93%	4.80%	-1.99	-1.13	-2.08	0.19	-0.04	0.15	2.51%
Real estate activities	9.99%	9.17%	1.64%	1.47%	-0.82	-0.17	14.12	0.27	-0.01	0.26	2.72%
Professional, scientific and technical activities	2.20%	2.60%	2.93%	3.80%	0.40	0.87	31.37	0.02	0.07	0.09	1.15%
Administrative and support service activities	0.91%	2.01%	1.76%	4.98%	1.10	3.21	15.91	0.01	0.08	0.10	1.03%
Education[1/]	4.64%	4.40%		1.75%	-0.23	1.75	25.65	-0.15	0.10	-0.05	-3.83%
Human health and social work activities	2.76%	3.47%	2.81%	5.32%	0.71	2.51	42.30	-0.04	0.17	0.14	-1.01%
Arts, entertainment and recreation	0.95%	0.96%	0.65%	0.87%	0.01	0.22	16.13	0.02	0.02	0.03	1.66%
Other service activities	2.88%	2.81%	1.49%	1.41%	-0.07	-0.09	19.52	0.09	0.01	0.10	3.28%
Whole economy (A and O sections excluded)	100%	100%	100%	100%	N/A	N/A	N/A	3.28	-0.35	2.9[2/]	3.14%

Note: N/A, not applicable. [1/] Data for education sector only available from 2009 onwards. Productivity growth decomposition does not add to the aggregate rate because of a lack of employment data for the education sector from 1998 to 2008. Sector 'A' corresponds to agriculture, forestry and fishing and sector 'O' corresponds to public administration and defence; compulsory social security. Sectors excluded because of a lack of data.

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

TABLE 7: TAIWAN: CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH BY MANUFACTURING SUB-SECTORS, 1998–2019

Manufacturing sub-sector	1998–2007 (average, percentage points)			2008–2010 (average, percentage points)			2011–2019 (average, percentage points)			1998–2019 (average, percentage points)		
	Intra-industry productivity growth effect	Allocation effect	Total	Intra-industry productivity growth effect	Allocation effect	Total	Intra-industry productivity growth effect	Allocation effect	Total	Intra-industry productivity growth effect	Allocation effect	Total
Manufacture of food products	0.03	-0.05	-0.02	0.00	0.05	0.06	0.00	0.04	0.04	0.01	0.00	0.02
Manufacture of textiles	0.04	-0.08	-0.04	0.02	-0.02	0.00	0.00	0.01	0.01	0.02	-0.03	-0.02
Manufacture of wearing apparel	-0.01	0.00	-0.01	0.00	0.00	0.01	0.01	-0.01	0.00	0.00	0.00	0.00
Manufacture of leather and related products	0.00	-0.01	-0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Manufacture of wood and of products of wood and cork	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manufacture of paper and paper products	0.03	-0.03	0.00	-0.01	0.03	0.02	0.01	0.00	0.00	0.02	-0.01	0.01
Printing and reproduction of recorded media	0.03	-0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	-0.01	0.01
Manufacture of coke and refined petroleum products	0.16	-0.08	0.09	-0.05	-0.13	-0.18	-0.04	0.04	-0.01	0.05	-0.04	0.01
Manufacture of chemicals	0.19	-0.11	0.08	0.07	0.21	0.28	0.04	-0.03	0.01	0.11	-0.04	0.08
Manufacture of other chemical products	0.02	-0.01	0.01	0.03	0.01	0.04	0.02	0.00	0.02	0.02	0.00	0.02
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.01	0.00	0.02	0.00	0.02	0.02	0.00	0.01	0.01	0.00	0.01	0.01
Manufacture of rubber products	0.01	0.00	0.01	0.01	-0.01	0.01	-0.01	0.02	0.01	0.00	0.01	0.01
Manufacture of plastic products	0.02	-0.07	-0.05	0.01	0.05	0.06	0.03	0.01	0.04	0.02	-0.02	0.00
Manufacture of other non-metallic mineral products	0.07	-0.04	0.03	0.14	-0.12	0.03	0.02	-0.05	-0.03	0.06	-0.05	0.01
Manufacture of basic metals	0.07	0.04	0.11	0.07	-0.04	0.04	0.11	-0.11	0.00	0.09	-0.03	0.06
Manufacture of fabricated metal products, except machinery and equipment	0.00	0.04	0.04	0.02	0.05	0.07	0.05	0.02	0.07	0.02	0.03	0.06
Manufacture of electronic parts and components	0.95	0.01	0.96	1.33	-1.07	0.25	0.82	-0.30	0.51	0.94	-0.26	0.68
Manufacture of computers, electronic and optical products	0.32	-0.10	0.22	0.41	-0.20	0.22	0.18	-0.15	0.03	0.27	-0.13	0.14
Manufacture of electrical equipment	0.02	0.00	0.02	-0.02	0.06	0.04	0.01	-0.01	0.01	0.01	0.00	0.02
Manufacture of machinery and equipment	0.06	0.03	0.09	0.07	-0.04	0.03	-0.02	0.08	0.06	0.03	0.04	0.07
Manufacture of motor vehicles, trailers and semi-trailers	0.04	-0.02	0.01	0.02	0.00	0.02	-0.01	0.02	0.02	0.02	0.00	0.02
Manufacture of other transport equipment	0.02	-0.02	0.00	-0.02	0.03	0.01	0.00	0.01	0.02	0.01	0.00	0.01
Manufacture of furniture	0.00	-0.01	-0.01	0.00	-0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Other manufacturing	0.04	-0.03	0.01	0.00	0.02	0.02	0.03	0.01	0.03	0.03	-0.01	0.02
Total manufacturing	2.34	-0.79	1.55	2.23	-1.18	1.05	1.30	-0.43	0.87	1.90	-0.70	1.20

Note: N/A, not applicable.

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

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

Manufacturing sub-sector	Change, 1998–2007, percentage points			Change, 2008–2010, percentage points			Change, 2011–2019, percentage points			Change, 1998–2019, 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
Manufacture of food products	-0.19	-0.28	-1.13	0.09	0.10	11.00	2.59	0.15	31.94	0.18	-0.01	44.86
Manufacture of textiles	-0.78	-1.02	-10.98	-0.01	-0.10	2.28	0.24	-0.27	16.87	-0.88	-1.49	20.19
Manufacture of wearing apparel	-0.40	-0.75	28.28	0.02	-0.06	15.89	-0.08	-0.15	-1.59	-0.42	-1.03	49.83
Manufacture of leather and related products	-0.15	-0.36	-17.37	0.00	-0.02	3.28	-0.03	-0.15	36.98	-0.16	-0.59	38.87
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-0.05	-0.18	-0.98	-0.01	-0.03	5.66	-0.02	-0.03	14.85	-0.06	-0.26	34.71
Manufacture of paper and paper products	-0.17	-0.25	-29.53	0.03	0.00	18.20	-0.01	-0.10	7.10	-0.16	-0.42	11.60
Printing and reproduction of recorded media	-0.01	0.00	-19.86	-0.01	-0.05	17.08	-0.01	-0.17	27.78	-0.06	-0.24	23.46
Manufacture of coke and refined petroleum products	0.02	-0.07	-4.14	0.28	-0.01	12.96	-0.05	-0.02	45.46	-0.83	-0.11	20.56
Manufacture of chemicals	0.23	-0.17	-18.21	1.47	-0.02	62.65	-0.02	-0.01	-13.88	0.60	-0.23	-11.84
Manufacture of other chemical products	-0.11	-0.09	-21.45	0.06	0.00	-1.78	0.15	-0.04	9.69	0.07	-0.11	-4.33
Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.06	0.00	8.90	0.04	0.05	3.92	0.09	0.03	8.70	0.09	0.09	26.73
Manufacture of rubber products	-0.05	-0.07	2.40	0.01	-0.03	1.70	0.00	0.00	40.99	-0.02	-0.10	47.54
Manufacture of plastic products	-0.90	-0.59	-37.06	0.07	-0.10	13.84	0.02	-0.20	18.16	-0.56	-1.06	12.98
Manufacture of other non-metallic mineral products	-0.14	-0.45	-2.09	-0.03	-0.01	-39.15	0.15	-0.15	-21.21	-0.52	-0.64	-72.36
Manufacture of basic metals	0.43	-0.09	51.40	-0.11	-0.03	-28.98	-0.39	-0.08	-65.94	0.15	-0.18	-24.60
Manufacture of fabricated metal products, except machinery and equipment	-0.62	0.00	8.42	-0.02	-0.21	2.84	-0.14	-0.19	14.32	-0.27	-0.47	37.90
Manufacture of electronic parts and components	5.95	3.13	-85.51	-0.36	-0.32	-28.68	0.12	-0.40	-5.96	8.63	2.77	-148.17
Manufacture of computers, electronic and optical products	0.68	0.42	-59.55	0.29	-0.18	-12.55	3.35	-0.32	-30.93	0.69	-0.08	-89.93
Manufacture of electrical equipment	-0.18	-0.68	27.82	0.12	0.05	10.41	-1.07	-0.25	10.77	-0.24	-0.91	49.11
Manufacture of machinery and equipment n.e.c.	0.26	0.27	-2.67	-0.01	-0.24	-2.70	-0.03	0.08	28.85	0.48	0.22	29.67
Manufacture of motor vehicles, trailers and semi-trailers	-0.38	-0.12	-13.52	0.08	-0.04	-0.87	0.15	-0.08	20.57	-0.38	-0.26	16.27
Manufacture of other transport equipment	-0.27	-0.17	-16.93	-0.12	-0.04	8.31	-0.05	0.03	7.50	-0.22	-0.17	9.55
Manufacture of furniture	-0.21	-0.33	-7.00	-0.02	-0.01	-3.50	0.03	0.01	43.10	-0.21	-0.38	39.08
Other manufacturing	-0.33	-0.33	-17.08	0.00	-0.02	4.11	0.02	0.00	0.31	-0.18	-0.37	-3.57
Total manufacturing	2.38	-2.26	-22.71	1.91	-1.27	-3.60	0.12	-2.29	-1.37	5.52	-6.05	-35.04

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

TABLE 9: TAIWAN: PRODUCTIVITY GROWTH DECOMPOSITION OF 'MARKET SECTORS', 1998–2019

Economic sector	All sectors			'Market' sectors		
	Contribution to productivity growth (1998–2019, average, percentage points)			Contribution to productivity growth (1998–2019, 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)
Mining and quarrying	0.00	-0.01	-0.01	0.00	-0.01	-0.01
Manufacturing	1.90	-0.70	1.20	2.32	-0.67	1.65
Electricity, gas, steam and air conditioning supply	0.05	-0.05	0.00	0.06	-0.05	0.01
Water supply; sewerage, waste management and remediation activities	0.02	0.01	0.02	0.02	0.01	0.03
Construction	0.03	-0.02	0.01	0.03	-0.01	0.03
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.54	0.05	0.59	0.65	0.17	0.82
Transportation and storage	0.14	-0.09	0.05	0.17	-0.09	0.08
Accommodation and food service activities	-0.02	0.14	0.12	-0.02	0.18	0.16
Information and communication	0.21	-0.07	0.13	0.25	-0.07	0.18
Financial and insurance activities	0.19	-0.04	0.15	0.24	-0.01	0.23
Real estate activities	0.27	-0.01	0.26	N/A	N/A	N/A
Professional, scientific and technical activities	0.02	0.07	0.09	0.03	0.10	0.13
Administrative and support service activities	0.01	0.08	0.10	0.02	0.11	0.12
Education	-0.15	0.10	-0.05	N/A	N/A	N/A
Human health and social work activities	-0.04	0.17	0.14	N/A	N/A	N/A
Arts, entertainment and recreation	0.02	0.02	0.03	0.02	0.03	0.04
Other service activities	0.09	0.01	0.10	0.11	0.02	0.14
Whole economy	3.28	-0.35	2.93	3.90	-0.28	3.62

Note: N/A, not applicable.

Source: Authors' computation, based on data from the Taiwan Statistical Bureau.

Appendix I. Definitions of variables and data sources

Variable	Measure, units	Source
Labour (hours)	Average monthly working hours (hours)	Taiwan Statistical Bureau (2021). Earnings database.
Labour (people)	Employee (persons), thousands	
Output (real values)	Gross value added, chained (2016), million NT$	Taiwan Statistical Bureau (2021). National Accounts
Output (nominal values)	Gross value added (current prices, million NT$)	

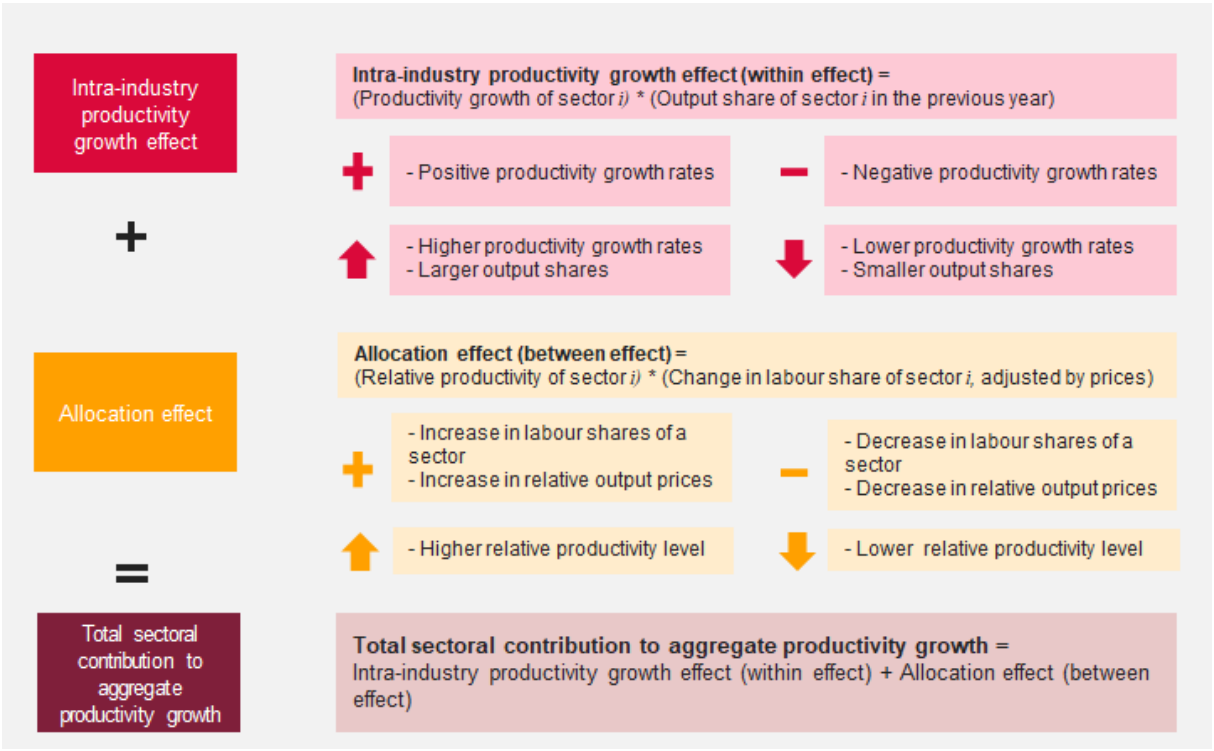
Appendix II. Decomposition of productivity growth

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 productivity growth rates in two main components, as described in Tang and Wang:[6] (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 changes in the relative size of sectors.

The *intra-industry productivity growth effect* takes positive (negative) values whenever sector i shows positive (negative) productivity growth. Its magnitude depends on the size of 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* takes positive (negative) values if the sector increases (decreases) in size. The relative size is also determined by changes in relative prices of the output of sector i, namely, how much output prices in sector i change in relation with 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).

[6] 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.

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