

Insights from Singapore

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



About this report

This report analyses sectoral sources of labour productivity growth in Singapore during the 2010–19 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.

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Key messages

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

- In 2017 Singapore had the highest labour productivity level among the economies analysed in this study.
- Singapore also had the fourth-fastest labour productivity growth in the 2011–17 period (with an average annual growth of 1.9% measured as output per worker and 2.1% measured as output per hour), behind that observed in China, Korea and Germany.

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

- The sectors that made the largest contributions to Singapore's aggregate productivity growth in the 2010–19 period include: financial and insurance activities (20.3%); manufacturing (18.6%); wholesale and retail trade (15.9%); other service activities (15.5%); and administrative and support services (11.3%).

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

- The contribution of the top sectors driving aggregate productivity growth in the 2010–19 period is mainly explained by their high productivity growth; however, changes in the relative size of sectors in the economy have also influenced aggregate productivity growth during this period.
- Manufacturing, wholesale and retail trade, and financial and insurance activities are the sectors that made the largest contributions via their intra-industry productivity effect (productivity growth weighted by output share). These sectors maintained productivity growth rates above 3% and output shares above 10% in the 2010–19 period.
- The contraction of manufacturing, wholesale and retail trade and construction have impacted aggregate productivity growth negatively. These sectors experienced a decline in employment shares from 2010 to 2019. Reductions in relative output prices also contribute to explaining the negative allocation effects observed in construction and wholesale and retail trade.
- Manufacturing plays a key role in Singapore's economy, with important spill-over effects in knowledge-intensive services, and it constitutes a priority in national industrial and innovation policy. Although Singapore experienced among the largest contractions in manufacturing shares among the economies studied, this trend seems to have reverted in recent years, sustaining manufacturing output shares above 20%. For this reason, manufacturing continues to make a relatively large contribution to Singapore's aggregate productivity growth.

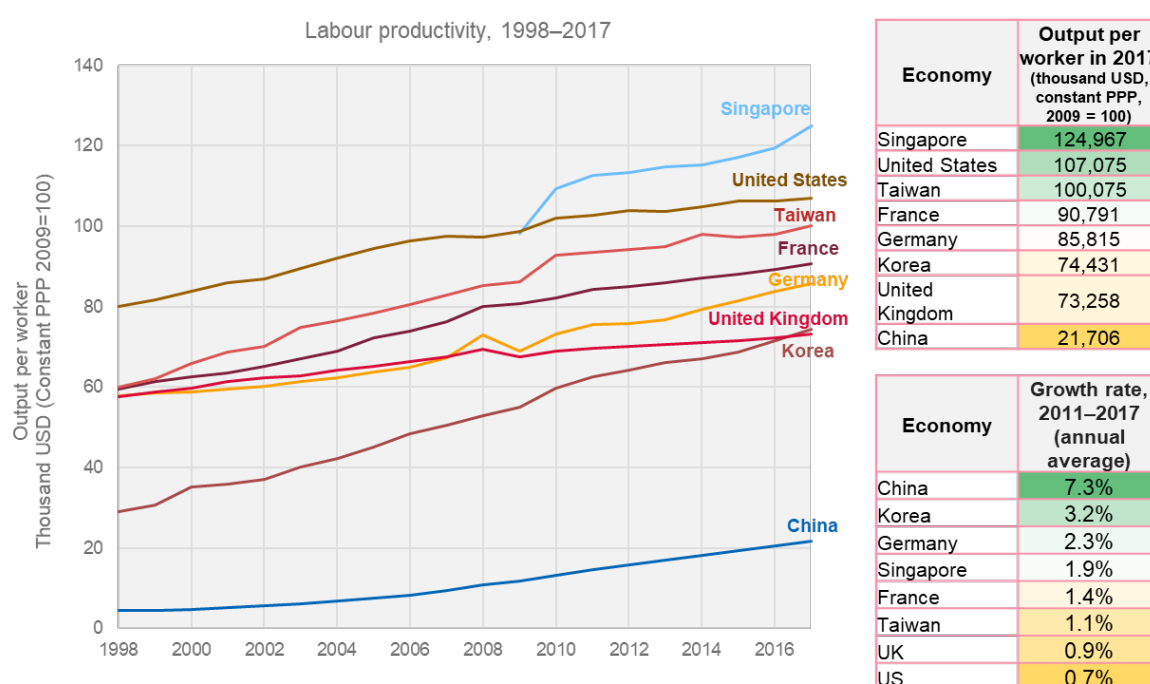
1. How does Singapore's productivity performance compare with that observed in other economies?

Productivity growth data for Singapore is only available from 2010 onwards, and thus it is only possible to discuss the productivity developments in the decade after the financial crisis. During this period Singapore showed faster productivity growth than many advanced economies, such as the US and Japan.¹

From the sample of economies analysed in this report,² Singapore saw the highest productivity levels, at US\$124,967 output per worker in 2017.³ As Figure 1 shows, between 2011 and 2017 the country experienced the fourth-fastest labour productivity growth, behind that observed in China, Korea and Germany (1.9% measured as output per worker and 2.1% measured as output per hour, average annual growth in 2011–17).

Previous studies have highlighted how improvements in capital intensity and in the quality of skilled work largely explain aggregate productivity growth in Singapore. These investments and the related capabilities have also helped the country to attract leading manufacturing firms in high-technology industries, such as electronics and biotechnology.⁴

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



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.

¹ Toh, B. and Ting, J. (2020). *Drivers of labour productivity growth in Singapore, 2009-2019*. Ministry of Trade and Industry.

² China, France, Germany, Korea, Taiwan, Singapore, the United Kingdom and the United States.

³ Constant purchasing power parity (PPP), 2009 = 100.

⁴ National Research Foundation (2021). *Manufacturing, trade and connectivity*. RIE2025 Plan.

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

The sectors that made the largest contributions to Singapore's aggregate productivity growth in 2010–19 include: financial and insurance activities (20.3%); manufacturing (18.6%); wholesale and retail trade (15.9%); other service activities (15.5%); and administrative and support services (11.3%).

FIGURE 2: TOP FIVE SECTORS CONTRIBUTING TO SINGAPORE'S AGGREGATE PRODUCTIVITY GROWTH (2010–19)

Singapore: top five sectors <i>Aggregate productivity growth rate: 2.97%</i> <i>(based on their contribution to aggregate productivity growth in 2010-2019, measured as output per hour)</i>			
	Sector	% of aggregate productivity growth	Percentage points
	Financial and insurance activities	20.3	0.60
	Manufacturing	18.6	0.55
	Wholesale and retail trade	15.9	0.47
	Other service activities	15.5	0.46
	Administrative and support service activities	11.3	0.34

Source: Authors' computation, based on data from Singapore Department of Statistics, Singapore Ministry of Trade and Industry and Manpower Research and Statistics Department.

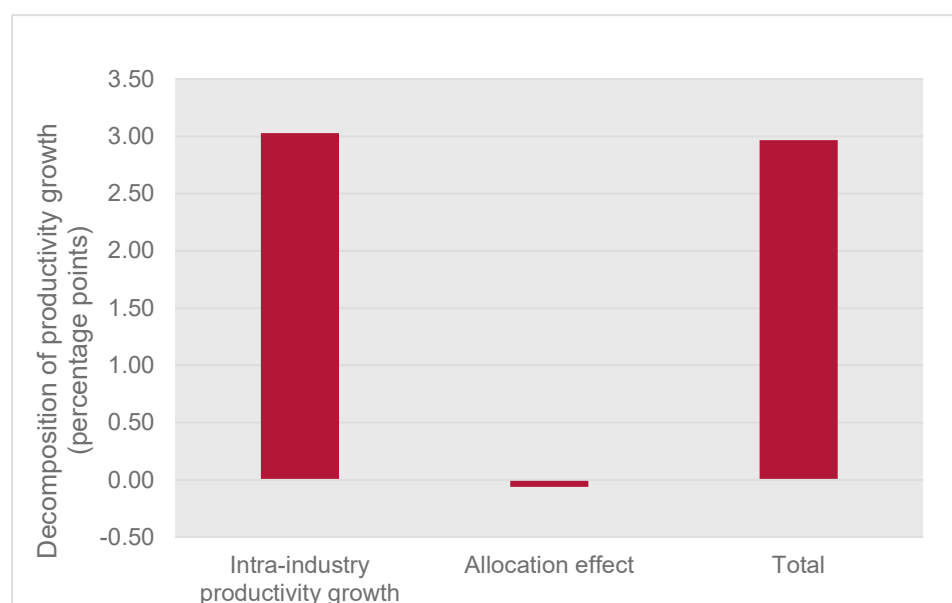
3. How do sectoral dynamics explain recent trends in aggregate productivity growth?

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.⁵ Appendix II explains this decomposition.

Most of Singapore’s aggregate productivity growth is explained by intra-industry productivity growth, as depicted in Figure 3. During the period of 2010–19 the allocation effect component was negative and explained only 2% of aggregate productivity growth. Although the allocation effect is negligible at aggregate level, it does help to explain how the expansion and decline of economic sectors contribute to productivity growth.

FIGURE 3: DECOMPOSITION OF SINGAPORE'S AGGREGATE PRODUCTIVITY GROWTH (2010–19)



Note: Total of the whole economy used in the decomposition excludes imputed rents.

Source: Authors' computation, based on data from Singapore Department of Statistics, Singapore Ministry of Trade and Industry and Manpower Research and Statistics Department.

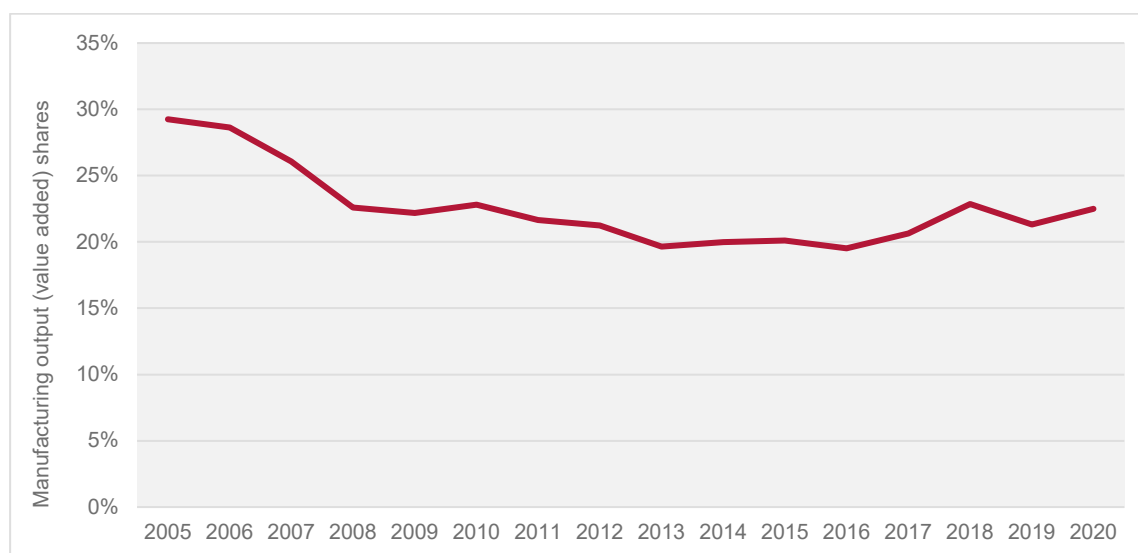
The negative allocation effects of manufacturing (-0.83 percentage points), wholesale and retail trade (-0.23 percentage points) and construction (-0.15 percentage points) help to explain the aggregate negative allocation effect. These sectors experienced a decline in their employment shares in the period analysed (from 2010 to 2019): -3.93 percentage points in manufacturing; -

⁵ 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.

1.32 percentage points in wholesale and retail trade; and -0.12 percentage points in construction (Table 2). The decline of manufacturing was mainly driven by reductions in employment shares in the manufacturing of other transport equipment (motor vehicles, trailers and semi-trailers) and rubber and plastic products. Reductions in relative output prices also help to explain the negative allocation effects observed in construction and wholesale and retail trade. Relative output prices contracted by 3.9 percentage points and 10.38 percentage points in these sectors.

Although Singapore experienced among the largest contractions in manufacturing shares across the economies studied, it has managed to revert this trend in recent years and to sustain manufacturing output shares above 20% (Figure 4). Similar manufacturing output shares (above 20%) are also observed in economies such as China, Germany, Korea and Taiwan. For this reason, manufacturing continues to make a relatively large contribution to Singapore's aggregate productivity growth (0.55 percentage points, 18.6% of aggregate productivity growth in 2010–19) (Table 2).

FIGURE 4: SINGAPORE: MANUFACTURING OUTPUT SHARES 2005–2020



Source: Authors' computation, based on data from the Singapore Department of Statistics.

Manufacturing plays a key role in Singapore's economy, with electronics and precision engineering being two of the main industries driving this growth.⁶ It is estimated that for every Singaporean dollar of value added generated by the manufacturing sector, a corresponding 0.28 Singaporean dollars are produced in the rest of the economy, particularly in knowledge-intensive services.⁷

The relationship between manufacturing and knowledge-intensive services works both ways, and the development of Singapore's biomedical industry illustrates this. In 2000 the Singaporean government launched a strategy to develop a biomedical industry. The early stages required the development and attraction of scientific talent and proactive attraction of foreign direct

⁶ The World Bank (2019). Singapore. [Overview](#).

⁷ National Research Foundation (2021). [Manufacturing, trade and connectivity](#). RIE2025 Plan.

investment, while the more recent phases saw many companies locating manufacturing, research and management activities in the country..⁸

This is explained by a high emphasis on manufacturing in Singapore's innovation and industrial policy. Public investments in research and development prioritise advanced manufacturing and engineering technologies. The Research, Innovation and Enterprise 2025 (RIE 2025) Plan has allocated S\$25 billion for basic and applied research on manufacturing and aims to strengthen Singapore's manufacturing competitiveness, investing in deepening capabilities in areas such as supply chain management, microelectromechanical systems and artificial intelligence..⁹ In addition, the 10-year 'Manufacturing 2030' plan, announced in 2021, set the goal to grow manufacturing value added by 50%, while maintaining a share of approximately 20% of the gross domestic product..¹⁰

Other sectors that contribute the most to Singapore's aggregate productivity growth include (in brackets, average annual contribution 2010–19, in percentage points and relative terms): financial and insurance activities (0.60 percentage points, 20.3%); wholesale and retail trade (0.47 percentage points, 15.9%); other service activities (0.46 percentage points, 15.5%); and administrative and support services (0.34 percentage points, 11.3%) (Table 2).

From these, manufacturing (1.38 percentage points), wholesale and retail trade (0.70 percentage points) and financial and insurance activities (0.54 percentage points) are the sectors that observed the largest contributions via their intra-industry productivity effect (productivity growth weighted by output share). This is explained by productivity growth rates above 3% and output shares above 10% (Table 1).

In absolute terms, the sectors that showed the largest values of output per hour between 2010 and 2019 include: financial and insurance activities (S\$123.3); real estate activities (S\$87.6); manufacturing (S\$62.2); and information and communication (S\$59.3) (Table 1). With the exception of real estate activities, these are outward-oriented sectors, which tend to be more productive as a result of international pressure to remain competitive..¹¹

Sectors that increased their contribution to Singapore's economy between 2010 and 2019 include: financial and insurance activities (↑3.2 percentage points output shares and ↑0.51 percentage points employment shares); administrative and support service activities (↑1.82 percentage points output shares and ↑1.29 percentage points employment shares); information and communication (↑0.98 percentage points output shares and ↑0.79 percentage points employment shares); other service activities (↑0.79 percentage points output shares and ↑1.69 percentage points employment shares); and professional, scientific and technical activities (↑0.10 percentage points output shares and ↑0.78 percentage points employment shares) (Table 2).

These sectors include both high-productivity activities (financial and insurance, information and communication, and professional, scientific and technical activities) and low-productivity activities (administrative and support services and other service activities), and thus their expansion is having mixed effects on aggregate productivity growth.

⁸ Policy Links (2021). Singapore's Biomedical Cluster. Lessons from two decades of innovation and manufacturing policy.

⁹ Ibid.

¹⁰ Singapore Economic Development Board (2021). Singapore seeking frontier firms for 'Manufacturing 2030'.

¹¹ Ibid.

The government has continued to support a strong financial ecosystem. In 2017 the government launched the regional finance hub 'Asia's Infrastructure Exchange', with the aim of integrating infrastructure players along the whole value chain: multilateral banks, private financiers, lawyers, accountants, engineers and other professional services..¹²

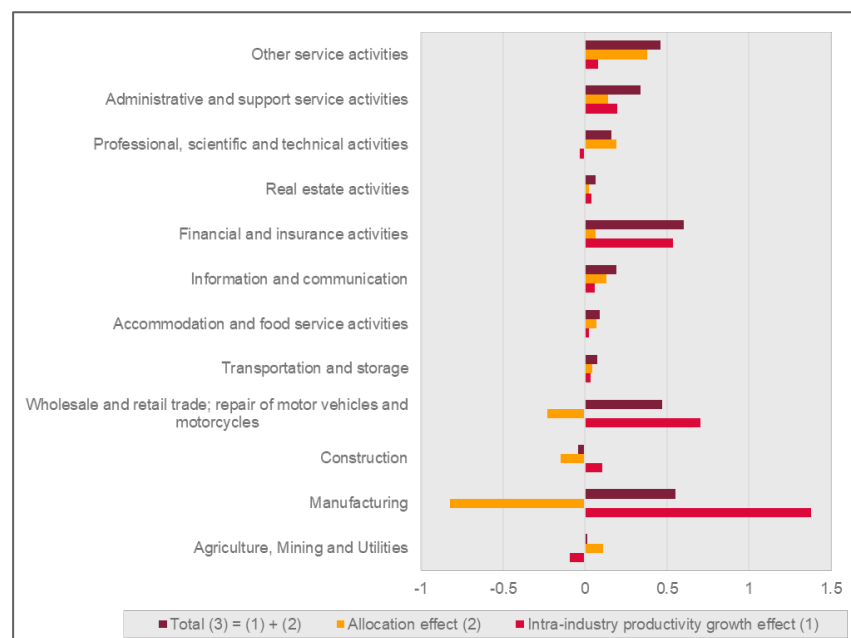
TABLE 1: SINGAPORE: PRODUCTIVITY LEVELS AND GROWTH RATES BY SECTOR, 1998–2020

Economic sector	Output per hour (2010–19)	
	Average absolute value (\$\$, chained 2015)	Average annual growth
Agriculture, mining and utilities	61.8	-6.2%
Manufacturing	62.2	6.5%
Construction	15.0	1.9%
Wholesale and retail trade; repair of motor vehicles and motorcycles	57.5	3.6%
Transportation and storage	52.1	0.4%
Accommodation and food service activities	16.6	1.1%
Information and communication	59.3	1.5%
Financial and insurance activities	123.3	4.4%
Real estate activities ^{1/}	87.6	0.9%
Professional, scientific and technical activities	47.8	-0.5%
Administrative and support service activities	34.7	5.3%
Other service activities	27.0	0.8%
Whole economy ^{1/}	44.38	3.0%

Note: ^{1/} Excludes imputed rents.

Source: Authors' computation, based on data from Singapore Department of Statistics, Singapore Ministry of Trade and Industry and Manpower Research and Statistics Department.

FIGURE 5: SECTORAL CONTRIBUTION TO SINGAPORE'S AGGREGATE PRODUCTIVITY GROWTH, SELECTED SECTORS 2010–2019



Source: Authors' computation, based on data from Singapore Department of Statistics, Singapore Ministry of Trade and Industry and Manpower Research and Statistics Department.

¹² The World Bank (2019). Singapore. [Overview](#).

TABLE 2: SINGAPORE: SECTORAL CONTRIBUTIONS TO OVERALL PRODUCTIVITY GROWTH, 2010–2019

Economic sector	Output shares		Employment shares		Change (2010–19, percentage points)			Contribution to productivity growth (2010–19, percentage points)			Labour productivity growth (2010–19)
	2010	2019	2010	2019	Output	Employment	Relative output prices	Intra-industry productivity growth effect (1)	Allocation effect (2)	Total (3) = (1) + (2)	
Agriculture, mining and utilities	1.6%	1.3%	0.7%	0.7%	-0.36	-0.01	73.25	-0.10	0.11	0.01	-6.16%
Manufacturing	22.8%	21.3%	16.8%	12.8%	-1.51	-3.93	2.15	1.38	-0.83	0.55	6.54%
Construction	4.8%	4.0%	12.2%	12.1%	-0.87	-0.12	-10.38	0.10	-0.15	-0.05	1.93%
Wholesale and retail trade; repair of motor vehicles and motorcycles	19.9%	18.5%	14.2%	12.9%	-1.41	-1.32	-3.90	0.70	-0.23	0.47	3.60%
Transportation and storage	8.5%	6.8%	6.7%	6.9%	-1.69	0.30	-12.74	0.03	0.04	0.08	0.38%
Accommodation and food service activities	2.0%	2.2%	6.6%	7.0%	0.13	0.40	8.89	0.02	0.07	0.09	1.07%
Information and communication	3.8%	4.8%	3.2%	4.0%	0.98	0.79	-0.76	0.06	0.13	0.19	1.46%
Financial and insurance activities	11.4%	14.6%	4.8%	5.3%	3.20	0.51	-5.03	0.54	0.06	0.60	4.44%
Real estate activities	4.7%	3.6%	2.6%	2.2%	-1.16	-0.40	3.54	0.04	0.02	0.06	0.86%
Professional, scientific and technical activities	6.1%	6.2%	5.9%	6.7%	0.10	0.78	8.12	-0.03	0.19	0.16	-0.47%
Administrative and support service activities	3.3%	5.1%	5.4%	6.7%	1.82	1.29	0.12	0.20	0.14	0.34	5.27%
Other services industries	10.9%	11.7%	20.9%	22.6%	0.79	1.69	12.86	0.08	0.38	0.46	0.75%
Whole economy ^{1/}	100%	100%	100%	100%	N/A	N/A	N/A	3.03	-0.06	2.97	2.97%

Note: N/A, not applicable. ^{1/} Excludes imputed rents.

Source: Authors' computation, based on data from Singapore Department of Statistics, Singapore Ministry of Trade and Industry and Manpower Research and Statistics Department.

Appendix I. Definitions of variables and data sources

Variable	Measure, units	Source
Labour (hours)	Average weekly total paid hours worked per employee, hours	Ministry of Manpower (2021). Statistical table: Hours worked
Labour (people)	Total employment by industry, thousands	Ministry of Manpower (2021). Email communication
Output (real values)	GVA in chained (2015) S\$, million	Singapore Department of Statistics (2019). National Accounts. Gross Domestic Product In Chained (2015) Dollars, By Industry (SSIC 2020)
Output (nominal values)	GVA at current prices, million S\$	Singapore Department of Statistics (2021). National Accounts. Gross Domestic Product At Current Prices, By Industry (SSIC 2020)

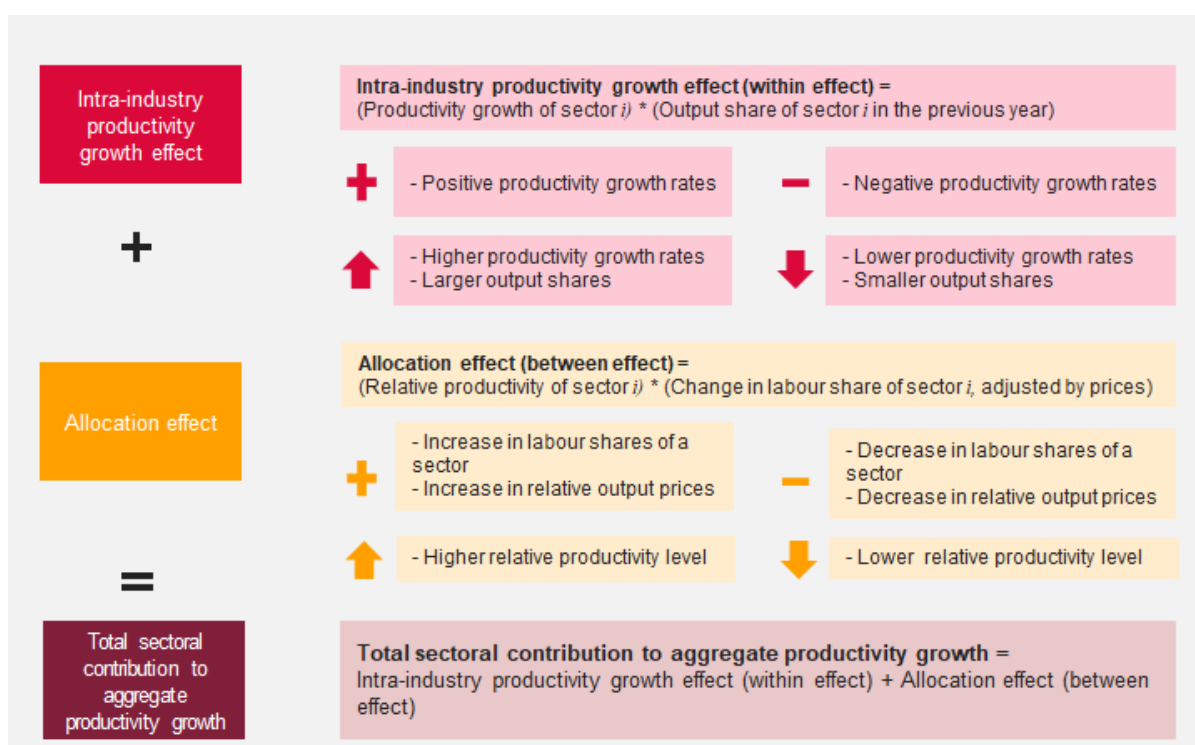
Appendix II. Decomposition of productivity growth

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

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