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Republic of Singapore**

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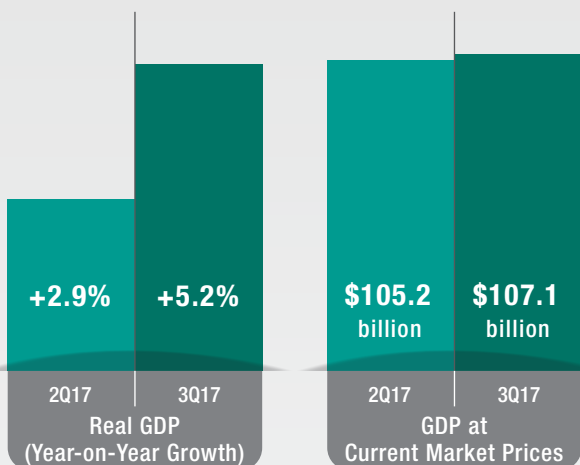
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Manufacturing and Services in Singapore's Economy:
Twin Engines of Growth and their Asymmetric Dependencies

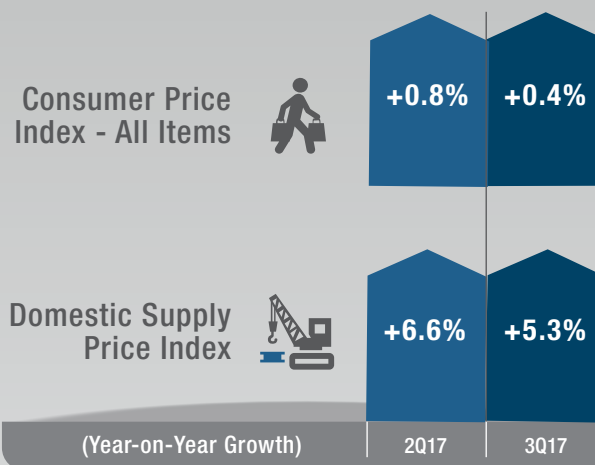


MAIN INDICATORS OF THE SINGAPORE ECONOMY

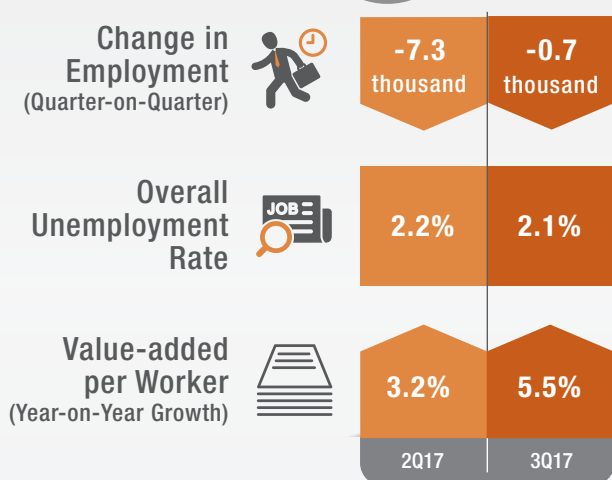
OVERALL ECONOMY



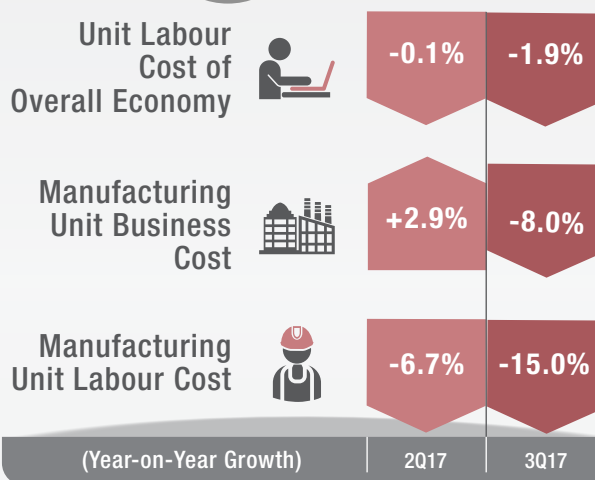
PRICES



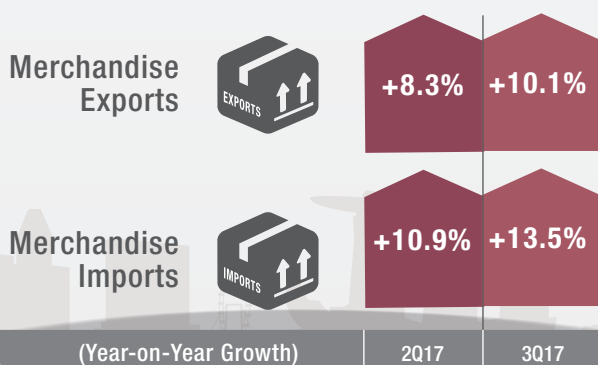
LABOUR MARKET



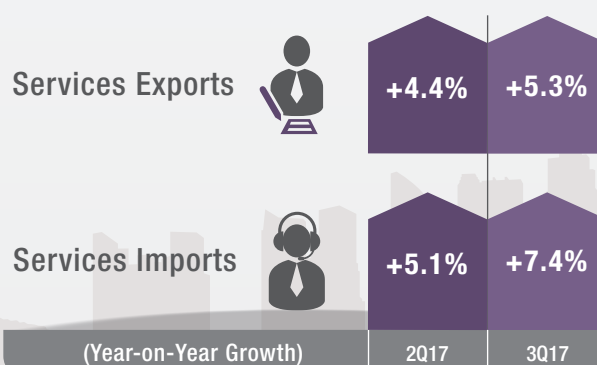
COSTS



MERCHANDISE TRADE



SERVICES TRADE



CHAPTER 1

Economic Performance





CHAPTER 1

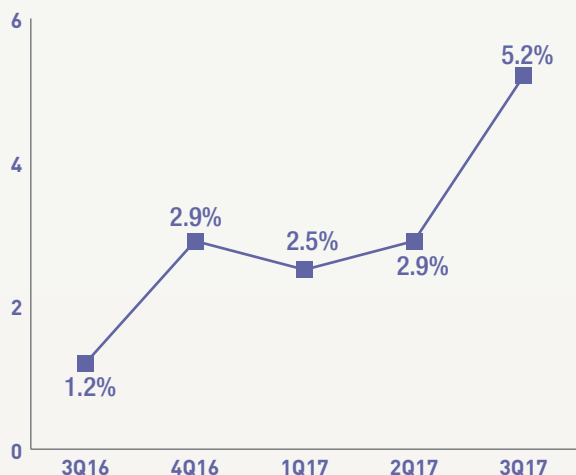
THE SINGAPORE ECONOMY

ECONOMIC PERFORMANCE

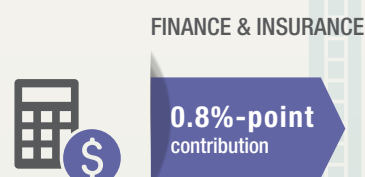


Real GDP grew by
5.2% in 3Q17

Quarterly Growth (Year-on-Year)



Main Drivers of Growth in 3Q17



In total, these sectors accounted for

77% of GDP growth

LABOUR MARKET



RESIDENT
UNEMPLOYMENT
RATE



3.1%
in 3Q17

EMPLOYMENT
(Q-O-Q CHANGE)



-700
employed

Sectors with the Highest Employment Growth in 3Q17



PRODUCTIVITY

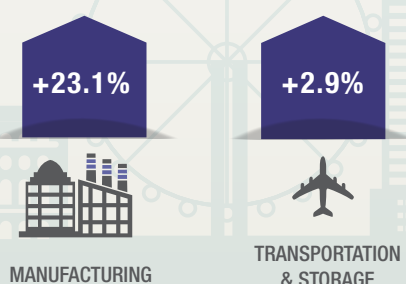


VALUE-ADDED
PER WORKER
(Y-O-Y GROWTH)



+5.5%

Sectors with the highest Value-added per Worker Growth in 3Q17



COSTS



Overall Unit Labour Cost declined by

1.9% in 3Q17

WITHIN THE
MANUFACTURING SECTOR



-8.0%

-15.0%

Unit Business Cost | Unit Labour Cost
3Q17

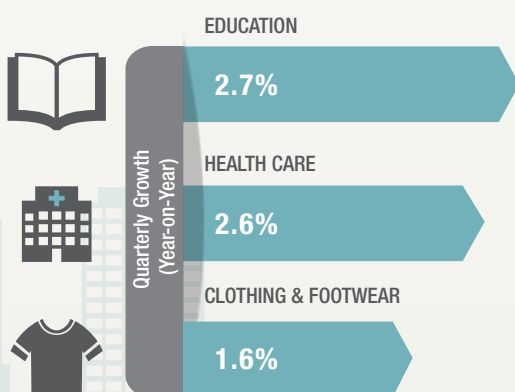
PRICES



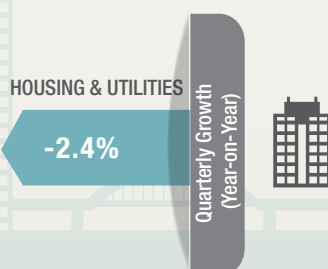
The Consumer Price Index (CPI) rose by

0.4% in 3Q17

CATEGORIES WITH PRICE INCREASES



CATEGORY WITH PRICE DECLINES



INTERNATIONAL TRADE



Total Merchandise Exports rose by

10.1% in 3Q17

+19.3%

+9.3%

+7.6%



OIL
DOMESTIC EXPORTS



RE-EXPORTS



NON-OIL
DOMESTIC EXPORTS

Main Drivers of
Services Export Growth were...

+4.8%



TRANSPORT
SERVICES

+8.9%



FINANCIAL
SERVICES

+4.0%



OTHER BUSINESS
SERVICES

OVERVIEW

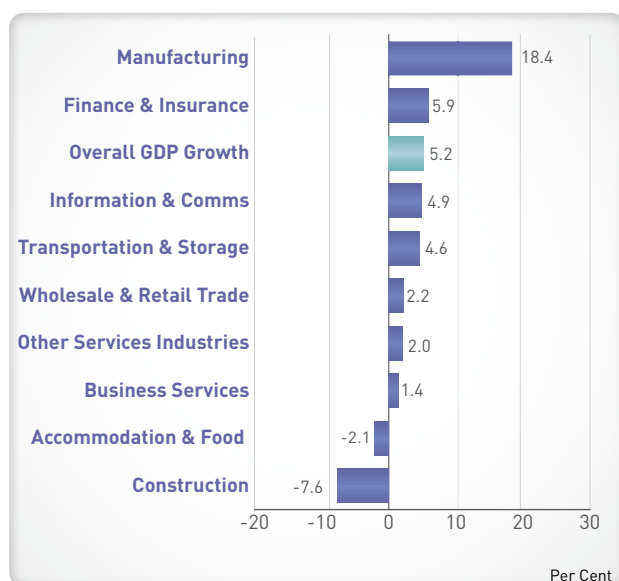
In the third quarter of 2017,

- The economy expanded by 5.2 per cent compared to the same period in 2016. The sectors that contributed the most to GDP growth were the manufacturing and finance & insurance sectors.
- In the labour market, the seasonally-adjusted overall and citizen unemployment rates declined in September 2017 as compared to June 2017, while the resident unemployment rate remained unchanged. The number of workers retrenched in the third quarter was similar to that in the previous quarter but lower compared to that in the same period a year ago.
- Total employment fell by 700 on a quarter-on-quarter basis, smaller than the declines of 6,800 and 7,300 recorded in the first and second quarters respectively. The fall in employment was mainly due to a decrease in Work Permit Holders in the manufacturing and construction sectors.
- The Consumer Price Index (CPI) rose by 0.4 per cent on a year-on-year basis, slower than the 0.8 per cent rise in the second quarter.

OVERALL PERFORMANCE

The economy grew by 5.2 per cent on a year-on-year basis in the third quarter, faster than the 2.9 per cent growth in the previous quarter (Exhibit 1.1). On a quarter-on-quarter seasonally-adjusted annualised basis, the economy expanded by 8.8 per cent, accelerating from the 2.2 per cent growth in the second quarter.

Exhibit 1.1: GDP and Sectoral Growth Rates in 3Q 2017



The manufacturing sector expanded at a robust pace of 18 per cent in the third quarter, extending the 8.4 per cent growth in the previous quarter. Growth was broad-based, with all manufacturing clusters recording output expansions, except for the transport engineering cluster, which continued to register a decline in output.

The services producing industries grew by 3.0 per cent, faster than the 2.5 per cent growth in the second quarter. Among the services sectors, the finance & insurance sector posted the strongest pace of growth (5.9 per cent), with growth largely supported by robust expansions in insurance, fund management and financial intermediation activities, as well as a turnaround in forex trading volumes. This was followed by the information & communications (4.9 per cent), transportation & storage (4.6 per cent) and wholesale & retail trade (2.2 per cent) sectors. The other services (2.0 per cent) and business services (1.4 per cent) sectors also recorded positive growth in the third quarter. On the other hand, the accommodation & food services sector contracted by 2.1 per cent, extending the 2.0 per cent contraction in the previous quarter, weighed down by the sluggish performance of both the accommodation and food services segments.

Meanwhile, the construction sector shrank by 7.6 per cent, extending the 9.1 per cent contraction in the preceding quarter. The sector's poor performance was due to a weakness in both private sector and public sector construction activities.

The sectors that contributed the most to GDP growth in the third quarter were the manufacturing and finance & insurance sectors (Exhibit 1.2). Collectively, they accounted for 77 per cent of overall GDP growth during the quarter.

Exhibit 1.2: Percentage-Point Contribution to Growth in Real GDP in 3Q 2017 (By Industry)



SOURCES OF GROWTH

Total demand rose by 6.3 per cent in the third quarter, higher than the 4.1 per cent growth in the previous quarter (Exhibit 1.3). The expansion in total demand was supported by both external and domestic demand. External demand rose by 4.6 per cent, accelerating from the 2.7 per cent increase in the previous quarter. Domestic demand also increased at a faster pace of 12 per cent compared to the 8.1 per cent growth in the preceding quarter.

In turn, domestic demand was driven primarily by a larger build-up in inventories. At the same time, consumption expenditure also supported the increase in domestic demand, rising by 3.7 per cent on the back of higher public and private consumption expenditure.

Exhibit 1.3: Changes in Total Demand*

	2016		2017		
	III	IV	I	II	III
Total Demand	-0.7	2.8	3.9	4.1	6.3
External Demand	2.5	1.6	5.4	2.7	4.6
Total Domestic Demand	-9.3	6.3	-0.2	8.1	11.6
Consumption Expenditure	-0.1	-0.3	0.5	2.0	3.7
Public	-1.3	7.0	4.1	4.0	6.4
Private	0.2	-2.3	-0.8	1.5	3.0
Gross Fixed Capital Formation	-4.3	-5.0	-4.6	-9.4	-4.5
Changes in Inventories	-5.7	5.8	0.7	7.0	7.1

* For inventories, this refers instead to change as a percentage of GDP in the previous year.

By contrast, gross fixed capital formation (GFCF) fell by 4.5 per cent, weighed down by declines in both private and public investments. In particular, private GFCF declined by 4.9 per cent, extending the 9.1 per cent contraction in the previous quarter. The fall in private GFCF could be largely attributed to lower investment spending on private construction & works and machinery & equipment. Meanwhile, public GFCF declined by 3.0 per cent, following the 11 per cent drop in the preceding quarter, weighed down by a decline in investment spending on public construction & works and transport equipment.

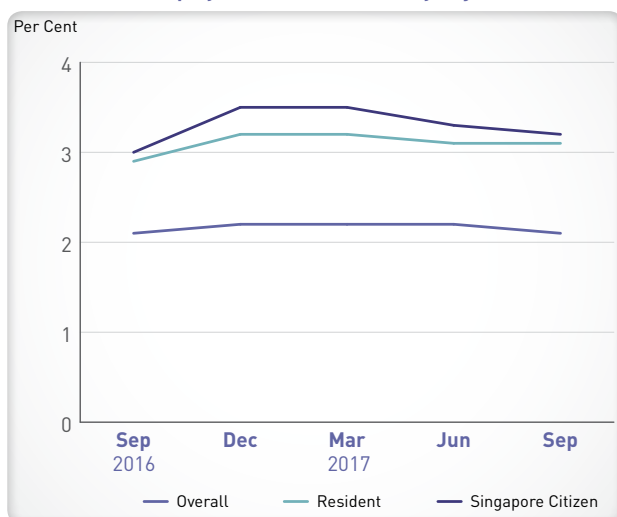
LABOUR MARKET

Unemployment and Retrenchment¹

Based on preliminary estimates, the seasonally-adjusted overall unemployment rate declined to 2.1 per cent in September 2017 from 2.2 per cent in June 2017. Over the same period, the unemployment rate for citizens fell to 3.2 per cent from 3.3 per cent, while that for residents remained unchanged at 3.1 per cent (Exhibit 1.4). However, both the citizen and resident unemployment rates remained higher compared to the same period a year ago.

¹ Figures pertain to private sector establishments with at least 25 employees and the public sector.

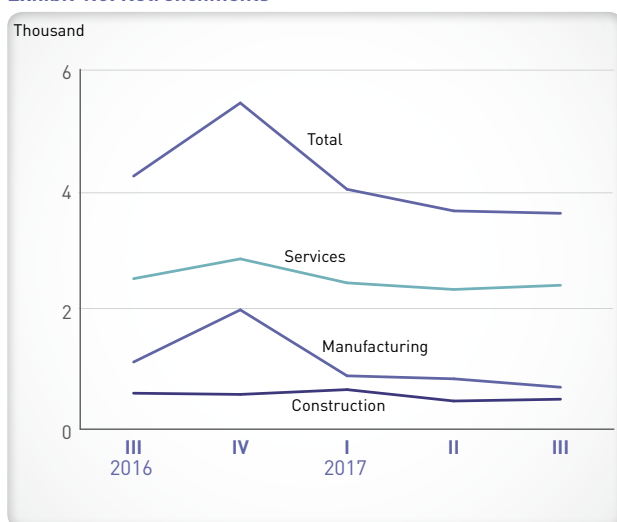
Exhibit 1.4: Unemployment Rate (Seasonally Adjusted)



As at September 2017, the estimated number of residents unemployed was 71,900, higher than the 70,800 in June 2017. However, the estimated number of unemployed citizens fell to 62,600 from 63,800.²

Around 3,600 workers were retrenched during the third quarter, similar to that in the second quarter (3,640) but lower than that in the same period a year ago (4,220). By broad sectors, retrenchments in the manufacturing sector fell (from 840 in the second quarter to 700 in the third quarter), while retrenchments in both the construction (from 470 to 500) and services (from 2,330 to 2,400) sectors increased (Exhibit 1.5).

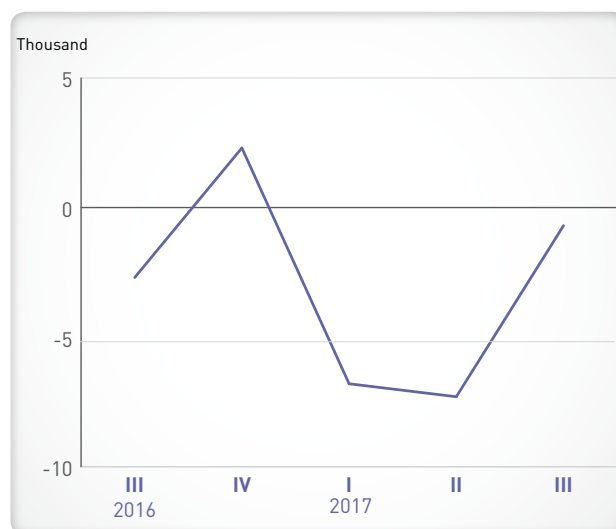
Exhibit 1.5: Retrenchments



Employment³

Total employment fell by 700 on a quarter-on-quarter basis in the third quarter, smaller than the declines of 6,800 and 7,300 recorded in the first and second quarters respectively (Exhibit 1.6). Excluding foreign domestic workers (FDWs), employment contracted by 2,500, easing from the declines of 9,400 and 7,900 in the first and second quarters respectively, and lower than the decline of 4,200 in the same period in 2016.

Exhibit 1.6: Change in Total Employment, Quarter-on-Quarter



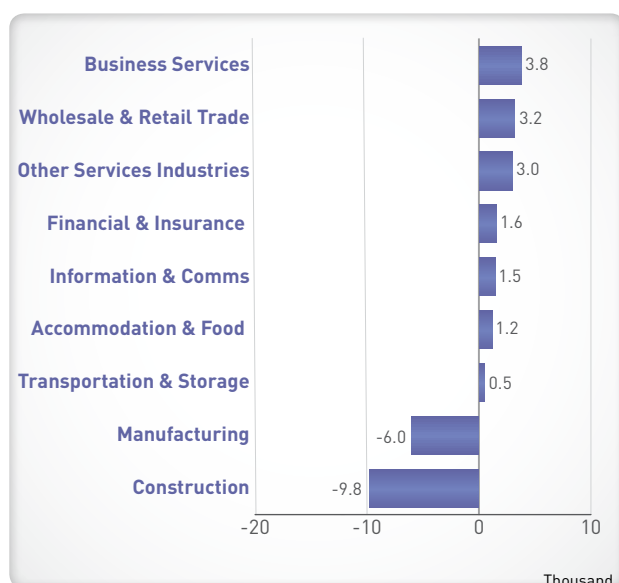
The decline in employment in the third quarter was mainly due to the continued shedding of Work Permit Holders in the manufacturing and construction sectors. Employment in the manufacturing sector declined by 6,000 in the third quarter, the twelfth consecutive quarter of decline. Manufacturing employment continued to be weighed down by weakness in the marine & offshore engineering segment, which was adversely affected by the sluggish demand for oil rigs and oilfield equipment amidst low global oil prices. Employment in the construction sector also fell (-9,800) for the fifth consecutive quarter, due to continued weakness in construction activities (Exhibit 1.7).

The employment declines in the manufacturing and construction sectors were partially offset by employment gains in the services sectors (14,900). Among the services sectors, the business services (3,800), wholesale & retail trade (3,200) and other services (3,000) sectors saw the strongest employment gains.

² Based on seasonally-adjusted data on the number of unemployed persons.

³ Based on preliminary estimates.

Exhibit 1.7: Changes in Employment by Industry in 3Q 2017



Hiring Expectations

Hiring expectations in the manufacturing sector continued to be negatively affected by firms in the marine & offshore engineering segment. According to EDB's latest Business Expectations Survey for the Manufacturing Sector, a net weighted balance of 11 per cent of manufacturers expected to hire fewer workers in the fourth quarter of 2017 as compared to the third quarter. The weak hiring sentiment was largely due to the marine & offshore engineering segment, where a net weighted balance of 52 per cent of firms expected lower levels of hiring. By contrast, firms in the petrochemicals and aerospace segments were the most optimistic, with a net weighted balance of 24 per cent and 15 per cent of firms in the respective segments expecting to increase hiring in the fourth quarter.

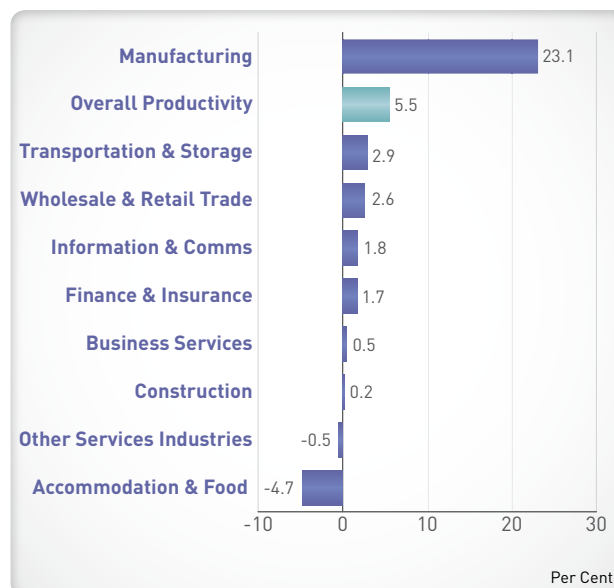
On the other hand, hiring expectations in the services sector remained positive. According to DOS' latest Business Expectations Survey for the Services Sector, a net weighted balance of 7 per cent of services firms expected to increase hiring in the fourth quarter of 2017 as compared to the third quarter. In particular, a net weighted balance of 23 per cent of firms in the accommodation segment and 17 per cent of firms in the retail trade segment expected to hire more workers in the fourth quarter, likely due to the year-end festivities.

COMPETITIVENESS

Productivity

Overall labour productivity, as measured by value-added per worker, increased by 5.5 per cent in the third quarter compared to the same period a year ago (Exhibit 1.8). This was higher than the 3.2 per cent increase achieved in the second quarter.

Exhibit 1.8: Changes in Value-added per Worker for the Overall Economy and Sectors in 3Q 2017



The manufacturing (23 per cent), transportation & storage (2.9 per cent) and wholesale & retail trade (2.6 per cent) sectors saw the highest productivity growth rates in the third quarter. By contrast, the accommodation & food services (-4.7 per cent) and other services (-0.5 per cent) sectors experienced declines in productivity.

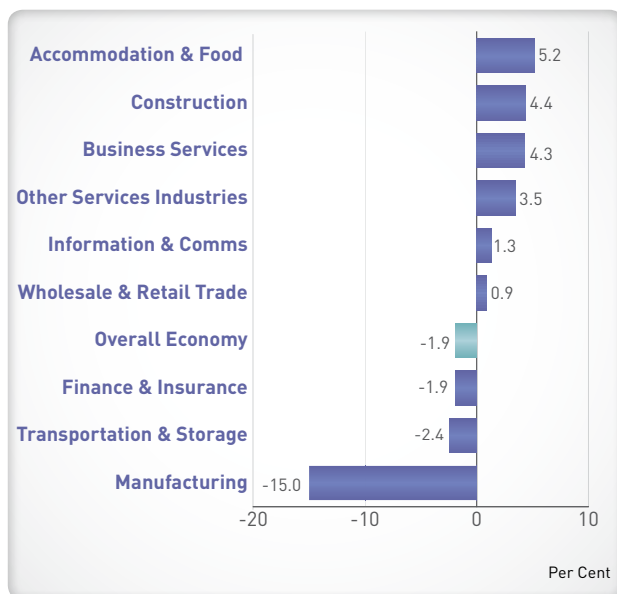
Outward-oriented sectors as a whole registered higher productivity growth than domestically-oriented sectors. Compared to the same period last year, the productivity of outward-oriented sectors rose by 8.7 per cent in the third quarter, picking up from the 5.5 per cent growth in the second quarter.⁴ On the other hand, the productivity of domestically-oriented sectors fell by 0.5 per cent, similar to the 0.6 per cent decline in the previous quarter.

⁴ Based on MTI estimates. Outward-oriented sectors refer to manufacturing, wholesale trade, transportation & storage, accommodation, information & communications, finance & insurance and professional services. Domestically-oriented sectors refer to construction, retail trade, food & beverage services, other business services and other services industries.

Unit Labour Cost and Unit Business Cost

Overall unit labour cost (ULC) for the economy fell by 1.9 per cent in the third quarter, a larger decline compared to the 0.1 per cent fall in the previous quarter (Exhibit 1.9). The decline in the overall ULC in the third quarter was due to labour productivity gains that exceeded the increase in total labour cost per worker.

Exhibit 1.9: Changes in Unit Labour Cost in 3Q 2017

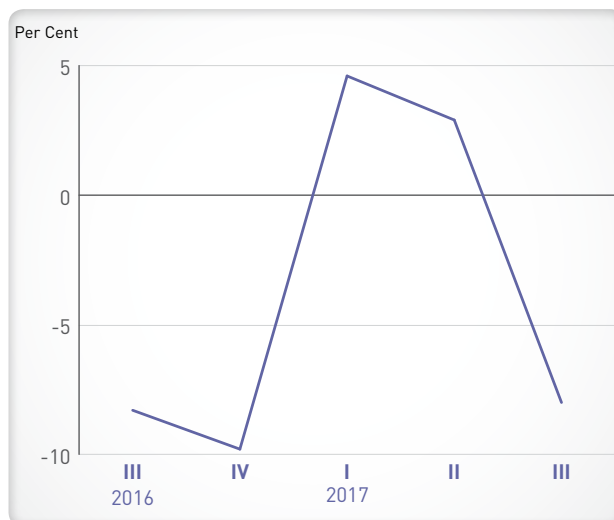


By sectors, the ULC for the manufacturing sector fell by 15 per cent, the seventh consecutive quarter of decline, on the back of strong productivity gains.

On the other hand, the ULC for services producing industries rose by 1.4 per cent, slightly higher than the 1.3 per cent increase in the previous quarter. All services sectors, with the exception of finance & insurance and transportation & storage, saw increases in their respective ULCs. Construction ULC also edged up by 4.4 per cent, as the rise in total labour cost per worker outpaced labour productivity growth in the sector.

Unit business cost (UBC) for the manufacturing sector fell by 8.0 per cent in the third quarter, a reversal from the 2.9 per cent increase in the previous quarter (Exhibit 1.10). The fall in the manufacturing UBC was driven by declines in unit non-labour production taxes (-18 per cent), manufacturing ULC (-15 per cent) and unit services cost (-5.6 per cent).

Exhibit 1.10: Changes in Unit Business Cost for Manufacturing

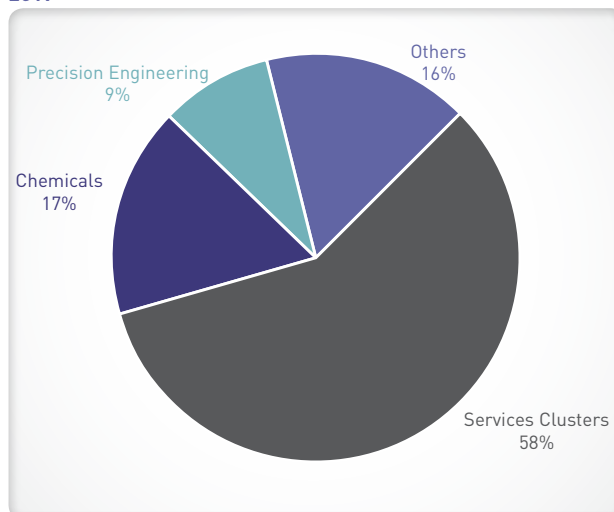


Investment Commitments

Investment commitments in terms of Fixed Asset Investments (FAI) and Total Business Expenditure (TBE) amounted to \$1.2 billion and \$1.0 billion respectively in the third quarter (Exhibit 1.11 and Exhibit 1.12).

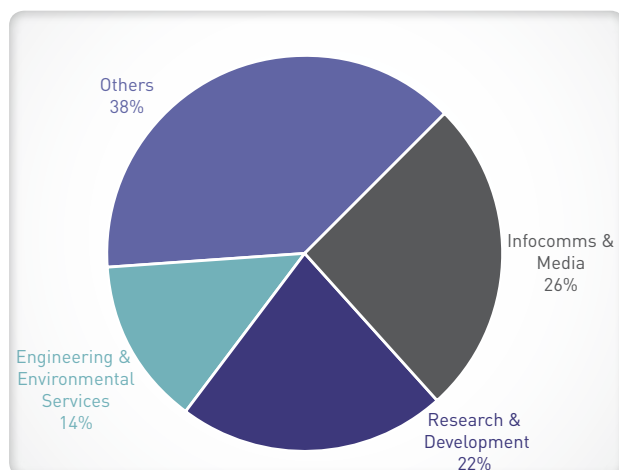
In terms of FAI, the largest contribution came from the services clusters, which garnered \$683 million in commitments, mainly from the research & development sub-cluster. This was followed by the chemicals cluster, which attracted \$195 million in commitments. Investors from Asia Pacific & Others contributed the most to FAI commitments, accounting for \$359 million (31 per cent) of total FAI commitments.

Exhibit 1.11: Fixed Asset Investments by Industry Cluster in 3Q 2017



In terms of TBE, the infocomms & media cluster attracted the highest amount of commitments at \$256 million, followed by the research & development cluster at \$212 million. Investors from Europe were the largest source of TBE, accounting for \$296 million (30 per cent) of total TBE committed.

Exhibit 1.12: Total Business Expenditure by Industry Cluster in 3Q 2017



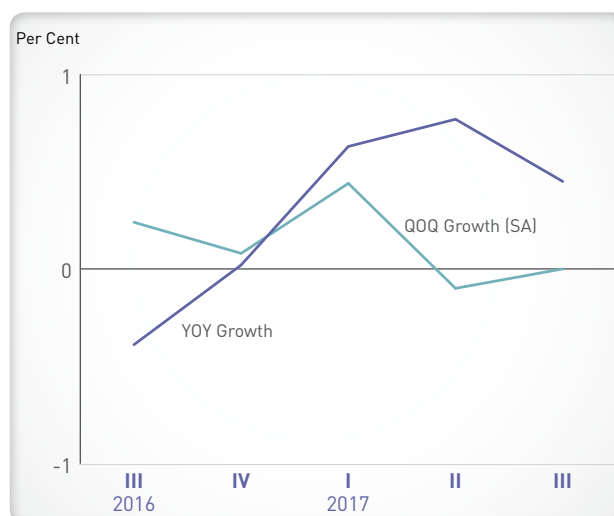
When fully realised, these commitments are expected to generate value-added of \$1.8 billion and more than 4,300 jobs.

PRICES

Consumer Price Index

The Consumer Price Index (CPI) increased by 0.4 per cent on a year-on-year basis in the third quarter, slower than the 0.8 per cent rise in the second quarter (Exhibit 1.13). On a seasonally-adjusted quarter-on-quarter basis, the CPI was unchanged in the third quarter, following the 0.1 per cent decline in the previous quarter.

Exhibit 1.13: Changes in CPI



Among the CPI categories, food was the largest positive contributor to inflation in the third quarter, with prices rising by 1.3 per cent on a year-on-year basis on the back of price increases for hawker food and restaurant meals, as well as non-cooked food items such as fish & seafood and fruits (Exhibit 1.14). Transport costs rose by 1.5 per cent on account of higher petrol prices and parking charges as well as the expiry of the road tax rebate, which more than offset the effect of lower car prices and bus & train fares.

Exhibit 1.14: Percentage Changes in CPI over Corresponding Quarter of Previous Year

	2016		2017		Per Cent
	III	IV	I	II	III
All items	-0.4	0.0	0.6	0.8	0.4
Food	2.1	2.0	1.5	1.4	1.3
Clothing & Footwear	-1.6	-0.2	-0.9	1.4	1.6
Housing & Utilities	-4.3	-3.8	-3.2	-2.2	-2.4
Household Durables & Services	3.1	2.6	1.7	0.6	1.0
Health Care	0.6	2.1	2.7	2.7	2.6
Transport	-1.6	0.1	3.8	3.4	1.5
Communication	0.8	-0.6	0.3	0.4	0.6
Recreation & Culture	1.1	0.9	0.4	0.0	0.2
Education	3.4	3.2	3.6	3.2	2.7
Miscellaneous Goods & Services	0.0	0.1	-0.1	0.1	0.4

Meanwhile, education costs increased by 2.7 per cent as a result of higher fees at commercial institutions, universities, polytechnics, childcare centres and kindergartens. Healthcare costs went up by 2.6 per cent due to more expensive hospital and outpatient services. Prices of household durables & services picked up by 1.0 per cent as a rise in the salaries of foreign domestic workers more than offset the fall in the prices of household durables. Clothing & footwear costs rose by 1.6 per cent because of an increase in the prices of ready-made garments and footwear. Communications costs edged up by 0.6 per cent due to the higher cost of telecommunication services. The prices of miscellaneous goods & services increased by 0.4 per cent on account of a rise in the cost of personal effects items. Lastly, recreation & culture costs rose by 0.2 per cent due to an increase in admission charges to places of interest.

The price gains in these CPI categories were partially offset by a 2.4 per cent fall in the cost of housing & utilities. In turn, the fall in housing & utilities cost came on the back of a decline in accommodation costs which outweighed the increase in electricity tariffs, water price and housing maintenance charges.

INTERNATIONAL TRADE

Merchandise Trade

Singapore's total merchandise trade increased by 12 per cent year-on-year in the third quarter, extending the 9.5 per cent growth in the preceding quarter (Exhibit 1.15). The expansion in trade was due to growth in both oil and non-oil trade. Total oil trade increased by 22 per cent in nominal terms on the back of higher oil prices compared to a year ago, while non-oil trade rose by 9.6 per cent.

Exhibit 1.15: Growth Rates of Total Merchandise Trade, Merchandise Exports and Merchandise Imports (In Nominal Terms)

	2016			2017			Per Cent
	III	IV	Ann	I	II	III	
Merchandise Trade	-6.6	4.0	-4.9	16.3	9.5	11.7	
Merchandise Exports	-4.5	2.1	-5.1	16.9	8.3	10.1	
Domestic Exports	-8.0	7.6	-5.8	29.1	9.6	11.0	
Oil	-13.7	20.2	-12.6	72.0	26.9	19.3	
Non-Oil	-5.4	2.7	-2.8	15.0	3.0	7.6	
Re-Exports	-1.0	-2.4	-4.4	6.5	7.0	9.3	
Merchandise Imports	-9.1	6.1	-4.7	15.5	10.9	13.5	
Oil	-23.9	16.8	-20.6	89.8	33.0	26.3	
Non-Oil	-4.9	3.9	-0.6	3.0	6.1	10.7	

Total merchandise exports rose by 10 per cent in the third quarter, extending the 8.3 per cent increase in the preceding quarter. This marked the fourth consecutive quarter of growth, and could be attributed to an increase in both domestic exports (11 per cent) and re-exports (9.3 per cent).

The increase in domestic exports was in turn due to an expansion in oil and non-oil domestic exports. In particular, oil domestic exports grew by 19 per cent in the third quarter on the back of higher oil prices compared to levels observed a year ago. In volume terms, oil domestic exports declined by 1.2 per cent.

Non-oil domestic exports (NODX) grew by 7.6 per cent in the third quarter, following the 3.0 per cent growth in the previous quarter, supported by an increase in both electronics and non-electronics NODX.

Total merchandise imports rose by 14 per cent in the third quarter, following the 11 per cent increase in the previous quarter. This was due to a rise in both oil and non-oil imports. Specifically, oil imports increased by 26 per cent on the back of higher oil prices and higher import volumes. Meanwhile, non-oil imports rose by 11 per cent, driven by an increase in both electronics and non-electronics imports.

Services Trade

Total services trade expanded by 6.4 per cent in the third quarter, picking up from the 4.7 per cent growth in the previous quarter (Exhibit 1.16). Services exports grew by 5.3 per cent, up from the 4.4 per cent growth in the preceding quarter. The rise in services exports was largely attributable to increases in transport, financial and other business services exports. Similarly, services imports grew by 7.4 per cent, faster than the 5.1 per cent increase in the previous quarter. The growth in services imports was mainly due to increases in the imports of transport and other business services, as well as payments for the use of intellectual property.

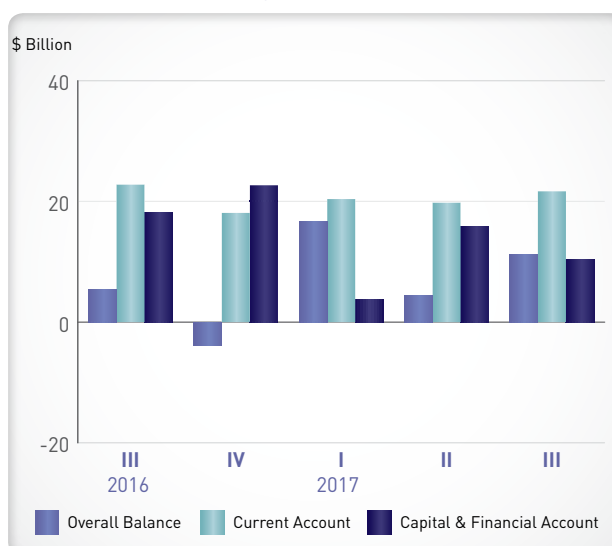
Exhibit 1.16: Growth Rates of Total Services Trade, Services Exports and Services Imports (In Nominal Terms)

	2016			2017			Per Cent
	III	IV	Ann	I	II	III	
Total Services Trade	0.4	3.4	1.2	4.5	4.7	6.4	
Services Exports	0.6	3.1	1.2	4.7	4.4	5.3	
Services Imports	0.2	3.7	1.2	4.4	5.1	7.4	

BALANCE OF PAYMENTS

The overall balance of payments recorded a larger surplus of \$11 billion in the third quarter, compared to \$4.4 billion in the second quarter (Exhibit 1.17). This occurred as net outflows from the capital and financial account decreased, and the current account surplus increased.

Exhibit 1.17: Balance of Payments⁵



Current Account

The current account surplus rose to \$22 billion in the third quarter, from \$20 billion in the previous quarter. This was due to an increase in the goods surplus as well as lower deficits in both the services and primary income accounts. Meanwhile, the deficit in the secondary income account was broadly stable.

The surplus in the goods balance increased by \$0.8 billion to \$30 billion in the third quarter, as goods exports rose more than imports. At the same time, the deficit in the services balance narrowed from \$2.8 billion to \$2.6 billion in the third quarter, as lower net payments for travel services more than offset higher net payments for transport services, other business services, and for the use of intellectual property.

The deficit in the primary income balance decreased by \$0.8 billion to \$2.1 billion in the third quarter as primary income receipts rose more than primary income payments.

⁵ Net inflows in net balances are indicated by a minus (-) sign. For more details regarding the change in sign convention to the financial account, please refer to DOS' information paper on "Singapore's International Accounts: Methodological Updates and Recent Developments".

Capital and Financial Account

Net outflows from the capital and financial account fell to \$10 billion in the third quarter, from \$16 billion in the preceding quarter. This was driven by larger net inflows of direct investment as well as smaller net outflows of portfolio and other investments. These outweighed the decline in net inflows of financial derivatives.

Net inflows of direct investment increased by \$4.1 billion to \$18 billion in the third quarter of the year, as foreign direct investment into Singapore rose while residents' direct investment abroad fell.

At the same time, net outflows of portfolio investment fell by \$5.8 billion to \$11 billion in the third quarter. This largely reflected a switch by domestic deposit-taking corporations from net acquisitions to net divestments of foreign securities, which more than offset the non-bank private sector's switch from net divestments to net acquisitions of foreign securities.

Meanwhile, net outflows from the "other investment" account declined slightly by \$0.9 billion to \$24 billion in the third quarter. In comparison, net inflows of financial derivatives fell to \$6.4 billion in the third quarter from \$12 billion in the second quarter.



The Digital Economy in Singapore

The digital economy broadly encompasses the production and consumption of digital products and services, digital platforms and business activities that are enabled by digital technologies. This may include activities as ubiquitous as sending emails to more sophisticated ones such as big data analytics. In recent years, the digital economy has garnered the attention of policymakers globally, which is not surprising given that the adoption of digital technologies offers significant potential to empower individuals, transform industries and enhance the competitiveness of economies. In view of its rising prominence, it is important for policymakers to gain a better understanding of the development and contribution of the digital economy.

In this article, we examine the recent trends in, and contribution of, the digital economy in Singapore. We do so by (i) presenting the broad trends in digital adoption among households and enterprises; (ii) estimating the economic contribution of the industries that produce or enable digital goods and services; and (iii) deriving the value that cross-border data flows bring to our economy.

Singapore has made significant progress in its digital infrastructure, which has enabled the increased adoption of digital capabilities among households and enterprises

Singapore has significantly enhanced its digital infrastructure in recent years, most notably through the introduction of optical fibre and 4G networks, which has in turn dramatically increased the speed at which information is transmitted. For instance, following the roll-out of the optical fibre network, Singapore's average internet connection speed increased from 5.4 Megabits per second (Mbps) in 2012 to 20 Mbps in 2016,¹ comparable to that in Japan and Finland. Likewise, Singapore's 4G connection speed is one of the fastest in the world,² in part due to continued network investments.

On the back of advancements in our digital infrastructure, the total number of optical fibre broadband and 4G subscriptions in Singapore has more than doubled over the past five years.³ Partly facilitated by faster internet speeds, Singapore households have also gradually shifted more of their activities onto the digital space. In particular, between 2010 and 2015, there was a broad-based increase in the share of households that engaged in internet activities such as online shopping and online financial transactions (Exhibit 1A), based on findings from an annual survey conducted by the Infocomm Media Development Authority (IMDA).

On the enterprise front, firms in Singapore are also increasing their investments in digital assets to enhance their digital capabilities. Specifically, gross capital expenditure on digital fixed assets⁴ by firms rose at a Compounded Annual Growth Rate (CAGR) of 7.1 per cent between 2013 and 2015, thereby resulting in a significant accumulation of digital fixed assets among firms over this period. In tandem with their investments in digital assets, firms are also increasingly adopting digital tools in their day-to-day business activities. For instance, according to IMDA, a higher share of enterprises is using e-payment systems and mobile services to do business (Exhibit 1B).

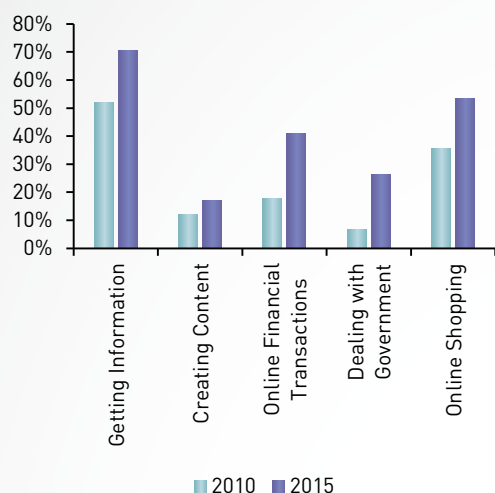
¹ Based on data from Akamai.

² Based on OpenSignal's latest 4G Speed metric, Singapore's 4G speed stood at 47 Mbps, one of the fastest in the world.

³ According to the Infocomm Media Development Authority, the total number of optical fibre broadband subscriptions increased from around 0.3 million in 2012 to over 1.1 million in 2016. Similarly, the total number of pre- and post-paid 4G subscriptions more than doubled from 2.1 million in 2013 to close to 4.9 million in 2016.

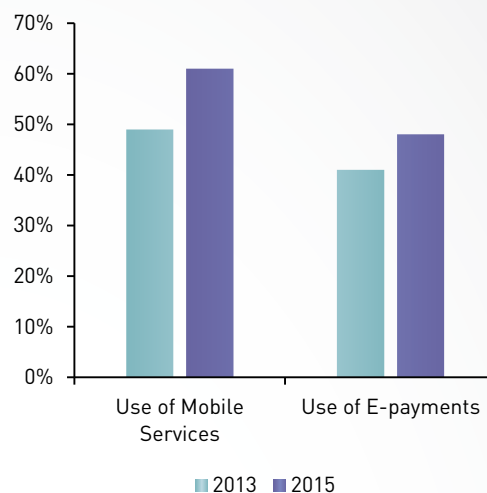
⁴ Digital fixed assets refer to computers & peripheral equipment and telecommunications equipment. Other fixed assets include land, building & structure, furniture & fittings, transport, and other machinery & equipment.

Exhibit 1A: Type of Infocomm Usage among Individuals Aged 15 and Above, 2010 and 2015



Source: Infocomm Media Development Authority

Exhibit 1B: Type of Digital Tools Used among Enterprises, 2013 and 2015



In addition to the trends highlighted above, anecdotal accounts suggest that the diffusion of other types of digital tools and capabilities such as cloud services, smart factories, etc. has also increased in recent years. With the Government's push towards greater digitalisation of the economy (e.g., through the Smart Nation initiative), the pace of digital adoption among households and enterprises is likely to be sustained or even quicken going forward.

The infocomm media sector plays a major role as a key digital enabler of individuals and enterprises...

The infocomm media (ICM) sector, comprising twelve segments that produce or enable digital goods and services (i.e., hardware⁵, telecommunications, IT services, software⁶, games, online services⁷, printing, post & courier, publishing, broadcasting, film & video and music), plays an important role in facilitating digital adoption among households and enterprises in Singapore. For instance, firms in the telecommunications industry provide services that enable access to the internet, while those in the IT services segment offer enterprises with computer programming services.

...and has grown significantly on the back of an increase in demand for digital goods and services

The rise in demand for digital goods and services among individuals and enterprises has propelled the growth of the ICM sector in recent years. Between 2011 and 2015, the nominal value-added (VA) of the ICM sector grew at a CAGR of 7.2 per cent, faster than the 4.2 per cent recorded for the overall economy (Exhibit 2A). Similarly, employment in the ICM sector rose between 2011 and 2015, although the pace of increase, at 2.5 per cent per annum (p.a.), was slower than that seen in the overall economy (3.2 per cent p.a.). Taken together, the productivity of the ICM sector in terms of VA per worker (VAPW) increased at a faster pace of 4.6 per cent p.a. over this period, as compared to the 0.6 per cent p.a. increase seen for the overall economy (Exhibit 2B).

⁵ The hardware segment consists of the wholesale and retail sales of computers and related accessories, telecommunication apparatus as well as office machinery and equipment.

⁶ The software segment consists of the development, publishing and wholesale sales of software (excluding games).

⁷ The online services segment consists of activities such as the development of e-commerce applications, web portals, etc.

Exhibit 2A: Nominal VA Growth, 2011 – 2015

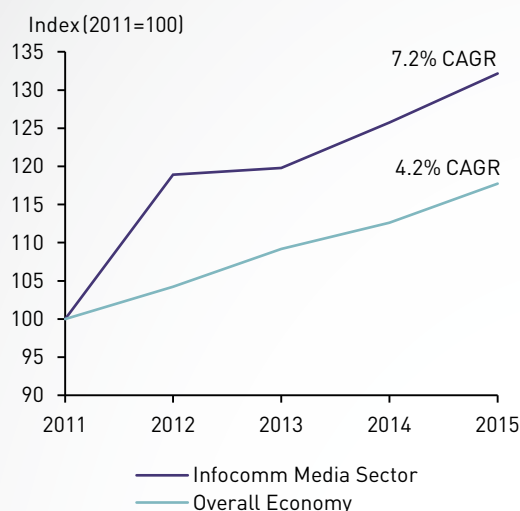
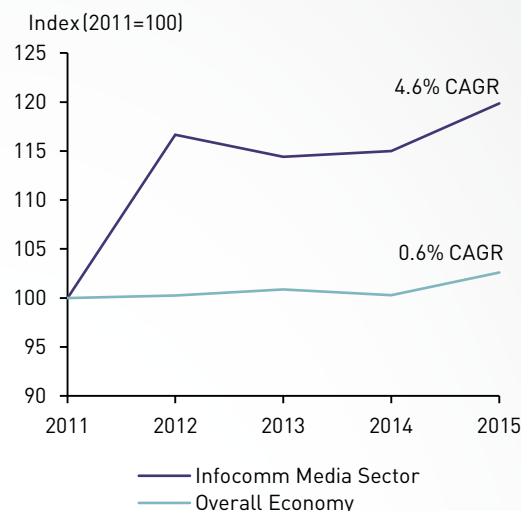


Exhibit 2B: Nominal VAPW Growth, 2011 – 2015



Source: Department of Statistics, Economic Development Board, Ministry of Manpower and MTI Staff Estimates

As a result of its robust growth, the contribution of the ICM sector to the economy increased from 7.4 per cent of nominal GDP in 2011 to 8.3 per cent in 2015. Specifically, the sector's nominal VA reached \$32 billion in 2015, with the hardware (40 per cent), telecommunications (16 per cent) and IT services (15 per cent) segments accounting for most of the sector's nominal VA (Exhibit 3A). In terms of employment, although employment in the ICM sector rose between 2011 and 2015, the ICM sector's share of total employment in the economy edged down slightly to 5.3 per cent in 2015, from 5.5 per cent in 2011. As at 2015, the ICM sector employed around 200,000 workers, with the IT services (28 per cent), hardware (17 per cent) and software & games (17 per cent) segments contributing the most to the sector's employment (Exhibit 3B).

Exhibit 3A: Share of the ICM Sector's Nominal VA by Segment, 2015

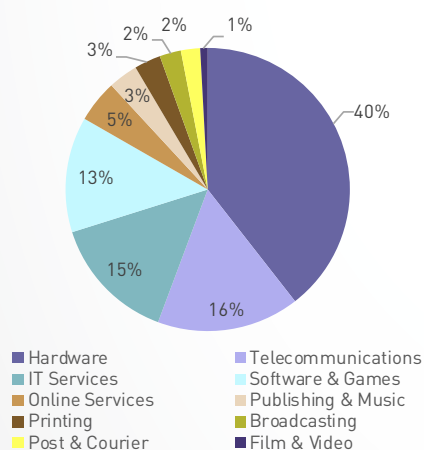
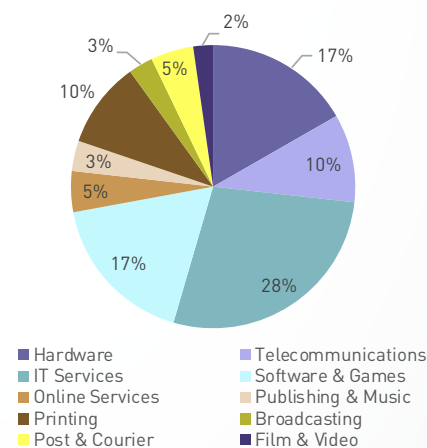


Exhibit 3B: Share of the ICM Sector's Employment by Segment, 2015

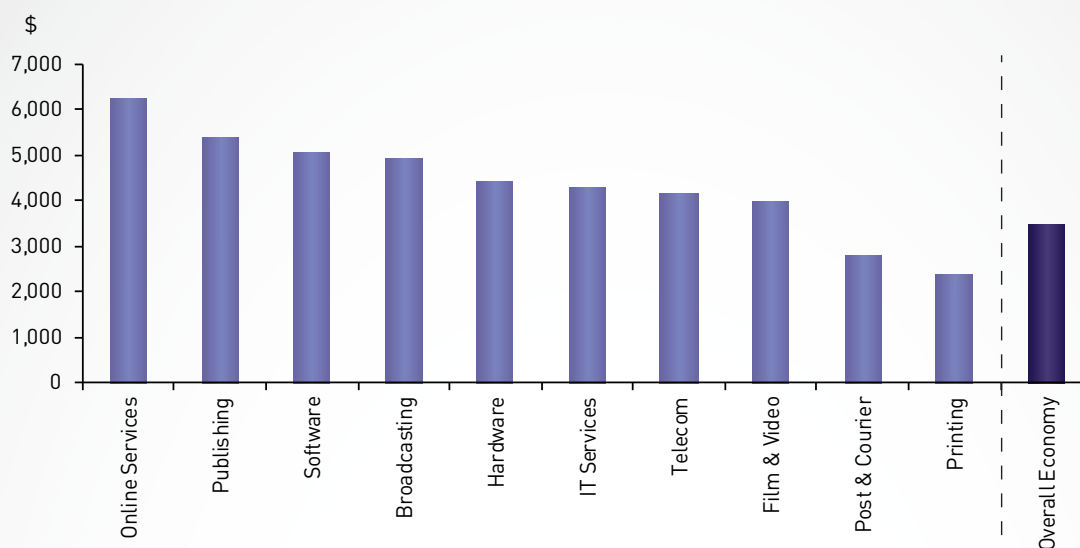


Source: Department of Statistics, Economic Development Board and Ministry of Manpower

The ICM sector is also a source of good jobs for resident workers, with median wages that are higher than the median wage in the overall economy

The ICM sector is also a source of good jobs for resident workers. With the exception of the post & courier and printing segments, the median wages of resident workers in the other segments of the ICM sector were higher than the median wages of resident workers in the overall economy in 2015 (Exhibit 4).

Exhibit 4: Median Nominal Gross Monthly Income from Work of Full-Time Resident Employees, 2015



Source: Ministry of Manpower

Notes: The median nominal gross monthly income from work excludes employer CPF contribution. Data for the games and music segments were excluded due to data suppression.

In summary, the ICM sector plays an important role in the Singapore economy as it is a key enabler of digital adoption by individuals and enterprises. Bolstered by the strong demand for digital goods and services, the ICM sector has outperformed the overall economy in recent years in terms of nominal VA and productivity growth. The ICM sector is also a source of good jobs for Singaporeans, paying median wages that are higher than the median wages in the overall economy.

Another major aspect of the digital economy relates to cross-border data flows

Cross-border data flows constitute an important part of the digital economy, as they partly reflect the amount of services that are traded between countries via digital means. In particular, some services firms rely on Information & Communications Technology (ICT) to access international markets and export their services to overseas customers, and in doing so, generate data flows between countries. Examples would include market research or legal services firms that provide services to overseas clients mainly through digital means (e.g., over email, cloud-based platforms or the firm's own platform on the World Wide Web).

Such information flows between countries – which are stored as bytes of data⁸ – are facilitated by a network of physical cables located under the seabed, with the transmitted information accessible through a platform such as the World Wide Web. In general, submarine cable networks can be categorised as public networks⁹ or private networks¹⁰, with the latter increasingly being deployed by large digital content providers like Google, Facebook and Amazon. Given that the amount of cross-border data flows is likely to be correlated with the pervasiveness of the digital economy, the former can be used as a broad indicator to track how countries are performing in relation to the digitalisation of their economies.

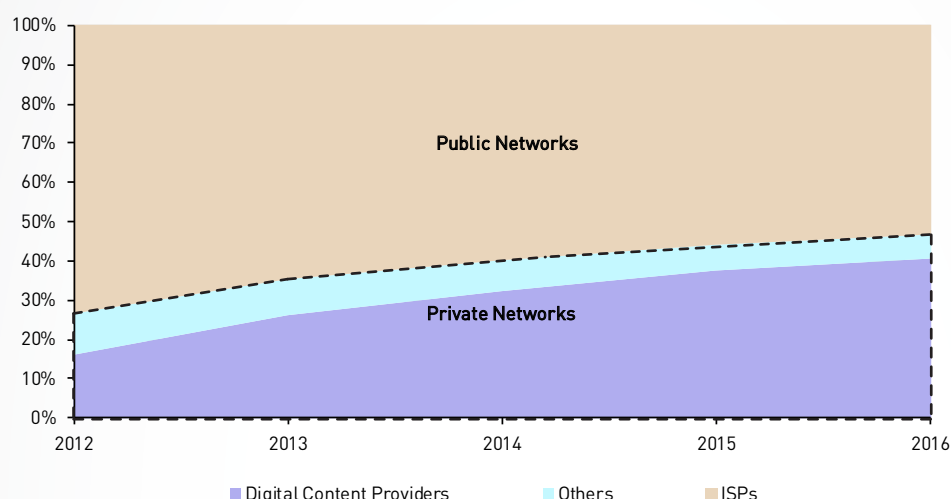
⁸ For instance, ten bytes of data could contain information on one word, while hundred bytes could contain information on a sentence.

⁹ Public networks refer to network cable capacity that is typically jointly owned by a consortium of internet service providers (ISPs). Each ISP in the consortium is allotted a specific bandwidth capacity and contributes to the maintenance and upkeep of the network. The ISPs in turn sell access to the bandwidth that they own to their clients. As the bandwidth capacity on these networks is available to a wide range of users at a given time, there may be instances of latency (i.e., longer time taken for data to be transmitted) and a reduction of quality during periods of high traffic.

¹⁰ Private networks refer to network cable capacity that is deployed by institutions who require bandwidth capacity for their dedicated use. Examples of such institutions include large digital content providers such as Google, Facebook and Amazon. These digital content providers require cross-border bandwidth to synchronise the data in their data centres that are located around the world and to distribute their content to end-users. Institutions may choose to own their own private network capacity for a variety of reasons, including cost considerations, to reduce latency, to improve quality and also for privacy reasons.

In our region, for example, we find that cross-border data flows (measured by used international bandwidth) passing through Asia¹¹ rose sharply at a CAGR of 51 per cent between 2012 and 2016. This came on the back of an increase in the number of broadband subscriptions in the region, in line with increasing digital adoption by households and enterprises.¹² At the same time, the share of cross-border data flows accounted for by private networks has also increased steadily over the years, from 16 per cent in 2012 to 40 per cent in 2016, driven by large digital content providers (Exhibit 5).¹³ This suggests that regional demand for the services (e.g., international video calling, cloud computing services, etc.) supplied by these content providers has surged in recent years.

Exhibit 5: Share of Cross-Border Flows in Asia, 2012 – 2016



Source: Telegeography Research

Notes: Others refer to private network capacity that is owned by institutions other than large digital content providers. Examples of such institutions include research and educational institutions.

Similar to the trends in Asia, cross-border data flows passing through Singapore have also increased rapidly...

The volume of cross-border data (from public and private networks) passing through Singapore has increased significantly in recent years. Specifically, Singapore's cross-border data flows grew by 65 per cent p.a. from 2012 to 2016 to reach 24,000 gigabits per second in 2016. This pace of growth was generally on par with or higher than that seen in other digitally-ready economies (Exhibit 6A).¹⁴ On a per capita basis, Singapore's cross-border data flows has also outstripped that of other digitally-ready economies (Exhibit 6B).

¹¹ Cross-border data flows passing through Asia refer to imports, exports as well as transshipment data traffic.

¹² According to Telegeography, the number of broadband subscriptions in Asia grew at a CAGR of 27 per cent from 2012 to 2016, with China contributing to a substantial portion of this growth.

¹³ Traditionally, large digital content providers leased bandwidth capacity from ISPs to transmit their data across borders. However, as the amount of data they handle has risen sharply over time, fuelled by robust demand for their services (e.g., international video calling, cloud computing services etc.), it has become more economically viable for the content providers to directly own the network cable capacity. Doing so also allows them to improve the quality of the services (i.e., reduced latency) that they provide.

¹⁴ This article defines digitally-ready economies as the top-ranked countries in the World Economic Forum's Networked Readiness Index. Apart from Singapore, these include the United States, Sweden, Finland, Norway and Japan.

Exhibit 6A: Cross-border Data Flows of Selected Economies, 2012 – 2016

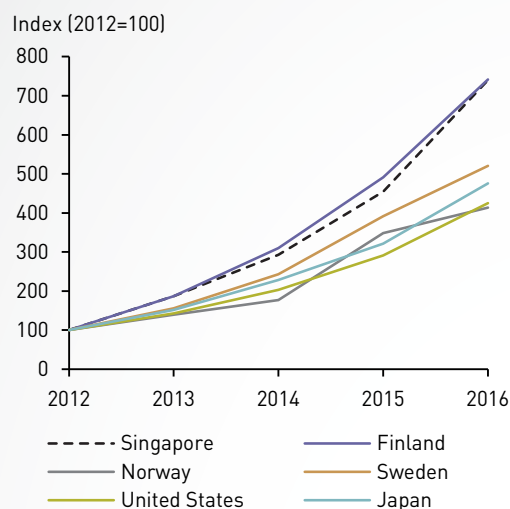
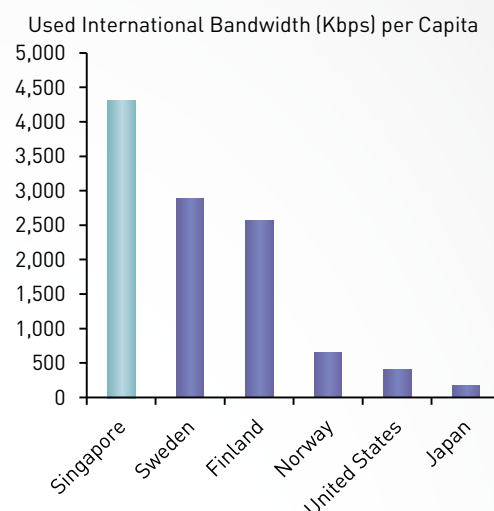


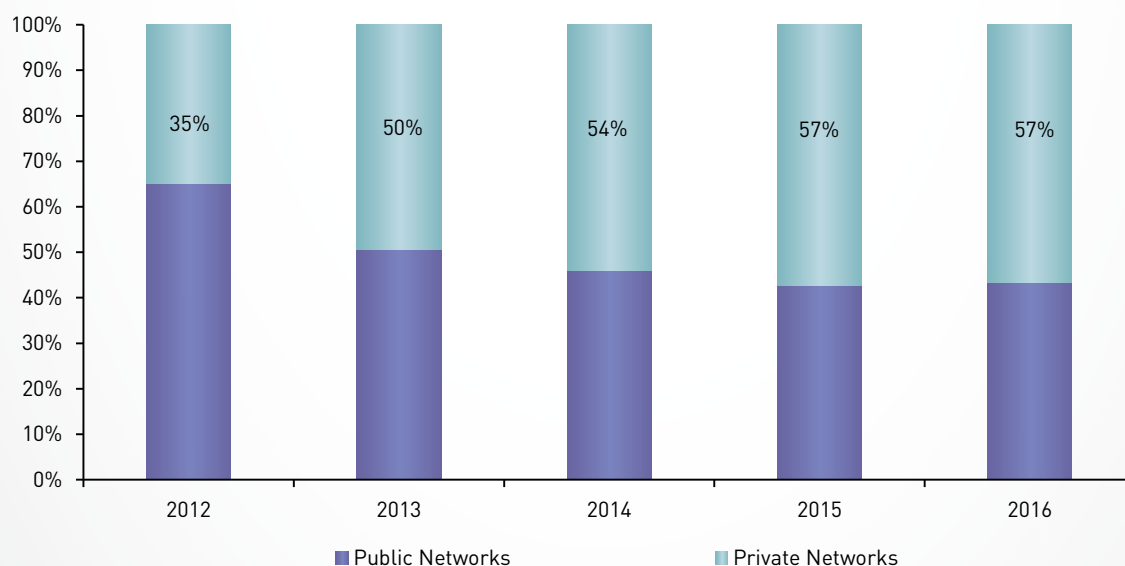
Exhibit 6B: Cross-border Data Flows Per Capita of Selected Economies, 2016



Source: Telegeography Research, United Nations Department of Economic and Social Affairs, World Population Prospects

The increase in Singapore's cross-border data flows over this period was largely driven by data flows through private networks. Indeed, the share of Singapore's cross-border flows through private networks rose rapidly within a span of five years to reach 57 per cent in 2016, surpassing that of public networks (Exhibit 7). In turn, the increase in data flows via private networks was driven by digital content providers. According to analysts such as those in Telegeography, Singapore is a key hub for the distribution of digital content to the region. They attribute this to Singapore's pro-business environment, advanced ICT infrastructure and extensive network connectivity, which have helped to attract digital content providers to deploy network capacity as well as host their content and services in Singapore.

Exhibit 7: Share of Cross-border Data Flows Through Public and Private Networks in Singapore, 2012 – 2016



Source: Telegeography Research

...reflecting in part the rising prominence of services trade that can be delivered digitally

In addition to reflecting Singapore's hub status for the distribution of digital content in the region, the increase in cross-border data flows through Singapore may also be due to the rising prominence of digitally-deliverable services trade.¹⁵ The dollar value associated with the export of such digitally-delivered services is the most direct economic value that can be ascribed to cross-border data flows.¹⁶ As such, following the framework employed by the US Department of Commerce, this section quantifies the direct economic contribution of cross-border data flows by estimating the value generated by services trade that are digitally deliverable.¹⁷

For a start, we determine the categories of services trade that are likely to be primarily delivered through digital means. The United Nations Conference on Trade and Development defines seven categories of services trade that are ICT-enabled, or digitally deliverable. These categories correspond to five broad categories of our services trade statistics as shown in Exhibit 8 below.

Exhibit 8: Digitally-Deliverable Services Trade Categories in Singapore

Digitally-Deliverable Services Trade	
Financial & Insurance Services	Includes financial intermediary and auxiliary services, commissions on financial derivative transactions, as well as the payment of insurance premiums
Telecommunications, Computer & Information Services	Includes teleconferencing services, computer software consultancy services and web design & development services
Charges for the Use of Intellectual Property (IP)	Includes charges for patents, industrial processes and designs & franchises
Personal, Cultural & Recreational Services	Includes audio-visual services and services associated with the production of motion pictures
Other Business Services	Includes a diverse range of services such as advertising and market research services, architectural design services and legal services

Notes: We are unable to determine the share of trade in these categories that are actually delivered by digital means. As such, we take the trade value of the entire services trade category (e.g., personal, cultural & recreational services) to be digitally-deliverable services trade rather than just the segments that are traded digitally (e.g., production of motion pictures). Hence, similar to Nicholson and Noonan (2014), our view is that this analysis can be interpreted as an upper-bound estimate of the value accruing to digitally-deliverable services trade.

Singapore's trade in digitally-deliverable services has grown at a faster pace compared to other digitally-ready economies

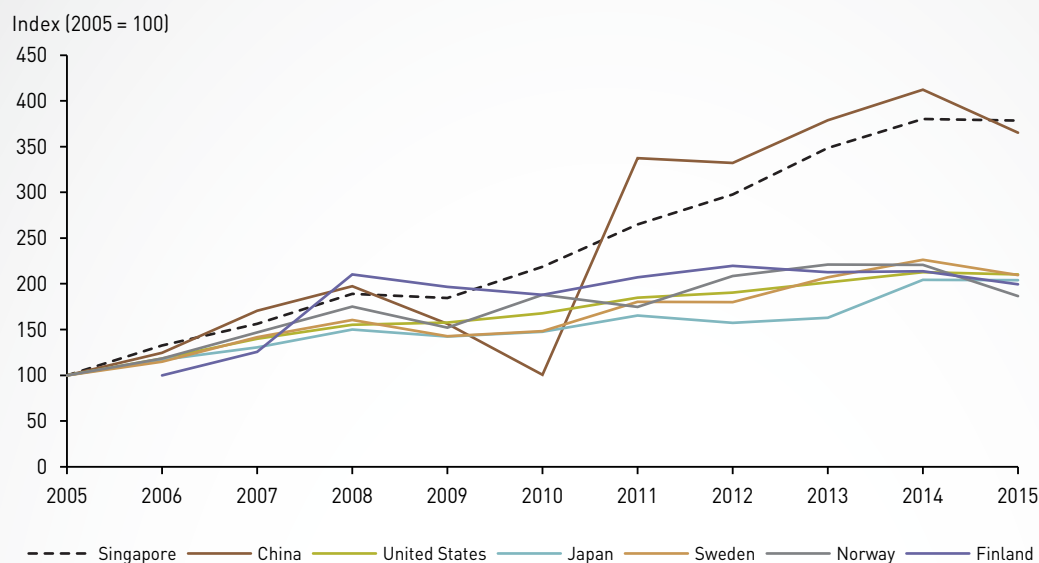
Summing up the value of trade (in nominal terms) in the above five categories, we find that Singapore's total trade (i.e., imports and exports) of digitally-deliverable services has grown at a faster pace than other digitally-ready economies. Specifically, Singapore's total trade in digitally-deliverable services (in US dollars) grew by 14 per cent p.a. from 2005 to 2015, similar to the pace of growth in China, but faster than other digitally-ready economies such as the United States (7.7 per cent p.a.) and Japan (7.4 per cent p.a.) (Exhibit 9).

¹⁵ Digitally-deliverable services trade would include the distribution of digital content in the region if a fee is involved, e.g., subscription to Apple music, purchase of cloud storage services, etc.

¹⁶ To note, a higher volume of cross-border data flows may not necessarily be associated with a higher value of services trade that is delivered digitally. For instance, the free streaming of a high-definition video that is hosted on a server located overseas may generate a large amount of cross-border data. On the other hand, the export of legal services through the internet may involve large sums of money but only generate a small amount of cross-border data.

¹⁷ This framework was used in a US Department of Commerce study by Nicholson and Noonan (2014) on "The Value of Digitally Deliverable Services". Similar to the study, our analysis does not capture digitally-deliverable data and services delivered at no price (e.g., data flows related to the use of social media services and other free online services). However, services related to the operation of these free services, such as advertising services, are included in this analysis if they are exported to other countries from Singapore.

Exhibit 9: Trade in Digitally-Deliverable Services of Selected Economies, 2005 – 2015

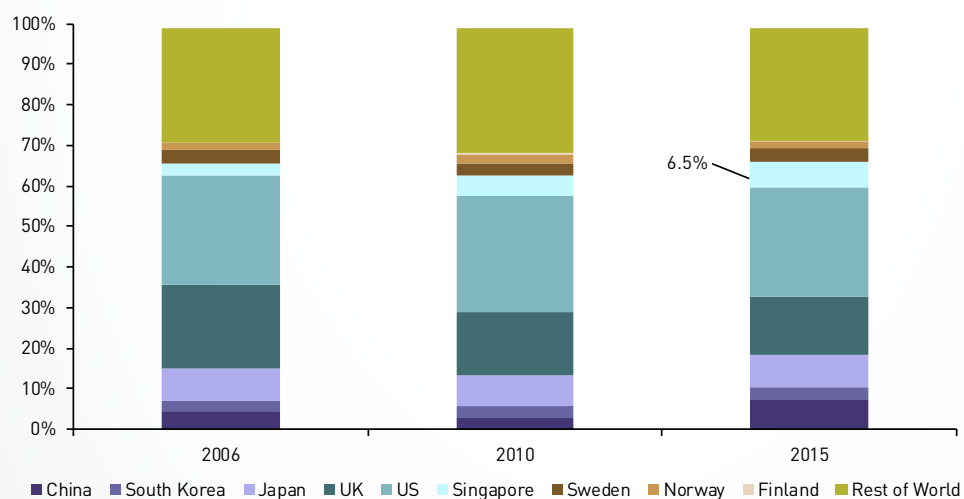


Source: World Trade Organisation Trade in Commercial Services

Notes: Data for Finland in 2005 is not available. As such, a base year index of 2006 is used instead.

Given the rapid pace of growth in our digitally-deliverable services trade, Singapore's share of the global trade in digitally-deliverable services has close to doubled, from 3.5 per cent in 2005 to 6.5 per cent in 2015 (Exhibit 10). By contrast, Singapore's share of global merchandise trade (in nominal terms) has remained stable at around 2 per cent over the same period.

Exhibit 10: Global Share of Digitally-Deliverable Services in Value Terms, 2005 – 2015



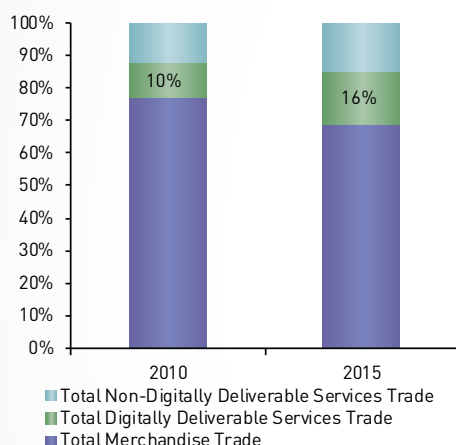
Source: World Trade Organisation Trade in Commercial Services

Notes: Data for Finland in 2005 is not available.

Within Singapore, digitally-deliverable services trade has also risen in prominence over the years, driven by the trade in financial & insurance services and other business services

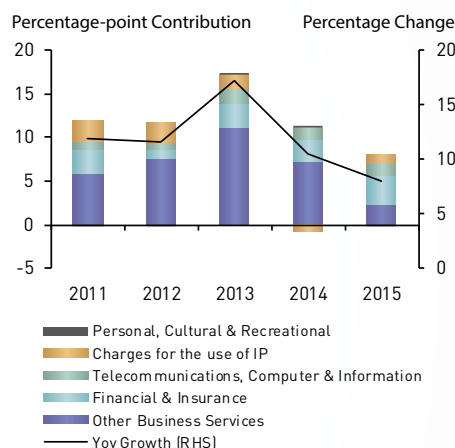
In tandem with its strong growth, the share of digitally-deliverable services trade in Singapore's total trade (i.e., comprising digitally-deliverable services trade, other categories of services trade¹⁹ and merchandise trade) has also increased, from 10 per cent in 2010 to 16 per cent in 2015 (Exhibit 11A). This increase was driven primarily by trade in the financial & insurance and other business services categories (Exhibit 11B). Collectively, these two categories of digitally-deliverable services trade grew by 13 per cent p.a. between 2010 and 2015, and by 2015, accounted for around 75 per cent of total digitally-deliverable services trade in Singapore. Underpinned by a conducive business environment and well-established ICT infrastructure, the rapid growth of digitally-deliverable services trade in Singapore is likely a reflection of our position as an attractive business location from which firms are able to operate out of to serve the region.

Exhibit 11A: Share of Total Goods and Services Trade, 2010 and 2015



Source: Department of Statistics and MTI Staff Estimates

Exhibit 11B: Decomposition of Digitally-Deliverable Services Trade Growth, 2011 – 2015



Singapore's digitally-deliverable services exports generate significant VA for our economy

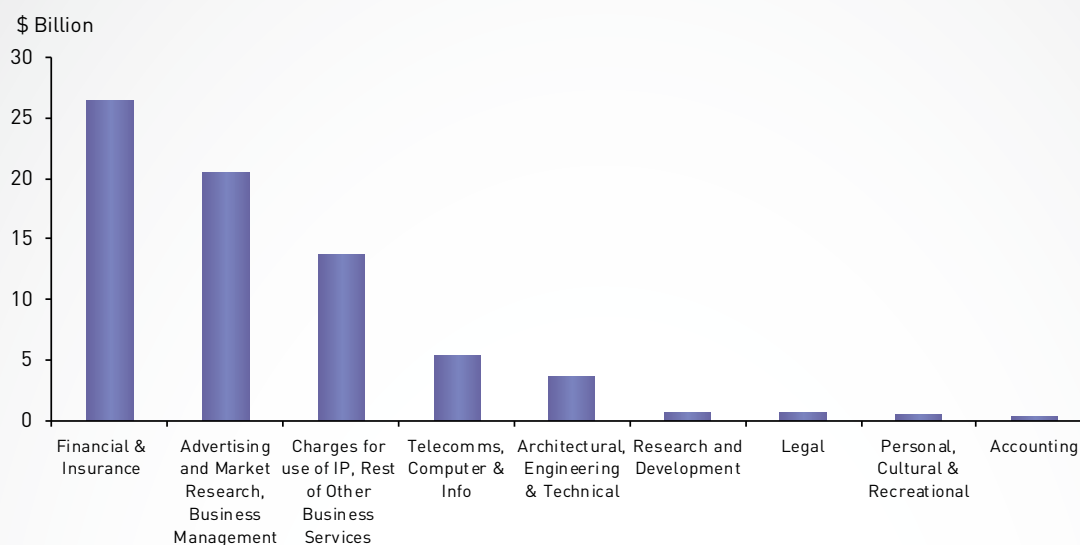
We next estimate the VA generated from digitally-deliverable services exports using the latest 2013 Input-Output Tables published by the Department of Statistics (see Annex for details on the methodology).²⁰ Our results show that the VA from digitally-deliverable services exports accounted for around 18 per cent of Singapore's nominal GDP in 2015, with financial & insurance as well as advertising and market research & business management services exports contributing the most to GDP (Exhibit 12).²¹

¹⁹ These services trade categories are those that are not primarily delivered online. Examples include tourism services, construction services, transportation services etc.

²⁰ This methodology was also used by Nicholson and Noonan (2014).

²¹ As previously noted, we are not able to determine the share of exports in these categories that are delivered by digital means. As such, this estimate can be taken as an upper-bound estimate of the direct value accruing to digitally-deliverable services exports.

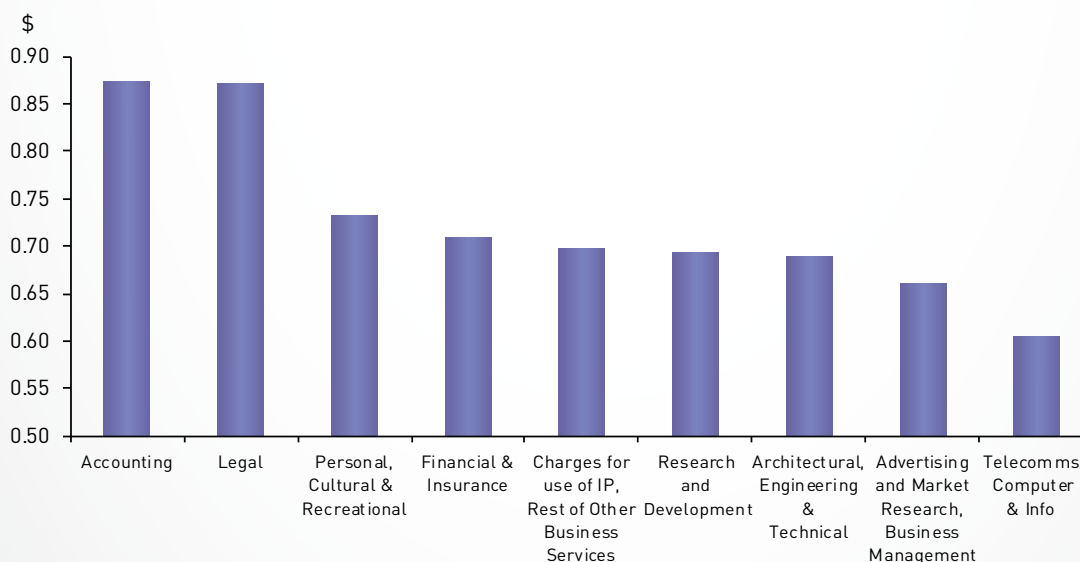
Exhibit 12: VA Contribution of Digitally-Deliverable Services Exports, 2015



Source: Department of Statistics and MTI Staff Estimates

In addition, digitally-deliverable services exports also generate higher VA per dollar of exports as compared to other forms of exports. Specifically, the VA per dollar of digitally-deliverable services exports was \$0.69, higher than that for non-digitally deliverable services exports (\$0.49) and merchandise exports (\$0.33). The higher VA that accrues to a dollar of digitally-deliverable services exports could be due to the fact that the intermediate inputs used in the production of such services exports have higher domestic content as compared to non-digitally deliverable services exports and merchandise exports, which use more imported products as intermediate inputs.²² In terms of the different types of digitally-deliverable services trade, we find that accounting and legal services exports generate the highest VA per dollar, while telecommunications, computer & information services exports generate the lowest VA per dollar among all the digitally-deliverable services exports (Exhibit 13).

Exhibit 13: VA per Dollar of Digitally-Deliverable Services Exports, 2013



Source: Department of Statistics and MTI Staff Estimates

²² This is broadly in line with the finding of an earlier study by Chan, Y. J. and Lim, Y. (2012) on an "Update on Value-added from Singapore's Exports", which noted that the VA per dollar of overall services exports in 2010 was 1.5 times as high as the VA per dollar of merchandise exports, because merchandise exports tend to use more imported products as intermediate inputs.

Conclusion

Over the years, Singapore has made significant progress in enhancing its ICT infrastructure, which forms the backbone of the digital economy. At the same time, more of our households and enterprises are also embracing the adoption of digital tools and digital capabilities. Collectively, these trends have supported the growth of the ICM sector and cross-border data flows in Singapore.

Reflecting the progress made, Singapore has been placed near or at the top of various international digital economy-related rankings. Most recently, Singapore was placed first on the World Economic Forum's Networked Readiness Index – an index that measures how well an economy uses ICT to boost competitiveness.²³ Nonetheless, there remains room for improvement. For instance, in terms of the usage of ICT by individuals and businesses, we are ranked behind the top digitally-ready economies in one of the sub-indices of the Networked Readiness Index. Towards this end, the Government will continue to assist individuals and companies to adopt and benefit from digitalisation, such as through the SkillsFuture for Digital Workplace initiative and the SME Go Digital programme.

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²³ The Networked Readiness Index is a composite indicator made up of four main sub-indices, namely Environment, Readiness, Usage and Impact. Under the Environment sub-index, pillars such as the political, regulatory, business and innovation environment are examined. For the Readiness sub-index, pillars such as ICT infrastructure, affordability and skills are considered. Under the Usage sub-index, the extent to which individuals, enterprises and the government leverages on ICT is evaluated. Lastly, for the Impact sub-index, the social and economic impact of ICT usage in the country are assessed.

Annex: Methodology for Estimating VA from Digitally-Deliverable Services Exports

We used a standard Input-Output (IO) open multiplier model to calculate the VA from exports to key markets based on the latest available (2013) IO tables.

Similar to previous studies by Nicholson and Noonan (2014) and Chan, Y. J. and Lim, Y. (2012), we map each digitally-deliverable export category to the 71 sectors of the IO tables. The VA multiplier for each sector, as given by the IO tables, is then multiplied to these export categories, to obtain the VA generated from digitally-deliverable services exports. For more information on the definition and interpretation of multipliers from the IO tables, please refer to the Department of Statistics' publication on the IO tables.

Our mapping of digitally-deliverable services exports to sectors in DOS' IO tables takes guidance from Nicholson and Noonan's (2014) mapping of digitally-deliverable services categories to the US Bureau of Economic Analysis' (BEA) IO tables. The mapping of digitally-deliverable services export categories to our IO tables is shown in the table below.

Digitally-Deliverable Services	IO2013 Sectors
Financial & Insurance	• Banking and finance • Insurance, reinsurance & pension funds • Fund management activities • Other auxiliary financial & insurance services
Accounting	• Accounting, tax consultancy and auditing services
Advertising and Market Research, Business Management	• Management consultancy, advertising and market research
Architectural, Engineering & Technical	• Architectural & Engineering Services
Research & Development	• Research & Development
Legal	• Legal services
Other Business Services (excluding Accounting, advertising and market research, business management, architectural, engineering and technical, research and development and legal services) and Charges for the Use of Intellectual Property	• Business representative offices & HQ • Other professional scientific and technical services • Rental & leasing • Real estate • Other administrative and business support services • Publishing
Telecommunications, Computers & Information	• Telecommunications • Computer programming, consultancy and information services
Personal, Cultural & Recreational	• Media entertainment • Arts, entertainment & recreation



CHAPTER 2

Sectoral Performance



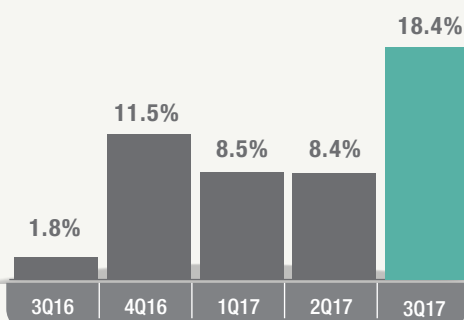
CHAPTER 2

SECTORAL PERFORMANCE

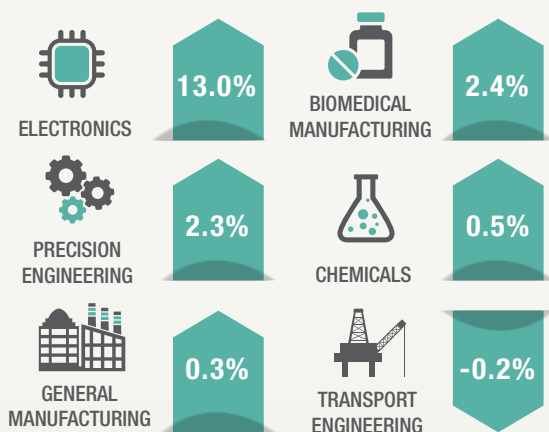
MANUFACTURING



Real Growth



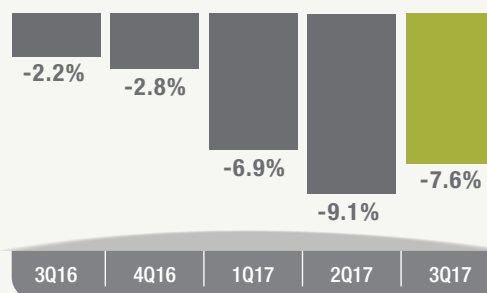
Clusters in Manufacturing Sector %-point contribution in 3Q17



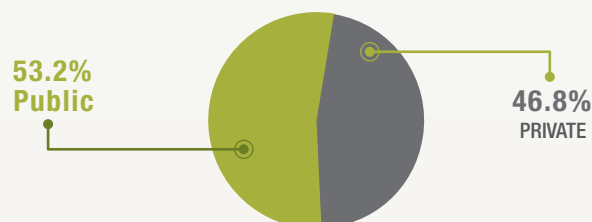
CONSTRUCTION



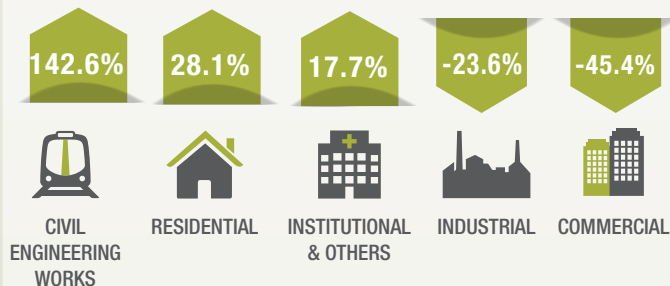
Real Growth



Certified Payments in 3Q17



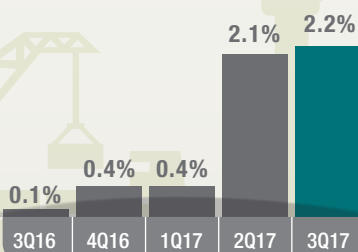
Contracts Awarded in 3Q17



WHOLESALE & RETAIL TRADE



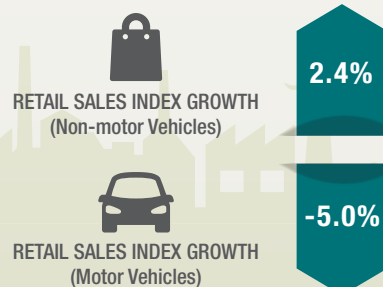
Real Growth



Wholesale Trade



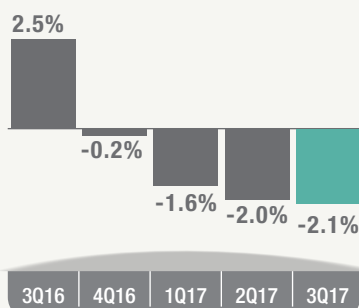
Retail Trade



ACCOMMODATION & FOOD SERVICES

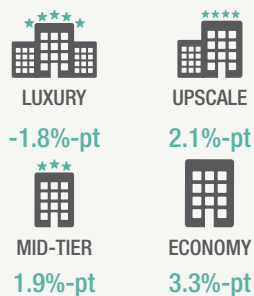


Real Growth



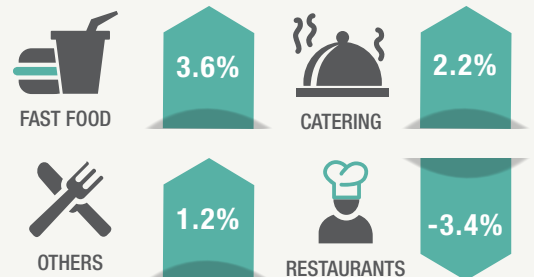
Accommodation

Occupancy rates of hotels (Y-O-Y CHANGE)



Food Services

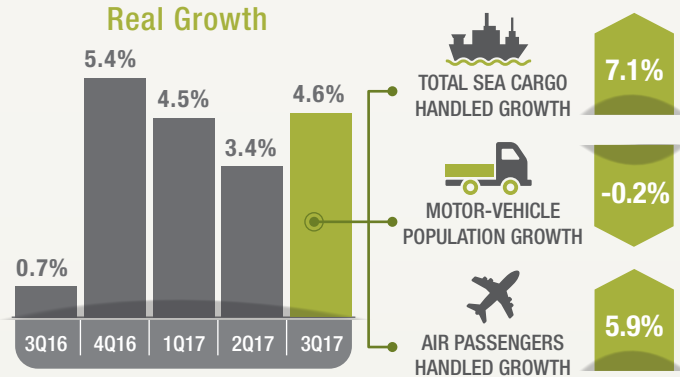
Performance of F&B (Sales growth)



TRANSPORTATION & STORAGE



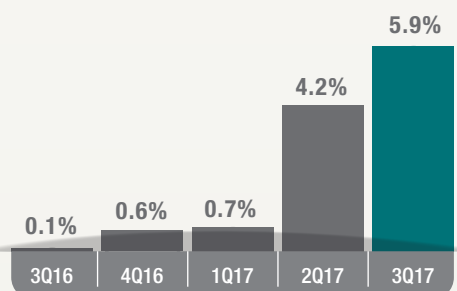
Real Growth



FINANCE & INSURANCE



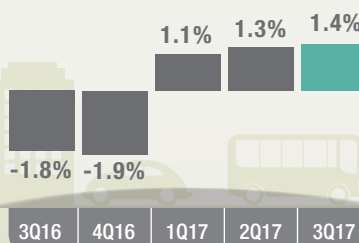
Real Growth



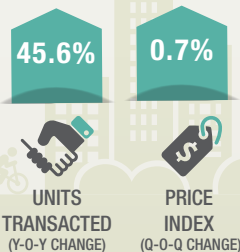
BUSINESS SERVICES



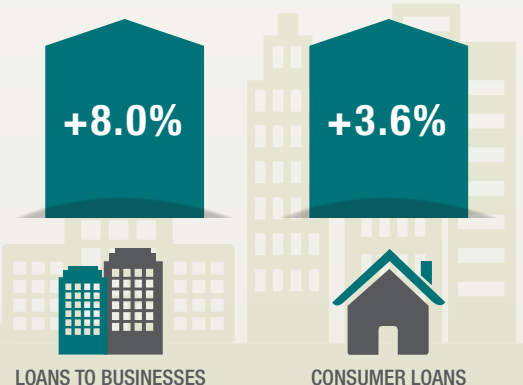
Real Growth



Private Residential Real Estate



Growth of bank loans & advances to non-bank customers in 3Q17



OVERVIEW

In the third quarter of 2017,

- The manufacturing sector expanded by 18 per cent, accelerating from the 8.4 per cent growth in the previous quarter. Growth was broad-based, with all manufacturing clusters recording output expansions, except for the transport engineering cluster.
- The construction sector contracted by 7.6 per cent, extending the 9.1 per cent decline in the previous quarter. The drop in construction output was due to continued weakness in both private sector and public sector construction activities.
- The wholesale & retail trade sector grew by 2.2 per cent, similar to the 2.1 per cent growth in the preceding quarter. Growth was supported by expansions in both the wholesale trade and retail trade segments.
- The transportation & storage sector expanded by 4.6 per cent, picking up from the 3.4 per cent expansion in the second quarter. Growth was supported by the water transport and air transport segments, which were in turn bolstered by an increase in the volume of sea cargo handled and air passenger traffic respectively.
- The accommodation & food services sector contracted by 2.1 per cent, extending the 2.0 per cent decline in the previous quarter, weighed down by the sluggish performance of both the accommodation and food services segments.
- The finance & insurance sector grew by 5.9 per cent, an improvement from the 4.2 per cent growth in the preceding quarter. Stronger outturns in the financial intermediation, fund management and insurance segments contributed to the improved performance of the sector.
- The business services sector expanded by 1.4 per cent, similar to the 1.3 per cent growth in the second quarter. Growth in the sector was supported primarily by the professional services and others segments.

MANUFACTURING

The manufacturing sector expanded by 18 per cent in the third quarter (Exhibit 2.1). Growth was supported by higher output across all manufacturing clusters, with the exception of the transport engineering cluster, which continued to register a decline in output (Exhibit 2.2).

Exhibit 2.1: Manufacturing Sector's Growth Rates

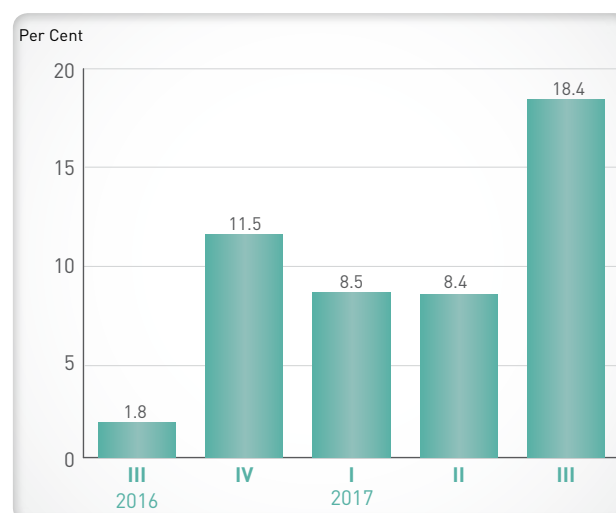
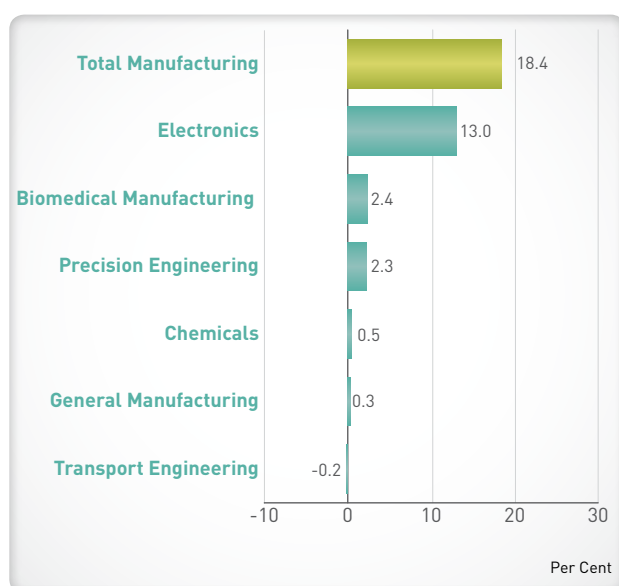


Exhibit 2.2: Percentage-Point Contribution to Manufacturing Sector's Growth in 3Q 2017



The output of the electronics cluster increased by 41 per cent in the third quarter, largely driven by a 57 per cent surge in the output of the semiconductors segment. The strong performance of the semiconductors segment came on the back of robust global semiconductor demand, which was in turn driven by improvements in the outlook for key end markets, such as the smartphone market. At the same time, the computer peripherals segment also registered healthy growth of 22 per cent, mainly due to rising demand for printer-related products. On the other hand, output in the data storage, other electronic modules & components and infocomms & consumer electronics segments declined by 25 per cent, 2.4 per cent and 0.3 per cent respectively.

The output of the biomedical manufacturing cluster rose by 13 per cent in the third quarter, driven by expansions in both the pharmaceuticals and medical technology segments. The pharmaceuticals segment grew by 10 per cent, partly due to a higher level of production of biological products. At the same time, the medical technology segment expanded by 20 per cent, as domestic manufacturers benefitted from higher export demand for medical devices.

The precision engineering cluster grew by 16 per cent in the third quarter, with both the machinery & systems (M&S) and precision modules & components (PMC) segments contributing strongly to growth. Output in the M&S segment rose by 14 per cent, largely driven by healthy global semiconductor equipment demand. Meanwhile, the PMC segment grew by 20 per cent on account of a higher level of production of dies, moulds, tools, jigs & fixture, optical instruments and metal precision components.

Output in the chemicals cluster increased by 5.4 per cent in the third quarter, led by expansions in the petrochemicals (13 per cent), other chemicals (5.6 per cent) and petroleum (7.2 per cent) segments. The strong performance of the petrochemicals segment was mainly due to the low base in the third quarter of last year when some plants were shut down for maintenance. Meanwhile, the other chemicals segment was supported by robust global demand for fragrances, while the petroleum segment recorded healthy production volumes on the back of strong refining margins.

The general manufacturing cluster's output expanded by 2.8 per cent in the third quarter. In particular, the food, beverages & tobacco segment saw a strong outturn, growing by 8.9 per cent on the back of an increase in production of beverage concentrates and dairy products. By contrast, the printing and miscellaneous industries segments contracted by 8.7 per cent and 1.2 per cent respectively, weighed down by the weak demand for print products and construction-related materials respectively.

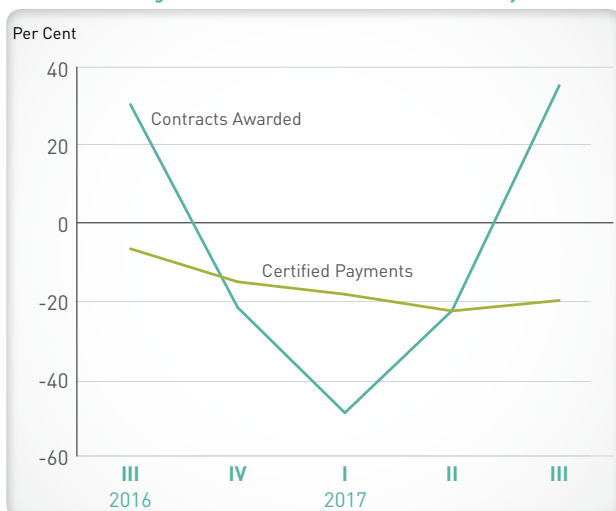
The transport engineering cluster shrank by 1.2 per cent in the third quarter, as output in the marine & offshore engineering segment declined by 17 per cent on account of lower levels of rig-building and shipbuilding and repair activities. The output decline in the M&OE segment more than offset robust output expansions in the aerospace (18 per cent) and land (12 per cent) segments. The aerospace segment was supported by a higher volume of repair and maintenance work from commercial airlines, while the land segment reported an increase in the production of motor vehicle parts.

CONSTRUCTION

The construction sector shrank by 7.6 per cent in the third quarter, extending the 9.1 per cent contraction in the preceding quarter, due to weakness in both private sector and public sector construction output.

In the third quarter, nominal certified progress payments (a proxy for construction output) fell for the fifth consecutive quarter, contracting at a pace of 20 per cent, easing from the 23 per cent drop in the previous quarter (Exhibit 2.3). The decline in construction output was primarily due to a fall in private certified progress payments. In particular, private certified progress payments declined by 28 per cent, driven by a slowdown in private residential building works (-30 per cent) and private industrial building works (-31 per cent). Construction output was also weighed down by a decline in public certified progress payments (-11 per cent), which came on the back of a fall in public residential building works (-30 per cent) and public civil engineering works (-6.2 per cent).

Exhibit 2.3: Changes in Contracts Awarded and Certified Payments



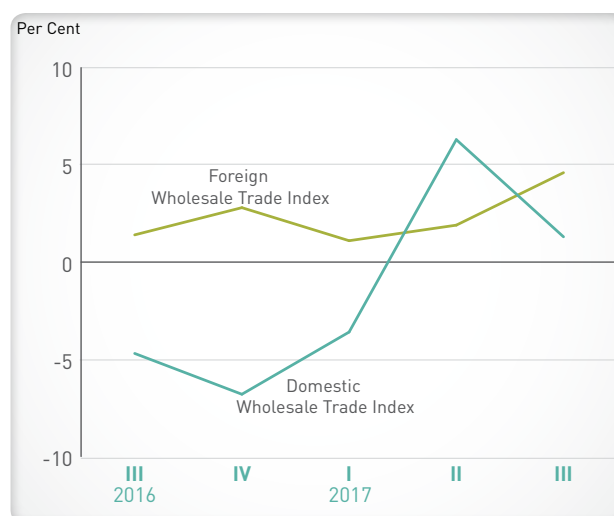
Construction demand in terms of contracts awarded rose by 35 per cent in the third quarter, a reversal from the 23 per cent decline in the previous quarter (Exhibit 2.3). The increase was largely due to higher public sector construction demand (194 per cent), which was in turn driven by a surge in demand for public civil engineering works (921 per cent) as contracts for Circle Line 6 and the Deep Tunnel Sewerage System were awarded. Public sector construction demand was also supported by public residential building works (45 per cent) and public institutional & other building works (6.9 per cent). On the other hand, construction demand was weighed down by private sector construction demand (-39 per cent), which fell on the back of weaker demand for private civil engineering works (-85 per cent) and private commercial building works (-46 per cent).

WHOLESALE & RETAIL TRADE

The wholesale & retail trade sector grew by 2.2 per cent in the third quarter, extending the 2.1 per cent growth in the previous quarter. Growth was supported by both the wholesale trade and retail trade segments.

The wholesale trade segment was boosted by expansions in both domestic and foreign wholesale trade sales volumes (Exhibit 2.4). The domestic wholesale trade index rose by 1.3 per cent in the third quarter, following an increase of 6.3 per cent in the previous quarter, on the back of expansions in the sales of petroleum & petroleum-related products (3.0 per cent) and others¹ (11 per cent).

Exhibit 2.4: Changes in Wholesale Trade Index at Constant Prices

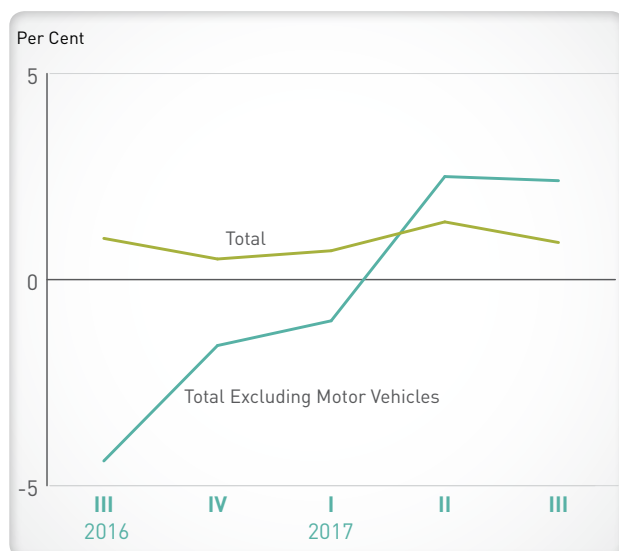


¹ Others consist of a diverse range of products that includes agricultural raw materials and live animals, tropical produce, personal effects and medicinal and pharmaceutical products, among others.

Meanwhile, the foreign wholesale trade index expanded by 4.6 per cent in the third quarter, faster than the 1.9 per cent growth in the second quarter. The improved performance of the index can be mainly attributed to a turnaround in the sales of petroleum & petroleum-related products. Specifically, the sales of petroleum & petroleum-related products expanded by 5.3 per cent in the third quarter, a reversal from the decline of 4.2 per cent in the second quarter. Additionally, robust expansions in the sales of electronic components (15 per cent) and food, beverages & tobacco (19 per cent) further lent support to growth.

Overall retail sales volume rose by 0.9 per cent in the third quarter, extending the 1.4 per cent growth in the previous quarter, supported by a sustained recovery in non-motor vehicle sales (Exhibit 2.5). Notably, retail sales volume (excluding motor vehicles) expanded by 2.4 per cent in the third quarter, similar to the 2.5 per cent increase in the previous quarter. The improvement in non-motor vehicle sales came on the back of an uptick in consumer sentiments as well as higher tourist expenditure on shopping. In particular, the sales volume of department stores, watches & jewellery, and wearing apparel & footwear rose by 4.6 per cent, 4.5 per cent and 4.1 per cent respectively.

Exhibit 2.5: Changes in Retail Sales Index at Constant Prices

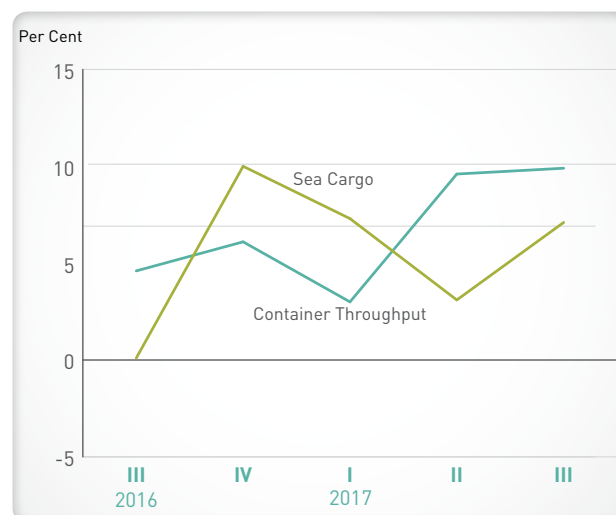


TRANSPORTATION & STORAGE

Growth in the transportation & storage sector picked up to 4.6 per cent in the third quarter, from 3.4 per cent in the previous quarter.

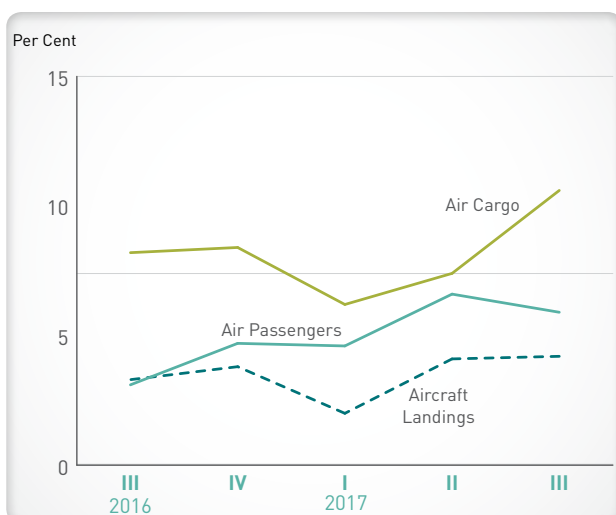
The water transport segment saw a healthy increase in the volume of sea cargo handled in the third quarter, with the latter growing by 7.1 per cent, higher than the 3.1 per cent growth in the previous quarter (Exhibit 2.6). The higher volume of sea cargo handled came on the back of a 9.9 per cent expansion in container throughput handled at Singapore's ports, in line with improvements in global container trade flows.

Exhibit 2.6: Changes in Container Throughput and Sea Cargo Handled



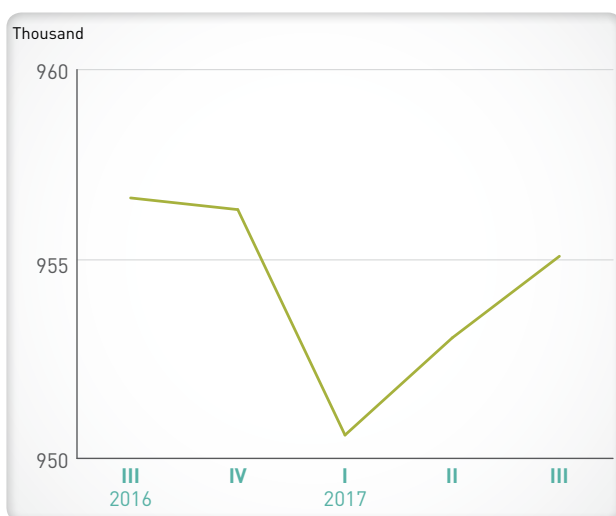
Similarly, the air transport segment was boosted by an increase in air passenger and air cargo volume handled at Changi Airport. Specifically, the volume of air passenger traffic passing through Changi Airport rose by 5.9 per cent in the third quarter, extending the 6.6 per cent increase in the second quarter (Exhibit 2.7). The higher volume of air passenger traffic was underpinned by strong growth on the Singapore-China and Singapore-Indonesia routes. Likewise, bolstered by robust non-oil export volumes, total air cargo shipments handled at Changi Airport rose by 11 per cent in the third quarter, faster than the 7.4 per cent growth in the preceding quarter. In addition, the number of aircraft landings increased by 4.2 per cent in the third quarter to reach 47,071, similar to the 4.1 per cent expansion in the previous quarter.

Exhibit 2.7: Changes in Air Transport



As of September 2017, the total number of motor vehicles registered with the Land Transport Authority was 955,156, representing a 0.2 per cent decline from a year ago (Exhibit 2.8). These comprised 543,991 private and company cars, 65,470 rental cars, 24,468 taxis, 18,827 buses, 141,893 motorcycles and scooters, and 160,507 goods vehicles & other vehicle types.

Exhibit 2.8: Motor Vehicles Registered



ACCOMMODATION & FOOD SERVICES

The accommodation & food services sector contracted by 2.1 per cent in the third quarter, extending the 2.0 per cent decline recorded in the previous quarter. The sector's growth was weighed down by the sluggish performance of both the accommodation and food services segments.

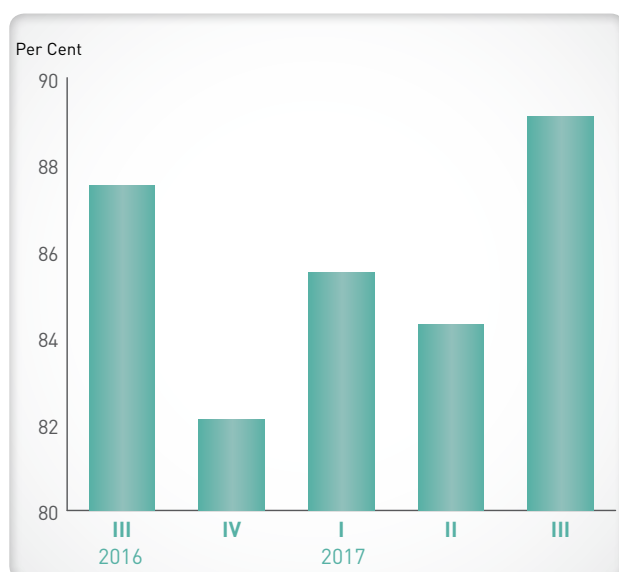
Exhibit 2.9: Visitor Arrivals



Total visitor arrivals rose by 6.2 per cent in the third quarter, improving from the 5.0 per cent increase in the preceding quarter (Exhibit 2.9). This came on the back of the robust growth in Indian and Chinese arrivals, which expanded by 19 per cent and 17 per cent respectively. The rise in visitor arrivals from these source markets was facilitated by the addition of flights connecting Changi Airport to the various Indian and Chinese cities.

In tandem with the growth in visitor arrivals, the overall average occupancy rate of gazetted hotels rose by 1.5 percentage-points from a year ago to reach 89 per cent in the third quarter (Exhibit 2.10). In particular, the average occupancy rate of the economy, mid-tier and upscale hotels rose by 3.3 percentage-points, 1.9 percentage-points and 2.1 percentage-points respectively as compared to the same period a year ago. Nevertheless, the average occupancy rate of the luxury hotel segment, which contributes a higher value-added per room, fell by 1.8 percentage-points in the third quarter as compared to the same period ago. The fall in the average occupancy rate of the luxury hotels occurred in tandem with a decline in their gross lettings as rooms were taken off the market for maintenance and renovation works. This in turn posed a drag on the value-added growth of the accommodation segment over the period.

Exhibit 2.10: Overall Average Occupancy Rate



For the food services segment, overall food & beverage sales volume remained tepid, declining by 0.1 per cent in the third quarter, although this was a moderation from 3.0 per cent contraction in the preceding quarter (Exhibit 2.11). The weak performance of the food services segment was primarily due to the lacklustre performance of restaurants, which posted a 3.4 per cent slump in sales volume over the period. By contrast, the sales volume of other eating places grew by 1.2 per cent in the third quarter, offsetting part of the decline in the sales volume of restaurants.

Exhibit 2.11: Changes in Food & Beverage Services Index at Constant Prices

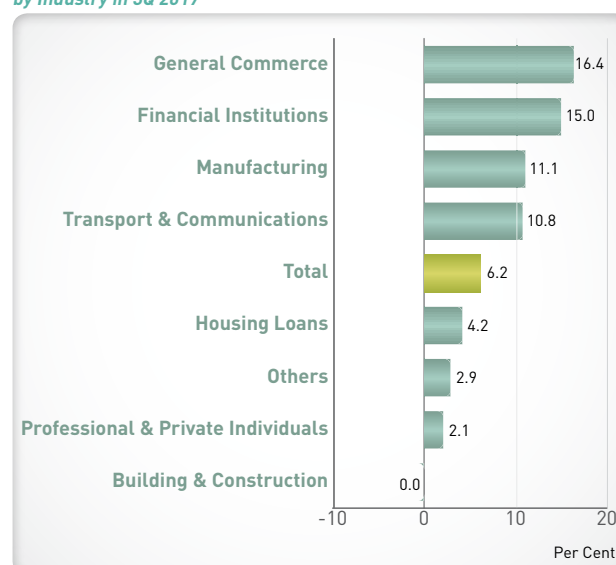


FINANCE & INSURANCE

The finance & insurance sector expanded by 5.9 per cent in the third quarter, extending the 4.2 per cent growth in the preceding quarter.

The improved performance of the sector was in part due to the stronger growth of the financial intermediation segments. Asian Currency Unit (ACU) non-bank lending increased by 11 per cent in the third quarter, after growing by 2.6 per cent in the previous quarter. Notably, non-bank lending to East Asia, Europe and the Americas saw robust growth, alongside the synchronous upturn in worldwide economic activity. Meanwhile, Domestic Banking Unit (DBU) non-bank lending grew by 6.2 per cent in the third quarter, following the 7.6 per cent growth in the second quarter, with broad-based increases in loans extended to most sectors of the economy (Exhibit 2.12). Banks also recorded steady growth in net fees and commissions earned from the provision of underwriting, merger & acquisition, portfolio management and credit-related services.

Exhibit 2.12: Growth of DBU Loans & Advances to Non-Bank Customers by Industry in 3Q 2017



Meanwhile, the insurance industry recorded a second consecutive quarter of strong growth, supported by both the life and general insurance segments. Additionally, the sentiment-sensitive cluster saw improved outcomes in the third quarter. Average daily forex turnover expanded by 8.8 per cent, as trading in several major currency pairs rose. Net fees and commissions received by fund managers also increased, benefitting from sustained fund inflows into regional assets.

BUSINESS SERVICES

The business services sector grew by 1.4 per cent in the third quarter, similar to the 1.3 per cent growth in the preceding quarter.

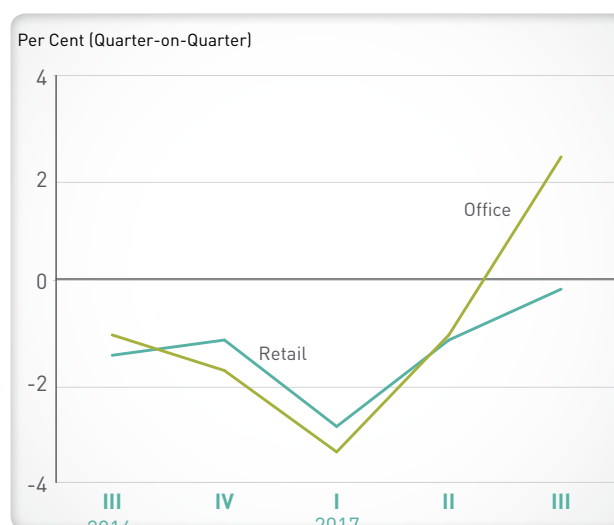
Growth in the sector was supported primarily by the professional services and others² segments. Meanwhile, the real estate segment continued to contract, although there were signs of improvement in the segment due to the rebound in private residential property prices and robust sales transactions. Private residential property prices rose by 0.7 per cent on a quarter-on-quarter basis in the third quarter, a reversal of the 0.1 per cent decline in the preceding quarter. This also marked the first increase after fifteen consecutive quarters of decline. At the same time, the sales transactions of private residential units remained healthy, in part supported by sustained interest in recent condominiums launches such as Le Quest and Martin Modern. Specifically, private home sales rose by 46 per cent year-on-year in the third quarter, extending the 52 per cent growth in the preceding quarter (Exhibit 2.13).

Exhibit 2.13: Total Sales Transactions for Private Residential Units and Private Residential Property Price Index



For the private retail space segment, rentals fell by 0.2 per cent on a quarter-on-quarter basis in the third quarter, extending the 1.2 per cent decline in the previous quarter (Exhibit 2.14). This came on the back of an increase in the supply of retail space. Reflecting the sluggish retail space market, the average occupancy rate of private retail space remained at 91 per cent in the third quarter, lower than the average occupancy rate of 93 per cent achieved in the past five years.

Exhibit 2.14: Changes in Rentals of Private Sector Office and Retail Spaces

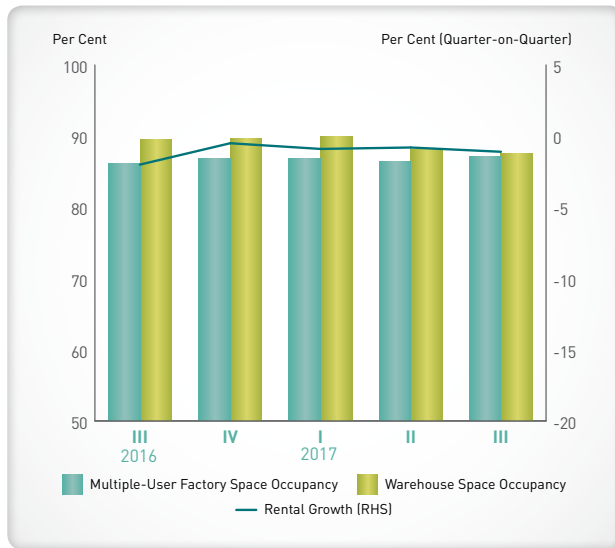


By contrast, the private office space segment saw a recovery in the third quarter. In particular, rentals rose by 2.4 per cent on a quarter-on-quarter basis, a turnaround from the 1.1 per cent decline in the previous quarter. Meanwhile, the average occupancy rate inched down slightly to 85 per cent in the third quarter, from 86 per cent in the previous quarter, on the back of an expansion in the supply of office space.

In the private industrial space market, overall rentals fell by 1.1 per cent on a quarter-on-quarter basis, extending the 0.8 per cent decline in the previous quarter (Exhibit 2.15). The occupancy rate for private sector warehouse space declined from 88 per cent in the second quarter to 87 per cent in the third quarter. On the contrary, the occupancy rate for private sector multiple-user factory space segment stood at 87 per cent, higher than the 86 per cent recorded in the previous quarter.

² The others segment consists of (i) rental & leasing, (ii) other professional, scientific & technical services and (iii) other administrative & support services. Rental & leasing activities include rental & leasing of motor vehicles, rental & leasing of other machinery, equipment and tangible goods and the leasing of non-financial intangible assets.

Exhibit 2.15: Occupancy Rate and Rental Growth of Private Sector Industrial Space



CHAPTER 3

Economic Outlook





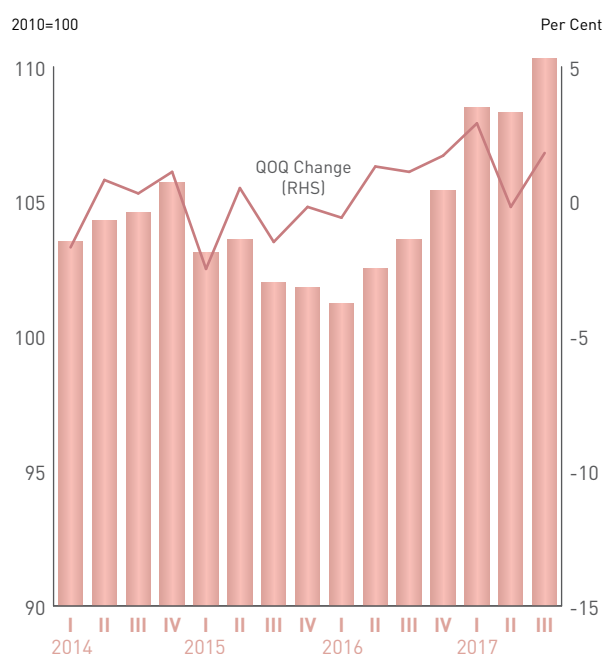
CHAPTER 3

ECONOMIC OUTLOOK

LEADING INDICATORS

The near-term economic outlook for Singapore has improved. The composite leading index (CLI) rose by 1.8 per cent on a quarter-on-quarter basis in the third quarter, a reversal from the 0.2 per cent dip in the previous quarter (Exhibit 3.1).

Exhibit 3.1: Composite Leading Index Levels and Growth Rate



Of the nine components in the CLI, six of them increased on a quarter-on-quarter basis, namely, the stock of finished goods, money supply, stock price, the US Purchasing Managers' Index, new companies formed and wholesale trade. On the other hand, non-oil sea cargo handled, domestic liquidity and non-oil retained imports declined compared to a quarter ago.

OUTLOOK FOR 2017

In recent months, the growth outlook for Singapore's key external demand markets such as the US, Eurozone, China and ASEAN-5 has improved, alongside a stronger-than-expected recovery in global electronics demand. In line with stronger external demand conditions, the Singapore economy performed better than expected in the third quarter. Growth in the quarter was primarily supported by externally-oriented sectors such as the manufacturing, finance & insurance, wholesale trade and transportation & storage sectors. Taking into account the robust performance of the Singapore economy in the third quarter, GDP growth in the first three quarters of the year came in at 3.5 per cent on a year-on-year basis.

For the rest of the year, Singapore's GDP growth is expected to moderate but remain firm. In particular, the externally-oriented sectors are projected to continue to expand, albeit at a more modest pace, and support growth for the rest of the year. Domestically-oriented sectors like the health, education & social services sector are also expected to remain resilient.

Taking these factors into consideration, the GDP growth forecast for 2017 is upgraded to **"3.0 to 3.5 per cent"**, from "2.0 to 3.0 per cent".

OUTLOOK FOR 2018

Global growth is expected to pick up marginally in 2018 on the back of stronger growth in the US and some emerging markets and developing economies. However, growth in several of Singapore's key external demand markets such as China and the Eurozone is projected to ease in the coming year.

In the US, growth is expected to pick up slightly in 2018, with continued support coming from private consumption and investment expenditure. On the other hand, the Eurozone's growth is projected to ease in 2018 following the rebound in 2017. Growth will continue to be supported by gradual improvements in labour market conditions and largely accommodative monetary policies. In Asia, China's growth is also expected to moderate in 2018 on the back of a slowdown in investment, even as consumption is likely to remain stable and provide support to growth. Meanwhile, growth in the key ASEAN economies is expected to stay resilient, supported by domestic demand and merchandise exports.

At the same time, there continues to be downside risks in the global economy. First, global policy uncertainty remains elevated, reflecting in part uncertainty over the US administration's policies and lingering concerns over the rise in protectionist sentiments. At the same time, geopolitical tensions in North Korea remain, and could affect the economies of regional countries if tensions escalate. Second, at this relatively advanced stage of the US' economic recovery, an upside surprise in inflation cannot be ruled out. Should this happen, monetary policy in the US could normalise faster than expected, thereby causing global financial conditions to tighten more than anticipated.

Against this external backdrop, the pace of growth of the Singapore economy is expected to moderate in 2018 as compared to 2017, but remain firm. First, the manufacturing sector is likely to continue to expand and provide support to overall GDP growth. In particular, the electronics and precision engineering clusters are expected to see sustained expansions on the back of healthy demand conditions in the global semiconductor and semiconductor equipment markets, although the pace of expansion is likely to taper in 2018 given less favourable base effects.

Second, externally-oriented services sectors such as wholesale trade, transportation & storage and finance & insurance are expected to benefit from the global economic recovery, although their growth momentum may ease in tandem with the moderation in growth in key advanced and regional economies. Third, sectors such as the information & communications and education, health & social services sectors are likely to remain resilient, supported by domestic drivers of growth like the Smart Nation initiatives and expansions in healthcare facilities respectively. Fourth, unlike most of the other sectors, the performance of the construction sector is expected to remain lacklustre, weighed down by the continued weakness in construction demand.

Taking into account the global and domestic economic environment, the Singapore economy is expected to grow by **"1.5 to 3.5 per cent"** in 2018. Barring unexpected outcomes in the global economy and key sectors in the domestic economy, MTI's central view is that GDP growth in 2018 is likely to come in around the middle of the forecast range.

FEATURE ARTICLE



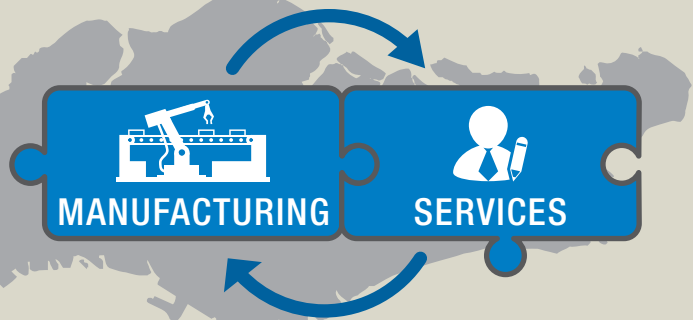


FEATURE ARTICLE

MANUFACTURING AND SERVICES IN SINGAPORE'S ECONOMY: TWIN ENGINES OF GROWTH AND THEIR ASYMMETRIC DEPENDENCIES

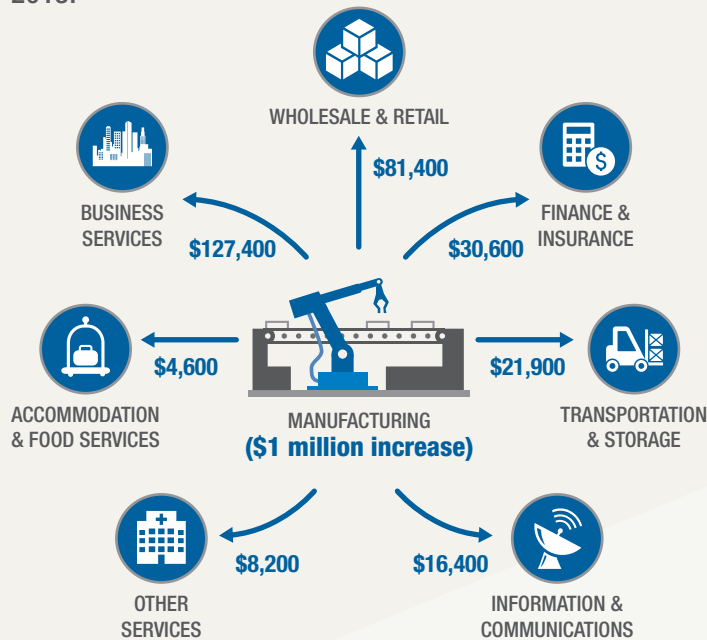
INTRODUCTION

Manufacturing and services are the twin engines of growth in the Singapore economy. Although they share a close, inter-dependent relationship, the development of services globally has historically depended more on the growth of the manufacturing sector than vice versa.

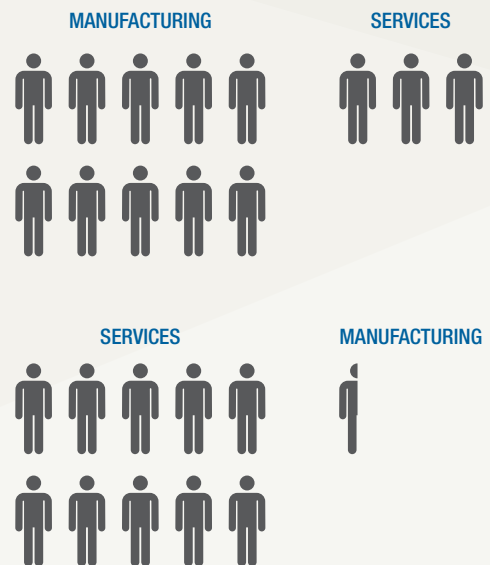


FINDINGS

The manufacturing sector was found to have stronger VA spillovers to the services sector than vice versa. For every \$1 million of VA generated in the manufacturing sector, \$0.29 million of VA were produced in the services sector in 2013.



Every 100 new manufacturing jobs were associated with 27 non-manufacturing jobs created. By contrast, every 100 new services jobs were associated with only 3 additional manufacturing jobs.



CONCLUDING REMARKS

In view of the manufacturing sector's strong backward linkages to the services sector, efforts to grow highly-productive modern services under the Government's Industry Transformation Maps will be supported by the concomitant development of a globally-competitive manufacturing sector.

EXECUTIVE SUMMARY

- Manufacturing and services are the twin engines of growth in the Singapore economy. Although they share a close, inter-dependent relationship, the development of services globally has historically depended more on the growth of the manufacturing sector than vice versa. This study examines whether the asymmetric dependencies between manufacturing and services hold in Singapore, and how this relationship has evolved over time.
- The manufacturing sector was found to have stronger value-added (VA) spillovers to the services sector than vice versa in 2013. Specifically, for every \$1 million of VA generated in the manufacturing sector, \$0.29 million of VA were produced in the services sector, particularly in knowledge-intensive professional services such as regional/international headquarters and engineering services, and wholesale trade. Notably, the chemicals and precision engineering clusters within the manufacturing sector contributed the most economic spillovers to the services sector. On the other hand, for every \$1 million of services VA generated, \$0.02 million of VA were produced in the manufacturing sector.
- Similarly, employment creation in the manufacturing sector was associated with greater employment creation in the services sector than vice versa. Specifically, every 100 new jobs in the manufacturing sector were associated with 27 jobs created in the services sector. Notably, jobs created in the biomedical manufacturing and chemicals clusters were associated with the most number of services jobs created, particularly in exportable services such as professional services and wholesale trade. By contrast, every 100 new services jobs were associated with only 3 new jobs in the manufacturing sector.
- Over time, the economic spillovers by both the manufacturing and services sectors have risen on the back of a strengthening of their backward linkages with other sectors within the domestic economy. Between 2000 and 2013, the indirect VA generated by the manufacturing sector rose by 2.2 per cent per annum, while that generated by the services sector increased by 0.2 per cent per annum. Within the manufacturing sector, the chemicals cluster saw the largest improvement in backward linkages (8.6 per cent per annum increase in VA spillovers), followed by the precision engineering (4.6 per cent per annum) and transport engineering (1.4 per cent per annum) clusters.
- In view of the manufacturing sector's strong backward linkages to the services sector, efforts to grow highly-productive modern services such as professional services, wholesale trade and finance & insurance under the Government's Industry Transformation Maps will be supported by the concomitant development of a globally-competitive manufacturing sector.

The views expressed in this paper are solely those of the author and do not necessarily reflect those of the Ministry of Trade and Industry or the Government of Singapore.¹

1. INTRODUCTION

Manufacturing and services are the twin engines of growth in the Singapore economy (see ECS, 1986; EPC, 1991; CSC, 1998; ERC, 2003; ESC, 2010; CFE, 2017). With services accounting for 69.4 per cent of its Gross Domestic Product (GDP) in 2016, Singapore is a predominantly services economy. Nonetheless, it continues to have a strong manufacturing base.² Over the medium term, the Government remains committed to maintaining a globally-competitive manufacturing sector that contributes to around 20 per cent of the economy.

¹ The author would like to thank Yong Yik Wei for her useful comments, as well as the Department of Statistics (DOS), Economic Development Board (EDB) and International Enterprise (IE) Singapore for their inputs to the study. All remaining errors belong to the author.

² In 2016, the manufacturing sector comprised 19.6% of Singapore's economy. As a comparison, the share of manufacturing in GDP was smaller in other advanced economies such as the United States (11.7% in 2016) and United Kingdom (9.7%) (BEA, 2017; World Bank, 2017). Developed countries that maintained a sizeable manufacturing presence in their economies included Ireland (36.7% of GDP in 2016), South Korea (29.3%) and Germany (22.6%).

Traditionally, manufacturing and services share a close, inter-dependent relationship (see Britton, 1990; Illeris, 1996; Daniels & Bryson, 2002; Kuan, 2016). However, their dependencies have also historically been asymmetric – i.e., the development of services depends more on the growth of the manufacturing sector than vice versa.

This study examines whether the asymmetric dependencies between manufacturing and services hold in Singapore, and how this relationship has evolved over time. With the cluster approach adopted under the Government's Industry Transformation Maps (ITMs) (see CFE, 2017), it is also important to understand the nature and extent of inter-sectoral linkages in order to maximise synergies across sectors.

The rest of the paper is organised as follows. Section 2 provides an overview of the literature on the relationship between manufacturing and services, with a focus on their asymmetric dependencies. Section 3 highlights the data sources and empirical methodology used to analyse manufacturing-services linkages in this study. Section 4 examines the inter-dependencies between manufacturing and services, in terms of the value-added (VA) and employment spillovers, at the broad sectoral level (i.e., manufacturing vs. services) as well as for the more detailed manufacturing clusters and services industries. Section 5 discusses broad policy implications and also provides concluding remarks.

2. LITERATURE REVIEW

The manufacturing sector has historically been viewed as having an important role in an economy because of its strong inter-sectoral linkages that stimulate development in the rest of the economy (Cornwall, 1977; Myint, 1980). This arises through backward linkages to sectors that the manufacturing sector draws inputs from, and forward linkages to sectors that the manufacturing sector supplies inputs to (Hirschman, 1958). Using input-output (IO) tables, Cornwall (1977) showed that the manufacturing sector had strong backward linkages through its purchases of inputs from other sectors in the economy, and also strong forward linkages given its role as a supplier of capital goods and new technologies to other sectors. Drawing on IO analysis of France, Pilat and Wölfl (2005) estimated that 29 per cent of manufacturing workers contributed indirectly to the production of non-manufacturing output (i.e., intermediate inputs to the rest of the economy). As a comparison, 13 per cent of services workers contributed indirectly to the production of non-services output.

While manufacturing and services share a close relationship, their inter-dependencies have been noted to be asymmetric. Early work by Galenson (1963) highlighted that the growth of manufacturing employment generated a much larger employment in the services sector than vice versa. Subsequent extensions by Park (1989) and Park and Chan (1989) showed that sustained employment and output growth in services depended on the contemporaneous development of manufacturing activities. In a study of six advanced economies (France, Germany, Netherlands, Spain, United Kingdom and United States) in the late 1990s, Gregory and Russo (2007) illustrated that 24 to 31 per cent of employment created from an injection of demand in the manufacturing sector flowed to the services sector.³ By contrast, services retained most of the employment gains from an increase in demand in the services sector, with only 6 to 11 per cent of new jobs going to the manufacturing sector. In general, the employment intensity (i.e., the number of economy-wide jobs created from final demand) in the manufacturing sector was similar to that in the services sector, with some countries (e.g., United States and United Kingdom) creating more jobs in the overall economy from manufacturing demand than services demand. In Sweden, Andersson (2006) examined regional employment data and found that even as manufacturing and services shared a propensity to co-locate, knowledge-intensive manufacturing industries had a stronger influence on anchoring knowledge-intensive producer services employment than vice versa. With manufacturing being a major purchaser of inputs from highly-productive modern services, Guerrieri and Meliciani (2005) and Felipe et al. (2013) concluded that the ability of countries to develop these services sectors was tied to the presence and structure of the manufacturing base.

³ In Gregory and Russo's (2007) study, a broader definition of manufacturing that included agriculture, mining and quarrying, public utilities and construction was adopted.

In Singapore's context, Thangavelu and Tan (2008) studied employment linkages in the economy and found that employment spillovers from manufacturing to services were more significant than in the reverse direction. For the same increase in final demand, manufacturing created 1.6 times as many jobs as services in the combined manufacturing and services sectors. Notably, the petrochemicals and electronics industries were found to have high employment spillovers to the services sector. Within the services sector, commerce activities, including marketing and wholesale & retail trade, benefited the most from an increase in final demand in the manufacturing sector.

3. DATA AND EMPIRICAL METHODOLOGY

This study examines manufacturing-services linkages using the Department of Statistics' (DOS) Singapore IO Tables 2000, 2005, 2010 and 2013. Employment statistics are sourced from the Ministry of Manpower (MOM).

Broadly, Singapore's IO Tables illustrate inter-sectoral linkages in the economy, and follow the notion that a sector's output is obtained by consuming inputs from other sectors. In turn, the output of the sector can also serve as inputs to other sectors. In notational form, output X in Singapore can be expressed as the following:

$$X = \begin{pmatrix} M \\ S \\ Z \end{pmatrix} = \begin{pmatrix} a_{mm} & a_{ms} & a_{mz} \\ a_{sm} & a_{ss} & a_{sz} \\ a_{zm} & a_{zs} & a_{zz} \end{pmatrix} \begin{pmatrix} M \\ S \\ Z \end{pmatrix} + \begin{pmatrix} f_m \\ f_s \\ f_z \end{pmatrix} = AX + F$$

where manufacturing, services and others (i.e., agriculture & fishing, construction and utilities) are denoted by M , S , and Z respectively, and f encapsulates the final demand generated by households and the government, exports of goods and services, gross fixed capital formation and changes in inventories. The technical coefficients in matrix A represent the amount of inputs from other sectors that is required by a sector in order to produce a unit of the latter's output. As an illustration, a_{sm} refers to the intermediate services input that flows to the manufacturing sector to support the production of one unit of manufacturing output.

Re-ordering the above notation gives the following expression:

$$X = (I - A)^{-1}F$$

where I is the identity matrix, and $(I - A)^{-1}$ is the Leontief Inverse Matrix where each coefficient in the matrix denotes the total output that is generated from an increase in final demand in a sector in matrix X .

VA multipliers for the various sectors are then derived by multiplying the Leontief Inverse Matrix with the ratio of total VA to total output for each sector. Similarly, the Leontief Inverse Matrix is multiplied with the ratio of total employment to total output for each sector to obtain the employment multipliers for the various sectors.

An increase in final demand in a sector can generate VA and create employment within the sector (directly or indirectly⁴), as well as in other sectors of the economy that it sources intermediate inputs from (i.e., through backward linkages). In the subsequent analysis, the indirect VA multiplier of sector x is estimated as the VA that is generated in other sectors (i.e., outside sector x) for an increase in VA (direct and indirect) in sector x .⁵

⁴ Second- and subsequent-order effects exist in the IO analysis of economic multipliers. For instance, an increase in final demand for sector x stimulates production in sector y if the latter provides the former with intermediate inputs. This in turn further raises output in sector x if sector y draws inputs from it.

⁵ The increase in the VA (direct and indirect) of sector x in turn arises through an increase in its final demand.

4. RESULTS

Analysis at Broad Sectoral Level

Based on the 2013 IO Tables, the manufacturing sector was found to have stronger VA spillovers to the services sector than vice versa (Exhibit 1). Specifically, for every \$1 million of VA generated in the manufacturing sector, \$0.29 million of VA were produced in the services sector and another \$0.04 million in the other sectors of the economy (i.e., construction, utilities, and other goods producing industries). Conversely, for every \$1 million of VA generated in the services sector, \$0.02 million of VA were generated in the manufacturing sector and another \$0.01 million in the other sectors of the economy.

Exhibit 1: VA spillovers generated for a \$1 million increase in manufacturing/ services VA, 2013

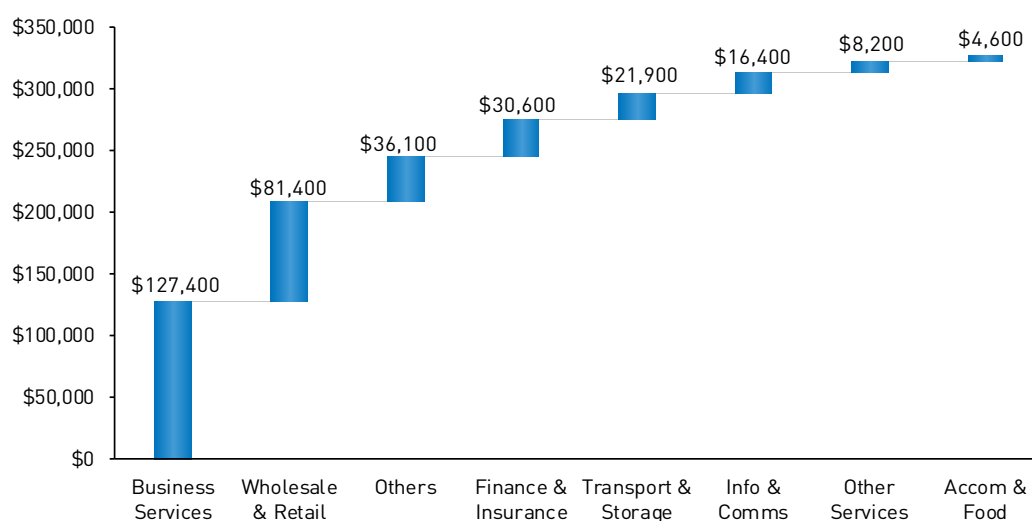
Increase in VA:	Manufacturing	Services	Others
Manufacturing	\$1m	\$290,500	\$36,100
Services	\$20,900	\$1m	\$14,100

Source: Estimates based on the Singapore IO Tables 2013

Notes: The increase in VA arises from an increase in final demand. The "Others" category includes construction, utilities and other goods producing industries.

Exhibit 2 shows a more detailed breakdown of the VA spillovers to the various sectors generated by a \$1 million increase in VA in the manufacturing sector. As can be seen, growth in the manufacturing sector generated significant spillovers to the business services (particularly knowledge-intensive professional services such as regional/international headquarters⁶ and engineering services) (\$127,400), and wholesale & retail trade (\$81,400) industries.⁷

Exhibit 2: Indirect VA generated for a \$1 million increase in manufacturing VA, 2013



Source: Estimates based on the Singapore IO Tables 2013

Note: The "Others" category includes construction, utilities and other goods producing industries.

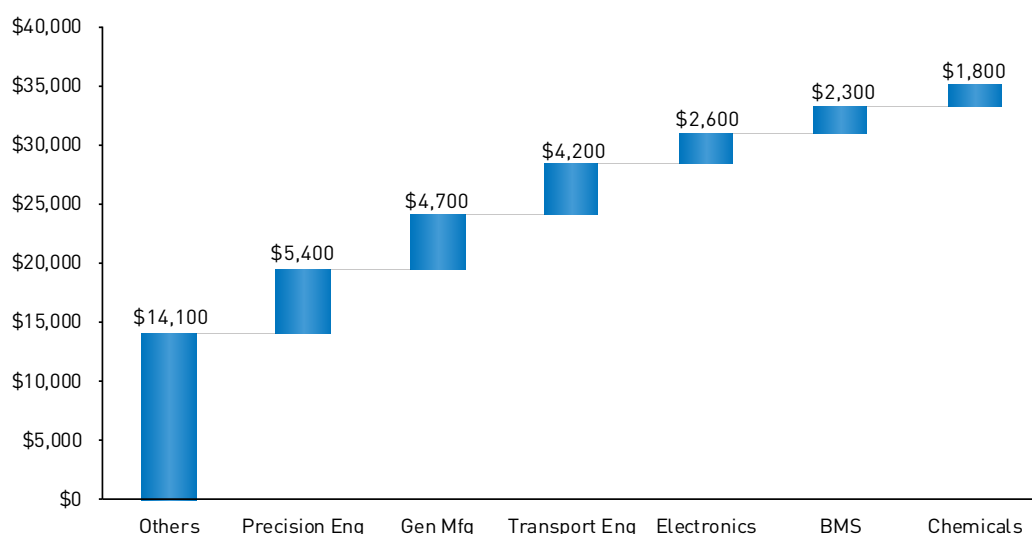
Similarly, Exhibit 3 shows a breakdown of the indirect VA generated by a \$1 million increase in VA in the services sector. Notably, the most significant spillovers were observed in the "Others" category which comprised the utilities (\$8,600 of indirect VA) and construction (\$5,400) industries.⁸ Of the \$20,900 of VA spillovers to the manufacturing sector, the precision engineering cluster derived the greatest benefit (\$5,400), followed by the general manufacturing (\$4,700) and transport engineering (\$4,200) clusters.

⁶ In 2013, 19.6% of the output of business representative offices and headquarters activities was tied to Singapore's domestic manufacturing sector.

⁷ Spillovers to the wholesale & retail trade industry were largely driven by the wholesale trade segment. In 2013, Singapore's manufacturing sector demanded \$10.2 billion of intermediate output from the wholesale trade segment, over 100 times the intermediate output sourced from the retail trade segment (\$99 million).

⁸ Nonetheless, for the same \$1 million increase in VA, the manufacturing sector generated more indirect VA in the utilities (\$28,100) and construction (\$7,300) industries in 2013.

Exhibit 3: Indirect VA generated for a \$1 million increase in services VA, 2013



Source: Estimates based on the Singapore IO Tables 2013

Note: The "Others" category includes construction, utilities and other goods producing industries.

In terms of employment, job creation in the manufacturing sector was associated with greater job creation in the services sector than vice versa (Exhibit 4). For every 100 new jobs in the manufacturing sector, 31 non-manufacturing jobs were created in the overall economy, of which 27 were services jobs. By contrast, every 100 new services jobs were associated with only 5 additional non-services jobs in the economy, of which 3 were manufacturing jobs.

Exhibit 4: Employment creation associated with an increase in 100 manufacturing/ services jobs, 2013

Increase in Jobs:	Manufacturing	Services	Others
Manufacturing	100	27	4
Services	3	100	2

Source: Estimates based on the Singapore IO Tables 2013

Notes: The increase in 100 jobs arises from an increase in final demand. The "Others" category includes construction, utilities and other goods producing industries.

Analysis at Detailed Manufacturing Clusters and Services Industries

Given that the manufacturing and services sectors are highly heterogeneous, it is important to disaggregate the two broad sectors to better understand the extent to which individual manufacturing clusters and services industries within the broad sectors generate economic spillovers and create jobs outside their clusters and industries.

Reflecting the diversity in Singapore's manufacturing sector, economic spillovers differed across the clusters within the sector (Exhibit 5). Among the manufacturing clusters, chemicals produced the most VA spillovers in the economy, with \$1 million of chemicals VA associated with a \$1.2 million increase in VA in the rest of the economy. Notably, the indirect VA generated across the various services industries (\$967,500) was nearly as large as the VA produced in the chemicals cluster, with wholesale trade being a key beneficiary.⁹ The precision engineering (\$515,300), transport engineering (\$372,000), general manufacturing (\$364,000) and electronics (\$275,800) clusters also generated healthy VA spillovers to the other industries in the economy. By contrast, biomedical manufacturing had weaker linkages within the domestic economy, with most of the economy-wide VA generated from its growth (91.1 per cent) retained within the cluster.¹⁰

⁹ Wholesale trade accounted for half of total intermediate services inputs to the chemicals cluster. The refineries and petrochemical plants in the chemicals cluster are supported by crude oil and chemicals trading, where trading companies are engaged to competitively source feedstock and efficiently market the cluster's end-products to customers.

¹⁰ Most of the inputs to the production of pharmaceuticals and biological products in the biomedical manufacturing cluster are imported. Additionally, as the products are primarily produced for export, with a smaller proportion of the products being used as intermediate inputs to other manufacturing clusters, there are fewer second- and subsequent-order effects on the economy as compared to the other manufacturing clusters.

Exhibit 5: VA spillovers generated for a \$1 million increase in manufacturing VA by manufacturing cluster, 2013

Manufacturing Cluster	Own Cluster	Rest of Economy	Rest of Manufacturing	Services	Others
Electronics	\$1m (78.4%)	\$275,800 (21.6%)	\$26,200 (2.1%)	\$210,100 (16.5%)	\$39,500 (3.1%)
Chemicals	\$1m (44.7%)	\$1.2m (55.3%)	\$94,900 (4.2%)	\$967,500 (43.2%)	\$177,000 (7.9%)
Biomedical Manufacturing	\$1m (91.1%)	\$97,500 (8.9%)	\$6,300 (0.6%)	\$84,300 (7.7%)	\$6,800 (0.6%)
Precision Engineering	\$1m (66.0%)	\$515,300 (34.0%)	\$50,600 (3.3%)	\$437,000 (28.8%)	\$27,700 (1.8%)
Transport Engineering	\$1m (72.9%)	\$372,000 (27.1%)	\$49,900 (3.6%)	\$301,700 (22.0%)	\$20,400 (1.5%)
General Manufacturing	\$1m (73.3%)	\$364,000 (26.7%)	\$27,900 (2.0%)	\$294,800 (21.6%)	\$41,400 (3.0%)

Source: Estimates based on the Singapore IO Tables 2013

Notes: The "Others" category includes construction, utilities and other goods producing industries. The numbers in parenthesis denote the share of VA that is generated in the overall economy from an increase in VA in the manufacturing cluster. The figures for "Rest of Manufacturing", "Services" and "Others" may not sum to that of "Rest of Economy" due to rounding.

In terms of jobs, the manufacturing clusters also generated healthy spillovers to the rest of the economy, particularly in the various services industries (Exhibit 6). The creation of 100 jobs in each manufacturing cluster was associated with the creation of 19 (for general manufacturing) to 117 (for biomedical manufacturing¹¹) jobs in the broader economy. Notably, job creation in the biomedical manufacturing, chemicals and electronics clusters was associated with a significant number of jobs created in the various services industries (94, 58 and 38 services jobs respectively for every 100 manufacturing jobs). These included jobs in the business services and wholesale & retail trade industries.

Exhibit 6: Employment creation associated with an increase in 100 manufacturing jobs by manufacturing cluster, 2013

Manufacturing Cluster	Own Cluster	Rest of Economy	Rest of Manufacturing	Services	Others
Electronics	100 (64.4%)	55 (35.6%)	8 (5.3%)	38 (24.5%)	9 (5.7%)
Chemicals	100 (56.8%)	76 (43.2%)	9 (5.2%)	58 (32.8%)	9 (5.2%)
Biomedical Manufacturing	100 (46.0%)	117 (54.0%)	11 (5.3%)	94 (43.4%)	12 (5.3%)
Precision Engineering	100 (75.8%)	32 (24.2%)	4 (2.8%)	26 (19.4%)	3 (2.1%)
Transport Engineering	100 (79.4%)	26 (20.6%)	5 (4.0%)	19 (14.9%)	2 (1.7%)
General Manufacturing	100 (83.8%)	19 (16.2%)	2 (1.6%)	15 (12.4%)	3 (2.2%)

Source: Estimates based on the Singapore IO Tables 2013

Notes: The increase in 100 manufacturing jobs arises from an increase in final demand in the manufacturing cluster. The "Others" category includes construction, utilities and other goods producing industries. The numbers in parenthesis denote the share of employment that is generated in the overall economy in line with an increase in 100 jobs in the manufacturing cluster. The figures for "Rest of Manufacturing", "Services" and "Others" may not sum to that of "Rest of Economy" due to rounding.

¹¹ The biomedical manufacturing cluster generated weaker VA spillovers as previously illustrated. Nonetheless, as the cluster is highly productive (i.e., requiring fewer workers per unit of VA generated), when normalised by jobs created in the cluster, each biomedical manufacturing job was associated with a larger number of jobs created in the overall economy. In 2016, nominal VA per worker in the biomedical manufacturing cluster was \$732,100, much higher than that in the overall economy (\$111,800).

As for services, much of the economic spillovers generated was found to accrue more to the various services industries rather than to the manufacturing sector (Exhibit 7). In particular, manufacturing only accounted for 0.5 per cent (finance & insurance) to 4.6 per cent (accommodation & food services) of the economy-wide VA that was generated from the growth of the different services industries. Among the services industries, the accommodation & food services industry had the largest VA spillovers to the rest of the economy (\$556,100) for a \$1 million increase in VA, as it drew significant inputs from the real estate, food manufacturing and wholesale trade segments. This was followed by the transportation & storage (\$409,300), other services (\$325,700), wholesale & retail trade (\$312,800), information & communications (\$267,700), business services (\$186,600) and finance & insurance (\$126,200) industries.

Exhibit 7: VA spillovers generated for a \$1 million increase in services VA by services industry, 2013

Services Industry	Own Industry	Rest of Economy	Rest of Services	Manufacturing	Others
Wholesale & Retail Trade	\$1m (76.2%)	312,800 (23.8%)	290,800 (22.2%)	12,500 (1.0%)	9,500 (0.7%)
Accommodation & Food Services	\$1m (64.3%)	556,100 (35.7%)	429,700 (27.6%)	71,600 (4.6%)	54,800 (3.5%)
Transportation & Storage	\$1m (71.0%)	409,300 (29.0%)	330,900 (23.5%)	58,400 (4.1%)	20,000 (1.4%)
Information & Communications	\$1m (78.9%)	267,700 (21.1%)	216,700 (17.1%)	36,600 (2.9%)	14,500 (1.1%)
Finance & Insurance	\$1m (88.8%)	126,200 (11.2%)	116,400 (10.3%)	5,400 (0.5%)	4,400 (0.4%)
Business Services	\$1m (84.3%)	186,600 (15.7%)	141,800 (12.0%)	23,300 (2.0%)	21,400 (1.8%)
Other Services	\$1m (75.4%)	325,700 (24.6%)	257,000 (19.4%)	40,000 (3.0%)	28,700 (2.2%)

Source: Estimates based on the Singapore IO Tables 2013

Notes: The "Others" category includes construction, utilities and other goods producing industries. The numbers in parenthesis denote the share of VA that is generated in the overall economy from an increase in VA in the services industry. The figures for "Rest of Services", "Manufacturing" and "Others" may not sum to that of "Rest of Economy" due to rounding.

In terms of employment, growth in the various services industries also primarily supported employment creation within the services sector, with limited spillovers to the manufacturing sector (Exhibit 8). For every 100 jobs that were created in each services industry through an increase in final demand, the number of manufacturing jobs created through spillovers ranged from 1 (for finance & insurance) to 8 (for transportation & storage) jobs. Employment creation in the transportation & storage industry was associated with the most jobs created in the broader economy (45 jobs for every 100 transportation & storage jobs). This was followed by the wholesale & retail trade (34), information & communications (29), business services (26), finance & insurance (25), accommodation & food services (17) and other services (13) industries.

Exhibit 8: Employment creation associated with an increase in 100 services jobs by services industry, 2013

Services Industry	Own Industry	Rest of Economy	Rest of Services	Manufacturing	Others
Wholesale & Retail Trade	100 (74.4%)	34 (25.6%)	31 (22.9%)	2 (1.5%)	2 (1.2%)
Accommodation & Food Services	100 (85.8%)	17 (14.2%)	11 (9.5%)	4 (3.2%)	2 (1.5%)
Transportation & Storage	100 (69.0%)	45 (31.0%)	34 (23.7%)	8 (5.5%)	3 (1.7%)
Information & Communications	100 (77.3%)	29 (22.7%)	23 (17.6%)	4 (3.5%)	2 (1.6%)
Finance & Insurance	100 (79.7%)	25 (20.3%)	23 (18.1%)	1 (1.1%)	1 (1.0%)
Business Services	100 (79.1%)	26 (20.9%)	16 (12.8%)	4 (3.1%)	6 (5.0%)
Other Services	100 (88.4%)	13 (11.6%)	10 (8.7%)	2 (1.6%)	1 (1.3%)

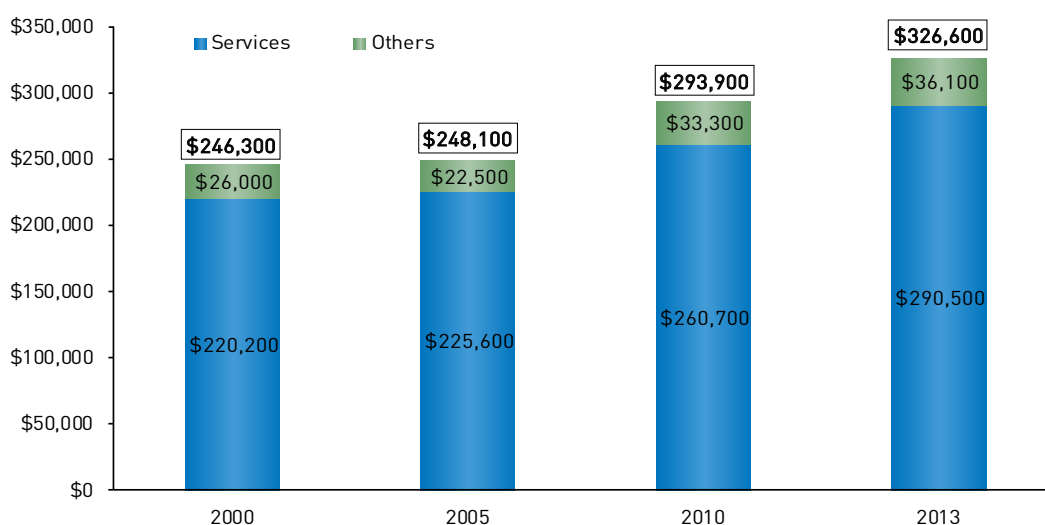
Source: Estimates based on the Singapore IO Tables 2013

Notes: The increase in 100 services jobs arises from an increase in final demand in the services industry. The "Others" category includes construction, utilities and other goods producing industries. The numbers in parenthesis denote the share of employment that is generated in the overall economy in line with an increase in 100 jobs in the services industry. The figures for "Rest of Services", "Manufacturing" and "Others" may not sum to that of "Rest of Economy" due to rounding.

Analysis of Inter-Sectoral Linkages Over Time

Over time, economic spillovers generated by both manufacturing and services have risen on the back of a strengthening of their backward linkages with other sectors within the domestic economy (Exhibits 9 and 10).¹² Between 2000 and 2013, indirect VA generated in the rest of the economy by the manufacturing and services sectors rose by 2.2 per cent per annum (p.a.) and 0.2 per cent p.a. respectively. Notably, the manufacturing sector has deepened its backward linkages with several individual services industries in the economy such as business services. Between 2000 and 2013, the indirect VA generated in the business services industry from a \$1 million increase in manufacturing VA rose by 4.1 per cent p.a. (from \$75,700 to \$127,400).

Exhibit 9: Indirect VA associated with a \$1 million increase in manufacturing VA, 2000-2013

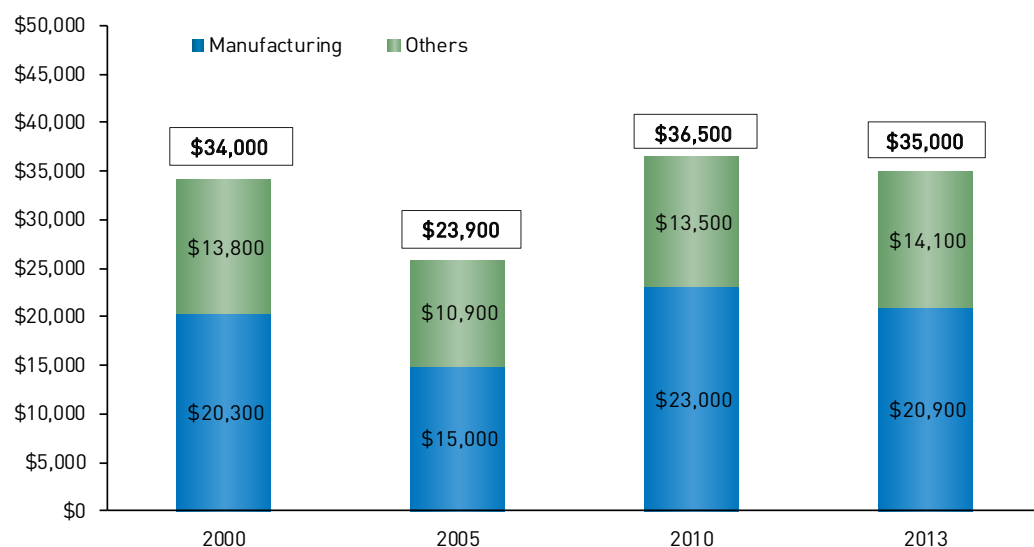


Source: Estimates based on the Singapore IO Tables 2000, 2005, 2010 and 2013

Notes: The "Others" category includes construction, utilities and other goods producing industries. The numbers may not sum to the total due to rounding.

¹² Changes in economic spillovers over time could also be influenced by changes in prices and the make-up of the IO industries, as well as methodological updates.

Exhibit 10: Indirect VA associated with a \$1 million increase in services VA, 2000-2013

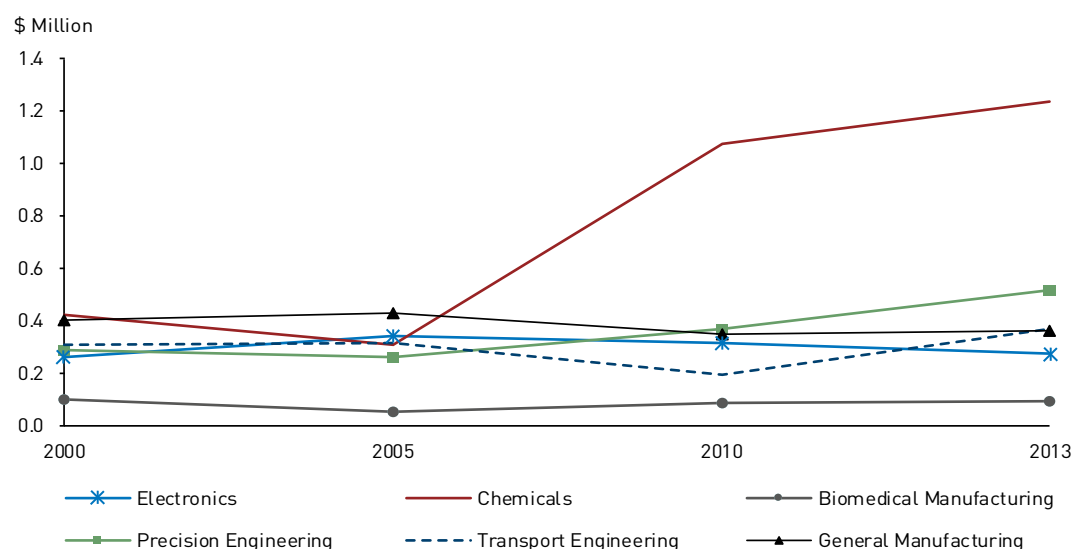


Source: Estimates based on the Singapore IO Tables 2000, 2005, 2010 and 2013

Notes: The "Others" category includes construction, utilities and other goods producing industries. The numbers may not sum to the total due to rounding.

Within the manufacturing sector, the chemicals cluster saw the largest improvement in backward linkages in the domestic economy (Exhibit 11). Between 2000 (when Jurong Island¹³ was officially opened) and 2013, the VA spillovers from the chemicals cluster to the rest of the economy rose by 8.6 per cent p.a., supported by increases in VA spillovers to other manufacturing clusters (10.9 per cent p.a.) and the services sector (8.9 per cent p.a.).¹⁴ During this period, VA spillovers from the precision engineering and transport engineering clusters to the rest of the economy also increased by 4.6 per cent p.a. and 1.4 per cent p.a. respectively.¹⁵ On the other hand, VA spillovers from the electronics, biomedical manufacturing and general manufacturing clusters have remained fairly stable over time.

Exhibit 11: Indirect VA associated with a \$1 million increase in manufacturing VA by manufacturing clusters, 2000-2013



Source: Estimates based on the Singapore IO Tables 2000, 2005, 2010 and 2013

¹³ Using a model of 'state-enabled industry integration' (see Chan, 2011), Singapore established a specialised 33km² cluster of chemical activities on Jurong Island to harness scale economies and linkages between firms.

¹⁴ VA spillovers from the chemicals cluster to the construction, utilities and other goods producing industries also rose by 6.6% p.a. between 2000 and 2013.

¹⁵ Between 2000 and 2013, the precision engineering cluster's VA spillovers to services (5.4% p.a.) and the other manufacturing clusters (2.2% p.a.) rose, while VA spillovers to the construction, utilities and other goods producing industries remained stable. For the transport engineering cluster, there was an increase in VA spillovers to services (1.7% p.a.) and the construction, utilities and other goods producing industries (0.4% p.a.), while VA spillovers to the other manufacturing clusters remained at similar levels between 2000 and 2013.

5. CONCLUDING REMARKS

In recent years, the rapid growth of services worldwide has led to views that countries can pursue services-centric pathways of development (e.g., Bhagwati, 2010; Romer, 2012; Ghani & O'Connell, 2014). Indeed, such views are supported by several characteristics of the services sector (e.g., its strong intra-sectoral linkages and capacity to generate employment opportunities), as well as the attractiveness of modern services.

However, the manufacturing sector continues to retain many important engine-of-growth properties (see Haraguchi et al., 2017). Arising from their asymmetric dependencies, manufacturing development anchors services activities, but services growth may not stimulate the development of manufacturing activities. As such, the loss of manufacturing capabilities is harder to restore as the sector does not benefit significantly from a thriving services-centric economy. The manufacturing sector's strong inter-sectoral linkages, particularly backward linkages to the services sector, offer countries the opportunity to undertake complementary approaches to develop both the manufacturing and services sectors.

Similar to the observations in other economies, this study highlights that there are also asymmetric dependencies between manufacturing and services in Singapore, a predominantly services economy with a manufacturing base. Linkages are strong from manufacturing to services, but comparatively weaker in the opposite direction. As such, growth in the manufacturing sector results in more significant spillovers to the services sector, in terms of VA generated and jobs created, than vice versa.

The cluster approach under the ITMs is undertaken in recognition of the increasingly complex linkages across sectors in the economy. In view of their synergies, efforts to grow highly-productive modern services such as professional services, wholesale trade, and finance & insurance under the ITMs will be supported by the concomitant development of a globally-competitive manufacturing sector.

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