ECONOMIC SURVEY OF SINGAPORE

SECOND QUARTER 2018

MTI MINISTRY OF TRADE AND INDUSTRY SINGAPORE

August 2018

Ministry of Trade and Industry
Republic of Singapore

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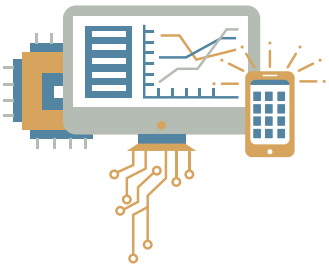

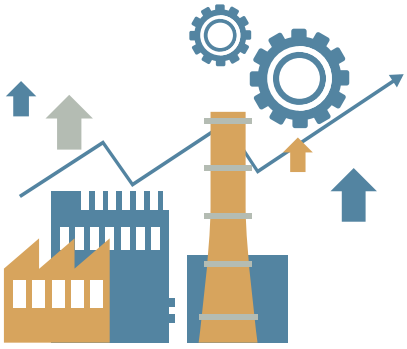

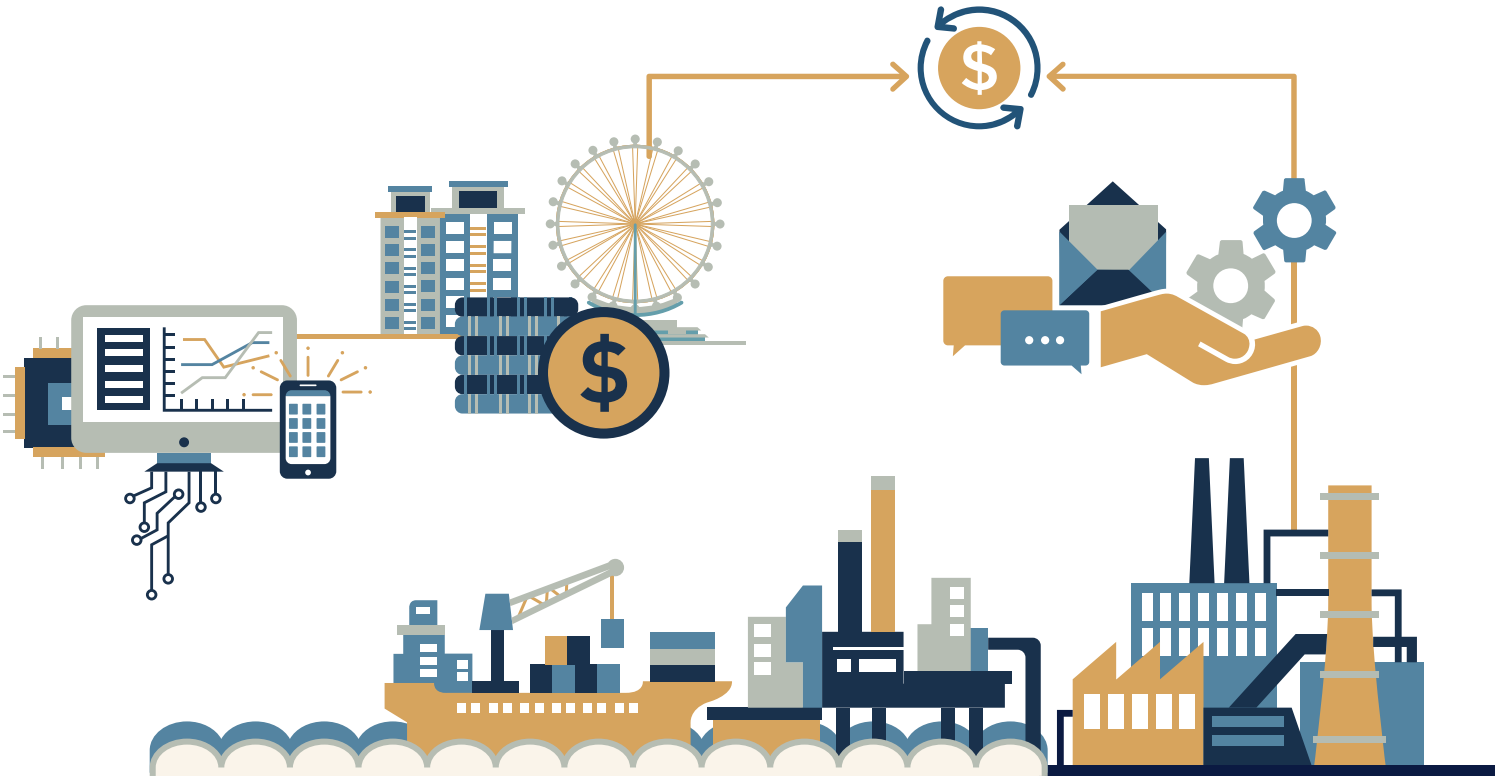

MAIN INDICATORS OF
THE SINGAPORE ECONOMY

OVERALL ECONOMY

Real GDP (Year-on-Year Growth)

1Q18	2Q18
+4.5%	+3.9%

GDP at Current Market Prices

1Q18	2Q18
$114.2 billion	$114.4 billion

PRICES

Consumer Price Index - All Items (Year-on-Year Growth)

1Q18	2Q18
+0.2%	+0.3%

Domestic Supply Price Index (Year-on-Year Growth)

1Q18	2Q18
-0.2%	+7.5%

LABOUR MARKET

Change in Employment (Quarter-on-Quarter)

1Q18	2Q18
3.7 thousand	7.0 thousand

Overall Unemployment Rate

1Q18	2Q18
2.0%	2.1%

Value-added per Worker (Year-on-Year Growth)

1Q18	2Q18
+4.4%	+3.4%

COSTS

Unit Labour Cost of Overall Economy (Year-on-Year Growth)

1Q18	2Q18
-0.8%	-0.2%

Unit Business Cost of Manufacturing (Year-on-Year Growth)

1Q18	2Q18
-1.0%	-1.2%

Unit Labour Cost of Manufacturing (Year-on-Year Growth)

1Q18	2Q18
-5.4%	-7.4%

MERCHANDISE TRADE

Merchandise Exports

1Q18	2Q18
$128,665 million	$138,628 million
+2.3% Year-on-Year Growth	+9.4% Year-on-Year Growth

Merchandise Imports

1Q18	2Q18
$112,853 million	$122,339 million
+2.8% Year-on-Year Growth	+11.1% Year-on-Year Growth

SERVICES TRADE

Services Exports

1Q18	2Q18
$57,230 million	$59,237 million
+5.2% Year-on-Year Growth	+3.8% Year-on-Year Growth

Services Imports

1Q18	2Q18
$58,897 million	$60,084 million
+3.5% Year-on-Year Growth	+2.1% Year-on-Year Growth

CHAPTER 1

THE SINGAPORE ECONOMY

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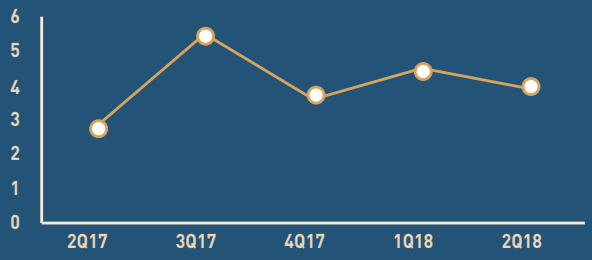
ECONOMIC PERFORMANCE

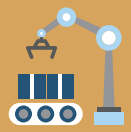
Real GDP grew by
3.9% in 2Q18

Quarterly Growth (Year-on-Year)



Main Drivers of Growth in 2Q18

Manufacturing



1.9%-point contribution

Finance & Insurance

0.9%-point contribution

In total, these sectors accounted for
71% of GDP growth

LABOUR MARKET

Resident Unemployment Rate

3.0% in 2Q18

Employment (Q-O-Q CHANGE)

+7,000 employed

Sectors with the Highest Employment Growth in 2Q18

2,900 employed

Business Services

2,800 employed

Transportation & Storage

2,700 employed

Information & Communications

PRODUCTIVITY

Value-added Per Worker grew by
3.4% in 2Q18

Sectors with the highest Value-added per Worker Growth in 2Q18

12.2%

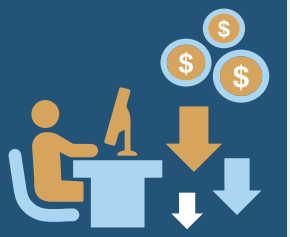
Manufacturing

4.0%

Finance & Insurance

COSTS

Overall Unit Labour Cost declined by **0.2%** in 2Q18



Within the manufacturing sector

-1.2%	-7.4%
Unit Business Cost	Unit Labour Cost

PRICES

The Consumer Price Index (CPI) rose by **0.3%** in 2Q18

Categories with Price Increases

2.9%	2.2%	1.4%
Education	Health Care	Food

Quarterly Growth (Year-on-Year)

INTERNATIONAL TRADE

Total Merchandise Exports rose by **9.4%** in 2Q18

20.6%	9.4%	5.7%
Oil Domestic Exports	Non-Oil Domestic Exports	Re-exports

Total Services Exports rose by **3.8%** in 2Q18

Main Drivers of Services Export Growth were...

4.1%	18.3%	5.9%
Transport Services	Charges for the use of Intellectual Property	Financial Services

OVERVIEW

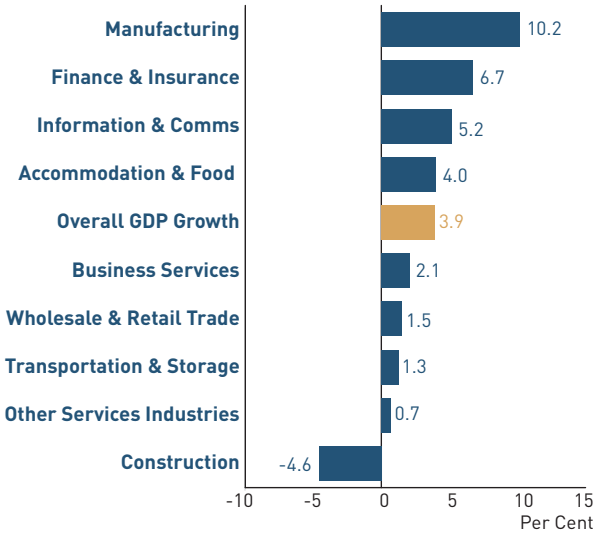
In the second quarter of 2018,

- The economy expanded by 3.9 per cent compared to the same period in 2017. The sectors that contributed the most to GDP growth were the manufacturing and finance & insurance sectors.
- Total employment rose by 7,000 on a quarter-on-quarter basis, higher than the 3,700 increase in the first quarter. Excluding foreign domestic workers, employment increased by 7,100 in the second quarter.
- The seasonally-adjusted overall, resident and citizen unemployment rates rose in June 2018 as compared to March 2018, but remained lower than that in the same period a year ago. Retrenchments, while slightly higher in the second quarter as compared to the first quarter, also remained lower than that recorded a year ago.
- The Consumer Price Index (CPI) rose by 0.3 per cent on a year-on-year basis, slightly faster than the 0.2 per cent increase in the previous quarter.

OVERALL PERFORMANCE

The economy grew by 3.9 per cent on a year-on-year basis in the second quarter, easing from the 4.5 per cent growth in the previous quarter (Exhibit 1.1). On a quarter-on-quarter seasonally-adjusted annualised basis, the economy expanded by 0.6 per cent, slower than the 2.2 per cent growth in the preceding quarter.

Exhibit 1.1: GDP and Sectoral Growth Rates in 2Q 2018



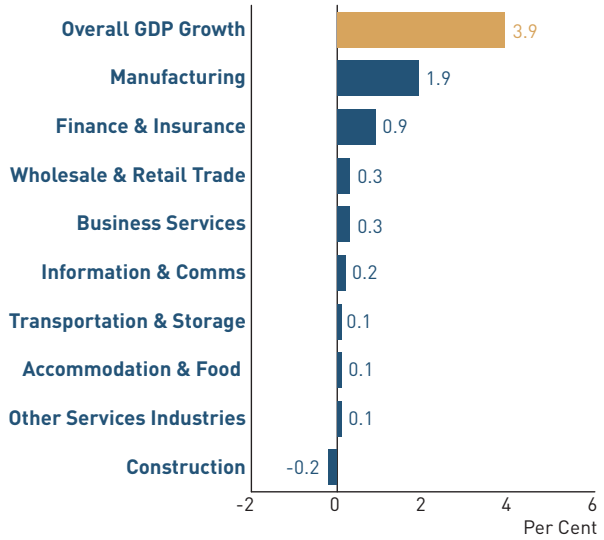
The manufacturing sector grew at a robust pace of 10 per cent year-on-year in the second quarter, extending the 11 per cent growth in the previous quarter. Growth was broad-based, with all manufacturing clusters recording output expansions.

The services producing industries expanded by 2.8 per cent year-on-year, moderating from the 4.0 per cent growth in the preceding quarter. The finance & insurance sector posted the fastest pace of growth (6.7 per cent), followed by the information & communications (5.2 per cent) and accommodation & food services (4.0 per cent) sectors. The business services, wholesale & retail trade, transportation & storage and other services sectors also recorded positive growth of 2.1 per cent, 1.5 per cent, 1.3 per cent and 0.7 per cent respectively.

By contrast, the construction sector shrank by 4.6 per cent year-on-year, extending the 5.2 per cent decline in the previous quarter. The contraction was largely due to weakness in public sector construction activities.

The sectors that contributed the most to GDP growth in the second quarter were the manufacturing and finance & insurance sectors (Exhibit 1.2). Collectively, they accounted for 71 per cent of GDP growth during the quarter.

Exhibit 1.2: Percentage-Point Contribution to Growth in Real GDP in 2Q 2018 (By Industry)



SOURCES OF GROWTH

Total demand rose by 3.4 per cent year-on-year in the second quarter, extending the 3.5 per cent growth in the previous quarter (Exhibit 1.3). The increase in total demand was supported by both external and domestic demand.

External demand expanded by 3.6 per cent, similar to the 3.5 per cent growth in the previous quarter. Domestic demand rose at a slower pace of 3.0 per cent compared to 3.6 per cent in the previous quarter. This was due to a smaller build-up in inventories and a moderation in the pace of increase in consumption expenditure.

Consumption expenditure increased by 3.0 per cent, slower than the 4.8 per cent growth in the previous quarter. Growth in the second quarter was largely supported by a 3.2 per cent increase in private consumption, even as public consumption growth slowed to 2.2 per cent from 8.7 per cent in the first quarter.

Meanwhile, gross fixed capital formation (GFCF) grew by 3.3 per cent, a reversal from the 0.9 per cent contraction in the previous quarter. The expansion came on the back of a 5.6 per cent increase in private GFCF, which was in turn supported by higher investment spending on transport equipment and machinery & equipment. On the other hand, public GFCF declined by 6.7 per cent, largely weighed down by lower investment spending on public construction & works.

*Exhibit 1.3: Changes in Total Demand**

	2017			2018	
	II	III	IV	I	II
Total Demand	3.7	5.5	4.9	3.5	**3.4**
External Demand	2.5	4.4	4.2	3.5	**3.6**
Total Domestic Demand	7.3	8.5	6.6	3.6	**3.0**
Consumption Expenditure	3.2	5.7	4.4	4.8	**3.0**
Public	5.3	7.1	0.5	8.7	**2.2**
Private	2.7	5.3	5.5	3.4	**3.2**
Gross Fixed Capital Formation	-3.5	-2.7	2.2	-0.9	**3.3**
Changes in Inventories	4.7	4.1	2.4	0.6	**0.0**

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

LABOUR MARKET

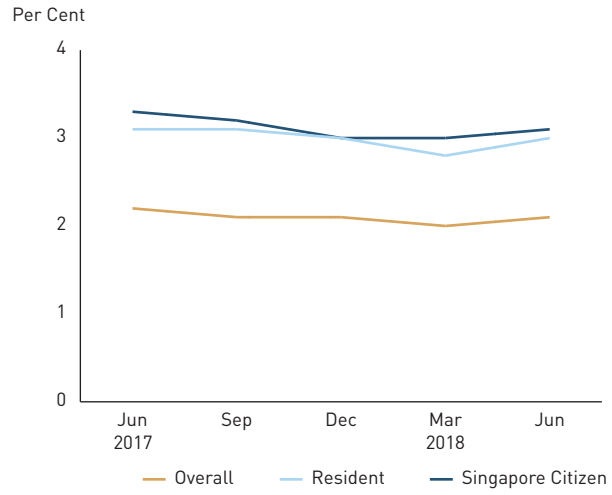
Unemployment and Retrenchment[1]

Unemployment rates rose over the quarter from March 2018 to June 2018, as more persons entered the labour force to look for work on the back of a continued expansion in economic activities.[2] Specifically, the seasonally-adjusted unemployment rates edged up at the overall level (from 2.0 per cent in March 2018 to 2.1 per cent in June 2018), as well as for residents (from 2.8 per cent to 3.0 per cent) and citizens (from 3.0 per cent to 3.1 per cent) (Exhibit 1.4). Nonetheless, the unemployment rates in June 2018 remained lower than that in the same period a year ago.

In June 2018, an estimated 69,500 residents, including 60,600 Singapore citizens, were unemployed. These were higher than the number of unemployed residents (64,800) and citizens (57,600) in March 2018.[3]

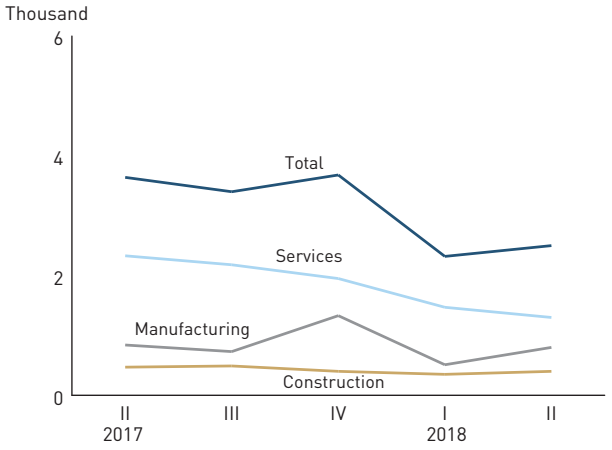
1 *Figures pertain to private sector establishments with at least 25 employees and the public sector.*
2 *Also commonly known as an "encouraged worker effect".*
3 *Based on seasonally-adjusted data on the number of unemployed persons.*

Exhibit 1.4: Unemployment Rate (Seasonally-Adjusted)



Total retrenchments came in at around 2,500 in the second quarter. This was up from the 2,320 in the previous quarter, but lower than the 3,640 recorded in the same period a year ago (Exhibit 1.5). By broad sectors, retrenchments in the services sector fell from 1,470 in the first quarter to 1,300 in the second quarter. On the other hand, retrenchments increased in both the manufacturing (from 510 to 800) and construction (from 350 to 400) sectors.

Exhibit 1.5: Retrenchments



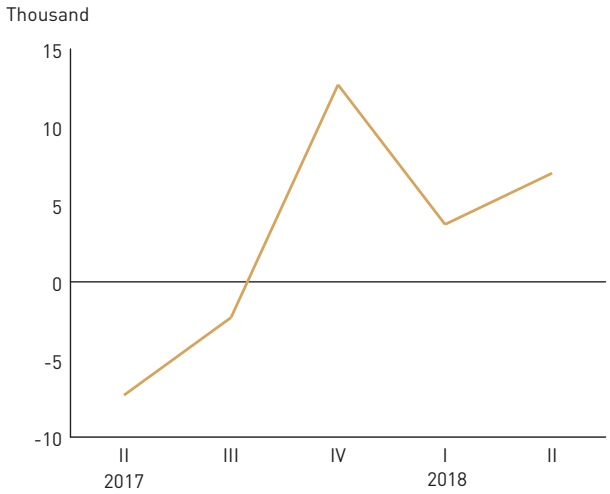
Employment[4]

Total employment rose by 7,000 on a quarter-on-quarter basis in the second quarter, higher than the 3,700 increase in the first quarter. This also represented a reversal from the decline of 7,300 registered in the same quarter a year ago (Exhibit 1.6). The improvement compared to a year ago came on the back of a larger increase in services employment, even as employment declines in the manufacturing and construction sectors moderated. Excluding foreign domestic workers (FDWs), employment rose by 7,100 in the second quarter.

By broad sectors, employment in services producing industries rose by 7,700 (including FDWs) on a quarter-on-quarter basis in the second quarter, with the business services (2,900), transportation & storage (2,800) and information & communications (2,700) sectors contributing the most to the increase.

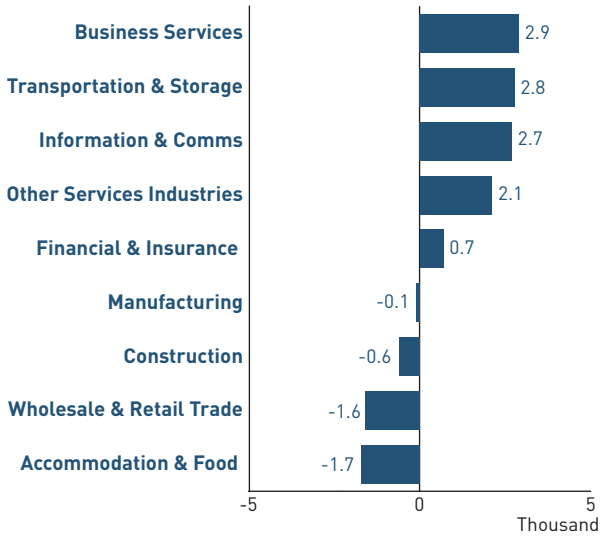
However, the employment gains in the services producing industries were partially offset by employment declines in the manufacturing (-100) and construction (-600) sectors. Manufacturing employment contracted for the fifteenth consecutive quarter, weighed down by employment losses in the marine & offshore engineering segment due to challenging business conditions in the segment. Construction employment fell for the eighth consecutive quarter, in tandem with the continued weakness in construction activities.

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



4 *Based on preliminary estimates.*

Exhibit 1.7: Changes in Employment by Industry in 2Q 2018



Hiring Expectations

According to EDB's Business Expectations Survey for the Manufacturing Sector, a net weighted balance of 2 per cent of manufacturers expected to hire fewer workers in the third quarter of 2018 as compared to the second quarter. Firms in the semiconductors and infocomms & consumer electronics segments had the weakest hiring sentiments, with a net weighted balance of 21 per cent and 14 per cent of firms in the respective segments expecting lower levels of hiring in the third quarter. By contrast, firms in the pharmaceuticals and computer peripherals segments were the most optimistic, as a net weighted balance of 26 per cent and 21 per cent of firms in the respective segments expected to increase hiring in the third quarter.

Hiring expectations for firms in the services sector were positive. According to DOS' Business Expectations Survey for the Services Sector, a net weighted balance of 10 per cent of services firms expected to increase hiring in the third quarter of 2018. In particular, a net weighted balance of 16 per cent of firms in the business services (excluding real estate) segment and 15 per cent of firms in the recreation, community & personal services segment expected to hire more workers in the third quarter.

COMPETITIVENESS

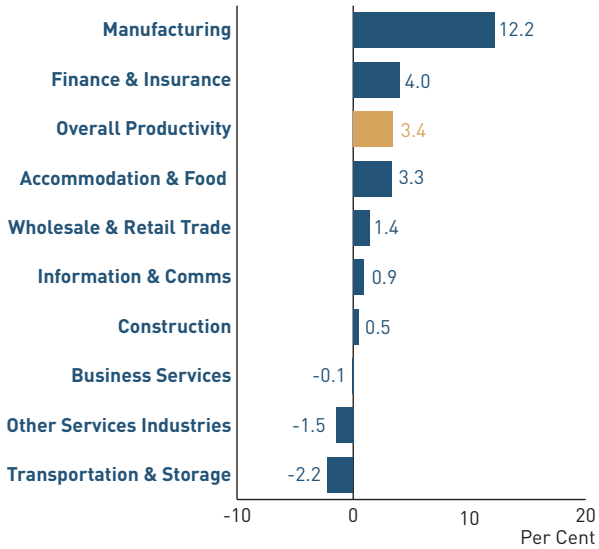
Productivity

Overall labour productivity, as measured by real value-added per worker[5], increased by 3.4 per cent in the second quarter compared to the same period a year ago (Exhibit 1.8). This was lower than the 4.4 per cent increase recorded in the first quarter.

The manufacturing (12 per cent), finance & insurance (4.0 per cent) and accommodation & food services (3.3 per cent) sectors saw the highest productivity growth rates in the second quarter. By contrast, the transportation & storage (-2.2 per cent) and other services (-1.5 per cent) sectors experienced declines in productivity.

Outward-oriented sectors as a whole continued to achieve stronger productivity growth than domestically-oriented sectors. Compared to the same period last year, the productivity of outward-oriented sectors rose by 4.1 per cent in the second quarter, slower than the 5.6 per cent growth in the previous quarter.[6] For domestically-oriented sectors, productivity rose by 0.5 per cent, lower than the 1.2 per cent increase in the preceding quarter.

Exhibit 1.8: Changes in Value-added per Worker for the Overall Economy and Sectors in 2Q 2018

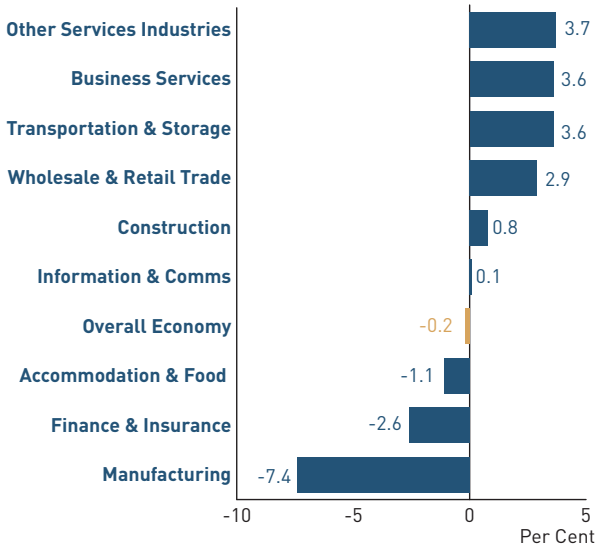


5 *Real value-added per actual hour worked is currently only available on an annual basis.*
6 *Based on MTI estimates. Outward-oriented sectors refer to manufacturing, wholesale trade, transportation & storage, accommodation, information & communications, finance & insurance and professional services. 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 0.2 per cent on a year-on-year basis in the second quarter, moderating from the 0.8 per cent decline in the previous quarter (Exhibit 1.9). The fall in the overall ULC 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 2Q 2018



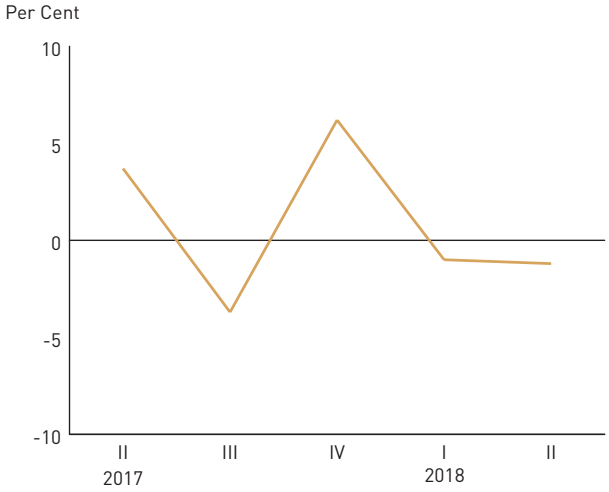
By sectors, the ULC for the manufacturing sector fell by 7.4 per cent year-on-year, the tenth consecutive quarter of decline, on the back of strong productivity gains in the sector.

On the other hand, the ULC for services producing industries rose by 1.9 per cent, faster than the 0.7 per cent increase in the previous quarter. Most services sectors saw increases in their ULCs. The only exceptions were the accommodation & food services and finance & insurance sectors, where productivity gains outweighed the rise in total labour cost per worker.

Meanwhile, construction ULC rose by 0.8 per cent, slightly higher than the 0.6 per cent increase in the preceding quarter, as the rise in total labour cost per worker outpaced productivity growth in the sector.

Unit business cost (UBC) for the manufacturing sector fell by 1.2 per cent year-on-year in the second quarter, extending the 1.0 per cent decline in the previous quarter (Exhibit 1.10). The decrease in manufacturing UBC was on account of the 7.4 per cent decline in manufacturing ULC, which was able to more than offset the 0.6 per cent increase in unit services cost (which includes royalties, utilities and other services costs such as professional and advertising fees).

Exhibit 1.10: Changes in Unit Business Cost for Manufacturing

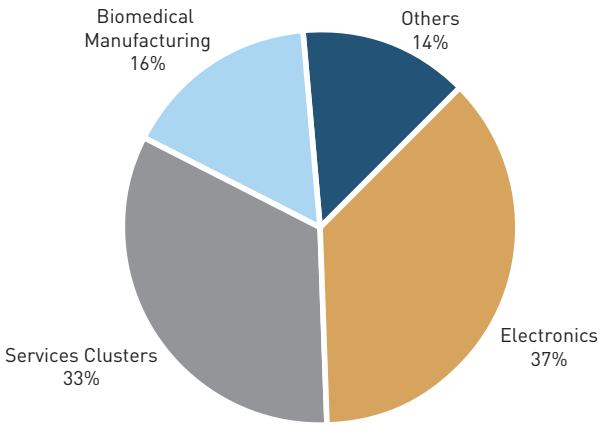


Investment Commitments

Investment commitments in terms of Fixed Asset Investments (FAI) and Total Business Expenditure (TBE) amounted to $4.5 billion and $2.8 billion respectively in the second quarter (Exhibit 1.11 and Exhibit 1.12).

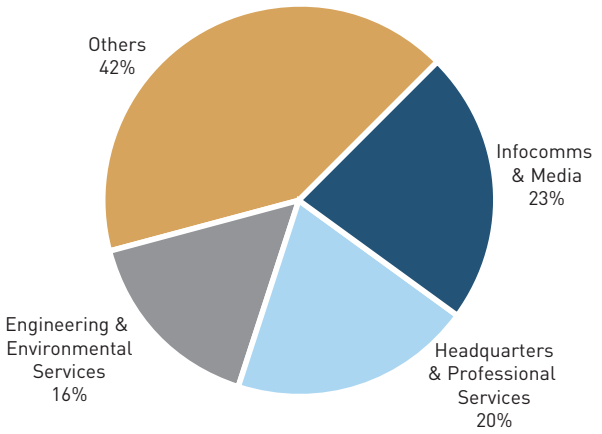
In terms of FAI, the biggest contribution came from the manufacturing sector. Within the manufacturing sector, the electronics cluster garnered the largest amount of commitments, at $1.7 billion. This was followed by the biomedical manufacturing cluster, which attracted $712 million in commitments. Investors from the United States were the largest contributor to total FAI commitments (45 per cent). They were followed by investors from Europe who accounted for about $1.2 billion of the FAI commitments (27 per cent).

Exhibit 1.11: Fixed Asset Investments by Industry Cluster in 2Q 2018



In terms of TBE, the infocomms & media cluster attracted the highest amount of commitments, at $643 million, followed by the headquarters & professional services cluster with $552 million. Investors from Europe contributed the most to TBE, at $889 million (32 per cent). They were followed by investors from Singapore who accounted for $870 million (31 per cent).

Exhibit 1.12: Total Business Expenditure by Industry Cluster in 2Q 2018



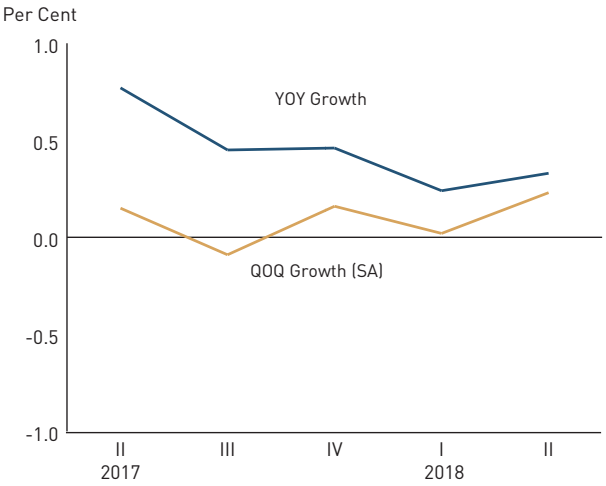
When fully realised, these commitments are expected to generate a value-added of $6.6 billion and more than 7,600 jobs.

PRICES

Consumer Price Index

The Consumer Price Index (CPI) rose by 0.3 per cent on a year-on-year basis in the second quarter, slightly faster than the 0.2 per cent increase in the preceding quarter (Exhibit 1.13). On a quarter-on-quarter seasonally-adjusted basis, the CPI edged up by 0.2 per cent in the second quarter, after remaining unchanged in the first quarter.

Exhibit 1.13: Changes in CPI



Among the CPI categories, food was the largest positive contributor to inflation in the second quarter, with prices rising by 1.4 per cent on a year-on-year basis on the back of price increases for food servicing services like hawker food and restaurant meals, as well as non-cooked food items such as fish & seafood and bread & cereals (Exhibit 1.14). Meanwhile, education costs rose by 2.9 per cent on account of higher fees at kindergartens & childcare centres, commercial institutions, universities and polytechnics.

Healthcare costs increased by 2.2 per cent due to more expensive hospital services and outpatient services. Recreation & culture costs rose by 1.1 per cent because of the higher costs of holiday travel. Prices of miscellaneous goods & services picked up by 0.9 per cent as an increase in the price of cigarettes more than offset a fall in the prices of personal care items. The cost of household durables & services increased by 0.8 per cent as a rise in the salaries of foreign maids outweighed a dip in the prices of household durables. Clothing & footwear costs rose by 1.0 per cent due to more expensive footwear and ready-made garments.

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

Per Cent

	2017			2018	
	II	III	IV	I	II
All items	0.8	0.4	0.5	0.2	**0.3**
Food	1.4	1.3	1.4	1.3	**1.4**
Clothing & Footwear	1.4	1.6	0.4	1.0	**1.0**
Housing & Utilities	-2.2	-2.4	-2.4	-2.6	**-2.0**
Household Durables & Services	0.6	1.0	1.0	0.9	**0.8**
Health Care	2.7	2.6	2.0	2.3	**2.2**
Transport	3.4	1.5	1.7	0.3	**-0.1**
Communication	0.4	0.6	1.0	-0.1	**-0.7**
Recreation & Culture	0.0	0.2	0.6	1.0	**1.1**
Education	3.2	2.7	2.6	2.9	**2.9**
Miscellaneous Goods & Services	0.1	0.4	0.2	0.6	**0.9**

The price gains in these CPI categories were partially offset by declines in other categories. Housing & utilities costs posed the largest drag on CPI-All Items inflation, declining by 2.0 per cent as a fall in accommodation costs more than offset higher water prices and electricity tariffs, as well as housing maintenance charges. Likewise, communication costs fell by 0.7 per cent due to cheaper telecommunication services. Transport costs edged down by 0.1 per cent as lower car prices and bus & train fares more than offset higher petrol prices.

INTERNATIONAL TRADE

Merchandise Trade

Singapore's total merchandise trade expanded by 10 per cent year-on-year in the second quarter, accelerating from the 2.5 per cent increase in the preceding quarter (Exhibit 1.15). The expansion came on the back of a rise in both oil and non-oil trade. Total oil trade increased by 23 per cent in nominal terms on the back of higher oil prices compared to a year ago, while non-oil trade rose by 7.1 per cent.

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

Per Cent

	2017				2018	
	II	III	IV	Ann	I	II
Merchandise Trade	9.5	11.6	7.8	11.1	2.5	**10.2**
Merchandise Exports	8.3	10.1	6.6	10.3	2.3	**9.4**
Domestic Exports	9.6	11.0	15.3	15.8	3.5	**13.0**
Oil	26.9	19.3	26.1	33.4	8.6	**20.6**
Non-Oil	3.0	7.6	10.4	8.8	1.1	**9.4**
Re-Exports	7.0	9.3	-1.3	5.2	0.9	**5.7**
Merchandise Imports	11.0	13.4	9.1	12.1	2.8	**11.1**
Oil	33.0	26.3	30.5	41.6	3.7	**26.3**
Non-Oil	6.2	10.4	4.0	5.8	2.6	**7.0**

Total merchandise exports rose by 9.4 per cent in the second quarter, faster than the 2.3 per cent rise in the preceding quarter. This also marked the seventh consecutive quarter of growth, and was supported by an increase in both domestic exports (13 per cent) and re-exports (5.7 per cent).

The growth in domestic exports was due to a rise in both oil and non-oil domestic exports. In particular, oil domestic exports expanded by 21 per cent, supported by higher oil prices compared to levels a year ago. In volume terms, oil domestic exports declined by 7.4 per cent.

Non-oil domestic exports (NODX) grew by 9.4 per cent, up from the 1.1 per cent increase in the previous quarter. Growth in NODX was driven by an increase in non-electronics NODX, which outweighed the decline in electronics NODX.

Total merchandise imports expanded by 11 per cent in the second quarter, higher than the 2.8 per cent increase in the previous quarter. Both oil and non-oil merchandise imports increased. Specifically, oil imports rose by 26 per cent on the back of higher oil prices, while non-oil imports grew by 7.0 per cent, driven by an increase in both electronics and non-electronics imports.

Services Trade

Total services trade increased by 3.0 per cent year-on-year in the second quarter, following the 4.3 per cent growth in the previous quarter (Exhibit 1.16). Services exports grew by 3.8 per cent, moderating from the 5.2 per cent growth in the first quarter. The increase in services exports was largely attributable to a rise in exports of transport services, as well as receipts from charges for the use of intellectual property. Meanwhile, services imports rose by 2.1 per cent, moderating from the 3.5 per cent increase in the previous quarter. The rise in services imports was mainly due to higher imports of other business services, financial services and insurance services.

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

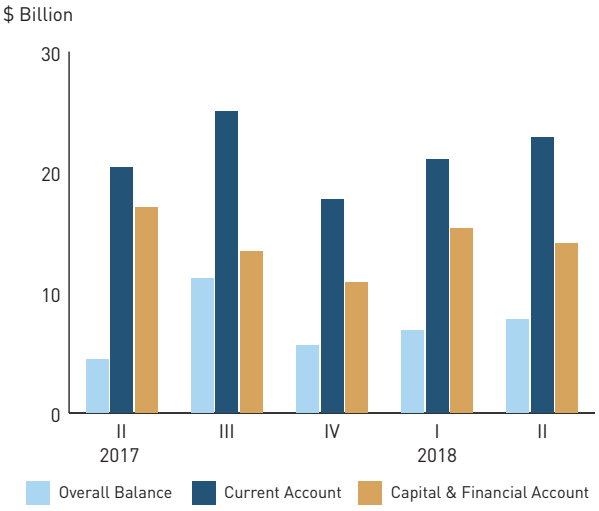
Per Cent

	2017				2018	
	II	III	IV	Ann	I	II
Total Services Trade	3.9	6.6	4.1	4.7	4.3	**3.0**
Services Exports	3.7	5.3	3.2	4.2	5.2	**3.8**
Services Imports	4.0	7.9	5.0	5.1	3.5	**2.1**

BALANCE OF PAYMENTS

The overall balance of payments recorded a larger surplus of $7.8 billion in the second quarter, compared to $6.8 billion in the first quarter (Exhibit 1.17). This resulted from both an increase in the current account surplus as well as a decline in net outflows from the capital and financial account.

Exhibit 1.17: Balance of Payments[7]



Current Account

The current account surplus rose to $23 billion in the second quarter, from $21 billion in the preceding quarter. This was due to an increase in the goods account surplus, as well as smaller deficits in the services and primary income balances. By contrast, the deficit in the secondary income balance rose slightly.

The surplus in the goods balance increased by $0.9 billion to $30 billion in the second quarter, as goods exports rose more than imports.

At the same time, the deficit in the services balance narrowed from $1.7 billion in the first quarter to $0.8 billion in the second quarter. Although net payments for travel and other business services increased, these were more than offset by lower net payments for the use of intellectual property, as well as a reversal from a net payments to a net receipts position for transport services.

7 *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's information paper on "Singapore's International Accounts: Methodological Updates and Recent Developments".*

Meanwhile, the deficit in the primary income balance fell to $4.3 billion in the second quarter from $4.6 billion in the first quarter, as primary income receipts rose more than payments.

Capital and Financial Account

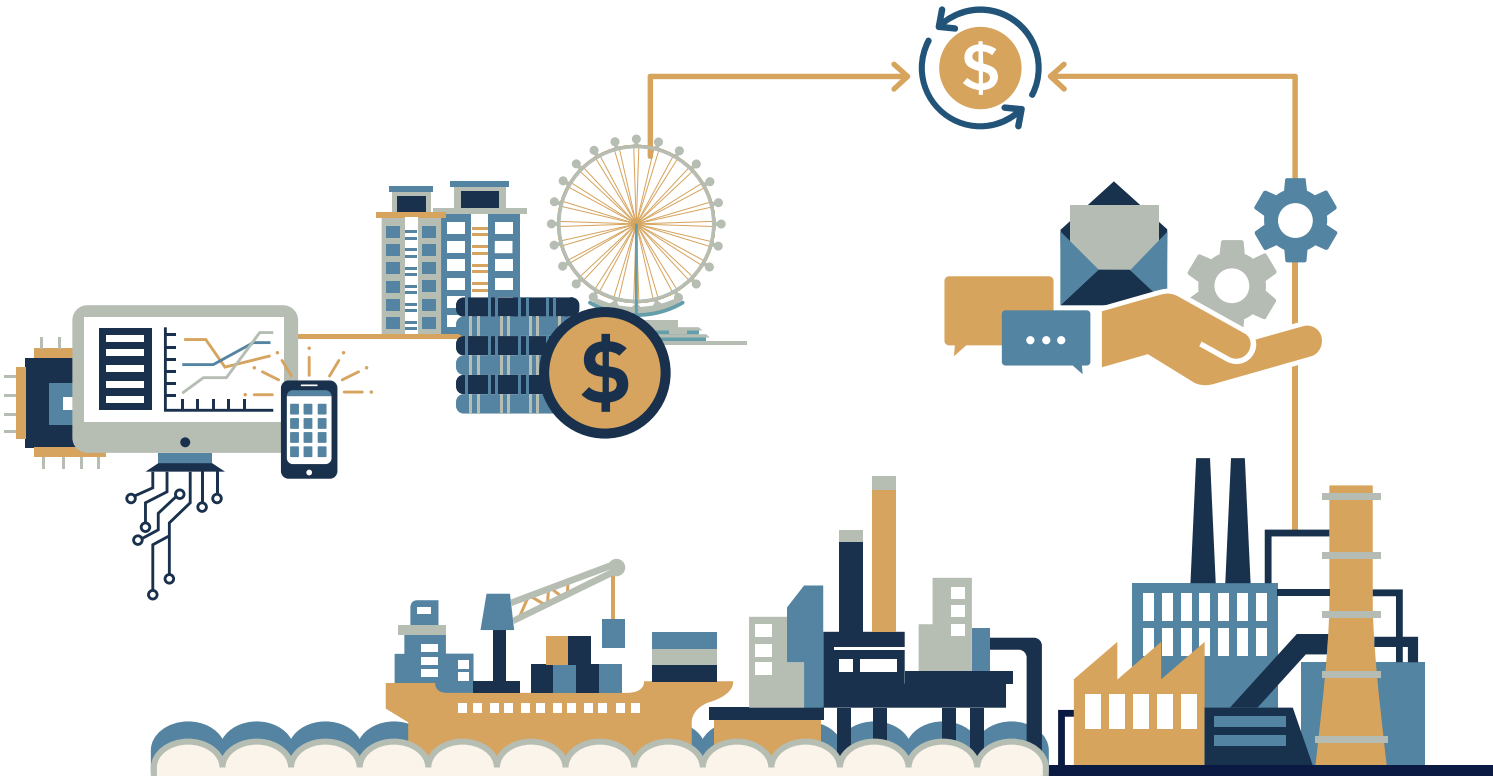
Net outflows from the capital and financial account declined to $14 billion in the second quarter, from $15 billion in the previous quarter. This was due to a rise in the net inflows of direct investment and a fall in the net outflows of other investment, which outweighed the higher net outflows of portfolio investment and the lower net inflows of financial derivatives.

Net inflows of direct investment reached $14 billion, up from $8.5 billion in the first quarter. This largely reflected an increase in foreign direct investment into Singapore.

Meanwhile, net outflows from the "other investment" account fell by $8.2 billion to $18 billion in the second quarter. This was mainly due to a reversal of the non-bank private sector from a net outflow to a net inflow position, which had more than offset the increase in net outflows from domestic deposit-taking corporations.

On the other hand, the net outflows of portfolio investment increased by $5.8 billion to $10 billion in the second quarter. This was driven by a higher net acquisition of overseas securities by both the non-bank and official sectors, which outweighed the increase in net sales of foreign securities by domestic deposit-taking corporations.

At the same time, net inflows of financial derivatives fell to $0.9 billion in the second quarter, from $7.3 billion in the first quarter.

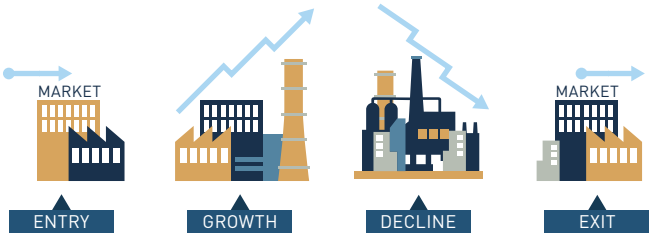


BOX ARTICLE 1.1

Employment Dynamics of Firms in Singapore: Young Firms vs. Older Firms

INTRODUCTION

Business dynamism – the process of birth, growth, decline and exit of firms – is an important aspect of a healthy economy. In this article, we examine the growth dynamics of firms by the age-employment size dimensions and take a closer look at the process of employment creation and destruction by firms of different ages through the lenses of the entry, growth and exit of these firms.



FINDINGS

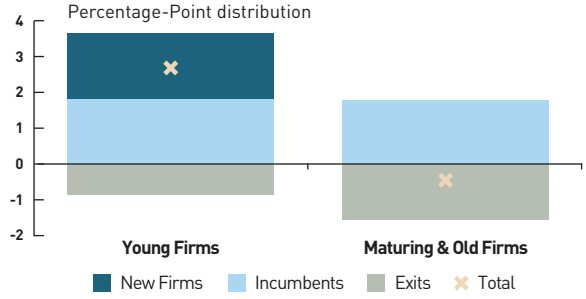
FINDING 1

Young firms were more likely than old firms to transit out of their initial size category after a five-year period. Notably, young firms were more likely than old firms to transit to a larger employment size category, with a small proportion growing significantly to large or very large employment size categories after five years.

FINDING 2

Decomposing the average annual net employment change over the 2009-2016 period, we find that young firms contributed more than maturing and old firms to net job creation. Breaking down the contribution of young firms further to understand the contribution of new firms (i.e., entrant firms) and incumbent young firms that were expanding, we find that the entry of new firms accounted for a significant portion of the young firms' contribution to net job creation during the period.

Decomposition Of Average Annual Net Employment Change By Firm Age And Firm Type Over The 2009-2016 Period



FINDING 3

We find that a sizeable portion of the jobs created by new firms in Singapore have been in industries that have average monthly earnings that were higher than that of the overall economy for the 2009-2016 period, such as other services, wholesale trade, manufacturing, information & communications and finance & insurance.

POLICY TAKEAWAY

In view of the importance of young firms in employment creation, the Government will continue to be mindful of the need to create and maintain conditions that are conducive for firms to enter and grow. At the same time, the Government will continue its efforts to help workers who may be affected by firm exits so that they can enter new and better jobs. These include providing support to help Singaporeans stay relevant through the SkillsFuture programme, and helping displaced workers to plug skills gaps and re-enter employment through the Adapt & Grow initiative.

The economic literature suggests that business dynamism – the process of birth, growth, decline and exit of firms – is an important aspect of a healthy economy. This dynamism is a feature of market economies such as the United States where the high pace of job and worker reallocation has been important for productivity growth and job creation (Decker et al., 2014).

In this article, we examine the growth dynamics of firms by the age-employment size dimensions.[1,2] In particular, we take a closer look at the process of employment creation and destruction by firms of different ages through the lenses of the entry, growth and exit of these firms. We also explore the contribution of young and older firms to aggregate net employment creation in the Singapore economy.

For the purpose of this article, we adopt the firm age and employment size categories described in Exhibits 1A and 1B respectively.

Exhibit 1A: Categories for Firm Age

Age Category	Age (in years)
New firms	0
Young	0-5
Maturing	6-10
Old	>10

Exhibit 1B: Categories for Firm Size

Size Category	No. of Employees
Micro	1-10
Small	11-50
Medium	51-100
Large	101-200
Very Large	>200

Young firms account for a significant share of total firm count in the Singapore corporate landscape

We first provide an overview of Singapore's corporate landscape along the age dimension. Over the 2009-2016 period, young firms accounted for a substantial proportion of total firm count in Singapore, but contributed the least to the overall stock of employment. Specifically, while 39 per cent of all firms in Singapore were young firms (Exhibit 2A), they only accounted for 17 per cent of total employment in Singapore (Exhibit 2B), implying that young firms were smaller on average as compared to their maturing and old counterparts in terms of employment size.[3] This was similarly observed in OECD countries, where 37 per cent of all firms were young firms but they only accounted for 21 per cent of total employment (Criscuolo et al., 2014).[4] In terms of revenue size, young firms in Singapore also tended to have lower revenue than their maturing and old counterparts. Specifically, young firms were on average around four times smaller than old firms in terms of revenue size over the 2009-2016 period (Exhibit 2C).

1 *Firms in this study refer to all business entities, i.e., companies, partnerships, limited liability partnerships, limited partnerships, and sole proprietorships.*
2 *The relationship between firm churn (i.e., the pace of entry and exit of firms) and productivity growth has been studied by Gwee et al. (2016) for Singapore's manufacturing sector. Specifically, the authors found that firm churn and worker reallocation effects contributed positively to the manufacturing sector's productivity growth over the 2009-2013 period.*
3 *Over the 2009-2016 period, the average employment size of young firms was 8, while that for maturing firms and old firms were 15 and 31 respectively.*
4 *Data on OECD countries was obtained from OECD and the data covers the manufacturing, construction and non-financial services sectors. The percentage of young firms and their employment contribution in OECD countries is computed as the average across all available years and countries where data is available. The period covered is 2001-2011 for Belgium, Finland, Hungary, the Netherlands, the United Kingdom and the United States; 2001-2010 for Austria, Brazil, Spain, Italy, Luxembourg, Norway and Sweden; 2001-2009 for Japan and New Zealand; 2001-2007 for France; and 2006-2011 for Portugal.*

Exhibit 2A: Distribution of Firms by Age, 2009-2016

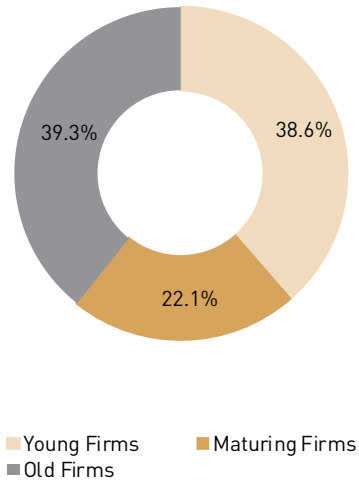


Exhibit 2B: Distribution of Employment by Firm Age, 2009-2016

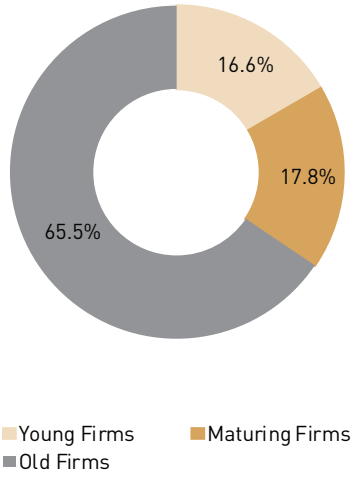
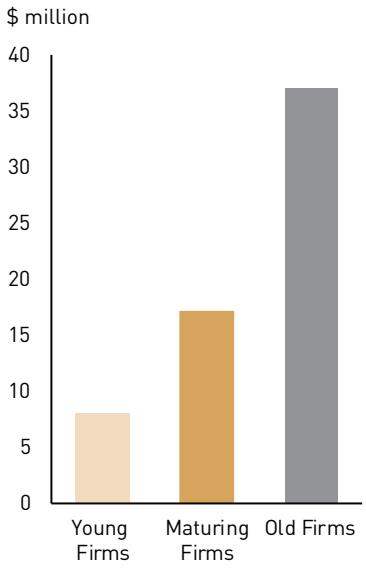


Exhibit 2C: Average Revenue by Firm Age, 2009-2016



Source: Department of Statistics (DOS)
Notes: Data may not add up to 100% due to rounding.

Young firms are more likely than their old counterparts to grow in employment size

We next turn our attention to the growth dynamics of firms in Singapore to see how firms of different ages and employment sizes transit across employment size categories over time. In particular, we focus on the growth dynamics of young and old firms, as these constituted the two largest groups of firms.[5]

To do so, we construct transition matrices that show how the 2011 cohort of young and old firms of different employment sizes transit across employment size categories over a five-year period (Exhibits 3A and 3B). The salient observations are as follows:

- Among both young and old firms, firms tended to remain in their initial employment size category at the end of the five-year period, as seen from the high shares in the diagonals of the transition matrices.

- However, comparing young and old firms, young firms were more likely than the old firms to transit out of their initial size category after a five-year period (i.e., the shares in the diagonal for young firms were lower than that for old firms). For instance, 43 per cent of young micro firms remained as micro firms after five years (Exhibit 3A), whereas 68 per cent of old micro firms remained in the same size category over the same period (Exhibit 3B).

- Young firms also had a much higher likelihood of exit after five years relative to old firms, especially in the case of micro and small firms. This is not surprising as the business model and financial conditions of firms tend to be less stable in the initial years after formation.

- Among the firms that survived, young firms were more likely than old firms to transit to a larger employment size category[6], with a small proportion growing significantly to large or very large employment size categories (i.e., beyond 100 workers) after five years.

5 *The observations are similar if we compare young firms and maturing firms.*
6 *Across all initial employment size categories for the 2011 cohort of firms, 9.3 per cent of young firms were found to have grown into a larger employment size category after a period of five years, while only 5.5 per cent of old firms managed to grow into a larger employment size category at the end of five years.*

Exhibit 3A: Five-year Transition Matrix of Young Firms, 2011 Cohort

		Size in 2016					Exit
		Micro	Small	Medium	Large	Very Large	
Size in 2011	Micro	42.9%	8.7%	0.5%	0.1%	0.1%	47.8%
	Small	14.7%	48.3%	6.0%	1.6%	0.4%	29.0%
	Medium	5.2%	24.7%	33.7%	14.7%	3.3%	18.4%
	Large	4.4%	8.8%	19.5%	30.7%	19.9%	16.7%
	Very Large	3.8%	3.8%	1.3%	12.1%	69.4%	9.6%

Source: DOS
Notes: 'Exit' firms include firms that had ceased operations by 2016 or had no employment in 2016. The data in each row may not add up to 100% due to rounding.

Exhibit 3B: Five-year Transition Matrix of Old Firms, 2011 Cohort

		Size in 2016					Exit
		Micro	Small	Medium	Large	Very Large	
Size in 2011	Micro	67.9%	4.8%	0.1%	0.0%	0.0%	27.2%
	Small	16.4%	66.0%	4.4%	0.4%	0.1%	12.7%
	Medium	2.8%	23.7%	50.6%	12.8%	1.5%	8.6%
	Large	2.3%	5.6%	20.3%	50.6%	13.9%	7.4%
	Very Large	1.0%	1.9%	3.0%	10.6%	78.4%	5.0%

Source: DOS
Notes: 'Exit' firms include firms that had ceased operations by 2016 or had no employment in 2016. The data in each row may not add up to 100% due to rounding.

Young firms contribute significantly to net employment creation in the economy...

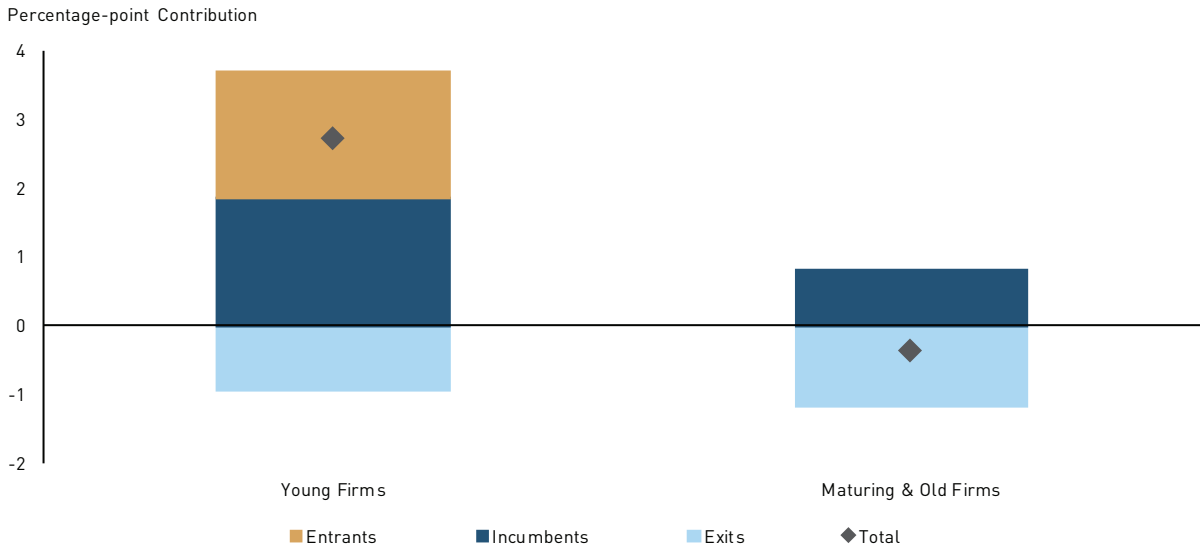
In this section, we examine the contribution of young firms to net job creation in Singapore vis-à-vis that of maturing and old firms. Between 2009 and 2016, total employment growth in Singapore averaged 2.3 per cent per annum. Decomposing the average annual net employment change over this period to obtain the contribution of firms in different age categories (Exhibit 4), we find the following:

- Young firms contributed more than maturing and old firms to net job creation. Specifically, young firms contributed 2.7 percentage-points (pp) to the average annual net employment growth of 2.3 per cent over this period, while the combined contribution of maturing and old firms was slightly negative, at -0.4pp.

- Breaking down the contribution of young firms further to understand the contribution of new firms (i.e., entrant firms) and incumbent young firms that were expanding, we find that the entry of new firms accounted for a significant portion (nearly half) of the young firms' contribution to net job creation during the period.

- In line with our earlier finding that young firms that survived were more likely than old firms to transit to a larger employment size category, we also find that young incumbent firms (1.8pp) contributed more than maturing and old incumbent firms (0.8pp) to average annual net employment growth over this period.

Exhibit 4: Average Annual Total Employment Change by Age and Firm Type, 2009-2016

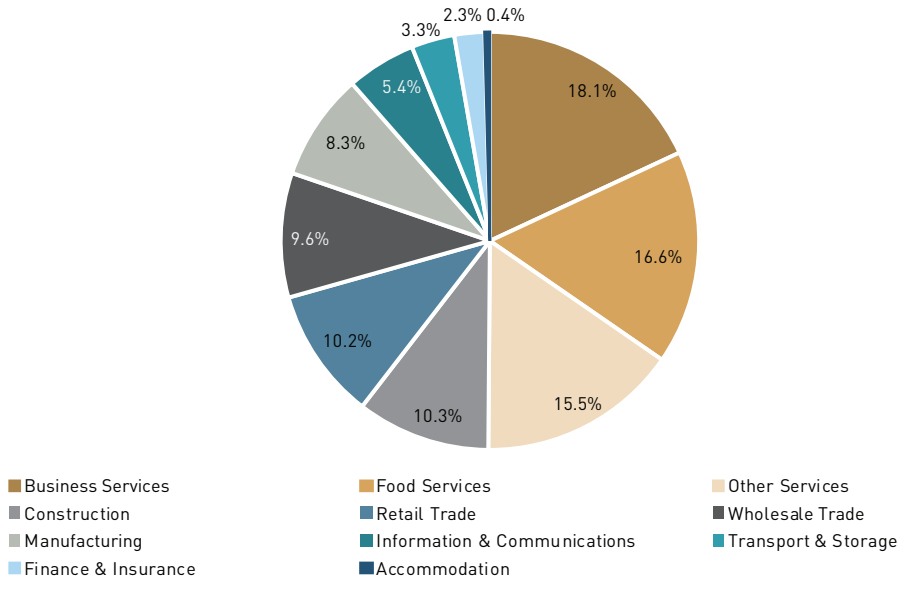


Source: DOS
Notes: Due to the scope of the study, the results in this chart will not be comparable with the Ministry of Manpower's employment change data. When comparing employment change between year t+1 and t, 'new firms' are defined as newly registered employing firms in t+1, and 'incumbents' are defined as firms that are live and have valid employment data in both t+1 and t. 'Exits' are defined either as firms that were live in year t but ceased operations in t+1, or firms that are live in both periods but have no employment in t+1.

...and a sizeable portion of the jobs created by new firms between 2009 and 2016 were in industries with good wage prospects

Finally, we find that a sizeable portion of the jobs created by new firms over the 2009-2016 period were in industries with good wage prospects, such as other services (16 per cent), wholesale trade (9.6 per cent), manufacturing (8.3 per cent), information & communications (5.4 per cent) and finance & insurance (2.3 per cent) (Exhibit 5). In particular, these industries had average monthly earnings that were higher than that of the overall economy for the 2009-2016 period.

Exhibit 5: Share of Jobs Created by New Firms by Industries, 2009-2016 Average



Source: DOS

Conclusion

Overall, we find that young firms in Singapore are more likely than old firms to increase their employment, with a small proportion experiencing significant employment growth, although young firms are also more likely to exit. Decomposing the average annual net employment change over the 2009-2016 period, we find that young firms contributed significantly more than maturing and old firms to net employment growth over this period. This can in turn be attributed to both new firms entering the market, as well as the expansion of incumbent young firms.

In view of the importance of young firms in employment creation, the Government will continue to be mindful of the need to create and maintain conditions that are conducive for firms to enter and grow. At the same time, the Government will continue its efforts to help workers who may be affected by firm exits so that they can enter new and better jobs. These include providing support to help Singaporeans stay relevant through the SkillsFuture programme, and helping displaced workers to plug skills gaps and re-enter employment through the Adapt & Grow initiative.

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Economist
Economics Division
Ministry of Trade and Industry

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CHAPTER 2

SECTORAL PERFORMANCE

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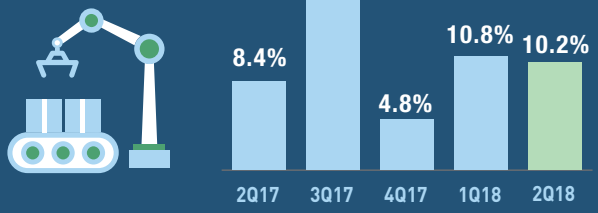
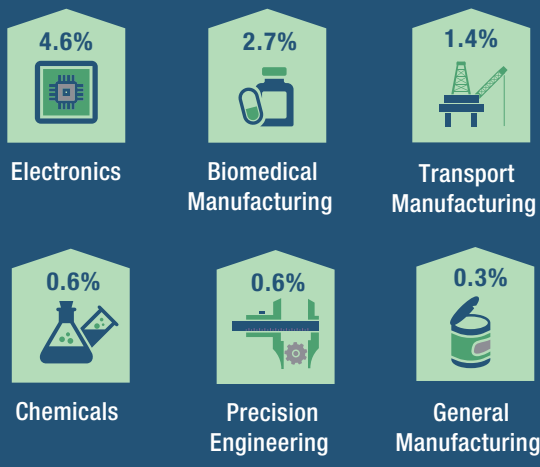
SECTORAL PERFORMANCE

MANUFACTURING

REAL GROWTH

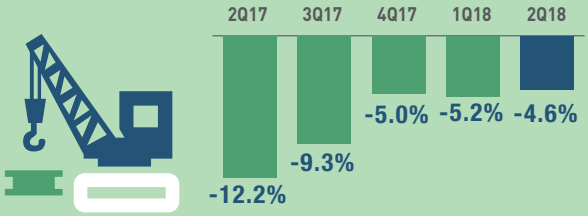


CLUSTERS IN MANUFACTURING SECTOR %-POINT CONTRIBUTION IN 2Q18

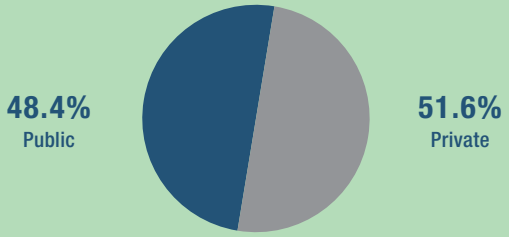


CONSTRUCTION

REAL GROWTH



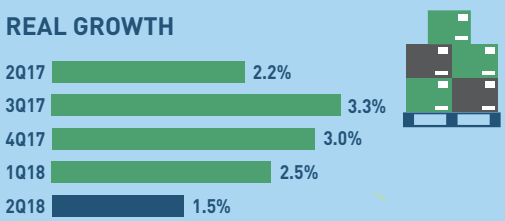
CERTIFIED PAYMENTS IN 2Q18



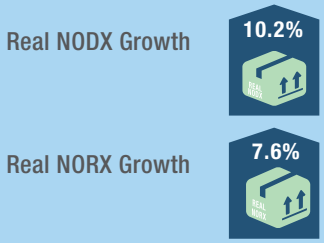
CONTRACTS AWARDED IN 2Q18

WHOLESALE & RETAIL TRADE

REAL GROWTH



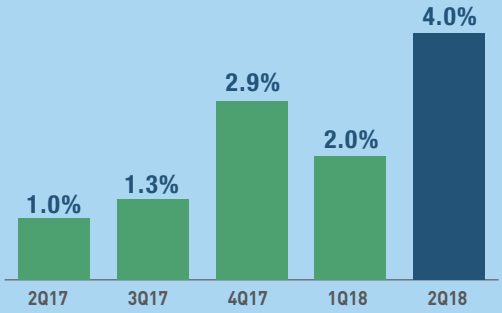
WHOLESALE TRADE



RETAIL TRADE

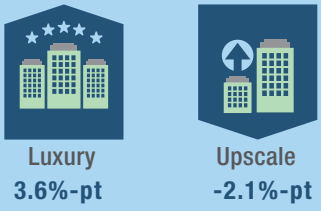
ACCOMMODATION & FOOD SERVICES

REAL GROWTH



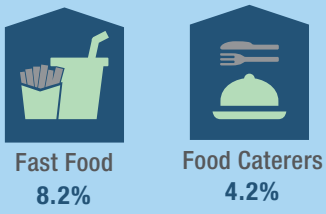
ACCOMMODATION

Occupancy Rates of Hotels (Y-O-Y CHANGE)



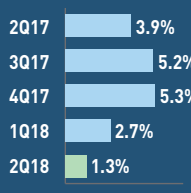
FOOD SERVICES

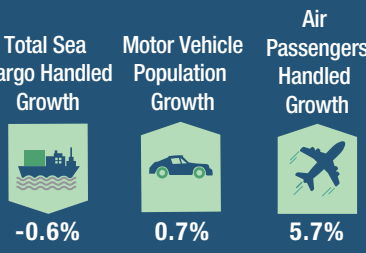
F&B Sales Index Growth (Y-O-Y CHANGE)



TRANSPORTATION & STORAGE

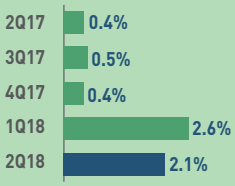
REAL GROWTH



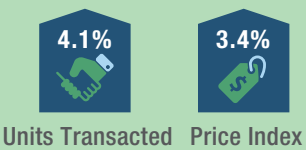


BUSINESS SERVICES

REAL GROWTH

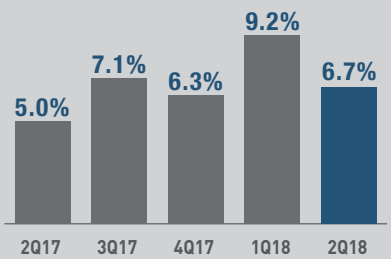


PRIVATE RESIDENTIAL REAL ESTATE

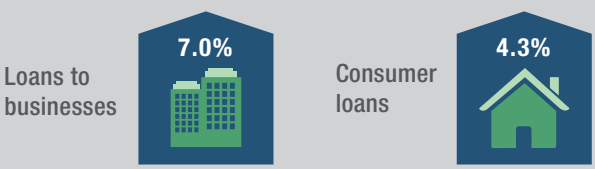


FINANCE & INSURANCE

REAL GROWTH



GROWTH OF BANK LOANS & ADVANCES TO NON-BANK CUSTOMERS IN 2Q18



OVERVIEW

In the second quarter of 2018,

- The manufacturing sector expanded by 10 per cent, extending the 11 per cent growth in the preceding quarter. All clusters within the sector grew, with the electronics, biomedical manufacturing and transport engineering clusters contributing the most to growth.
- The construction sector contracted by 4.6 per cent, easing from the 5.2 per cent contraction in the previous quarter. The fall in construction output was primarily due to weakness in public sector construction activities.
- The wholesale & retail trade sector grew by 1.5 per cent, moderating from the 2.5 per cent growth in the previous quarter. Growth was largely supported by the wholesale trade segment.
- The transportation & storage sector expanded by 1.3 per cent, slowing from the 2.7 per cent expansion in the first quarter. Growth was led by the air transport segment within the sector.
- Growth in the accommodation & food services sector came in at 4.0 per cent, faster than the 2.0 per cent in the previous quarter. The pickup in the performance of the sector was mainly due to the accommodation segment.
- The finance & insurance sector grew by 6.7 per cent, moderating from the 9.2 per cent growth in the preceding quarter. Broad-based expansions across segments, including the financial intermediation, insurance and fund management segments, contributed to the growth of the sector.
- The business services sector expanded by 2.1 per cent, extending the 2.6 per cent growth in the first quarter, on the back of healthy growth in the others and professional services segments.

MANUFACTURING

Manufacturing output rose by 10 per cent year-on-year in the second quarter, extending the 11 per cent expansion in the first quarter [Exhibit 2.1]. Growth was supported by higher output across all manufacturing clusters, with the electronics, biomedical manufacturing and transport engineering clusters contributing the most to the growth of the sector [Exhibit 2.2].

Exhibit 2.1: Manufacturing Sector's Growth Rate

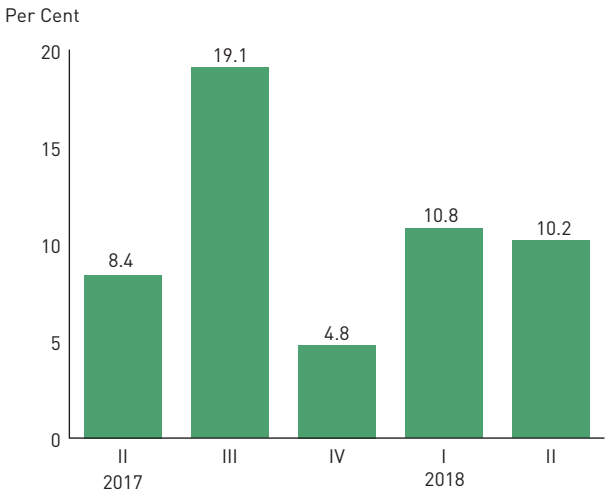
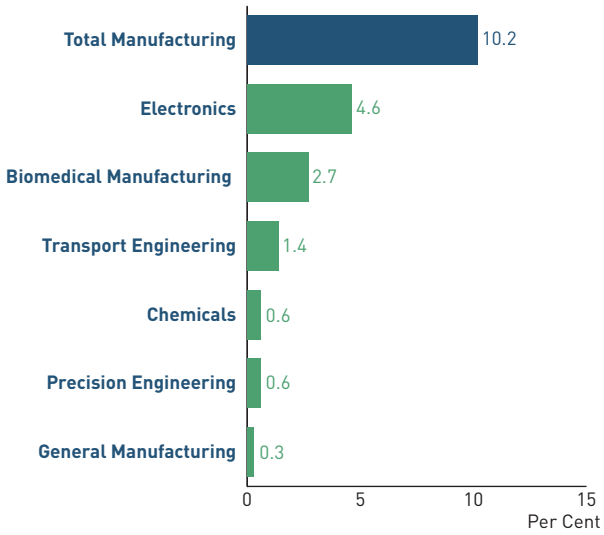


Exhibit 2.2: Percentage-Point Contribution to Manufacturing Sector's Growth in 2Q 2018



The output of the electronics cluster increased by 12 per cent in the second quarter, driven by an 18 per cent expansion in the output of the semiconductors segment. The healthy performance of the semiconductors segment came on the back of robust global semiconductor demand from the server, PC, industrial and automotive markets. By contrast, the rest of the segments within the electronics cluster posted output declines.

The biomedical manufacturing cluster expanded by 15 per cent in the second quarter, supported by both the pharmaceuticals and medical technology segments. In particular, the output of the pharmaceuticals segment grew by 19 per cent on the back of a higher level of production of pharmaceutical and biological products. At the same time, higher export demand for medical devices contributed to the 5.9 per cent growth of the medical technology segment.

Output of the transport engineering cluster rose by 12 per cent in the second quarter. The marine & offshore engineering segment expanded by 16 per cent on the back of a higher level of work done in offshore projects. Meanwhile, the output of the aerospace segment increased by 13 per cent due to a rise in the volume of engine repair and maintenance work from commercial airlines. By contrast, the land transport segment contracted by 13 per cent.

The chemicals cluster grew by 7.4 per cent in the second quarter. Growth was largely driven by the petrochemicals segment, which expanded by 20 per cent on the back of increased plant capacities. The petroleum and other chemicals segments also posted growth of 7.4 per cent and 4.8 per cent respectively, with the latter driven by a higher level of production of fragrances. On the other hand, the specialty chemicals segment registered flat growth during the quarter.

The precision engineering cluster expanded by 3.9 per cent in the second quarter, supported by output growth in both the precision modules & components (PMC) and machinery & systems (M&S) segments. Specifically, output in the PMC and M&S segments rose by 6.5 per cent and 2.5 per cent respectively, with the latter supported by an increase in the production of process control equipment.

The general manufacturing industries cluster grew by 3.0 per cent in the second quarter. The expansion was driven by the food, beverages & tobacco segment, which grew by 9.0 per cent on account of a higher level of production of infant milk and beverage products. By contrast, the printing and miscellaneous industries segments shrank by 8.3 per cent and 1.1 per cent respectively.

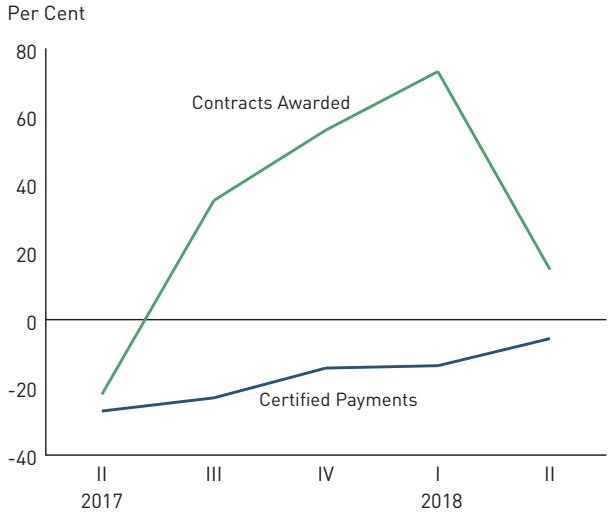
CONSTRUCTION

The construction sector contracted by 4.6 per cent year-on-year in the second quarter, easing from the 5.2 per cent decline in the previous quarter. The contraction was primarily due to the weakness in public sector construction output.

In the second quarter, nominal certified progress payments (a proxy for construction output) fell by 5.6 per cent, although this was an improvement from the 14 per cent drop in the first quarter (Exhibit 2.3). The decline in construction output was because of a fall in public certified progress payments (-11 per cent), which was in turn dragged down by contractions in public institutional & other building works (-33 per cent) and public residential building works (-7.6 per cent). By contrast, private certified progress payments increased marginally by 0.3 per cent, driven primarily by an expansion in private industrial building works (26 per cent).

On the other hand, construction demand in terms of contracts awarded continued to increase, rising by 15 per cent in the second quarter, extending the 73 per cent increase in the previous quarter (Exhibit 2.3). This was due to a rise in public sector construction demand (39 per cent) on the back of a higher demand for public civil engineering works (185 per cent) and public residential building works (39 per cent). On the other hand, private sector construction demand fell by 14 per cent, a reversal from the 80 per cent rise in the previous quarter. The decline was mainly due to weakness in contracts awarded for private industrial building works (-58 per cent) and private institutional & other building works (-58 per cent).

Exhibit 2.3: Changes in Contracts Awarded and Certified Payments



WHOLESALE & RETAIL TRADE

The wholesale & retail trade sector grew by 1.5 per cent year-on-year in the second quarter, moderating from the 2.5 per cent growth in the previous quarter. Both the wholesale trade and retail trade segments expanded during the quarter.

Growth of the wholesale trade segment came on the back of an expansion in trade volumes in Singapore. In particular, Singapore's non-oil domestic exports (NODX) rose by 10 per cent in volume terms in the second quarter, accelerating from the 4.0 per cent growth in the preceding quarter. The increase in NODX was primarily driven by higher domestic exports of chemicals & chemical products. Similarly, the volume of non-oil re-exports (NORX) grew by 7.6 per cent in the second quarter, faster than the 3.6 per cent expansion in the first quarter. The higher volume of NORX was supported by robust growth in the re-exports of machinery & equipment as well as chemicals & chemical products.

Exhibit 2.4: Changes in Wholesale & Retail Trade VA at 2010 Prices, Real NODX and Real NORX

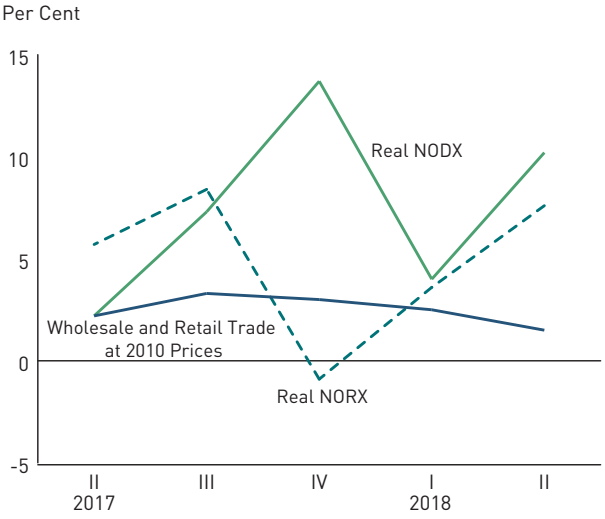
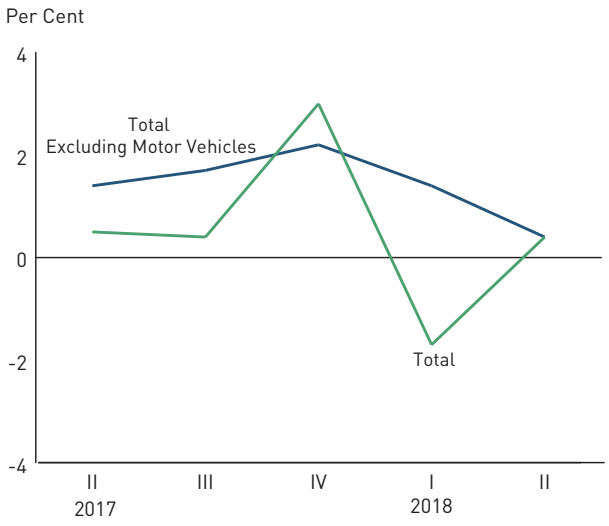


Exhibit 2.5: Changes in Retail Sales Index at Constant Prices



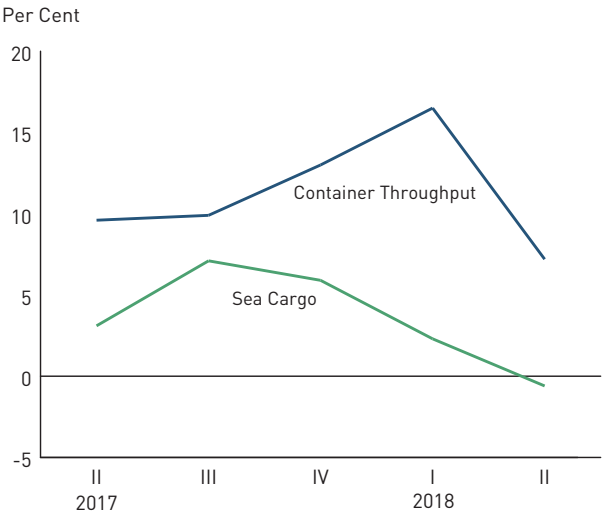
For the retail trade segment, overall retail sales volume rose by 0.4 per cent in the second quarter, reversing the 1.7 per cent decline in the previous quarter. The rise in overall retail sales volume could be attributed to an increase in the volume of sales of both motor vehicles (0.5 per cent) and non-motor vehicles (0.4 per cent) over the period (Exhibit 2.5). Notably, the pickup in non-motor vehicle sales volume came on the back of a modest recovery in consumer sentiments. By categories of products, the sales volume of medical goods & toiletries, furniture & household equipment and wearing apparel & footwear rose by 7.8 per cent, 4.5 per cent and 1.6 per cent respectively.

TRANSPORTATION & STORAGE

Growth of the transportation & storage sector came in at 1.3 per cent year-on-year in the second quarter, moderating from the 2.7 per cent increase in the previous quarter.

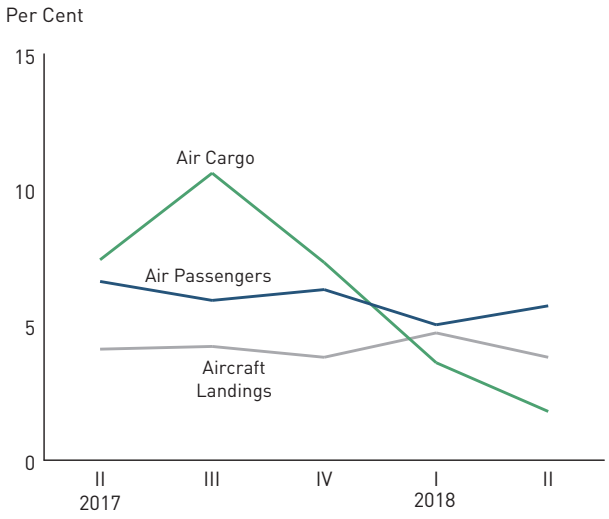
Within the sector, the water transport segment was weighed down by a 0.6 per cent fall in the volume of sea cargo handled in the second quarter, which was a reversal from the 2.3 per cent growth recorded in the previous quarter (Exhibit 2.6). In turn, the fall in the volume of sea cargo handled was primarily due to a 3.9 per cent decline in oil-in-bulk shipments, in line with the drop in oil trade volumes recorded. By contrast, container throughput handled at Singapore's ports rose by 7.2 per cent in the second quarter, extending the 16 per cent increase in the preceding quarter, on the back of sustained growth in global container trade flows.

Exhibit 2.6: Changes in Container Throughput and Sea Cargo Handled



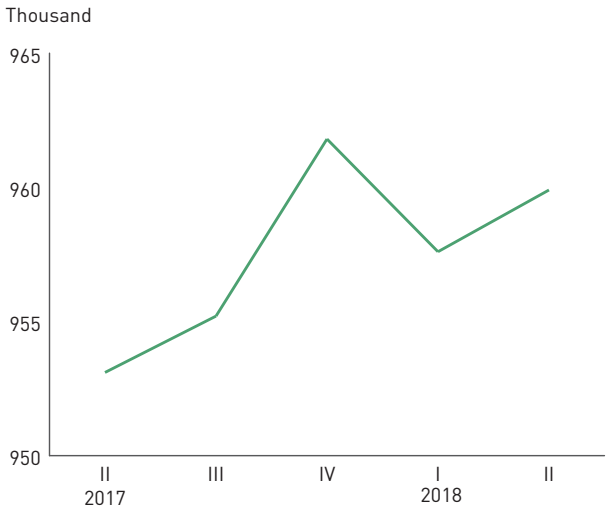
The air transport segment was boosted by an increase in both air passenger traffic and air cargo volume handled at Changi Airport. Specifically, the volume of air passenger traffic passing through Changi Airport rose by 5.7 per cent in the second quarter, extending the 5.0 per cent increase in the previous quarter (Exhibit 2.7). The rise in air passenger traffic volume was underpinned by robust growth on the Singapore-India and Singapore-China routes. Meanwhile, in line with the growth of Singapore's non-oil export volumes, total air cargo shipments handled at Changi Airport expanded by 1.8 per cent in the second quarter, albeit slower than the 3.6 per cent expansion in the preceding quarter. In addition, the number of aircraft landings rose by 3.8 per cent in the second quarter to reach 48,087, following a 4.7 per cent increase in the previous quarter.

Exhibit 2.7: Changes in Air Transport



As of June 2018, the total number of motor vehicles registered with the Land Transport Authority was 959,938, representing a 0.7 per cent increase from a year ago (Exhibit 2.8). These comprised 551,000 private and company cars, 68,817 rental cars, 21,164 taxis, 19,245 buses, 138,047 motorcycles and scooters, and 161,665 goods vehicles & other vehicle types.

Exhibit 2.8: Motor Vehicles Registered

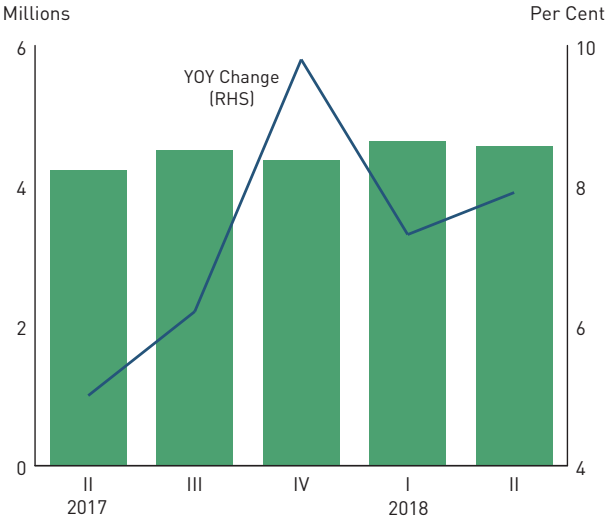


ACCOMMODATION & FOOD SERVICES

The accommodation & food services sector grew by 4.0 per cent year-on-year in the second quarter, accelerating from the 2.0 per cent growth in the first quarter. The sector's performance was bolstered by the accommodation segment on the back of healthy growth in visitor arrivals.

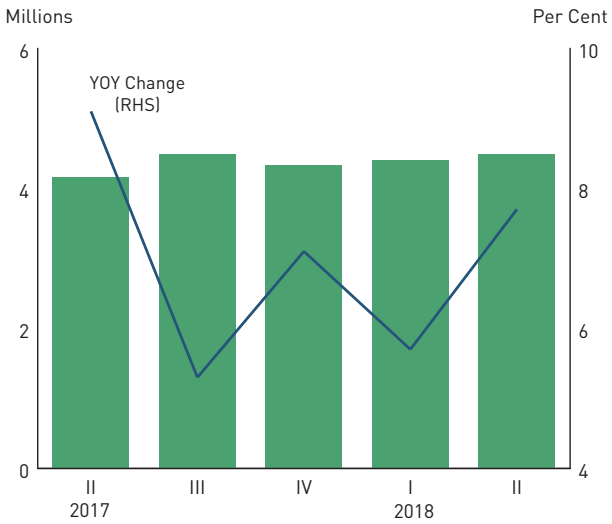
Total visitor arrivals rose by 7.9 per cent in the second quarter, improving from the 7.3 per cent growth in the previous quarter (Exhibit 2.9). This came on the back of buoyant travel demand from the Chinese and Indian source markets. Specifically, Chinese and Indian arrivals increased by 14 per cent and 13 per cent respectively in the second quarter.

Exhibit 2.9: Visitor Arrivals



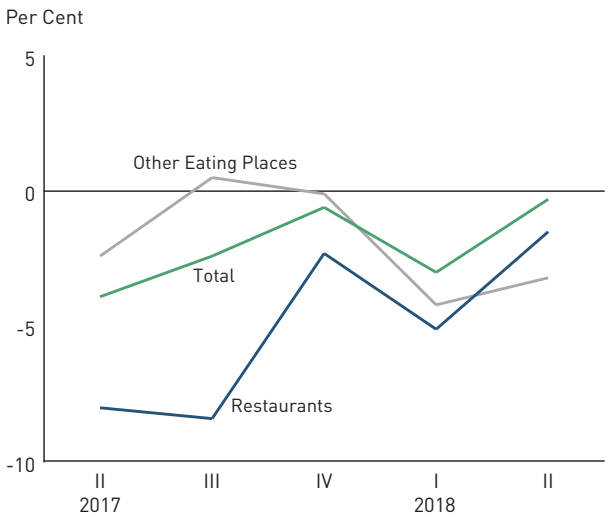
In tandem with the robust growth in visitor arrivals, gross lettings at gazetted hotels improved by 7.7 per cent in the second quarter, better than the 5.7 per cent increase posted in the previous quarter (Exhibit 2.10). The average occupancy rate of gazetted hotels rose by 1.3 percentage-points year-on-year to reach 85 per cent in the second quarter, as the rise in gross lettings outstripped a 6.1 per cent increase in available room-nights over the same period.

Exhibit 2.10: Gross Lettings at Gazetted Hotels



On the other hand, the food services segment remained lacklustre in the second quarter. The overall volume of food & beverage sales dipped by 0.3 per cent during the quarter, although this was an improvement from the 3.0 per cent contraction recorded in the first quarter (Exhibit 2.11). The weak performance of restaurants and other eating places weighed on the segment's growth over the period. Specifically, sales volumes at restaurants and other eating places fell by 1.5 per cent and 3.2 per cent respectively in the second quarter. By contrast, the sales volumes at fast food outlets (8.2 per cent) and food caterers (4.2 per cent) rose, partially offsetting the declines recorded by restaurants and other eating places.

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



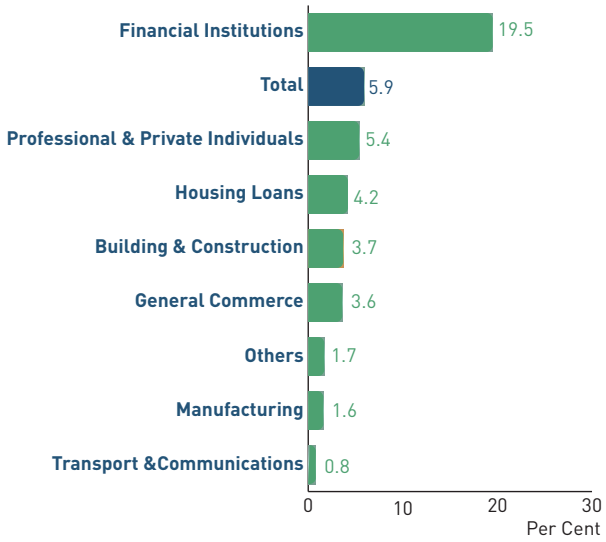
FINANCE & INSURANCE

The finance & insurance sector expanded by 6.7 per cent year-on-year in the second quarter, following the 9.2 per cent growth recorded in the previous quarter.

All segments within the sector expanded. In particular, firm global economic growth generated stronger demand for financial intermediation services. Asian Currency Unit (ACU) non-bank lending rose by 15 per cent in the second quarter, as loan demand from East Asia and the Americas remained robust. Domestic Banking Unit (DBU) non-bank loans also posted healthy growth of 5.9 per cent. Notably, loans to the building & construction segment increased by 3.7 per cent, a turnaround after three consecutive quarters of decline.

Growth in the insurance segment was boosted mainly by robust demand for life insurance products. Meanwhile, the fund management segment saw slower growth, with regional non-traditional players such as hedge funds posting muted returns in the first half of 2018 amidst global trade and political concerns.

Exhibit 2.12: Growth of DBU Loans & Advances to Non-Bank Customers by Industry in 2Q 2018



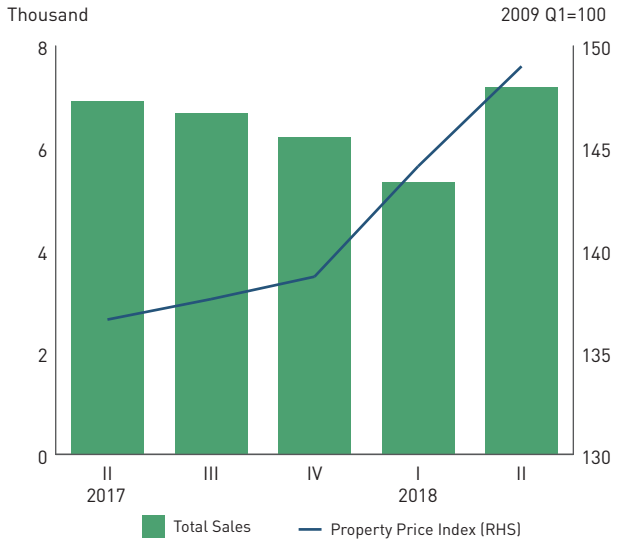
BUSINESS SERVICES

The business services sector grew by 2.1 per cent year-on-year in the second quarter, moderating from the 2.6 per cent growth in the preceding quarter.

Growth of the sector was driven primarily by the others[1] and professional services segments, which expanded on the back of sustained growth in economic activities domestically and in the region.

On the other hand, the real estate segment continued to contract, although there were signs of improvement in the segment as the prices and sales transactions of private residential units continued to improve during the quarter. In particular, private residential property prices rose by 3.4 per cent on a quarter-on-quarter basis in the second quarter, extending the 3.9 per cent increase in the previous quarter. At the same time, the sales transactions of private residential units remained healthy, rising by 4.1 per cent year-on-year in the second quarter, extending the 2.4 per cent increase in the previous quarter (Exhibit 2.13).

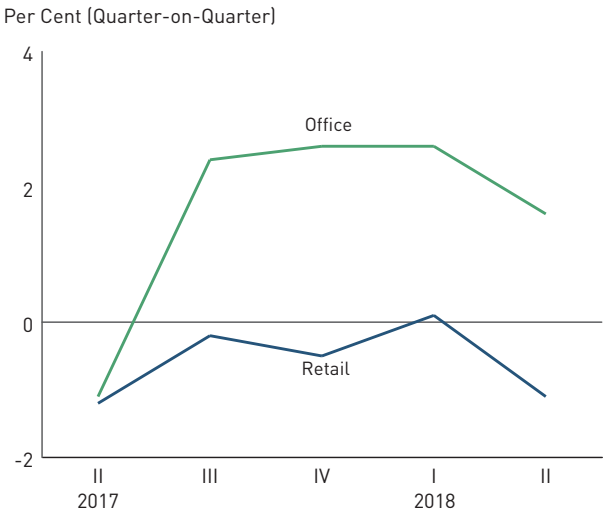
Exhibit 2.13: Total Sales Transactions for Private Residential Units and Private Residential Property Price Index



For the private retail space segment, rentals dropped by 1.1 per cent on a quarter-on-quarter basis in the second quarter, reversing the 0.1 per cent increase in the previous quarter (Exhibit 2.14). However, the average occupancy rate of private retail space remained at 92 per cent, unchanged from the preceding quarter, despite an expansion in the supply of retail space.

On the other hand, the rentals for private office space rose by 1.6 per cent on a quarter-on-quarter basis in the second quarter, marking the fourth consecutive quarter of increase. Reflecting the healthy demand for office space, the average occupancy rate rose from 86 per cent in the first quarter to 87 per cent in the second quarter, as the pickup in demand for office space outstripped the injection of new supply into the market.

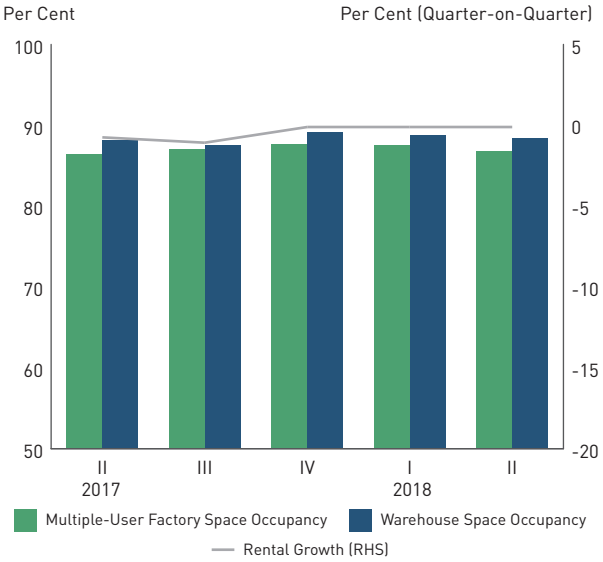
Exhibit 2.14: Changes in Rentals of Private Sector Office and Retail Spaces



As for the private industrial space market, overall rentals fell marginally by 0.1 per cent on a quarter-on-quarter basis in the second quarter, similar to the previous quarter (Exhibit 2.15). The occupancy rates for private sector multiple-user factory space and private sector warehouse space stood at 87 per cent and 88 per cent respectively in the second quarter, both of which were similar to the previous quarter's rates.

1 *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



BOX ARTICLE 2.1

Economic Contribution of Factoryless Goods Producing Firms in Singapore

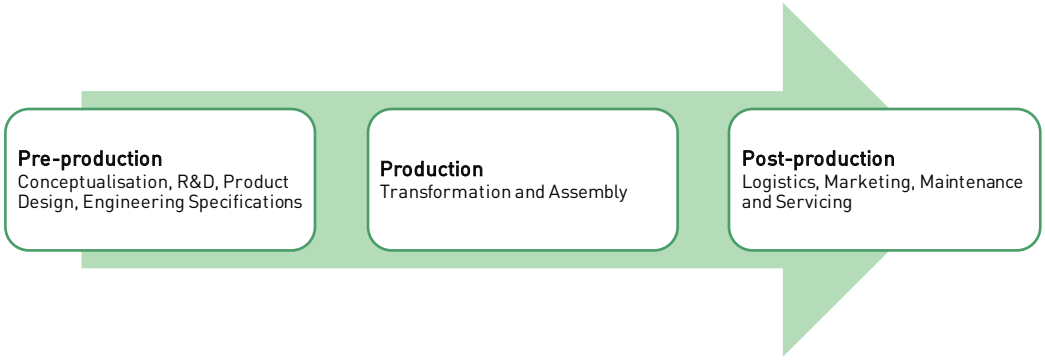
Given their rising global prominence, this article takes an in-depth look at factoryless goods producing firms in Singapore by examining their economic contribution to the Singapore economy.

With the fragmentation of global value chains, firms can participate in different stages of the production value chain

Over the years, production value chains have become fragmented as firms seek to take advantage of the comparative advantages of different locations, and/or to exploit economies of scale by specialising in one or multiple stages of the production process. Today, the different activities in a production value chain can be performed by a single firm or many different firms, and the activities can take place in different locations within a country or across country borders (Bernard and Fort, 2013).

The rise in the prominence of factoryless goods producing firms (FGPFs) globally is a reflection of the fragmentation of production value chains [Exhibit 1]. In this article, FGPFs are defined as firms that perform pre-production activities such as conceptualisation, research & development (R&D), product design and engineering or development of specifications for production in Singapore, but outsource the actual production of the good (i.e., physical production and assembly & testing of the good) to a related firm in another country or to a contract manufacturer in Singapore or another country.[1] A prominent example of FGPFs is the fabless semiconductor firm that engages in the design of semiconductor chips in Singapore, but outsources the production of the chips to a separate firm either within or outside Singapore.

Exhibit 1: Typical Production Value Chain



FGPFs have increased their presence in Singapore over the years

Over the years, FGPFs have increased their presence in Singapore, leveraging on our highly-skilled workforce to carry out knowledge-intensive pre-production activities.

1 *Based on this definition of FGPFs, a firm can be classified as a FGPF in Singapore even though its parent/sister/subsidiary company maybe engaged in production overseas. This definition is comparable to those currently used by national statistical agencies in the U.S.*

FGPFs in Singapore can be found in both the manufacturing and services sectors. According to international statistical convention, the ownership of the material inputs[2] used in the production process determines the ownership of the output produced, which in turn affects the sectoral classification of FGPFs. Specifically, FGPFs are classified as manufacturing FGPFs if they own the material inputs to production and hence, the output produced. On the other hand, FGPFs that do not own the material inputs to production, and thus do not have ownership over the output produced, will be classified under the services sector (e.g., within the wholesale trade or business services sector). Depending on the sector that a particular FGPF is classified under, its economic contribution (e.g., output, value-added and employment) will correspondingly be recorded under that sector.

The rest of this article focuses on the contribution of FGPFs in the manufacturing sector.

Manufacturing FGPFs provide well-paying, skilled job opportunities for local workers

FGPFs in the manufacturing sector contribute significantly to Singapore's economy and provide well-paying jobs for local workers, even though they do not directly undertake production activities and may not contribute to domestic exports in Singapore (see inset below). In particular, in 2016, roughly 78 per cent of the jobs created by manufacturing FGPFs were skilled jobs[3], while the average remuneration per worker for these firms was $117,000. Comparatively, the share of skilled jobs and the average remuneration per worker for the entire manufacturing sector were 69 per cent and $55,000 respectively. Local workers are the main beneficiaries of the good jobs generated by the manufacturing FGPFs as they account for a larger proportion of the workforce in the manufacturing FGPFs.

Apart from providing well-paying and skilled jobs for locals, manufacturing FGPFs are also more productive on a per worker basis as compared to the average manufacturing firm. For instance, the average nominal value-added (VA) per worker of manufacturing FGPFs in 2016 was $1.3 million, far higher than the $182,000 for the overall manufacturing sector.

Inset 1: Relationship between Manufacturing Output and Domestic Exports

As explained above, in line with international statistical classification standards, the economic contribution of manufacturing FGPFs such as their output and VA will be recorded under the manufacturing sector, even though they do not undertake production activities.

In terms of trade statistics, however, changes in the output of manufacturing FGPFs may not lead to a corresponding change in domestic exports (DX) if the FGPFs decide to outsource part or all of their production *overseas* and the manufactured goods are subsequently shipped out from the country of production to the destination market. This may then contribute to a divergence between the performance of manufacturing output and DX.

We have seen this especially in the case of electronics output and electronics DX given the rising prominence of fabless semiconductor firms in the electronics cluster in Singapore.[4] For instance, the production arrangement of fabless semiconductor firms in Singapore's electronics cluster was one of the factors that contributed to the divergence in electronics output and electronics DX in the first half of 2018, with the former rising by 16 per cent year-on-year (yoy) even as electronics DX declined by 7.7 per cent yoy over the same period.[5] There have also been other episodes of divergences where electronics DX rose even as electronics output fell (e.g., between 1Q15 and 3Q15) due to other factors such as a rise in the prices of our electronics products and/or a draw-down of inventories by electronics firms.

2 *Material inputs refer to the raw materials or intermediate goods that are transformed into the final good.*
3 *Skilled jobs refer to positions in the following occupations: professionals, managers, executive and technicians.*
4 *Apart from the presence of FGPFs, such divergences may also be contributed by other factors. First, as electronics DX is measured in nominal terms whereas electronics output is measured in volume terms, a change in the export prices of our electronics products could lead to a divergence between electronics DX and electronics output. Second, a build-up or draw-down of inventories by electronics firms in response to changes in demand conditions could also lead to a divergence between electronics DX and electronics output. See Box 6.1 of the Economic Survey of Singapore 2013 for more details.*
5 *Another contributing factor to the divergence in the first half of 2018 was a fall in the prices of our electronics exports.*

Additionally, manufacturing FGPFs add to the vibrancy of Singapore's manufacturing sector and help to strengthen our innovative capabilities...

In addition, manufacturing FGPFs add to the vibrancy of Singapore's manufacturing sector and play an important role in supporting the growth of other manufacturing firms. For instance, within the electronics cluster, some fabless semiconductor firms that engage in pre-production activities (e.g., R&D and product design) also outsource part of their production to local contract manufacturers, such as local foundries and assembly & testing firms, thereby supporting the growth of these firms.

Furthermore, these manufacturing FGPFs work closely with local contract manufacturers and equipment suppliers to jointly conduct R&D and co-develop production processes. This in turn helps to strengthen the innovative capabilities of Singapore's manufacturing sector.

...as well as anchor related companies that provide a suite of supporting functions in Singapore

Apart from supporting the growth of other manufacturing firms and spurring innovative activities, most FGPFs in Singapore are accompanied by a group of related companies[6] that provide supporting functions, such as logistics, distribution, and marketing & sales, among others. The economic activities of these companies in turn generate even more VA and employment for Singapore beyond that created by the FGPFs themselves.

Conclusion

FGPFs have become a more prominent feature of Singapore's manufacturing ecosystem. These firms engage in pre-production activities such as R&D and product design in Singapore, but outsource the physical production of the goods to a related firm in another country or to a contract manufacturer either in Singapore or overseas.

Despite not carrying out production activities directly, manufacturing FGPFs nonetheless contribute significantly to the Singapore economy and provide well-paying jobs for local workers. Moreover, they add to the vibrancy of Singapore's manufacturing sector and help to spur innovative activity through their partnerships with local contract manufacturers and equipment suppliers. As most manufacturing FGPFs are accompanied by related companies that provide a suite of supporting functions such as logistics and distribution, the economic footprint in terms of VA and employment of the entire group of firms is generally larger than that of the FGPF alone.

Going forward, MTI and EDB will continue to strengthen Singapore's manufacturing base and innovative capabilities by anchoring firms that engage in high-value manufacturing and also production-related services (e.g., R&D and product design) in Singapore. Given their symbiotic relationship, the co-existence of manufacturing and production-related services will allow Singapore to identify new areas of growth at an earlier stage and maintain our competitiveness in the global market.

Contributed by:
Economics Division
Ministry of Trade and Industry

Research and Statistics Unit and Electronics Division
Economic Development Board

6 Related companies refer to subsidiaries, sister or parent companies that belong to the same business group.

Reference

Bernard and Fort (2013), "Factoryless Goods Producers in the US", National Bureau of Economic Research, pp. 1.

CHAPTER 3

ECONOMIC OUTLOOK

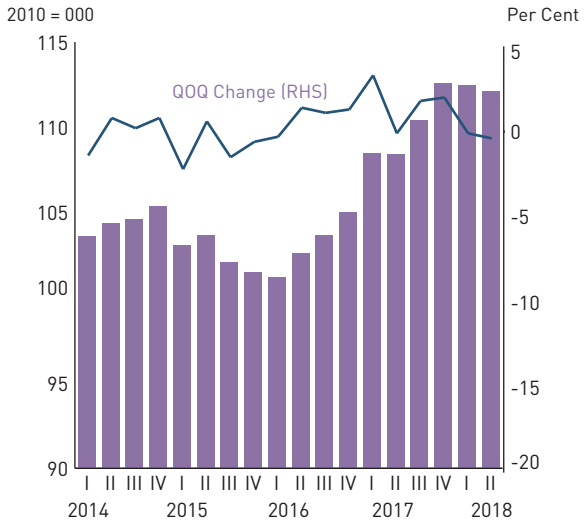
CHAPTER 3
ECONOMIC OUTLOOK

LEADING INDICATORS

On a quarter-on-quarter basis, the composite leading index (CLI) fell by 0.4 per cent in the second quarter, extending the 0.1 per cent decline in the previous quarter (Exhibit 3.1).

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

Exhibit 3.1: Composite Leading Index Levels and Growth Rate



OUTLOOK FOR 2018

Since May 2018, the growth outlook of some of the key advanced economies such as the Eurozone and Japan has weakened slightly, in part due to their weaker-than-expected performance in the first half of 2018. Looking ahead, growth in several of Singapore's key final demand markets is expected to moderate in the second half of the year as compared to the first half of the year.

In the US, following a strong performance in the first half of 2018, GDP growth is expected to ease in the second half of the year. Growth for the rest of the year will continue to be supported by domestic demand. Resilient labour market conditions are likely to support private consumption, while private investment, which has been boosted by the tax reforms implemented at the start of the year, is expected to remain firm. Meanwhile, growth in the Eurozone economy came in weaker than anticipated in the first half of the year, and is likely to remain largely subdued for the rest of the year. Nonetheless, domestic demand is expected to provide some support to growth in the second half of 2018. In particular, labour market conditions are likely to improve further, thereby supporting private consumption, while financing conditions are expected to remain largely accommodative.

In Asia, China's economy expanded at a slower pace in the second quarter as compared to the first quarter. Growth is projected to ease further in the second half of 2018 on the back of a moderation in exports growth as well as investment growth. On the other hand, growth in the key ASEAN economies is expected to remain firm for the rest of the year, supported by sustained improvements in domestic demand as well as merchandise exports.

At the same time, uncertainties and downside risks in the global economy have increased. First, recent tariff measures by the US have led to retaliatory tariffs imposed on the US by China, the European Union (EU) and several of the US' key trading partners. There is a risk of a further escalation of the ongoing trade conflicts that could lead to a vicious cycle of tit-for-tat measures between the US and other major economies. Should this happen, there could be a sharp fall in global business and consumer confidence, and in turn, investment and consumption spending. This could then have an adverse impact on global trade flows and global growth. Second, against the backdrop of generally tightening global financial conditions, an upside surprise in inflation could lead to a faster-than-expected normalisation of monetary policy in the US. This could trigger disorderly capital outflows from emerging market economies in the region, causing financial vulnerabilities in these economies to surface, particularly for those with elevated debt levels. If this occurs, there could be some pullback in investment and consumption growth, with spillover effects on the rest of the region.

Against this external backdrop, the pace of expansion in the Singapore economy is expected to moderate in the second half of 2018, following the strong performance in the first half of the year. Growth will continue to be supported primarily by outward-oriented sectors. In particular, the manufacturing sector is expected to continue to expand, supported in part by the electronics cluster, although growth will moderate from the high levels seen in the first half of the year. Similarly, while outward-oriented services sectors such as finance & insurance, wholesale trade and transportation & storage are projected to remain on an expansionary path, their growth momentum is likely to ease in tandem with the moderation in growth projected for key advanced and regional economies in the second half of the year.

Meanwhile, growth in domestically-oriented services sectors like retail and food services is likely to be supported by a pickup in consumer sentiments amidst improvements in the labour market. Sectors like information & communications and other services are also projected to remain resilient. However, the performance of the construction sector is likely to stay lacklustre for the rest of the year, given the earlier weakness in contracts awarded.

Taking into account the global and domestic economic environment, as well as the performance of the Singapore economy in the first half of the year, the GDP growth forecast for 2018 is maintained at **"2.5 to 3.5 per cent"**.

FEATURE ARTICLE

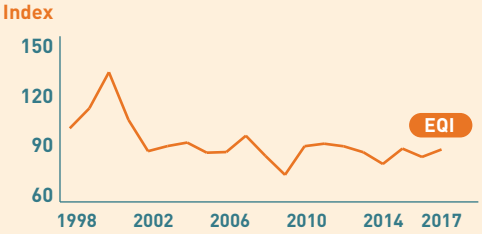
FEATURE ARTICLE

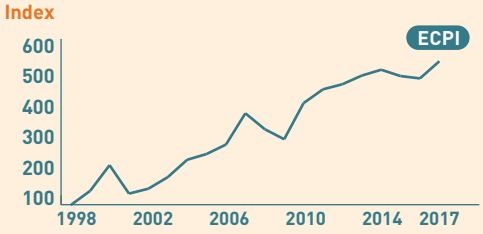
ENTREPRENEURIAL QUALITY AND GROWTH POTENTIAL IN SINGAPORE

INTRODUCTION

Using machine learning techniques, success probabilities of newly founded firms are estimated, using firm specific features like experience and intellectual property ownership. These probabilities are aggregated to create two indices, the Entrepreneurial Quality Index (EQI) and the Entrepreneurial Cohort Potential Index (ECPI), to provide timely measures of entrepreneurial quality and growth potential of new firms in Singapore respectively.

FINDINGS





FINDING 1

The EQI, a measure of the average quality of new firms, rose from 1998 to 2000 alongside the recovery from the Asian Financial Crisis (AFC). Additionally, the pickup in entrepreneurial quality also coincides with the dot-com boom in the late 1990s. Following the peak in 2000, entrepreneurial quality has remained broadly stable from 2001 – 2017.

FINDING 2

On the other hand, the ECPI, a measure of the growth potential of each new firm cohort, rose from 1998 to 2017, largely driven by the continued growth in the number of new firms formed each year.

FINDING 3

Growth in the Entrepreneurial Cohort Potential Index displays a positive correlation with GDP growth

KEY TAKEAWAY

The two new indices, when used in combination with existing statistics on business formation, provide us with a more holistic way to assess the current state of Singapore's entrepreneurial landscape. The strong correlation between GDP growth and the ECPI growth could be due to the positive signal that higher GDP growth conveys to entrepreneurs about the business environment, thereby encouraging more new firms to enter the market; and/or the increase in economic activity arising from the entry of new firms with growth potential.

EXECUTIVE SUMMARY

- This study aims to further our understanding of Singapore's entrepreneurial landscape through the construction of two measures of entrepreneurial quality and growth potential. First, using a dataset containing firm-level characteristics, we apply machine learning techniques to predict the probability that a new firm[1] will succeed, with success defined narrowly as being acquired or obtaining a listing on a public stock exchange. We also examine the characteristics (or features) of the new firms that are associated with success. In this regard, we find that features such as the cumulative number of years of experience that the founders of the new firm had in managing firms they previously founded, the exporting activity of the new firm, and the Intellectual Property (IP) ownership of the new firm are key features associated with success.

- Second, we average the predicted success probabilities of all new firms in a cohort (i.e., the new firms formed in a particular year) to derive the Entrepreneurial Quality Index (EQI) for the cohort. Doing so for every cohort of new firms since 1998, we find that the EQI and hence entrepreneurial quality has remained broadly stable in recent years. By multiplying the EQI of a cohort with the number of new firms in the cohort, we obtain the Entrepreneurial Cohort Potential Index (ECPI), which reflects the growth potential of each cohort of new firms. We find that the ECPI has shown an upward trend over the years, driven largely by an increase in the number of new firms formed every year. This suggests a steady increase in the growth potential of each cohort of new firms entering the market.

- We also find that growth in the ECPI has a positive correlation with GDP growth. This could be due to the positive signal that higher GDP growth conveys to entrepreneurs about the business environment, thereby encouraging more new firms to enter the market; and/or the increase in economic activity arising from the entry of new firms with growth potential.

The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the Ministry of Trade and Industry or the Government of Singapore.[2]

INTRODUCTION

The Global Entrepreneurship Monitor (GEM) report[3] in 2018 notes that the advent of new digital technologies and business models presents opportunities for budding entrepreneurs to start a business. In line with this, we have seen a rise in new firm formation in Singapore. Between 2008 and 2017, the number of new firms in Singapore grew by a robust 5.2 per cent per annum on average, with an average of 34,000 new firms entering the market per annum, more than twice the 14,000 recorded on average from 1998 to 2007. Singapore is also home to 4 out of 8 unicorns[4] in Southeast Asia, namely Sea (formerly known as Garena), Razer, Lazada and Grab.

Given the important role that entrepreneurship plays in contributing to the dynamism of an economy, it is critical for us to assess the state of entrepreneurship in Singapore in a timely manner, so that the Government, industry and other stakeholders are better able to calibrate policies to create an environment that is conducive for innovation and entrepreneurship.

1 *For the purposes of this study, a new firm is considered as an entity that is newly founded/registered in a particular year. Only companies, limited liability partnerships and limited partnerships are analysed in this study.*
2 *We would like to thank Yong Yik Wei and Kuhan Harichandra for their useful suggestions and comments. All remaining errors belong to the authors.*
3 *The GEM is a global survey that evaluates the entrepreneurial landscape of over 100 economies. For each economy, the GEM looks at the entrepreneurial behaviour and attitudes of individuals as well as the national context and how that impacts entrepreneurship.*
4 *Unicorns are high-tech startups valued at more than US$1 billion. The other 4 unicorns are based in Indonesia (3) and Philippines (1).*

While currently available statistics are able to provide a broad sense of Singapore's entrepreneurship landscape, they do not fully capture the quality and growth potential of the new firms formed. For instance, the monthly firm formation statistics reported by the Accounting and Corporate Regulatory Authority (ACRA) do not provide a sense of the growth potential of new firms, while other survey-based statistics such as those reported by the GEM are less timely and also do not track the entrepreneurial quality of new firms.

This study helps to plug the gap by developing measures of entrepreneurial quality and growth potential of new firms in Singapore through the application of machine learning techniques on firm-level data. We begin with a brief overview of the academic literature, followed by a description of the data and methodology used for our study. We then present the results before concluding.

LITERATURE REVIEW

To-date, only a few studies have examined the growth potential of firms and the determinants of their success. For instance, Belenzon et al. (2014) studied the performance of European firms and found that eponymous[5] ventures generated, on average, returns on assets that were 3 percentage-points higher as compared to non-eponymous firms. Azoulay et al. (2018) used firm-level administrative data in the US and found that apart from eponymy, entrepreneurs with prior work experience closer to the specific industry of the startup[6], and founders with longer experience in that industry, had substantially greater success rates, with success defined as the startup receiving venture capital financing or achieving a certain level of sales and employment growth. In addition, Wajsman et al. (2015) studied the impact of Intellectual Property (IP) ownership on firms in Europe, and found that SMEs and non-SMEs that owned IP had revenue per employee that was 32 per cent and 4.0 per cent higher than those that did not own IP respectively.

Our approach in this study is adapted from the approach taken by Guzman and Stern (2016). The authors defined successful startups[7] in the US as those that were acquired or listed on a public stock exchange within 6 years of formation. Using the characteristics of the startups observed at the time of founding (e.g., the industry of the startup, whether the startup is an eponymous startup, whether the startup owned patent or trademarks, etc.), they ran a logistic regression to predict the probability of success of the startups. They found that characteristics such as eponymy and patent application were key predictors of success. In order to obtain measures of entrepreneurial quality and the growth potential of startups, the authors then aggregated the probabilities of success of the startups to form the Entrepreneurial Quality Index (EQI) and the Regional Entrepreneurial Cohort Potential Index (RECPI), with the latter measuring the growth potential of each cohort of startups within a particular geographical region in the US (e.g., state). Using the constructed RECPI, the authors found that it had a better correlation with GDP growth than traditional firm formation statistics.

DATA AND EMPIRICAL METHODOLOGY

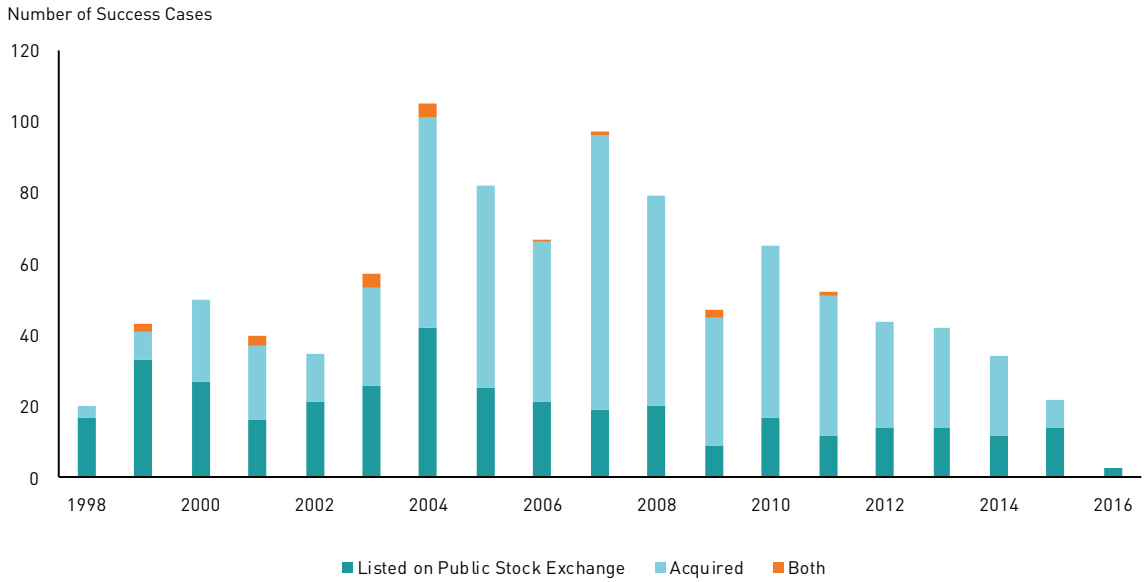
The key dataset used in this study is derived from ACRA's business registry from 1998 to 2017. For each firm, the dataset from ACRA contains information on its characteristics such as the name of the firm, the number of founders associated with the firm, the position holders in the firm, and the industry of the firm. For a more comprehensive dataset, we also merged in datasets containing other pertinent firm-level characteristics such as patent ownership.

Similar to Guzman and Stern (2016), we define a new firm to be successful if it is acquired or obtains an Initial Public Offering (IPO) on a public stock exchange within 6 years from the time of formation.[8] As the ACRA business registry does not include such data, we obtained information on the acquisition and IPO statuses of firms from the Bloomberg and Bureau van Dijk databases, and merged the information into our dataset.[9]

5 *Eponymous firms are firms that are named after their founders.*
6 *Azoulay et al. (2018) defined startups as newly founded firms.*
7 *Similarly, Guzman and Stern (2016) defined startups as newly founded firms.*
8 *While there are other measures of a firm's success (e.g., performance-based measures such as revenue and profit growth, and other market-based measures such as receipt of venture capital funding and market valuation), acquisitions or listing on a public stock exchange are two of the most direct indicators of success and represent the market's endorsement of the firm's operations.*
9 *IPO data from the Bureau van Dijk database was merged into our primary database via the company UEN, while acquisition data from the Bloomberg database was matched via the name of each firm using a fuzzy matching algorithm.*

Based on this narrow definition of success, the data shows that there were a total of 984 success cases in Singapore over the period of 1998 – 2017, out of more than 460,000 new firms formed during the period. Most of these cases were acquisitions between 2004 and 2008 (Exhibit 1).

Exhibit 1: Success Cases of New Firms by Type, 1998 – 2016



Notes:
1. "Both" refer to new firms that were acquired and subsequently listed on a public stock exchange.
2. There were no recorded success cases for new firms founded in 2017 due to the short runway.

Next, we select and engineer features from our dataset that can help to predict a new firm's probability of success. In addition to considering firm-specific features proposed by Guzman and Stern (2016) such as a firm's name and industry, we expand our feature list to include other firm-specific features such as a firm's exporting activity as well as founder-specific features (e.g., the cumulative number of years of experience of founders in managing firms they previously founded). The key features included in our analysis are listed in Exhibit 2. For example, to obtain features like the cumulative number of years of experience of the founders, we sum up the total number of years of experience each member in the founding team of the new firm had spent managing firms they previously founded.

Exhibit 2: Firm- and Founder-Specific Features Considered

Firm-Specific Features	Founder-Specific Features
Industry of new firm*	Cumulative number of previous firms founded by the founders of the firm
Eponymous new firm*	Cumulative number of previous firms founded by the founders of the firm that had failed
Short names (name of new firm has less than 3 words, excluding terms like Private, Limited etc.)*	Cumulative number of years of experience managing firms previously founded by the founders of the firm
Entity type (e.g., company)*	Percentage of foreigners in founding team
Holding company*	
Management size (i.e., how many people are in charge of the firm)	
Domestic exports and re-exports	
IP ownership* (i.e., patents, trademarks, designs)	

Notes:
1. Features with a * refer to dummy variables.
2. Years of experience captures the additional dimension of how much time a founder stays in his/her role, as compared to the number of new firms founded.

Finally, to predict a new firm's probability of success, we employ a range of techniques, ranging from logistic regression model to other machine learning models such as gradient boosted trees, random forest, single-layer neural network and linear discriminant analysis. To evaluate which model best predicts firm success, we examine each model's Area Under Curve (AUC) of the Receiver Operator Characteristic (ROC) curve, and select the model with the highest AUC.[10,11] We then use our selected model to generate a success probability for each new firm. In our final step, we aggregate the success probabilities of all new firms formed in a year to construct two economy-wide indices that can yield insights on how Singapore's entrepreneurial landscape has changed over time – the EQI and the Entrepreneurial Cohort Potential Index (ECPI):

- EQI: The EQI is constructed by taking a simple average of the predicted success probabilities of all new firms in each cohort (i.e., the new firms formed in a year). The index provides a measure of the entrepreneurial quality of a given cohort of new firms.

- ECPI: To holistically assess Singapore's entrepreneurial landscape, the ECPI combines both the quality and quantity measures of entrepreneurship. Specifically, the ECPI is obtained by multiplying the EQI of each cohort of new firms with the number of new firms in the cohort, and thus reflects the expected number of successful new firms in each cohort. This measure provides a sense of the growth potential of any given cohort of new firms in Singapore.

We construct the EQI and ECPI for every cohort of new firms between 1998 and 2017.

RESULTS AND DISCUSSION

Model Results and Features that Predict Success

In terms of the model that best predicts a new firm's success, we find that the gradient boosted trees model had the best predictive accuracy (i.e., an AUC of 0.84). In other words, this model was found to be best able to accurately predict successful new firms, even while minimising the number of falsely predicted success cases at the same time.

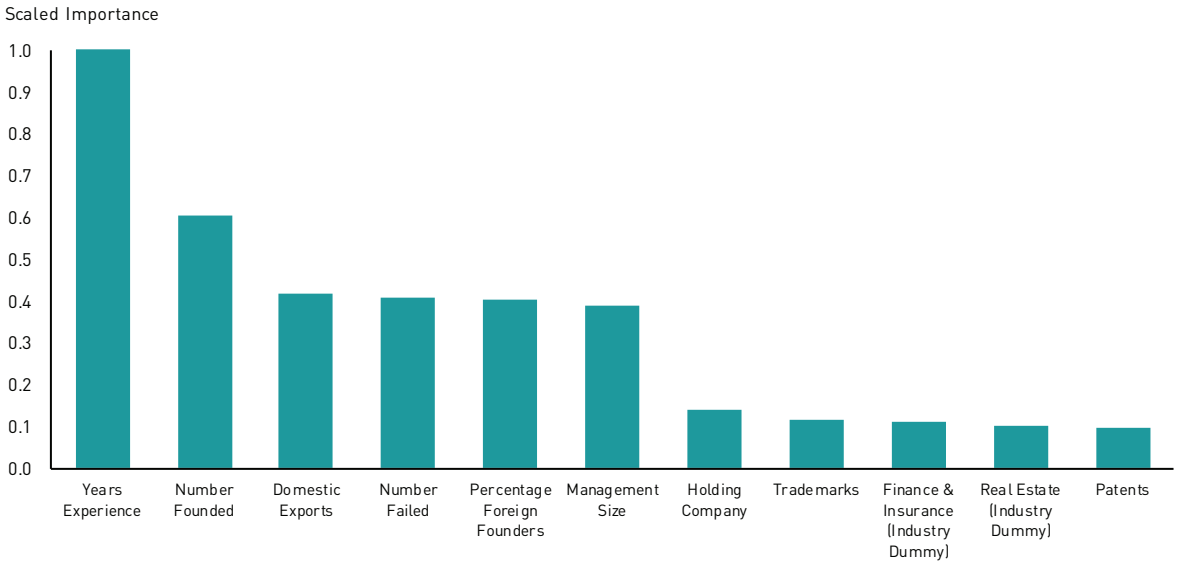
A variable importance[12] plot of the top features that contribute to the predicted probability of success using this model is shown in Exhibit 3. In particular, experience-based founder-specific features, *viz*. the cumulative number of years of experience of the founders of the new firm in managing firms previously founded and the cumulative number of firms previously founded by the founders emerged as the top 2 features. For firm-specific features, we find that a firm's exporting activity and the size of its management team are among some of the more important features that contribute to the likelihood of a new firm's success. The ownership of trademarks and patents is also associated with a higher likelihood of success.

10 To train our machine learning models, we first split the dataset into a training set and a testing set using random stratified sampling. Next, we tune the hyperparameters of each machine learning model using 10-fold cross-validations. Within each model, the combination of hyperparameter values that give the highest AUC under the ROC curve will be chosen.

11 The ROC curve is a tool to evaluate the predictive accuracy of machine learning models. The curve plots the true positive rate (i.e., the percentage of new firms that are correctly identified as being successful) against the false positive rate (i.e., the percentage of new firms that are incorrectly identified as being successful) of each model. A model with high predictive accuracy will exhibit a high true positive rate while maintaining a low false positive rate at the same time. This predictive accuracy is calculated using the AUC of each model. An AUC closer to 1 signifies high predictive accuracy, while an AUC closer to 0.5 signifies low predictive accuracy.

12 Variable importance represents the statistical significance of each feature in the data with respect to its effect on the prediction. The higher the scaled importance, the higher the importance of the feature in generating the prediction of success.

Exhibit 3: Variable Importance Plot



As the variable importance plot does not provide insights on how changes in the magnitude of each feature changes the probability of success, we also plot Partial Dependence Plots (PDPs)[13] for some of the key features derived from the variable importance plot (Exhibit 4A and 4B).

Exhibit 4A: PDP for Cumulative Years of Experience Managing Previously-Founded Firms

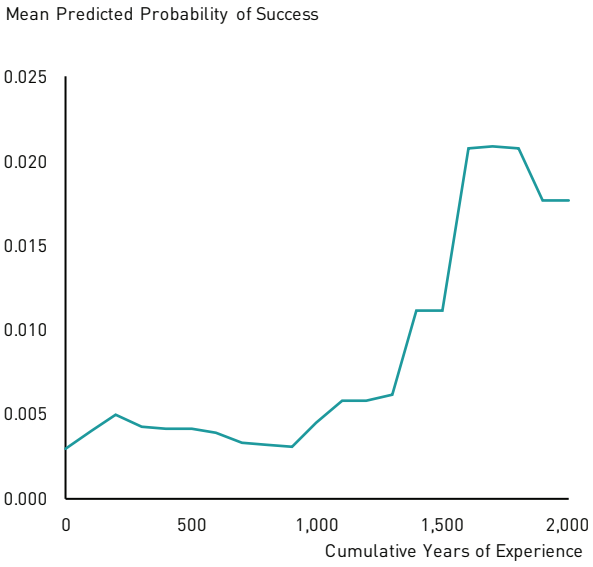
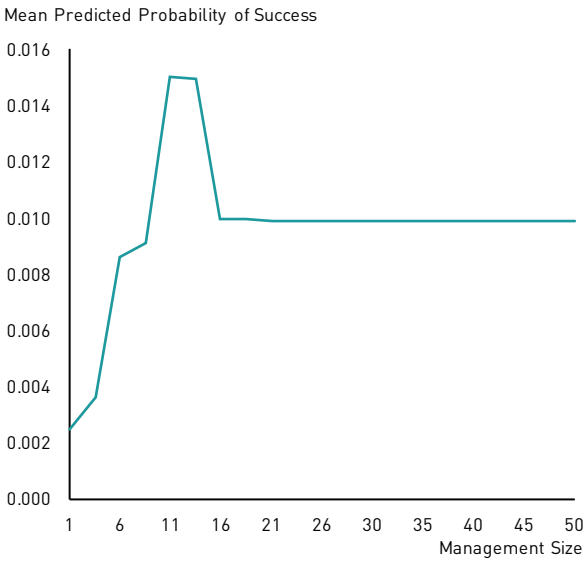


Exhibit 4B: PDP for Management Size



Based on the PDPs, a few salient observations can be made. First, in line with the results in the literature, more experience, as represented by a higher cumulative number of years of experience that founders had in managing previously-founded firms, led to higher predictions of success. Second, a larger management team improves the predicted probability of success, but only up to a certain point. This is similarly in line with the findings in the literature.

13 *PDPs give a sense of the marginal effect of each feature on the prediction of success. In other words, it plots how changes in the value of the feature (x-axis) changes the mean prediction of success (y-axis), holding the values of the rest of the features constant.*

Trends in EQI and ECPI

Exhibits 5A and 5B show the resulting EQI and ECPI for Singapore over the period of 1998 to 2017.[14] Based on the EQI, entrepreneurial quality rose from 1998 to 2000 alongside the economy's recovery from the 1997 Asian Financial Crisis and the dot-com boom in the late 1990s. After peaking in 2000, entrepreneurial quality has remained broadly stable from 2001 – 2017, apart from a dip in 2009 during the Global Financial Crisis.

Driven by an increase in the number of new firms formed each year, the ECPI exhibits an upward trend over the period of 1998 – 2017. This reflects a steady increase in the growth potential of each cohort of new firms formed over the years. The rise in the ECPI coincides with an increase in the funding for, and interest in, entrepreneurship over the years. For example, Government initiatives such as the expansion of Block 71 into LaunchPad @ One-North, as well as the roll out of startup-focused grants such as the Startup SG Tech[15] may have encouraged more individuals to embark on new ventures.

Exhibit 5A: EQI, 1998 – 2017

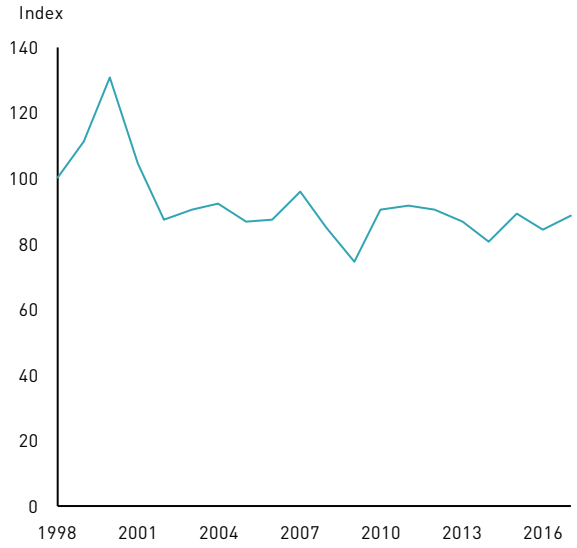
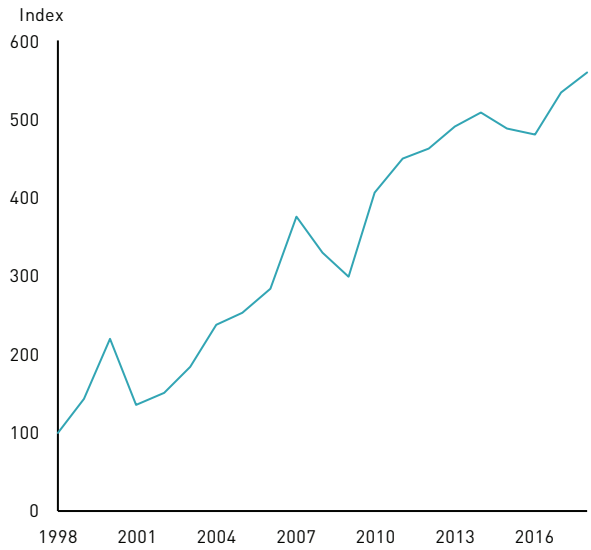


Exhibit 5B: ECPI, 1998 – 2017

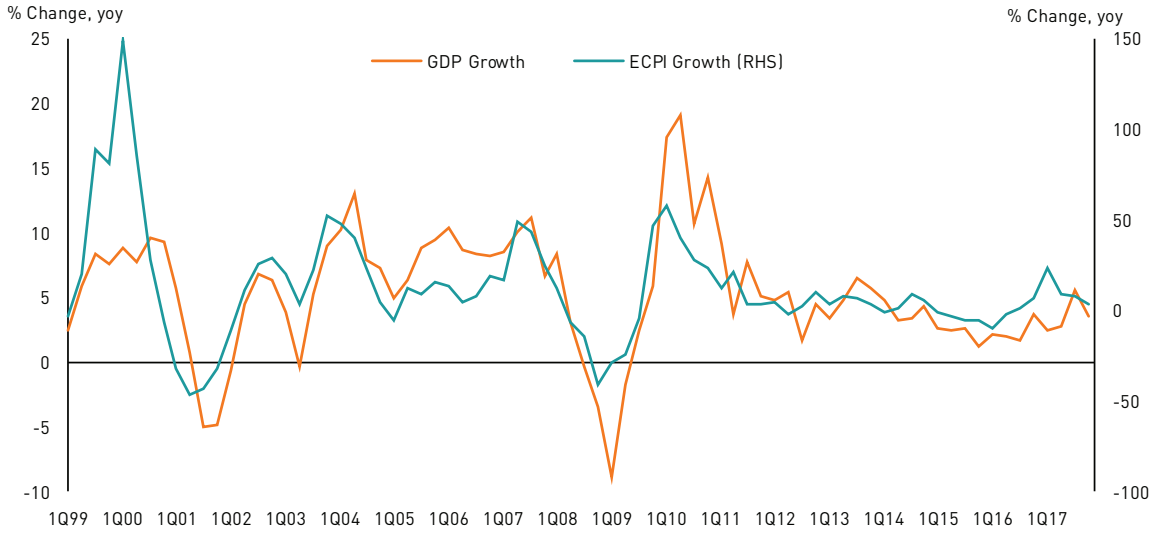


We also find that the ECPI tracks economic growth, with ECPI growth exhibiting a positive correlation with GDP growth (0.63) over the 1999 – 2017 period (Exhibit 6). There could be two possible reasons for this. The first is the signal that GDP growth conveys to entrepreneurs. Specifically, higher GDP growth is likely to be seen as a sign that the economic environment is conducive for business activity, which may then encourage more firms to enter the market. Conversely, when GDP growth is negative or low, firms are deterred from entering the market. This reason is corroborated by the GEM report for Singapore (GEM, 2014), which found that perceived opportunities to start a business in the next 6 months had a positive and significant correlation with both entrepreneurial intent and startup experience. The second possible reason is that an increase in the number of new firms with growth potential entering the market is beneficial for economic activity, in turn resulting in higher GDP growth.

The above finding thus suggests that it is important to keep our macroeconomic environment healthy in order to foster a thriving entrepreneurial landscape. It also suggests that the Government should continue to ensure that our startup landscape remains vibrant. Indeed, the Government is committed to doing so in collaboration with ecosystem partners from the industry and research institutions. In particular, entrepreneurs as well as investors looking to invest in startups may tap on the wide range of financial and non-financial support from schemes under Enterprise Singapore's StartupSG umbrella and our ecosystem partners.[16]

14 EQI and ECPI were constructed based on predictions from a model that only utilised data that was available at the point of firm formation to ensure the timeliness of the indices.
15 The Startup SG Tech scheme implemented by Enterprise Singapore Group (ESG) provides early funding to help startups commercialise their proprietary technology products and services.
16 StartupSG was launched in 2017, with the goal of unifying and streamlining startup support schemes. The different startup schemes target different stakeholders within the startup ecosystem. For instance, StartupSG Founder is focused on first-time entrepreneurs, while Startup SG Investor supports investors looking to invest in startups.

Exhibit 6: ECPI and GDP Growth, 1Q99 – 4Q17



CONCLUSION

This study has furthered our understanding of Singapore's entrepreneurial landscape through the construction of two new measures – the EQI and ECPI. To construct these measures, we use firms' characteristics as inputs to our machine learning model in order to predict their probability of success. We find that experience-based features such as the cumulative number of years of experience that the founders of a new firm had in managing previously-founded firms are key features associated with a higher probability of success.

Averaging the predicted probabilities of success of new firms entering the market every year, we construct the EQI as a proxy for entrepreneurial quality. We find that the EQI and hence entrepreneurial quality has remained broadly stable in recent years, notwithstanding an increase in the number of new firms formed annually over the years. Driven by the increase in the number of new firms formed every year, the ECPI has shown an uptrend over the years, suggesting that the growth potential of each cohort of new firms has increased over the years.

Last but not least, we find that ECPI growth is positively correlated with GDP growth. This could be due to the positive signal that higher GDP growth conveys to entrepreneurs about the business environment, thereby encouraging more new firms to enter the market; and/or the increase in economic activity arising from the entry of new firms with growth potential. This suggests the importance of keeping the macroeconomic environment healthy in order to foster a thriving entrepreneurial landscape, and also the importance of ensuring that our startup landscape remains vibrant.

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ISSN 2382-6541