Economic Survey of **SINGAPORE** SECOND QUARTER 2015



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Ministry of Trade and Industry Republic of Singapore

website: **www.mti.gov.sg** email: **mti_email@mti.gov.sg**

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MAIN INDICATORS OF THE SINGAPORE ECONOMY



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CHAPTER 1 THE SINGAPORE ECONOMY





OVERVIEW

In the second quarter of 2015,

- The economy expanded by 1.8 per cent compared to the same period last year, led by growth in the wholesale & retail trade and finance & insurance sectors.
- After contracting last quarter (-6,100), overall employment rose by 15,700 in the second quarter, supported by an increase in employment in the construction and services sectors. However, taken as a whole, employment growth in the first half of the year moderated compared to the same period a year ago.
- The labour market remained tight as overall unemployment stayed low in the second quarter, despite a marginal increase over the quarter. The number of redundancies fell for the second consecutive quarter, while overall hiring expectations remained positive.
- The Consumer Price Index (CPI) declined by 0.4 per cent compared to the same period a year ago.

OVERALL PERFORMANCE

The economy expanded by 1.8 per cent in the second quarter, slower than the 2.8 per cent growth in the first quarter (Exhibit 1.1). On a quarter-on-quarter seasonally-adjusted annualised basis, the economy contracted by 4.0 per cent, a reversal from the 4.1 per cent growth in the previous quarter.



Exhibit 1.1: GDP and Sectoral Growth Rates in 2Q 2015

Among the key sectors of the economy, the manufacturing sector recorded the weakest performance, contracting by 4.9 per cent, extending the 2.4 per cent decline in the previous quarter. The sector was primarily weighed down by declines in the output of the biomedical manufacturing and transport engineering clusters.

The services producing industries performed better, with all sectors except the accommodation & food services and transportation & storage sectors registering expansions. The finance & insurance sector posted the strongest growth of 7.1 per cent, followed by the wholesale & retail trade (5.0 per cent) and information & communications (4.5 per cent) sectors. By contrast, the transportation & storage sector contracted by 0.9 per cent, weighed down by a decline in sea cargo handled. The accommodation & food services sector also turned in a weak performance, contracting by 0.6 per cent, due to sluggish performance in the food services segment. Meanwhile, the construction sector grew by 2.5 per cent, an improvement over the 1.1 per cent growth in the first quarter.

The sectors that contributed the most to economic growth in the second quarter were the wholesale & retail trade and finance & insurance sectors (Exhibit 1.2). Together, they accounted for about 94 per cent of overall economic growth.



Exhibit 1.2: Percentage-Point Contribution to Growth in Real GDP in 2Q 2015 (By Industry)

SOURCES OF GROWTH

Total demand fell by 0.2 per cent in the second quarter, reversing the 0.4 per cent growth in the previous quarter (Exhibit 1.3). The contraction was due to domestic demand, which fell by 2.2 per cent, extending the 9.0 per cent decline in the first quarter. While external demand continued to expand, its rate of expansion slowed significantly from 3.9 per cent in the first quarter to 0.6 per cent.

Domestic demand was weighed down by changes in inventories, which fell by 3.9 per cent after the 8.0 per cent contraction in the previous quarter. In comparison, consumption expenditure rose by 3.0 per cent, following the 3.6 per cent expansion in the previous quarter. Private consumption was the key contributor to the expansion in consumption expenditure.

Growth in gross fixed capital formation rebounded to 4.1 per cent, from the 1.0 per cent decline in the previous quarter. The expansion was mainly due to the 12 per cent surge in public investments, a sharp reversal from the 5.0 per cent decline in the previous quarter. Private investments also provided support to growth, expanding by 2.3 per cent compared to the 0.2 per cent increase in the previous quarter.

Exhibit 1.3: Changes in Total Demand*

					Per Cent
		2014	2	015	
	11	Ш	IV	I	Ш
Total Demand	2.4	-0.9	0.4	0.4	-0.2
External Demand	2.0	-0.3	0.2	3.9	0.6
Total Domestic Demand	3.3	-2.6	0.8	-9.0	-2.2
Consumption Expenditure	4.9	1.5	2.4	3.6	3.0
Public	13.6	-0.2	3.3	4.6	-0.4
Private	3.1	1.9	2.2	3.3	3.8
Gross Fixed Capital Formation	-2.4	-5.6	1.2	-1.0	4.1
Changes in Inventories	1.0	-1.0	-0.8	-8.0	-3.9

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

LABOUR MARKET

Employment¹

Overall employment rose by 15,700 on a quarter-onquarter basis in the second quarter, after contracting by 6,100 in the previous quarter. However, this was a slower rate of increase as compared to the employment gains seen in the second quarter of 2014 (27,700) (Exhibit 1.4).

The increase in employment in the second quarter brought the total number of employed persons in June 2015 to 3,633,500, 2.4 per cent higher than a year ago. The rate of increase over the year was slower compared to that recorded in March 2015 (2.7 per cent).

At the sectoral level, employment in the services and construction sectors expanded on a quarteron-quarter basis in the second quarter, while manufacturing employment contracted.



Exhibit 1.4: Changes in Total Employment, Quarter-on-quarter Basis

Services employment rose by 11,400 in the second quarter, higher than the previous quarter's increase (4,300) but lower compared to the gains a year ago (25,200). While most services industries saw employment gains, employment in the wholesale & retail trade sector and the real estate segment of the business services sector contracted significantly (Exhibit 1.5). Employment in the wholesale & retail trade sector fell due to weaker re-exports, as well as sluggish retail sales (excluding motor vehicles) stemming in part from the weakness in visitor arrivals. As for the real estate segment, employment was adversely affected by the sluggish property market.

Exhibit 1.5: Changes in Employment by Industry in 20 2015, Quarter-on-quarter Basis



Construction employment grew by 7,800, reversing the decline (-3,600) in the previous quarter. Employment growth in the sector was supported by the expansion in public sector construction activities.

Meanwhile, employment in the manufacturing sector contracted at a slower pace (-3,500) in the second quarter compared to the preceding quarter (-6,900), although this was still faster than a year ago (-2,100). This decline can be attributed to the overall weak performance of the manufacturing sector. In particular, employment in the marine & offshore engineering segment was affected by the weak demand for oil rigs amidst lower oil prices.

Unemployment, Redundancy², and Hiring Expectations

While employment gains in the second quarter moderated compared to the same period last year, various labour market indicators suggest that the labour market remained tight.

<u>First</u>, even though the overall unemployment rate saw a slight uptick from March (1.8 per cent) to June (2.0 per cent), it remained low, unchanged from the unemployment rate a year ago in June 2014 (Exhibit 1.6). The resident and citizen unemployment rates both rose by 0.3 percentage-points over the quarter, from 2.5 per cent in March to 2.8 per cent in June for residents, and from 2.6 to 2.9 per cent for citizens.



Exhibit 1.6: Unemployment Rate (Seasonally Adjusted)

² Figures pertain to private sector establishments each with at least 25 employees and the public sector.

An estimated 84,700 residents, including 75,200 Singapore citizens, were unemployed in June 2015. The seasonally-adjusted figures were 62,900 for residents and 56,100 for citizens.

Second, fewer workers were made redundant in the second guarter of 2015 (3,100) compared to the preceding quarter (3,500). However, redundancy levels were still on the whole higher than that seen in the second quarter of 2014 (2,410) (Exhibit 1.7).

Exhibit 1.7: Total Redundancies



Across broad sectors, the construction sector registered the largest guarter-on-guarter decline in redundancies, from 610 to 300. Layoffs in the manufacturing sector also decreased from 950 to 800, whereas layoffs in the services sector increased slightly from 1,930 to 2,000 over the guarter.

Third, hiring expectations for the next quarter were generally positive.

For the services sector, a net weighted balance of 8 per cent of firms expected an increase in hiring in the third guarter of 2015 over the preceding guarter. Hiring expectations were especially strong in the finance & insurance, retail trade and food & beverage sectors, with a net weighted balance of 25 per cent, 25 per cent and 16 per cent of firms in these sectors expecting an increase in hiring respectively.

For the manufacturing sector, a net weighted balance of 4 per cent of firms in the sector expected to hire more workers in the third guarter, as compared to the second quarter. While the transport and precision engineering clusters planned to reduce headcount, the electronics, biomedical manufacturing and general manufacturing clusters expected to increase employment in the three months ahead. In particular, a net weighted balance of 25 per cent of electronics firms expected to increase hiring in the third quarter.

In summary, employment expanded in the second quarter of 2015, albeit at a slower pace compared to the same period last year. The labour market also remained tight, with unemployment rates remaining low and hiring expectations generally positive for the next three months.

COMPETITIVENESS

Productivity

Labour productivity declined by 0.6 per cent in the second quarter on a year-on-year basis, following the decline of 0.3 per cent in the first quarter (Exhibit 1.8).

Sectors that registered the strongest productivity growth in the second guarter were the wholesale & retail trade (3.3 per cent), finance & insurance (3.1 per cent) and construction (0.8 per cent) sectors. By contrast, sectors that saw the sharpest declines in productivity were the accommodation & food services (-3.9 per cent), transportation & storage (-3.4 per cent), and business services (-3.1 per cent) sectors.

Exhibit 1.8: Change in Labour Productivity for the Overall Economy and Sectors in 2Q 2015



Export-oriented sectors as a whole achieved higher productivity growth than domestically-oriented sectors. Compared to the same period last year, the productivity of export-oriented sectors is estimated to have increased by 0.5 to 1.0 per cent in the second quarter, while that of domestically-oriented sectors is estimated to have declined by 1.0 to 1.5 per cent.³

Unit Labour Cost and Unit Business Cost

Overall unit labour costs (ULC) for the economy rose by 5.4 per cent in the second quarter compared to the same period a year ago (Exhibit 1.9). This was faster than the 5.0 per cent increase in the preceding quarter. Overall ULC rose at a faster pace as labour costs continued to increase, amidst a decline in productivity.

Manufacturing ULC rose by 8.9 per cent in the second guarter, higher than the 6.1 per cent increase a guarter ago. The increase in manufacturing ULC can be attributed to the decline in productivity for the sector, even as labour costs continued to rise.

Exhibit 1.9: Changes in Unit Labour Cost



Unit business costs (UBC) in the manufacturing sector rose by 2.2 per cent in the second quarter, higher than the 0.3 per cent in the previous quarter (Exhibit 1.10).

The increase in manufacturing UBC was mainly driven by the faster pace of increase in the manufacturing ULC as well as a rise in services costs.

Exhibit 1.10: Changes in Unit Business Cost for Manufacturing



Investment Commitments

Investment commitments in terms of total fixed asset investments (FAI) and total business expenditure (TBE) amounted to \$3.1 billion and \$0.8 billion respectively in the second quarter (Exhibit 1.11 and Exhibit 1.12).

In terms of FAI, the largest contribution came from the chemicals cluster, which garnered \$2.1 billion in commitments, mainly from the petrochemicals segment. This was followed by the information communications & media cluster, which attracted \$0.3 billion in commitments. Investors from the United States were the biggest foreign contributor to FAI, accounting for \$2.5 billion (82 per cent) of total FAI commitments.

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



³ Based on MTI estimates. Export-oriented sectors refer to manufacturing, wholesale trade, transportation & storage, accommodation and finance & insurance. Domestically-oriented sectors refer to construction, retail trade, food & beverage services, information & communications, business services and other services industries.

In terms of TBE, the headquarters & professional services cluster attracted the highest amount of commitments, at \$422 million, followed by the chemicals cluster with \$138 million. Similarly, investors from the United Sates were the largest foreign source of TBE, accounting for \$250 million (31 per cent) of total TBE commitments.



Exhibit 1.12: Total Business Spending by Industry Cluster in 20 2015

When fully realised, these commitments are expected to generate value-added of \$1.3 billion and more than 2,700 skilled jobs.

PRICES

Consumer Price Index

The CPI fell by 0.4 per cent on a year-on-year basis in the second quarter, following the 0.3 per cent decline in the previous quarter (Exhibit 1.13). On a quarteron-quarter seasonally-adjusted basis, the CPI fell by 0.2 per cent, extending the 0.1 per cent decline in the preceding quarter.

Food was the largest positive contributor to CPI inflation in the second quarter, with prices rising by 1.9 per cent on a year-on-year basis (Exhibit 1.14). This was due to price increases for hawker food and restaurant meals, as well as non-cooked food items such as bread & cereals, fish & seafood, milk & eggs and meat.

Exhibit 1.13: Changes in CPI



Education costs rose by 3.1 per cent due to higher fees at commercial institutions, universities, polytechnics, childcare centres, kindergartens and playgroups, which more than offset the impact of the waiver of national examination fees for Singaporeans. Communication costs rose by 1.0 per cent because of the higher costs of telecommunication services, particularly mobile phone services. Transport costs edged up marginally by 0.1 per cent, as higher prices of cars, motorcycles & scooters as well as higher bus & train fares more than offset lower petrol prices and air fares.

However, the price gains registered in these CPI categories were outweighed by price declines in the other categories. In particular, housing & utilities posed the largest drag on headline inflation, with prices declining by 3.8 per cent on the back of a fall in accommodation costs and electricity tariffs, which more than offset higher housing maintenance charges and refuse collection fees. The prices of household durables & services fell by 0.7 per cent due to the reduction in concessionary levies on foreign domestic workers, which more than offset the higher salaries paid to these workers. Similarly, clothing & footwear costs fell by 0.6 per cent on account of cheaper ready-made garments.

Healthcare costs dipped by 0.3 per cent as the prices of outpatient services fell by more than the increase in the prices of hospital services. The prices of miscellaneous goods & services fell by 0.3 per cent because of lower prices of personal care and personal effects items. Recreation & culture costs also inched down by 0.1 per cent due to lower costs of holiday travel.



Exhibit 1.14: Percentage-point Contribution to Change in Overall CPI in 2Q 2015

INTERNATIONAL TRADE

Merchandise Trade

Singapore's total merchandise trade contracted by 11 per cent in the second quarter compared to the same period a year ago, extending the 11 per cent decline in the preceding quarter (Exhibit 1.15). This was mainly due to a 34 per cent drop in oil merchandise trade.

Total merchandise exports declined by 8.5 per cent in the second quarter, following the 5.4 per cent contraction in the preceding quarter. This marked the fourth consecutive quarter of decline and was caused by the 12 per cent and 5.0 per cent drop in domestic exports and re-exports respectively.

The fall in domestic exports was due to continued weakness in oil domestic exports, even as non-oil domestic exports (NODX) continued to increase. In particular, oil domestic exports declined sharply by 31 per cent in the second quarter, as low oil prices continued to depress the nominal value of oil exports. In volume terms, oil domestic exports rose by 2.7 per cent.

On the other hand, NODX posted its fourth consecutive quarter of expansion, increasing by 2.1 per cent in the second quarter. The increase in NODX was due to expansions in both electronic and non-electronic NODX. Exhibit 1.15: Growth Rates of Total Merchandise Trade, Merchandise Exports and Merchandise Imports (In Nominal Terms)

						Per Cent
		2	014		20	015
	Ш	Ш	IV	Ann	I.	П
Merchandise Trade	2.9	-3.5	-4.8	0.3	-10.5	-10.6
Merchandise Exports	2.7	-1.4	-3.8	1.1	-5.4	-8.5
Domestic Exports	3.2	-0.7	-6.6	-0.3	-11.5	-11.6
Oil	14.4	-3.3	-17.7	0.5	-34.7	-31.3
Non-Oil	-3.4	1.1	0.5	-0.7	4.8	2.1
Re-Exports	2.3	-2.3	-0.6	2.6	1.5	-5.0
Merchandise Imports	3.0	-5.7	-6.0	-0.6	-16.1	-12.9
Oil	5.6	-5.5	-18.0	-1.7	-44.2	-34.7
Non-Oil	1.8	-5.8	-0.6	-0.1	-2.0	-2.7

Total merchandise imports declined by 13 per cent in the second quarter, mainly due to the decline in oil imports. Oil imports decreased by 35 per cent as the weakness in oil prices depressed the nominal value of oil imports. In volume terms, oil imports increased by 2.4 per cent. Non-oil imports fell by 2.7 per cent in the second quarter, driven by declines in both electronic and non-electronic imports.

Services Trade

Total services trade expanded by 2.4 per cent in the second quarter, faster than the 0.6 per cent increase recorded in the first quarter (Exhibit 1.16). Services exports rose by 4.6 per cent, accelerating from the 1.0 per cent growth in the previous quarter. The growth in services exports can be attributed to expansions in financial services, transport services and maintenance & repair services exports. On the other hand, services imports increased marginally by 0.2 per cent, similar to the 0.3 per cent growth in the preceding quarter. Exhibit 1.16 Growth Rates of Total Services Trade, Services Exports and Services Imports (In Nominal Terms)

						Per Cent
		20	14		2	015
-	Ш	Ш	IV	Ann	1	Ш
Total Services Trade	1.6	1.5	-0.3	2.4	0.6	2.4
Services Exports	2.3	3.0	0.8	3.6	1.0	4.6
Services Imports	1.0	0.1	-1.4	1.2	0.3	0.2

BALANCE OF PAYMENTS

The overall balance of payments recorded a surplus of \$2.7 billion in the second quarter, compared to the deficit of \$1.3 billion in the preceding guarter (Exhibit 1.17). The turnaround was due to a smaller capital and financial account deficit. which more than offset the narrowing of the current account surplus.



Exhibit 1.17: Balance of Payments

Current Account

The current account surplus decreased from \$27 billion in the first guarter to \$23 billion in the second quarter. This was largely due to a reduction in the goods surplus. By contrast, the services balance registered a slightly higher surplus, while the primary and secondary income balances remained broadly unchanged.

The \$4.2 billion decline in the goods surplus to \$27 billion in the second guarter was due to the higher imports of goods, which exceeded the increase in exports.

The services balance, meanwhile, registered a surplus of \$0.5 billion in the second quarter, slightly higher than a guarter ago. Net receipts for maintenance & repair services and financial services rose, while net payments for the use of intellectual property declined. These outweighed the increase in net payments for travel and insurance services.

Capital and Financial Account

The deficit in the capital and financial account narrowed to \$19 billion in the second guarter, from \$31 billion in the previous guarter. This was largely caused by a reduction in net outflows from both the portfolio investment and "other investment" accounts.

Net outflows from the portfolio investment account fell by \$4.8 billion to \$12 billion in the second quarter. The reduction was due to domestic deposit-taking corporations intensifying their net disposal of foreign securities, while the domestic non-bank private sector reduced its purchases of securities abroad.

"Other investment" net outflows fell to \$21 billion from \$27 billion in the previous guarter. This reflected lower net outflows from the non-bank private sector, which more than offset increased net outflows from deposit-taking corporations.

BOX ARTICLE 1.1

Trends in Actual Hours Worked and Implications for Labour Productivity

EXECUTIVE SUMMARY

- The measurement of labour productivity is ideally based on real value-added (VA) per hour worked, rather than real VA per worker employed.¹ In this article, we estimate Actual Hours Worked (AHW) – a measure of labour input used internationally for comparisons of hours worked and productivity – for Singapore. We then examine the trends in AHW per worker and VA per AHW in recent years.
- We find that AHW has varied over the last five years, in line with the economic cycle. AHW per worker in the economy rose by 1.5 per cent in 2010, along with the economic recovery. It then declined by 3.6 per cent on a cumulative basis between 2010 and 2014. The decline in AHW per worker over the last four years was observed across all sectors of the economy. We find that the fall in AHW per worker was driven predominantly by a fall in hours worked by full-time local employees. A shift in employment patterns towards a greater reliance on part-time local employees also contributed to this trend.
- We find consequently that growth in labour productivity, as measured by real VA per AHW, has been higher than the growth in real VA per worker at the overall economy level, as well as in each sector in recent years. For the overall economy, real VA per AHW increased at a compounded annual growth rate (CAGR) of **2.9 per cent over 2009 to 2014**, compared to the 2.5 per cent recorded when productivity is measured simply as real VA per worker. It also increased by a compound average of **1.3 per cent over the four years from 2010 to 2014**, higher than the 0.3 per cent per annum for real VA per worker. The higher rate of growth reflects the fall in AHW per worker over this period.

Labour productivity can be measured on a per worker or per hour worked basis...

Internationally, labour productivity, as a measure of how efficiently labour inputs are used to produce a given level of output, is computed either as real value-added (VA) per worker or real VA per hour worked, depending on whether data is available on hours worked. In developed economies like the US, labour productivity is measured in terms of real VA per hour worked.

In Singapore, real VA per worker is the most commonly cited measure of productivity, as VA and employment data are readily available and easy to compute.² However, using hours worked as a measure of labour input better captures the actual amount of work in the economy. This alternative measure becomes more relevant given the entry of more part-time workers in the economy in recent years, and in view of cyclical changes in hours worked by full-time employees.

¹ The International Labour Organisation (ILO) recommends that international comparisons of productivity be based on actual hours worked. ² Employment refers to total employment in the economy, and includes full-time and part-time employees as well as self-employed.

Current measures of hours worked compiled in Singapore are Paid Hours Worked and Usual Hours Worked...

Singapore currently compiles two measures of hours worked, namely Paid Hours Worked (PHW) and Usual Hours Worked (UHW). Exhibit 1 below sets out the definitions and coverage of PHW and UHW. Neither of the measures comprehensively reflects the number of hours worked by the average worker in the economy due to the various gaps in coverage. At present, the PHW series is used to compute real VA per hour worked in Singapore as it captures the hours worked by both local and foreign employees, who form the bulk of the workforce.³

Measure	Definition	Coverage and Source
Paid Hours Worked	Sum of standard and paid overtime hours worked per employee	Covers both local and foreign employees. ⁴ However, self-employed workers are excluded.
		Excludes unpaid overtime work, e.g., by executives and management staff who are normally not paid for working overtime.
		No adjustments are made for annual leave, paid sick leave, etc.
		Data is collected through Ministry of Manpower's (MOM) Labour Market Survey of establishments, and is published on a quarterly basis.
Usual Hours Worked	Number of hours a person usually works in a typical week,	Covers local employees and self-employed, but not foreign employees.
	she is paid for it.	Includes unpaid overtime work.
		No adjustments are made for annual leave, paid sick leave, etc.
		Data is collected through MOM's Labour Force Survey, and is published on an annual basis.

Exhibit 1: Definition and Coverage of Paid Hours Worked and Usual Hours Worked

The International Labour Organisation recommends using Actual Hours Worked as a measure of labour input in the computation of productivity...

However, Actual Hours Worked (AHW) is regarded as the most reflective measure of labour input, with the International Labour Organisation (ILO) recommending its use for international comparisons of hours worked and productivity (Schreyer, 2001). Exhibit 2 sets out the definition and coverage of AHW. Nonetheless, given the comprehensive coverage of AHW, the ILO has also acknowledged that it is a measure that is difficult to obtain or to estimate reliably.

Internationally, countries adopt different approaches to estimate AHW due to differences in underlying data sources and coverage (Fleck, 2009). A brief survey of the methodologies can be found in Annex 1.

³ While the self-employed are not covered in the establishment surveys used to collect the PHW data, it is assumed that they have the same number of PHW as employed workers when calculating VA per PHW.

⁴ Although the PHW data covers both local and foreign employees, the data cannot be split by nationality.

Exhibit 2: Definition and Coverage of Actual Hours Worked							
Measure	Definition	Coverage					
Actual Hours Worked	Number of hours that a person in paid or self-employment spends on work activities.	Includes all hours spent on work activity, including paid or unpaid overtime work; time spent on preparation, repairs and maintenance; all hours spent waiting for reasons such as a lack of work, breakdown of machinery or accidents; time corresponding to short rest periods and breaks. Excludes hours paid but not worked such as paid annual leave, paid public holidays, and paid sick leave; meal breaks; time spent on travel from home to work and vice versa.					

Constructing a proxy for AHW using PHW and UHW data....

Singapore currently does not compile statistics on AHW. As such, we estimate AHW using existing UHW and PHW data [Exhibit 3]. Our AHW estimate uses UHW to measure hours worked by local employees and self-employed, as UHW includes **unpaid** overtime hours on top of paid hours worked and is thus a more comprehensive measure of hours worked. However, as UHW data is only available for local employees and the self-employed, we proxy the hours worked by foreign employees using the PHW of full-time employees.⁵ Lastly, we adjust the data to take into account total paid leave and holidays. Using this approach to estimate AHW is in line with international practices, and provides a better gauge of the hours an average worker in Singapore actually spends on work.

Exhibit 3: Proxy for AHW using PHW and UHW

	Local employees	Foreign employees	Self-employed	Adjustment for leave and holidays
Proxy for AHW	UHW	PHW	UHW	Adjust for public holidays, annual and sick leave based on MOM's Conditions of Employment Survey ⁶

AHW per worker has trended down across all sectors...

Examining the trends over time, we find that AHW per worker in the economy rose by 1.5 per cent in 2010 in tandem with the economic rebound from the global financial crisis, before declining by 3.6 per cent on a cumulative basis from 2010 to 2014. The decline in AHW per worker over the last four years was also observed across all sectors of the economy [Exhibit 4].

⁵ This is done at the industry level, i.e., we use the PHW for full-time employees in a particular industry to proxy for hours worked by foreign employees in the same industry.

⁶ As the survey is conducted once every two years, the figures from the survey are used for that reference year and the previous year. Part-time employees are assumed to take half the amount of leave as full-time employees, while no correction was made for self-employed persons.

Reasons for the Fall in Hours Worked After 2010

We conduct a shift-share analysis to understand the factors affecting the decline in AHW per worker for the overall economy and for each sector, using the following formula:

$$\frac{H_t - H_{t-1}}{H_{t-1}} = \sum_{j=1}^4 \left[\frac{W_{jt-1}}{W_{t-1}} * \frac{H_{jt} - H_{jt-1}}{H_{t-1}} \right] + \sum_{j=1}^4 \left[\left(\frac{W_{jt}}{W_t} - \frac{W_{jt-1}}{W_{t-1}} \right) * \frac{H_{jt-1}}{H_{t-1}} \right] + \varepsilon,$$

where *H* is the average annual hours worked per worker, *W* is the number of workers, ε is the dynamic shift effect, *t* is the time period, *j* refers to four types of workers – part-time local employees, full-time local employees, foreign employees or self-employed.⁷

In summary, under the shift-share analysis, the change in AHW per worker is decomposed into three components:

- <u>Within Effect</u>: the contribution of changes in the hours worked by part-time and full-time local employees, foreign employees and self-employed on the economy/sector's AHW per worker;
- <u>Static Shift Effect</u>: the contribution of changes in the shares of part-time and full-time local employees, foreign employees and self-employed on the economy/sector's AHW per worker; and
- <u>Dynamic Shift Effect</u>: the contribution resulting from changes in both the AHW and the shares of the different types of workers in the economy/sector.

The key observations are as follows [Exhibit 4]:

- At the overall economy level, the decline in AHW per worker (-3.6 per cent) from 2010 to 2014 was primarily due to the within effect. This was in turn driven by a fall in the average number of hours worked by full-time local employees, and could possibly reflect a greater emphasis on leisure time or the impact of a gradual slowdown in the economy in recent years. Another factor contributing to the decline in AHW per worker was the negative static shift effect, which was in turn largely due to an increase in the share of part-time local employees in the economy.
- All key sectors saw a decline in AHW per worker from 2010 to 2014, with the retail trade (8.4 per cent), transportation & storage (6.8 per cent) and food services sectors (5.8 per cent) registering the largest declines. Similar to the case for the overall economy, the within effect (i.e., full-time local employees working less hours on average) was the main factor driving the decline in the AHW per worker in each sector.
- The static shift effect was also negative in all sectors, primarily reflecting an increase in the share of part-time local workers in the sectors. In some sectors (e.g., retail and food services), a decline in the share of self-employed (who tend to work longer hours) also contributed to the negative shift effect for the sectors. The negative static shift effect was particularly strong for the retail trade, food services and transportation & storage sectors, with this effect explaining more than one-third of the decline in the AHW per worker in the respective sectors.

⁷ Full-time workers are defined as workers who worked at least 35 hours a week, while part-time workers are defined as workers who worked less than 35 hours a week.



* Excludes foreign domestic workers

Growth in real VA per AHW outpaces growth in real VA per worker...

Implications for Productivity Growth

Next, we compute real VA per AHW for the entire economy and the various sectors. Exhibit 5 summarises the trends in labour productivity growth for the economy from 2009 to 2014.

We find that labour productivity, measured as real VA per AHW, increased at a compounded annual growth rate (CAGR) of 2.9 per cent from 2009 to 2014, compared to the 2.5 per cent recorded when productivity is measured as real VA per worker. This is consistent with the Economic Strategies Committee's aim of achieving 2-3 per cent productivity growth per annum over the 10 years from 2009, but much of it was due to the strong rebound of 9.9 per cent in 2010 as the economy recovered from the global financial crisis.

Real VA per AHW increased by a CAGR of 1.3 per cent in the subsequent four years from 2010 to 2014, higher than the 0.3 per cent per annum for real VA per worker. The faster growth in real VA per AHW was in turn due to the fall in AHW per worker over the last four years, as described above.

	2010	2011	2012	2013	2014	2009-2014 (CAGR)	2010-2014 (CAGR)
Real VA	15.2	6.2	3.4	4.4	2.9	6.4	4.2
Real VA per AHW	9.9	3.8	-0.2	0.6	0.9	2.9	1.3
Real VA per worker	11.6	2.3	-0.5	0.3	-0.8	2.5	0.3

Exhibit 5: Real VA and Labour Productivity Growth, %

A comparison of the growth in real VA per worker and real VA per AHW by sectors from 2010 to 2014 is shown in Exhibit 6. Again, we find that the growth in real VA per AHW is higher than the growth in real VA per worker in every sector over this period. Notably, the retail trade, transportation & storage and food services sectors saw much higher growth in productivity when productivity is measured as real VA per AHW, in part due to the increase in part-time employment in these sectors.





Source: MTI Estimates

There is scope to improve compilation of AHW data...

Adopting real VA per AHW as a measure of productivity provides a more complete picture of productivity changes in the economy. It takes into account changes in employment patterns, such as the rise in parttime work, as well as cyclical effects on hours worked. Using this new measure, labour productivity growth over the last five years, as well as over the four years from 2010 to 2014, is higher compared to the real VA per worker measure. This is also true for all sectors of the economy from 2010 to 2014.

Going forward, MTI, along with the Department of Statistics (DOS) and MOM, will explore how to improve the compilation of AHW data and work towards publishing the real VA per AHW series on a regular basis.

Contributed by: Kenny Goh, Senior Economist Timothy Lin, Economist Economics Division Ministry of Trade and Industry

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ANNEX 1 – International Comparison of Methodologies to Obtain AHW

Countries adopt different approaches to estimate AHW per worker. Exhibit A1 compares the approaches taken by the United States, Canada, Australia and OECD (for calculations of AHW for South Korea and United Kingdom), with the method adopted for Singapore in this study.

			1		
Country	Source of AHW	Sources of data on total hours worked (by importance)	Hours concept used in source data	Sources of data on employment (by importance)	Methodology used to create average annual AHW per worker
Singapore	MTI Estimates	Labour force survey, establishment survey	UHW, PHW	Administrative data, labour force survey	Use UHW for local employees and self-employed. Peg hours worked for foreign employees to PHW for full-time workers at the sector level. Adjust for paid leave and holidays. Divide total hours by total employment.
United States	Bureau of Labour Statistics	Establishment survey, labour force survey	PHW, AHW	Labour force survey, data on armed forces	Total hours is adjusted to account for sporadic events and interpolated to produce estimates for all weeks in the year. Divide total hours by total employment.
Canada	Statistic Canada	Labour force survey, establishment survey, national accounts	AHW	Labour force survey, establishment survey, national accounts	Total hours is adjusted to account for sporadic events and interpolated to produce estimates for all weeks in the year. Divide total hours by total employment.
Australia	Australian Bureau of Statistics	Labour force survey	AHW	Labour force survey	Estimate total hours worked in a year by linearly interpolating hours worked data collected from labour force surveys and correcting for sporadic events. Divide total hours by total employment.
South Korea	OECD Statistics	Labour force survey, establishment survey	AHW	Labour force survey, establishment survey	Weekly actual hours worked are multiplied by a factor of 52 weeks to obtain annual hours worked before dividing by total employment.
United Kingdom	OECD Statistics	Labour force survey	AHW	Labour force survey	Weekly actual hours worked are multiplied by a factor of 52 weeks to obtain annual hours worked before dividing by total employment.

Exhibit A1: Comparison of Methodologies Adopted to Compute AHW per Worker

Source: Statistics Canada, Australian Bureau of Statistics, OECD Statistics, Fleck (2009)

In general, data collected from establishment surveys tend to produce lower estimates of AHW than data collected from labour force surveys. This is due to firms underreporting hours worked by employees, and respondents from labour force surveys overstating hours worked. In addition, countries adopt different approaches to account for public events and holidays. This includes estimating the time not worked due to the holidays and subtracting it from the total hours worked, as well as other statistical approaches. The differences in sources and methodologies partially explain the differences in AHW when comparing across countries.

More broadly, OECD has noted that there are many problems associated with the accurate measurement of AHW (Schreyer, 2001). Challenges include combining information from different survey sources and measuring the labour input of self-employed persons. Fleck (2009), recognising the variety of approaches, further recommends that only broad comparisons of AHW across countries be made and that the data be analysed as trends instead of levels.



CHAPTER 2 Sectoral Performance



CHAPTER 2 SECTORAL PERFORMANCE





OVERVIEW

In the second guarter of 2015,

- Manufacturing output declined by 4.9 per cent, extending the 2.4 per cent fall in the previous guarter. The biomedical manufacturing cluster posed the largest drag on the sector, contracting by 13 per cent on the back of lower output in the pharmaceuticals segment.
- The construction sector's growth picked up to 2.5 per cent, from 1.1 per cent in the previous guarter. The improvement came on the back of an uptick in public sector construction activities, which was in turn supported by a robust increase in public civil engineering works.
- The wholesale & retail trade sector grew by 5.0 per cent, a slight moderation from the 5.3 per cent expansion in the preceding quarter, in line with a slowdown in trade flows in Singapore.
- Weighed down primarily by the water transport segment, the transportation & storage sector contracted by 0.9 per cent, reversing the 1.4 per cent growth in the previous guarter.
- The accommodation & food services sector declined at a slightly faster pace of 0.6 per cent compared to the 0.1 per cent contraction in the previous guarter, on the back of continued weakness in visitor
- The finance & insurance sector expanded by 7.1 per cent, following the 7.8 per cent growth in the preceding quarter. Growth in the sector was supported by a strong outturn in the sentiment-sensitive
- Growth of the business services sector decelerated to 2.0 per cent, from 3.2 per cent in the previous quarter, weighed down by a slowdown in the real estate segment as well as the professional services

MANUFACTURING

Manufacturing output contracted by 4.9 per cent on a year-on-year basis in the second quarter, extending the contraction of 2.4 per cent in the previous quarter (Exhibit 2.1). The drop in manufacturing output was primarily due to declines in the output of the biomedical manufacturing and transport engineering clusters (Exhibit 2.2). On the other hand, the chemicals and electronics clusters contributed positively to the sector's growth.

Exhibit 2.1: Manufacturing Growth Rates





Exhibit 2.2: Percentage-Point Contribution to Manufacturing Sector's Growth in 20 2015

In the chemicals cluster, output increased by 3.3 per cent in the second quarter, with all segments posting expansions. In particular, growth was driven by the specialty chemicals segment, which expanded by 5.8 per cent on the back of capacity expansions. Growth was also supported by the petroleum segment, which expanded by 3.5 per cent as refineries increased throughput in tandem with improved refining margins.

The **electronics** cluster grew by 0.7 per cent in the second quarter. Growth was supported by expansions in the computer peripherals, data storage and other electronics modules & components segments of 13 per cent, 27 per cent and 47 per cent respectively. On the other hand, the semiconductors segment weighed on growth, contracting by 7.9 per cent. This could be attributed to lacklustre global semiconductor demand due to the softening of the overall PC and mobility devices market.

The **general manufacturing** industries cluster shrank by 3.5 per cent in the second quarter. While output in the food, beverages & tobacco segment expanded by 5.5 per cent, this was more than offset by the 5.1 per cent and 8.1 per cent decline in the output of the printing and miscellaneous industries segments respectively. The weak performance of the miscellaneous industries segment was in turn due to lower construction-related output such as metal doors, windows, grilles & gratings.

The **precision engineering** cluster contracted by 3.8 per cent in the second quarter, with all segments posting declines in output. In particular, the machinery & systems segment shrank by 2.2 per cent, weighed down by a lower volume of mechanical engineering works, as well as lower production of process control equipment and hoisting equipment, lifts & escalators. In addition, the semiconductor equipment manufacturing firms in the segment were affected by softer global demand. Aside from the machinery & systems segment, the precision modules & components segment also contracted by 5.6 per cent on account of a lower production of industrial rubber and fabricated metal products.

The transport engineering cluster's performance remained lacklustre in the second quarter, registering a decline of 11 per cent. Growth was mainly weighed down by the marine & offshore engineering segment, which saw an 11 per cent drop in output as cutbacks in capital expenditure in the oil & gas industry arising from low oil prices continued to place a drag on rig building activities. In addition, the aerospace segment contracted by 13 per cent due to weak demand for engine repair jobs.

Among the manufacturing clusters, the **biomedical** manufacturing cluster recorded the largest contraction of 13 per cent in the second quarter, dragged down by the pharmaceuticals segment. In particular, pharmaceuticals output fell by 19 per cent on the back of a different mix of active pharmaceutical ingredients produced. On the other hand, the medical technology segment posted robust growth of 19 per cent. Growth in the segment was underpinned by higher external demand for medical devices and supplies.

CONSTRUCTION

The construction sector expanded by 2.5 per cent in the second quarter, improving from the 1.1 per cent growth registered in the previous quarter. The pick-up in growth came on the back of a rebound in public sector construction activities, which was in turn supported by a robust expansion in public civil engineering works.

Nominal certified progress payments rose by 1.7 per cent, in contrast to the 3.9 per cent decline recorded in the previous quarter (Exhibit 2.3). This reversal stemmed from a pick-up in public sector construction output. Notably, public certified progress payments increased by 14 per cent, reversing the 5.2 per cent decline in the previous quarter, mainly due to a robust expansion in public civil engineering (37 per cent) works, including land preparation works for Changi Airport. In addition, the private commercial building segment also posted resilient growth of 7.3 per cent, largely because of the construction of larger projects such as Mediapolis@One-North.

By contrast, construction demand in terms of contracts awarded continued to weaken in the second quarter, declining by 34 per cent, following the 13 per cent fall in the previous guarter (Exhibit 2.3). The pullback in demand follows from a slowdown in both public sector (-38 per cent) and private sector (-29 per cent) construction demand. In particular, public sector contracts awarded for civil engineering (-36 per cent), residential building (-63 per cent), and institutional and other building (-49 per cent) developments fell in the second quarter. Similarly, the amount of private sector contracts awarded continued to slide, weighed down by declines in the contracts awarded for industrial building (-39 per cent) and residential building (-33 per cent) developments.

Exhibit 2.3: Changes in Contracts Awarded and Certified Payments

WHOLESALE & RETAIL TRADE

The wholesale & retail trade sector grew by 5.0 per cent, easing from the 5.3 per cent expansion in the preceding quarter.

Growth of the wholesale trade segment moderated in the second quarter in tandem with a slowdown in trade flows in Singapore. In particular, Singapore's non-oil domestic exports (NODX) in volume terms grew by 0.6 per cent in the second quarter, easing from the 3.8 per cent increase in the previous quarter. This was primarily due to slower growth in the domestic exports of integrated circuits and pharmaceuticals (Exhibit 2.4). On the other hand, non-oil re-exports (NORX) in volume terms dipped by 1.7 per cent in the second quarter, reversing the 5.2 per cent expansion in the first quarter. The decline came largely on the back of a weakness in the re-exports of integrated circuits and parts of integrated circuits.





By contrast, growth of the retail trade segment picked up in the second quarter due to strong motor vehicle sales. Following an increase in the supply of Certificate of Entitlements, motor vehicles sales surged by 64 per cent in the second quarter (Exhibit 2.5). Excluding motor vehicles, retail sales volume contracted by 0.8 per cent as discretionary sales fell on the back of continued weakness in tourist arrivals. For instance, the sales of optical goods & books, recreational goods and wearing apparel & footwear shrank by 7.7 per cent, 7.5 per cent and 2.4 per cent respectively.





TRANSPORTATION & STORAGE

The transportation & storage sector contracted by 0.9 per cent in the second quarter, a reversal from the 1.4 per cent growth in the previous quarter.

The slowdown in the transportation & storage sector was mainly attributable to the water transport segment. Specifically, the volume of sea cargo handled declined by 1.7 per cent, retreating from the positive growth of 2.8 per cent reported in the first quarter. This was in turn due to a fall in the volume of container throughput handled (-8.2 per cent) in the second quarter, the first quarterly decline since 2009 (Exhibit 2.6).



Exhibit 2.6: Changes in Container Throughput and Sea Cargo Handled

On the other hand, the number of air passengers handled by Changi Airport rose by 1.6 per cent in the second quarter, an improvement from the 0.7 per cent dip in the preceding quarter (Exhibit 2.7). The uptick in air passenger movements was supported by a recovery in passenger volumes on the Thailand and China routes, which more than offset the decline in air passenger traffic to and from Indonesia. However, total air cargo shipments handled at Changi Airport decreased marginally by 0.3 per cent, reversing the 0.8 per cent growth in the previous guarter.

The number of aircraft landings inched up by 0.5 per cent in the second quarter to reach 42,910, ending three consecutive quarters of contraction.

Exhibit 2.7: Changes in Air Transport



As of June 2015, the total number of vehicles registered with the Land Transport Authority fell marginally by 0.8 per cent to a total of 963,759. These comprised 589,615 private and company cars, 21,949 rental cars, 28,686 taxis, 17,787 buses, 144,332 motorcycles and scooters, and 161,390 goods vehicles and other vehicle types.

Exhibit 2.8: Motor Vehicles Registered



ACCOMMODATION & FOOD SERVICES

Weighed down by weak visitor arrivals to Singapore, the accommodation & food services sector contracted by a faster 0.6 per cent in the second quarter, compared to the 0.1 per cent decline in the previous quarter.

Total visitor arrivals fell by 0.5 per cent in the second quarter on the back of fewer visitors from key markets such as Indonesia, Hong Kong and Australia (Exhibit 2.9). For instance, the Indonesian inbound market remained weak, with Indonesian visitor arrivals declining by 12 per cent. On a positive note, the Chinese market showed signs of recovery, rebounding from a decline of 8.6 per cent in the first quarter to post strong growth of 40 per cent in the second quarter.

Exhibit 2.9: Visitor Arrivals



Lacklustre visitor arrivals, combined with the tight labour market, likely contributed to the 5.5 per cent decline in food & beverage sales volume in the second quarter (Exhibit 2.10). Leading this decline was the restaurant sub-segment, which reported a 9.1 per cent slide in sales volume, larger than the 3.3 per cent fall in the first quarter. On the other hand, the food catering sub-segment recorded growth in sales volume of 1.7 per cent, reversing five consecutive quarters of decline.

Exhibit 2.10: Changes in Food & Beverage Services Index at Constant Prices



The performance of gazetted hotels was also dampened by sluggish visitor arrivals. In particular, the average occupancy rate of hotels dipped by 0.7 percentage-point to reach 83 per cent, the lowest level since the fourth quarter of 2009. Consequently, the revenue per available room in hotels declined by 6.5 per cent to dip below \$200. However, due to an increase in overall room supply which contributed to a fall in average room rate, gross lettings rose at a faster pace of 5.4 per cent, compared to the 2.4 per cent in the previous quarter (Exhibit 2.11).





FINANCE & INSURANCE

Growth of the financial & insurance sector eased to 7.1 per cent in the second quarter, from 7.8 per cent in the preceding quarter.

The moderation in growth was partly due to a weak outturn in the Asian Currency Unit (ACU) segment. Offshore non-bank loan volumes fell by 2.2 per cent in the second quarter, posting its first contraction since the third quarter of 2009. The general slowdown in regional trade recently had affected credit demand from East Asia, particularly for trade financing. On the domestic front, trade bills were also lacklustre. However, the growth of loans extended to the building & construction industry and mortgage lending held firm. As a result, domestic banking unit (DBU) nonbank loan volumes continued to expand, albeit at a slower pace of 1.5 per cent compared to 2.3 per cent in the preceding quarter (Exhibit 2.12).





The sentiment-sensitive cluster turned in a resilient performance. Underpinned by sustained investor interest in the region, the fund management industry continued to register robust growth in net fees and commissions. Furthermore, the local bourse saw three new equity listings, which added S\$412 million to total market capitalisation, after a lull in the first quarter. There were also spurts of trading interest in April, on the back of optimism stemming from the strong showing in the China and Hong Kong bourses. However, the rout in Chinese stock markets and an escalation of the Greek debt crisis dampened sentiments and led to a retreat in the latter half of the quarter.

BUSINESS SERVICES

The business services sector expanded by 2.0 per cent in the second quarter, moderating from the 3.2 per cent growth in the previous quarter. Growth in the sector was dampened by a slowdown in the real estate and professional services segments.

In the real estate segment, growth stalled in the second quarter, as the sales transactions of private residential units remained weak. In particular, private home sales in the second quarter fell for the tenth consecutive quarter, by 2.5 per cent year-on-year, extending the 5.7 per cent decline in the previous quarter. In tandem with weak sales, private residential property prices declined by 3.7 per cent compared to a year ago (Exhibit 2.13).





For the private retail space segment, rentals fell by 0.5 per cent quarter-on-quarter, extending the 0.3 per cent decline seen in the previous quarter. This came about as retailers continued to face a challenging operating environment. Similarly, rentals in the office space segment softened in the second quarter, contracting by 2.6 per cent, reversing the 0.6 per cent increase registered in the previous quarter. However, the occupancy rate in the office space segment remained stable at 89 per cent, similar to that seen in the previous quarter (Exhibit 2.14).



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

In line with an increase in the supply of industrial space, overall rentals in the industrial space market declined by 0.7 per cent on a quarter-on-quarter basis, reversing the 0.4 per cent growth recorded in the previous quarter. Similarly, the occupancy rate for private multiple-user factory space declined marginally from 87 per cent in the first quarter to 86 per cent in the second quarter. By contrast, the occupancy rate for private for private sector warehouse space improved slightly to 92 per cent in the second quarter, as compared to the 90 per cent registered in the previous quarter (Exhibit 2.15).

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





CHAPTER 3 Economic Outlook



CHAPTER 3 ECONOMIC OUTLOOK

LEADING INDICATORS

The near-term economic outlook remains challenging, with the composite leading index (CLI) pointing towards subdued growth. The CLI rose marginally by 0.8 per cent on a quarter-on-quarter basis in the second quarter of 2015, reversing the 2.8 per cent decline in the previous quarter (Exhibit 3.1).

Exhibit 3.1: Composite Leading Index Levels and Growth Rate



Of the nine components within the index, six of them rose compared to the preceding quarter, namely stock price, new companies formed, money supply, domestic liquidity, non-oil retained imports and the stock of finished goods.

Meanwhile, two components – non-oil sea cargo handled and wholesale trade – declined compared to a quarter ago, while the US Purchasing Managers' Index remained flat.

CONCLUSION

The global economy performed weaker than expected in the first half of 2015. For the rest of the year, global growth is expected to pick up gradually, although the pace of growth is likely to be uneven across economies. In particular, the advanced economies are expected to see a gradual pick-up in growth, while the growth outlook of regional economies has generally softened.

The US economy recovered in the second guarter following the harsh weather conditions experienced at the start of the year. For the rest of 2015, the US economy is projected to grow at a modest pace, supported by private domestic demand. The Eurozone economy is expected to improve in the second half of the year, with growth supported by the quantitative easing measures implemented since March. However, growth in the bloc will likely remain modest due to sluggish labour market conditions. In Asia, China's growth is projected to ease, weighed down by the on-going property market correction and excess capacity in the heavy industries. Nonetheless, the stimulus measures implemented by the Chinese government are expected to contain downward pressures on the economy. Meanwhile, growth in key ASEAN economies is likely to be weighed down by weaker demand from China as well as softening domestic demand.

At the same time, several key downside risks in the external economic environment remain. In China, there is the risk of a sharper-than-expected correction in the real estate market, which could have significant negative spill-over effects on construction and real estate investment activities. The recent sharp correction in China's stock market has also heightened the risks to China's growth. In particular, consumer sentiments and spending in China could be adversely affected if the correction in the stock market worsens. In the Eurozone, while Greece has averted the immediate risk of an exit from the bloc, there is continuing political uncertainty and the crisis could flare up again if the Greek government fails to adhere to the bailout terms. Finally, with low commodity prices, the appreciation of the US dollar and anticipated normalisation of US interest rates, regional countries could face capital outflows and added pressures on their currencies and asset markets.

In tandem with the expected gradual pick-up in the global economy, externally-oriented sectors such as finance & insurance and wholesale trade are likely to support growth in the Singapore economy in the second half of the year. However, sector-specific factors could continue to weigh on the growth of some externally-oriented sectors. For instance, sustained low oil prices could continue to dampen growth in the marine & offshore segment. On the other hand, domestically-oriented sectors such as the business services and information & communications sectors are expected to see modest growth. With the labour market expected to remain tight, growth in some labour-intensive sectors such as food services may be weighed down by labour constraints.

Taking into account the above factors, the 2015 growth forecast for the Singapore economy is narrowed to 2.0 to 2.5 per cent, from 2.0 to 4.0 per cent.

FEATURE ARTICLE



FEATURE ARTICLE IMPACT OF RESEARCH & DEVELOPMENT ON PRODUCTIVITY

BACKGROUND

Research & Development (R&D) can bring about product innovation, process improvements and knowledge spillovers, resulting in productivity benefits.



FINDINGS

At the overall economy level, a \$1 increase in R&D stock was associated with an increase in multi-factor productivity of \$0.28 and \$1.01 in the short- and long-run respectively from 1978 to 2014.

At the firm-level, a \$1 increase in R&D stock was found to raise productivity in a firm with a median value-added to R&D stock ratio by \$0.35 from 2002 to 2013.

The dollar impact of R&D for the median firm has increased over time, from \$0.29 in 2002-2005, to \$0.37 in 2006-2010, and then to \$0.40 in 2011-2013.



EXECUTIVE SUMMARY

- Studies in other countries have found that investments in Research and Development (R&D) can lead to productivity improvements. Our study quantifies the impact of R&D on productivity at both the overall economy and firm levels in Singapore.
- At the overall economy level, we find that R&D has a positive and significant correlation with productivity. In particular, between 1978 and 2014, a \$1 increase in R&D stock was associated with an increase in multi-factor productivity of \$0.28 and \$1.01 in the short- and long-run respectively.¹
- Similarly, our findings indicate that R&D has a positive and significant impact on productivity at the firm level. Over the period of 2002 to 2013, a \$1 increase in R&D stock was found to raise productivity in a firm with a median value-added to R&D stock ratio by \$0.35. Dividing this period into sub-periods that coincide with the Research, Innovation and Enterprise (RIE) funding tranches, we find that the dollar impact of R&D has increased over time, from \$0.29 in 2002-2005, to \$0.37 in 2006-2010, and then to \$0.40 in 2011-2013.
- Our findings thus suggest that continued investments in R&D can help to raise productivity in the years ahead.

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

Research & Development (R&D) can bring about product innovation, process improvements and knowledge spillovers that enable firms to offer new and improved products, as well as lower production costs.³ These could in turn lead to improvements in productivity, thereby contributing to sustainable economic growth and higher wages.

R&D has been an integral part of our economic strategy. The Government supports R&D through 5-year Research, Innovation and Enterprise (RIE) funding tranches, with the three most recent plans being the Science & Technology (S&T) Plan 2005, the S&T Plan 2010, and the RIE Plan 2015. The budgets for these plans have steadily increased, from \$6 billion for the period of 2001-2005 to \$13.6 billion in 2006-2010, and \$16.1 billion in 2011-2015.

R&D expenditure in Singapore has also risen steadily over the years. Gross Expenditure on R&D (GERD) increased from \$4.6 billion in 2005 to \$7.6 billion in 2013, at a compounded annual growth rate (CAGR) of 6.5 per cent. Over this period, Business Expenditure on R&D (BERD) accounted for about 60-70 per cent of the GERD, while Public Expenditure on R&D (PUBERD)⁴ accounted for the remaining 30-40 per cent [Exhibit 1].

Given our growing investments in R&D, this study aims to quantify the impact of R&D on productivity in Singapore, both at the economy-wide and firm levels. This would allow us to better understand the economic benefits of R&D.

¹ The dollar impact of R&D on productivity reported in this study is in constant 2010 market prices, i.e., in real terms.

² We would like to thank Yong Yik Wei and Andy Feng for their helpful comments and suggestions. We would also like to acknowledge the statistical support received from Sherilyn Lim (Research and Statistics Unit, Agency for Science, Technology and Research). All errors belong to the authors. ³See Hall, Mairesse, and Mohnen (2010).

⁴ The public sector comprises government organisations, public research institutes, and higher education institutes.





IMPACT OF R&D ON PRODUCTIVITY IN THE OVERALL ECONOMY

Literature Review

At the economy-wide level, several studies have found a positive relationship between R&D stock and multi-factor productivity (MFP). MFP measures how efficiently inputs, usually capital and labour, are used in production. Improvements in MFP may arise from new technologies or improvements in the methods of production.

For example, Coe and Helpman (1995) found that a 1 per cent increase in R&D stock was associated with a 0.2 per cent increase in MFP in G7 countries⁵, and a 0.08 per cent increase in non-G7 OECD economies over the period of 1971 to 1990. In the case of Singapore, Toh and Choo (2002) and Ho, Wong and Toh (2009) found the elasticity over the period of 1978-2001 to be between 0.01 per cent and 0.02 per cent in the short run, and between 0.05 per cent and 0.08 per cent in the long run.

Data and Empirical Methodology

To examine the relationship between R&D stock and productivity at the economy-wide level in Singapore based on more recent data, we use annual MFP⁶ and R&D capital stock data from the Department of Statistics (DOS), spanning the years 1978 to 2014.

We adopt a growth accounting framework based on a Cobb-Douglas production function, as is commonly done in the literature (see equation 1). The logarithmic form of MFP is shown in equation 2.

$$Y = AL^{\alpha} K^{\beta} = (BS^{\gamma})L^{\alpha} K^{\beta}$$
⁽¹⁾

Where

Y = Output A = MFP = BS^v B = Non-R&D factors that affect MFP S = R&D capital stock L = Labour K = Physical capital stock

(2)

⁵ The G7 countries are the United States, United Kingdom, France, Germany, Canada, Italy and Japan.

⁶ More specifically, we construct an annual MFP index from MFP growth provided by DOS.

Similar to Toh and Choo (2002) and Ho, Wong and Toh (2009), we use an Auto-Regressive Distributive Lag model based on equation 2 to derive a short- and long-run relationship between R&D capital stock, S, and MFP over time t (equation 3).⁷

$$\log MFP_{\star} = \alpha + \beta_1 \log MFP_{\star,1} + \beta_2 \log S_{\star} + \varepsilon_{\star}$$
(3)

Results and Discussion

Over the period of the study, we estimate that a 1 per cent increase in R&D stock was associated with a 0.03 per cent increase in MFP in the short run (i.e., the same year in which the R&D investment was made) [Exhibit 2]. Given the lagged effect of R&D on productivity, the long run elasticity is larger, with a 1 per cent increase in R&D stock associated with a 0.108 per cent increase in MFP [Exhibit 3].⁸ In dollar terms⁹, a \$1 increase in R&D stock was associated with a \$0.28 and \$1.01 increase in MFP in the short- and long-run respectively.

xhibit 2: Regression Results				
	1978-2014			
β_1	0.724***			
eta_2	0.030***			
Adjusted R ²	0.970			

* p<0.10 ** p<0.05 *** p<0.01

Exhibit 3: Impact of R&D stock on MFP in the short- and long-run

	Short-run	Long-run
β_2	0.030	0.108
Dollar impact (\$)	0.28	1.01

Our elasticity estimates are slightly higher than that found in earlier studies for Singapore (e.g., Toh and Choo, 2002), suggesting an improvement in the translation of R&D investments to productivity improvements in recent years.

IMPACT OF R&D ON PRODUCTIVITY AT THE FIRM LEVEL

Next, we examine the impact of R&D at the firm level using micro-econometric analysis. Unlike the earlier analysis which examined R&D at the economy-wide level, this analysis focuses on the impact of R&D conducted by firms on their own productivity.

⁷ We find that log MFP_t and log S_t are cointegrated, and can thus be represented in this form. Dummies for recession years (1998, 2001, 2009) are also included in the equation.

⁸ The long-run elasticity of MFP with respect to R&D stock is equal to $\beta_2/(1-\beta_1)$.

[°] The dollar impact of R&D is equal to the elasticity of productivity with respect to changes in R&D stock multiplied by the ratio of the average GDP to average R&D stock from 1978 to 2014.

Literature Review

Firm-level studies overseas have found a positive relationship between R&D stock and productivity. For instance, a 1 per cent increase in R&D stock was estimated to have led to a 0.09 per cent increase in productivity in US firms in 1966-1977 (Griliches and Mairesse, 1984), 0.07 per cent in the case of French manufacturing firms in 1980-1987 (Hall and Mairesse, 1995), and 0.09 per cent in the case of German manufacturing firms in 1979-1989 (Harhoff, 1998).¹⁰ For Singapore, Toh and Choo (2002) showed that the elasticity of productivity to R&D stock was 0.04 per cent in the short run and 0.12 per cent in the long run in 1996-2001.

Data and Empirical Methodology

We use an anonymised unbalanced panel dataset compiled from the annual National Survey of R&D conducted by the Agency for Science, Technology and Research (A*STAR) over the period of 2002 to 2013. The regression sample comprises 965 firms that conducted in-house R&D for more than one year during this period.¹¹ The dataset contains information on the firms' R&D expenditure, employment, profits, net fixed asset investments, and industry.

Similar to other firm-level studies, we assume a standard Cobb-Douglas production function for each firm, with R&D capital stock being a determinant of productivity:

$$Y = AL^{\alpha} K^{\beta} = (BS^{\gamma})L^{\alpha} K^{\beta}$$
(4)

Where Y = Value-added of firm (VA) A = MFP

- B = Non-R&D factors that affect MFP
- S = R&D capital stock
- L = Labour
- K = Physical capital stock

Our empirical model is derived by taking the logarithmic form of equation 4¹², and adding control variables:

$$\log Y_{it} = c_i + \sum_t \theta_t d_t + \beta_s \log S_{it} + \beta_L \log L_{it} + \beta_K \log K_{it} + \beta_X X_{it} + \varepsilon_{it}$$
(5)

Where Y_{it} is firm i's VA at time t

c is the fixed effects term for firm i

- d, is a dummy for year t
- S_{it} is firm i's R&D stock at time t

 L_{it}^{s} and K_{it} are non-R&D employment and capital¹³ respectively for firm i at time t X_{it}^{s} is a set of control variables comprising dummies for area of research and industry, as well as interactions of year and industry dummies for firm i at time t ε_{it} is an error term associated with firm i at time t

We run a fixed effects regression on equation 5. As the regression controls for both observable (e.g., non-R&D fixed assets and employment) and time-invariant unobservable (e.g., managerial quality) characteristics of the firms, as well as macroeconomic and industry-specific factors that could affect R&D expenditure across firms, β_s can be interpreted as the average impact of a firm's R&D stock on the productivity of the firm.

¹⁰ These studies are cited as their empirical strategies are more comparable to ours. See Hall, Mairesse and Mohnen (2010) for a survey of the literature. ¹¹ We exclude R&D service providers (i.e., firms classified under SSIC2010 72) from our analysis, as their R&D expenditure would have directly contributed to the bulk of their VA.

¹²As a result, firms that had negative values for VA, non-R&D fixed assets and employment are excluded from the sample. See Annex A for the computation of the variables $Y_{it}S_{it}L_{it}$ and K_{it} .

¹³ This removes the double-counting of labour and capital engaged in R&D. Schankerman (1981, p454) pointed out that "research labour and capital are double-counted, once in the available measures of traditional labour and capital and again in the research expenditure input". He showed that failing to correct for double-counting would result in the estimated coefficient of R&D being biased downwards.

In our second firm-level regression, we allow for R&D to have varying effects on firm productivity over the three sub-periods that coincide with the RIE funding tranches i.e., 2002-2005, 2006-2010, and 2011-2013:

$$\log Y_{it} = c_i + \sum_t \theta_t d_t + \sum_j \beta_{sj} \log S_{it} \times \text{ tranche}_j + \sum_j \beta_{Lj} \log L_{it} \times \text{ tranche}_j + \sum_j \beta_{Kj} \log K_{it} \times \text{ tranche}_j + \beta_X X_{it} + \varepsilon_{it}$$
(6)

Where in addition to the variables defined in equation 5,

tranche, is a dummy for period j, where j = 2002-2005, 2006-2010 or 2011-2013

Results and Discussion

Over the period of 2002 to 2013, we find that R&D conducted by firms had a positive and significant impact on firm-level productivity [Exhibit 4]. In particular, we estimate that a 1 per cent increase in R&D stock raised firm-level productivity by 0.127 per cent on average over this period. In dollar terms, a \$1 increase in R&D stock in a firm with a median value-added to R&D stock ratio increased productivity by \$0.35.¹⁴ Our elasticity estimate compares favourably with those found in other countries (e.g., 0.09 per cent in Germany), although we note that these studies tend to be for earlier periods. It is also higher than the estimates found for Singapore in the earlier study by Toh and Choo (2002).

Exhibit 4: Impact of R&D stock on firm-level productivity

	2002-2013
β_s	0.127***
Dollar impact (\$)	0.35

^{*} p<0.10 ** p<0.05 *** p<0.01

When we break down the period into sub-periods corresponding to the three RIE funding tranches, we find the elasticity of productivity with respect to changes in R&D stock to be increasing over the tranches, from 0.102 per cent in 2002-2005, to 0.134 per cent in 2006-2010, and then to 0.150 per cent in 2011-2013. The dollar impact of R&D also followed a similar trend, growing from \$0.29 in 2002-2005, to \$0.37 in 2006-2010, and then to \$0.40 in 2011-2013 for the median firm¹⁵ [Exhibit 5].

Exhibit 5: Impact of R&D stock on firm-level productivity over the RIE funding tranches

	2002-2005	2006-2010	2002-2013
β_{s}	0.102***	0.134***	0.150***
Dollar impact (\$)	0.29	0.37	0.40

* p<0.10 ** p<0.05 *** p<0.01

CONCLUSION

Our study suggests that investments in R&D have improved productivity at both the economy-wide and firm levels in Singapore. We also find that, at the firm-level, the dollar impact of R&D on productivity has increased over the years, from 2002-2005 to 2006-2010, and further in 2011-2013. This coincides with the increased support provided by the Government for industry-relevant R&D in the public sector under S&T Plan 2010 and RIE Plan 2015. By tapping on industry-relevant knowledge generated by the public sector, firms might have been able to make better R&D investment decisions that reaped higher returns in the later tranches. In addition, over time, firms may have become better at capturing value from the R&D done, leading to improved revenues and higher productivity.

Our findings imply that continued investments in R&D can help to raise the level of productivity in Singapore. To help firms that may not have the financial resources or technical expertise to conduct R&D, the Government has put in place schemes such as the Productivity and Innovation Credit, Research Incentive Scheme for Companies, and Capability Development Grant to help companies make R&D investments and thereby raise their productivity. Firms may also work with public institutions to meet their technological needs, for example, through Centres of Innovation and the Technology Adoption Programme.

Contributed by:

Fan Shir Li. Economist Foo Xian Yun. Economist Kenny Goh, Senior Economist Economics Division Ministry of Trade and Industry

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ANNEX A: COMPUTATION OF VARIABLES FOR FIRM-LEVEL STUDY

Value-added Y_{it}

<u>First</u>, to obtain nominal value-added, we sum up net operating profit after taxes, indirect taxes, manpower expenditure and depreciation of fixed assets. <u>Next</u>, to obtain real value-added Y_{it}, we deflate nominal value-added using the Gross Domestic Product (GDP) deflator by industry from DOS.

R&D Stock S_{it}

<u>First</u>, we derive the real R&D expenditure E_{it} by deflating nominal R&D expenditure using the Gross Fixed Capital Formation (GFCF) deflator. The GFCF deflator is derived by dividing GFCF at current market prices by GFCF at 2010 market prices, both obtained from DOS.

<u>Next</u>, consistent with literature, we use the perpetual inventory method to compute the R&D capital stock S_{it} , assuming a depreciation rate δ of 15 per cent (equations 7 and 8).¹⁶

$$S_{it} = S_{it-1} \times (1 - \delta) + E_{it}$$
⁽⁷⁾

Where $S_{it} = R\&D$ capital stock for firm i at time t $\delta^{it} = Depreciation rate of R\&D capital stock$

E_{it} = Real R&D expenditure for firm i at time t

$$S_{it=0} = \frac{E_{it=0}}{g + \delta}$$
(8)

Where $S_{it=0} = R\&D$ capital stock for firm i when it first entered the dataset $E_{it=0} = Real R\&D$ expenditure of firm i when it first entered the dataset g = Growth rate of real R&D expenditure

We assume g to be 19 per cent, which is the estimated growth rate of BERD from 1990 to 2001, deflated using the GFCF deflator.

Physical Capital Stock K_{it}

We use net book value of fixed assets to proxy for total physical capital stock. We derive the real total physical capital stock by deflating nominal total physical capital stock using the net capital stock deflator. The net capital stock deflator is in turn derived by dividing net capital stock at current market prices by net capital stock at 2010 market prices, both obtained from DOS. Following Hall and Mairesse (1995), we deduct physical capital stock for R&D purposes from total physical capital stock to derive K_{it}, in order to correct for double counting.

Labour L_a

Following Hall and Mairesse (1995), L_{it} is total employment less R&D employment, to correct for double counting.



MINISTRY OF TRADE AND INDUSTRY 100 High Street, #09-01 The Treasury Singapore 179434

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