

Growth of Research and Development in Singapore : 2000–2005

By

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Introduction

This article analyses the trends in research and development¹ (R&D) expenditure and R&D manpower between 2000 and 2005. Data are based on findings from the National Survey of R&D in Singapore that is undertaken annually by the Agency for Science, Technology and Research (A*STAR), Singapore. The survey covers R&D in science and technology only, and excludes the social sciences and humanities.

Overview of R&D Growth, 2000–2005

R&D Expenditure

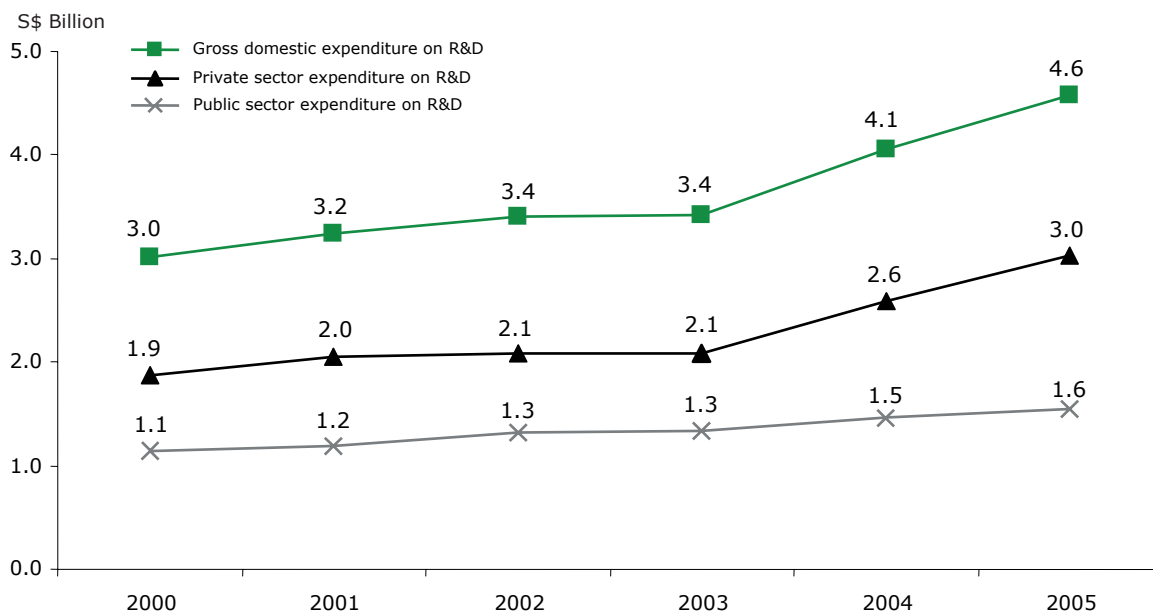
Gross expenditure on R&D (GERD) increased from S\$3.0 billion in 2000

to S\$4.6 billion in 2005 (Chart 1), translating into an average annual growth rate of 8.8 per cent. The growth was driven by the private sector, whose R&D spending increased from S\$1.9 billion in 2000 to S\$3.0 billion in 2005, or an increase of 10 per cent per annum. Public sector R&D expenditure also increased rapidly from S\$1.1 billion in 2000 to S\$1.6 billion in 2005, or an increase of 6.3 per cent per annum.

R&D Expenditure refers to all expenditures on R&D performed within an organisation. Expenditures made outside the organisation but in support of the R&D performed within the organisation are included. However, extra-mural R&D expenditures, which are sums an organisation paid or committed to pay to another organisation for the performance of R&D using the latter's facilities, are excluded.

¹ R&D comprises creative work undertaken on a systematic basis to increase the stock of knowledge, which in turn is used to devise new applications.

CHART 1 R&D EXPENDITURE, 2000-2005



As a percentage of GDP, GERD rose from 1.9 per cent in 2000 to 2.4 per cent in 2005. Private sector R&D spending as a proportion of GDP grew from 1.2 per cent in 2000 to 1.6 per cent in 2005, while the corresponding figures for the public sector were 0.7 per cent in 2000 vis-à-vis 0.8 per cent in 2005.

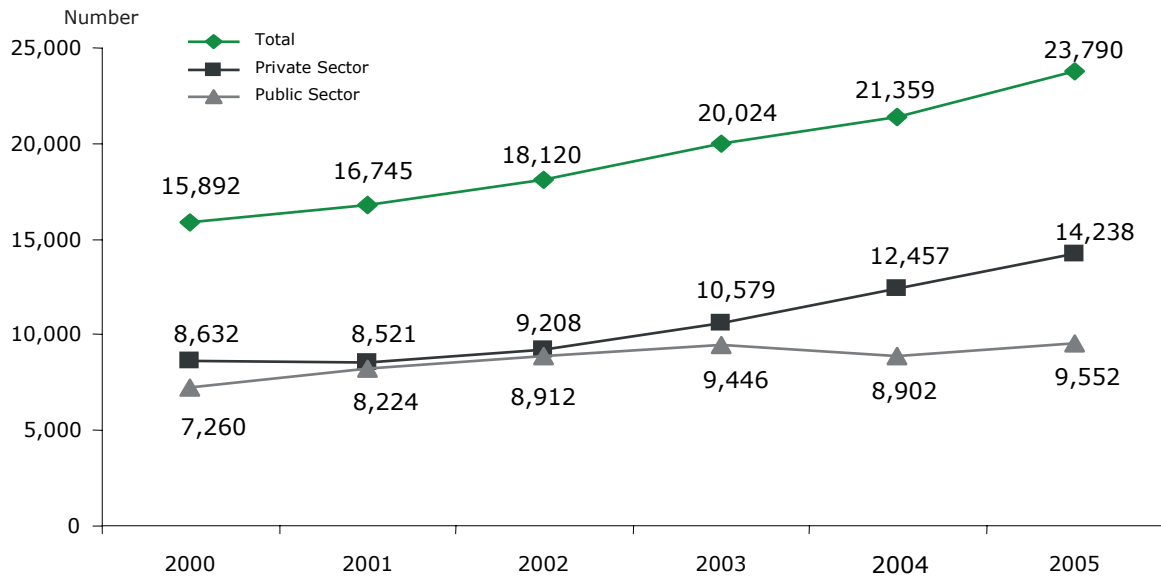
In terms of full-time equivalence (FTE), the FTE number of researchers in Singapore increased from 15,892 in 2000 to 23,790 in 2005, representing an increase of 8.4 per cent per annum during 2000-2005 (Chart 2). Analysis on R&D manpower for the rest of the article would be based on FTE number of researchers.

R&D Manpower – Researchers

The number of researchers in Singapore increased from 19,551 in 2000 to 27,969 in 2005. Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems or in the management of the projects concerned.

One Full-Time Equivalence (FTE) unit may be thought of as one person-year. A person who spends 30 per cent of his time on R&D and the rest on other activities during the year should be considered as 0.3 FTE. If a full-time R&D worker is employed for only six months during the year, this results in a 0.5 FTE.

CHART 2 FTE NUMBER OF RESEARCHERS, 2000–2005



R&D Expenditure by Sector in 2005

Private sector R&D spending grew faster than the public sector's with its share of GERD increasing from 62 per cent in 2000 to 66 per cent in 2005. The public sector accounted for the remaining 34 per cent in 2005.

Private Sector R&D Expenditure

Within the private sector, manufacturing accounted for close to two-thirds of private sector expenditure on R&D in 2005, with a total amount of S\$2.0 billion. The services sector contributed S\$1.1 billion, representing 35 per cent of private sector expenditure on

R&D (Chart 3).

Companies in the electronics industry constituted the bulk (60 per cent) of the manufacturing sector's expenditure on R&D. Within the electronics industry, semiconductor manufacturing accounted for over half the R&D spending in the sector in 2005 (51 per cent or S\$597 million). The next biggest segment was infocomms & consumer electronics manufacturing, which accounted for 19 per cent (or S\$219 million) of the R&D spending in the electronics industry.

Private Sector comprises all business enterprises, excluding institutions of higher education.

CHART 3 BREAKDOWN OF R&D EXPENDITURE BY INDUSTRY IN THE PRIVATE SECTOR, 2005

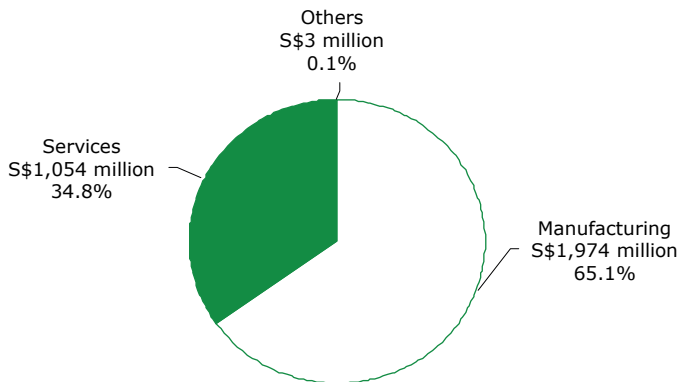
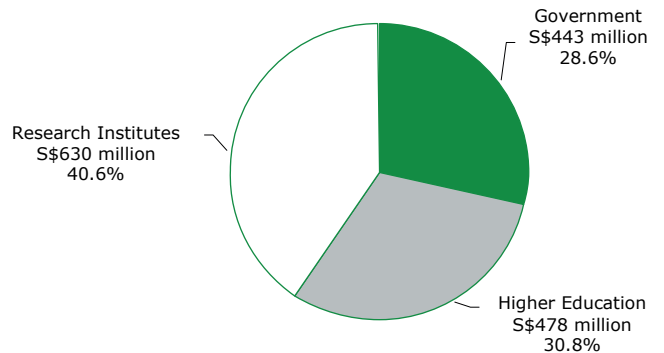


CHART 4 BREAKDOWN OF R&D EXPENDITURE IN THE PUBLIC SECTOR, 2005



Public Sector R&D Expenditure

Within the public sector, the public research institute sector and the higher education sector accounted for most of the reported expenditure on R&D in 2005. The public research institute sector contributed 41 per cent (or S\$630 million) of public sector expenditure on R&D, and the higher

education sector 31 per cent (or S\$478 million). The remaining 29 per cent (or S\$443 million) was contributed by the government sector (Chart 4).

R&D Manpower (Researchers) by Sector in 2005

In 2005, 60 per cent (or 14,238) of the researchers were found in the private sector. The public sector, which included full-time postgraduate students, accounted for the remaining 40 per cent (9,552) (Tables 1 and 2).

*Public Sector comprises the government sector, higher education sector and public research institutes. The government sector refers to all government organisations, excluding public institutions of higher education and the A*STAR research institutes. It includes all government ministries and statutory boards. The higher education sector comprises all institutions of higher education, including the universities and polytechnics. Public research institutes comprises the A*STAR research institutes.*

TABLE 1 RESEARCHERS BY EDUCATIONAL QUALIFICATION – PRIVATE VERSUS PUBLIC SECTOR, 2005

	FTE Number of Researchers				
	Total	PhD	Master	Bachelor	Non-Degree
Private Sector	14,238	893	3,007	7,930	2,408
Public Sector	5,834	2,252	1,613	1,851	118

TABLE 2 FTE NUMBER OF FULL-TIME POSTGRADUATE STUDENTS IN THE PUBLIC SECTOR BY LEVEL OF EDUCATION ATTENDING, 2005

TOTAL	3,718
PhD	2,675
Master	1,043

Private Sector R&D Manpower

A majority of researchers (56 per cent or 7,937 researchers) in the private sector were found in the manufacturing sector. The services sector employed about 44 per cent of researchers within the private sector in 2005, while the proportion of researchers employed by the primary industries & construction sector was less than 1 per cent.

Bachelor degree holders formed the largest group of researchers within the private sector. This group of researchers accounted for 7,930 out of the 14,238 researchers employed within the sector.

Public Sector R&D Manpower

Excluding full-time postgraduate students, the higher education sector accounted for the largest proportion (42 per cent or 2,460) of researchers in the public sector, followed by the public research institute sector (34 per cent or 2,010 researchers) and government sector (23 per cent or 1,364 researchers).

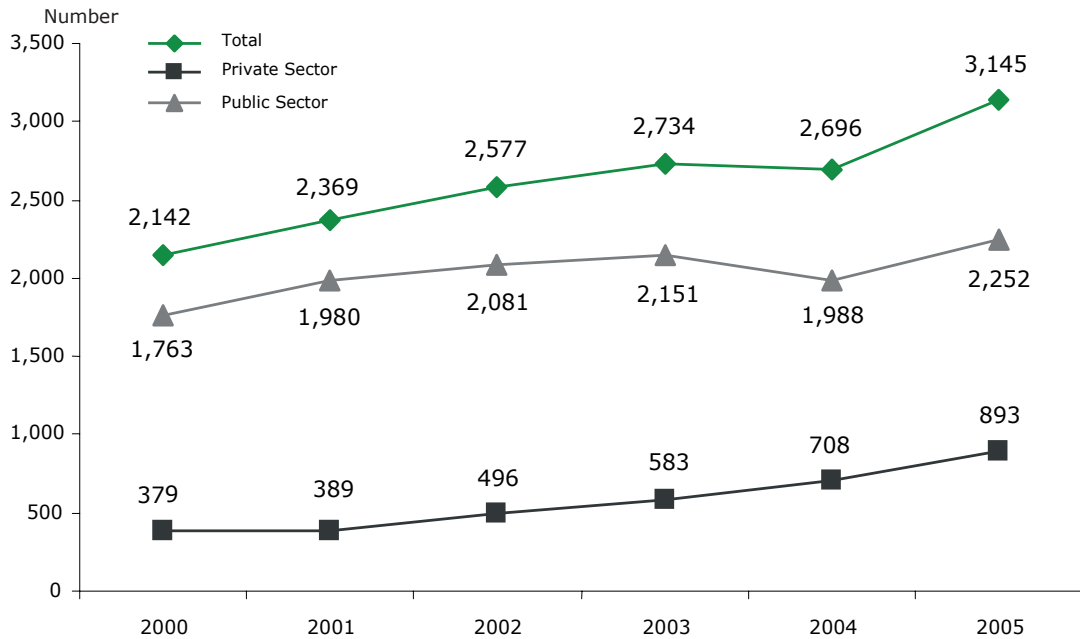
PhD holders formed the largest group of researchers employed in the public sector (excluding full-time postgraduate students) in 2005. They accounted for 39 per cent (or 2,252) of researchers employed.

There were 3,718 full-time postgraduate students in the public sector, of which 72 per cent (or 2,675) were full-time PhD students. The remaining 28 per cent (or 1,043) were full-time Master-level research students.

PhD Researchers

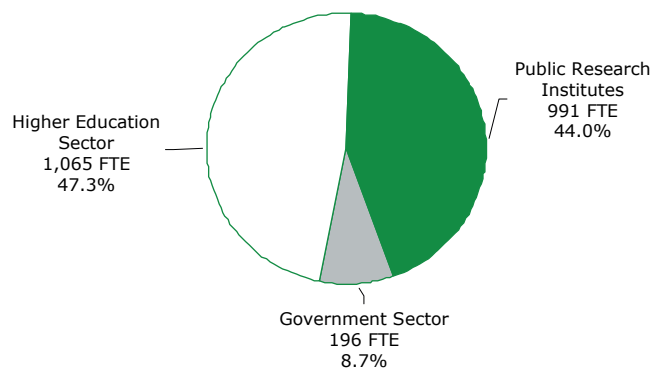
Researchers who are PhD holders formed the smallest group of researchers (excluding full-time postgraduate students) at the overall level (16 per cent). However, this group had grown rapidly over the last five years, increasing from 2,142 in 2000 to 3,145 in 2005, or an increase of 8.0 per cent per annum (Chart 5). Of the total PhD researchers in 2005, 28 per cent (or 893) were employed in the private sector and 72 per cent (or 2,252) in the public sector.

CHART 5 PHD RESEARCHERS BY SECTOR, 2000–2005



Within the private sector, a large proportion of the PhD researchers was employed in the services R&D industry (260). For the public sector, the majority was found in the higher education sector (47 per cent or 1,065), followed by the public research institute sector which accounted for 44 per cent (or 991) of the PhD researchers in the public sector (Chart 6). The government sector employed the remaining 8.7 per cent (or 196) of PhD researchers.

CHART 6 BREAKDOWN OF PHD RESEARCHERS IN THE PUBLIC SECTOR, 2005



International Comparison

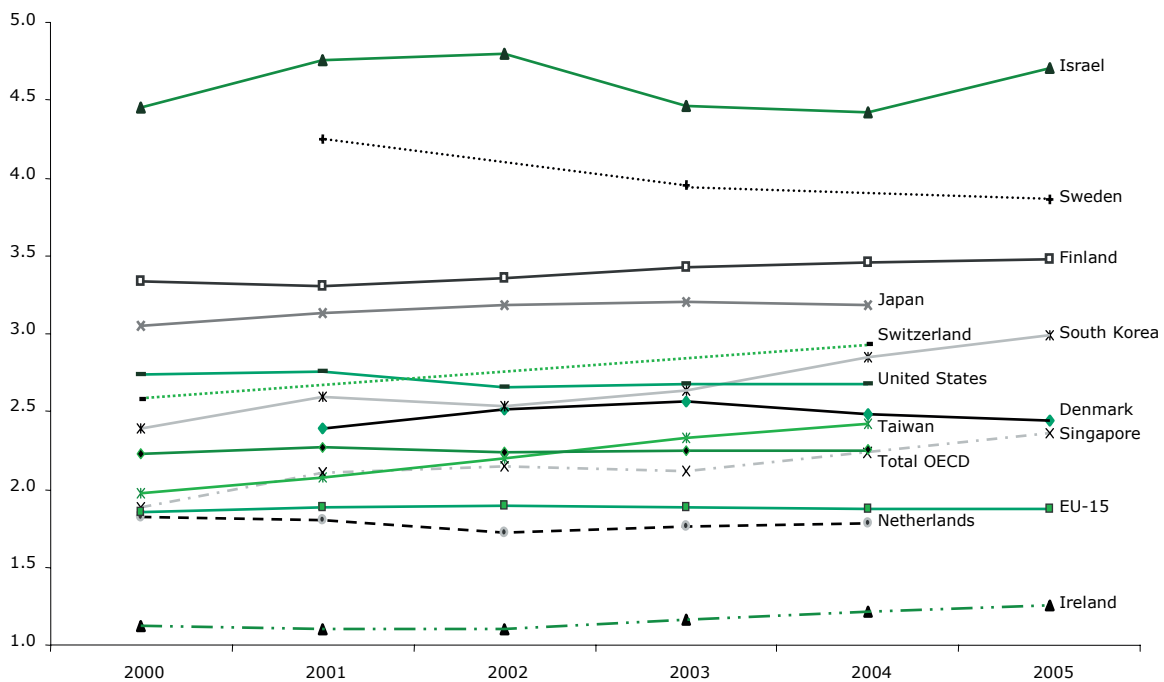
With GERD at 2.4 per cent of GDP in 2005, Singapore's R&D intensity² was ahead of the EU-15³'s average (1.9 per cent) and had surpassed the Organisation for Economic Co-operation and Development's (OECD) average (2.3 per cent) (Chart 7). However, Singapore's R&D intensity was still lower than that of the US (2.7 per cent) and Japan (3.2 per cent).

Compared with the small advanced countries, Singapore's R&D intensity was

ahead of Ireland's (1.3 per cent) and the Netherlands' (1.8 per cent) and on par with Denmark's (2.4 per cent). It was, however, below that of the world leaders, namely: Israel (4.7 per cent), Sweden (3.9 per cent), Finland (3.5 per cent) and Switzerland (2.9 per cent).

Among the Newly Industrialized Economies, Singapore's R&D intensity was close to that of Taiwan (2.4 per cent), but behind that of South Korea (3.0 per cent).

CHART 7 COMPARATIVE GERD/GDP DATA FOR SELECTED COUNTRIES, 2000–2005



Source : OECD Main Science and Technology Indicators, 2006-2

² R&D intensity refers to the R&D spending as a percentage of GDP.

³ The EU-15 comprises Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and United Kingdom.

Singapore Standard Occupational Classification 2005

Introduction

The Singapore Department of Statistics has just released the Singapore Standard Occupational Classification (SSOC) 2005. The SSOC 2005 is the national standard for classifying statistical information on occupations to ensure data comparability and consistency. It is designed for use in censuses of population and all other surveys where occupation data are collected. To maintain the currency and relevance of SSOC, the classification is revised regularly, taking into account economic, technological and organisational changes which tend to bring about emergence of new types of work as well as redundancy of some existing jobs.

The SSOC 2005 was updated from the SSOC 2000. It adopts the basic framework of the International Standard Classification of Occupations 1988 (ISCO-88), published by the International Labour Organisation (ILO). Appropriate modifications were made to meet national requirements while providing for international comparability of data.

Comparison with the SSOC 2000

The basic structure of the SSOC 2005 remains essentially the same as that in the SSOC 2000.

Arising from the changes in the job and skill requirements over the years, some occupational groups have been re-classified to better reflect the job scope and complexities in the tasks performed. For example, social work professionals who provide developmental, preventive and remedial intervention services and require specialised training at tertiary level have been moved from Major Group 3 'Social Work Associate Professionals' to Major Group 2 'Social Work Professionals'. Social work professionals such as counsellor in specialised areas like rehabilitation, drugs and alcohol and family, are assigned specific 5-digit codes within Major Group 2. Correspondingly, youth workers and school counsellors with lower job skill requirements are assigned specific 5-digit codes in Major Group 3 in SSOC 2005. A comparison of the classifications of 'social work professionals' and 'social work associate professionals' in SSOC 2000 and SSOC 2005 is shown in Table 1.

On the whole, the SSOC 2005 contains more categories at 4- and 5-digit levels as compared with SSOC 2000. The number of unit groups and occupations has been revised from 274 and 993 in SSOC 2000 to 317 and 999 in SSOC 2005 respectively.

TABLE 1 CHANGES IN SOCIAL WORK PROFESSIONALS AND ASSOCIATE PROFESSIONALS

SSOC 2005	Occupation	SSOC 2000
292	Social Work Professionals and Other Social Science and Related Professionals	
29231	Social Worker (General)	39301
29232	Social Worker, delinquency	39302
29233	Medical Social Worker	39303
29234	Counsellor, rehabilitation	new item
29235	Counsellor, drugs & alcohol	new item
29236	Counsellor, family	new item
29239	Other Social Work Professionals	39309 (part)
393	Social Work Associate Professionals	
39301	Youth Worker	new item
39302	School Counsellor	new item
39309	Other Social Work Associate Professionals	39309 (part)

The Singapore Standard Occupational Classification (SSOC) 2005 is available for free downloading from the SingStat website at :

<http://www.singstat.gov.sg/pdtsvc/pubn/ssoc.html>

For more information on Singapore's national statistical standards and classifications, please visit :

<http://www.singstat.gov.sg/stats/resources.html#ssc>

2006 in Brief

Singapore's population

... reached a total size of 4.48 million in June 2006.

Average life expectancy at birth

... was 78 years for males and 82 years for females.

Mean years of schooling

... was 9.9 years for male resident non-students aged 25 years and over and 8.7 years for female resident non-students aged 25 years and over.

Home ownership rate

... was 91 per cent.

Labour force participation rate

... was 76.2 per cent among males and 54.3 per cent among females.

Per capita Gross National Income

... was S\$45,353.

Official foreign reserves

... increased to S\$211 billion.

Mobile phone subscribers

... reached 1,034 per 1,000 population.

Residential broadband subscribers

... increased to 193 per 1,000 resident population.

Crime rate

... declined to 745 per 100,000 population.

Change in 2006 (Year-on-Year)

Unit Labour Cost Index

... was 0.5 per cent lower.

Consumer Price Index

... increased by 1.0 per cent.

Domestic Supply Price Index

... rose by 5.0 per cent.

Retail Sales Index

... was 5.4 per cent higher.

Catering Trade Index

... was 4.5 per cent higher.

Domestic Wholesale Trade Index

... grew by 8.9 per cent.

Foreign Wholesale Trade Index

... rose by 9.9 per cent.

Business Receipts Index

... increased by 3.3 per cent.

Industrial Production Index

... rose by 11.5 per cent.

Latest Releases

from the
Occasional Paper and Information Paper Series

Information on the latest statistical findings and updates on methodological improvements to statistical collections are released by the Singapore Department of

Statistics through articles published in the Occasional Paper (OP) and Information Paper (IP) Series. Summaries of the latest four releases are as provided.

Information Paper Series

Adoption of SSIC 2005 in the National Accounts – New Reporting Format for Output-Based GDP (Jan 2007)

The Singapore Department of Statistics has adopted the Singapore Standard Industrial Classification (SSIC) 2005 in the National Accounts. This paper introduces a new reporting format for the presentation of output-based GDP estimates and discusses the re-compilation of GDP estimates on the basis of SSIC 2005. The re-compilation of output-based GDP estimates on the basis of SSIC 2005 has relatively little impact on overall GDP estimates.

Softcopy of this IP may be downloaded from the SingStat website at

<http://www.singstat.gov.sg/papers/op/ip-e33.pdf>

Re-basing and Revision of the Retail Sales and Catering Trade Indices (2005=100) (Oct 2006)

The Retail Sales Index (RSI) and Catering Trade Index (CTI), which are short term indicators that provide a macro-view of the business trend of retail and catering trade industries, have been re-based to year 2005. This marked the fourth revision in the coverage and weighting patterns of the indices to reflect changes in the structure of retail and catering trades. This paper contains information on the data sources, methodology adopted and a comparison of the re-based series with the old series. Detailed weights for activities in retail and catering trades and the re-based series from January 2005 to July 2006 are included in the Annexes.

Softcopy of this IP may be downloaded from the SingStat website at

<http://www.singstat.gov.sg/papers/op/ip-b19.pdf>

Occasional Paper Series

Key Household Income Trends, 2006 (Feb 2007)

Sustained economic growth boosted household income growth among Singapore resident households in 2006. The expanding economy and improving labour market have benefited all income groups. Employed households across the board experienced an increase in income per household member in real terms. More key trends in household income from work in 2006 are available from this paper, which focuses its analysis on income trends among employed households (that is, households with at least one working person).

Softcopy of this OP may be downloaded from the SingStat website at

<http://www.singstat.gov.sg/papers/op/op-s12.pdf>

***Trends in Dual-Career Couples, 2005
(Dec 2006)***

With increasing labour force participation rate of married women, the prevalence of dual-career couples has risen over time. Through the analysis of married couples in resident households, with data drawn from the General Household Survey 2005, the paper presents a statistical profile of dual-career couples in 2005 and compares their key characteristics with sole-career couples. Where appropriate, data from the Census of Population 2000 are included in the analysis to highlight changes since 2000.

Softcopy of this OP may be downloaded from the SingStat website at

<http://www.singstat.gov.sg/papers/op/op-s11.pdf>

Notification on Release Date for DOS' Press Releases

Key statistical indicators released by the Singapore Department of Statistics (DOS) such as the **Consumer Price Index** and the **Retail Sales and Catering Trade Indices** are released according to scheduled release dates and times.

The current release dates and embargo times for DOS' key monthly and quarterly indicators are provided below :

Key Indicator	Scheduled Release Date/ Embargo Time (Singapore time)
Consumer Price Index	23rd of each month, at 1.00pm
Retail Sales and Catering Trade Indices	15th of each month, at 1.00pm
Wholesale Trade Index	21st of the second month of each quarter, at 1.00pm
Business Receipts Index	27th of the second month of each quarter, at 1.00pm
Business Expectations Survey for Services Sector	Last working day of the first month of each quarter, at 1.00pm

The press statement on the **Consumer Price Index** is released on the next working day if the 23rd falls on a Saturday/Sunday/public holiday in Singapore. For the press releases of other key indicators, they are released on the preceding working day at 1.00pm if the scheduled release date falls on a Saturday/Sunday/public holiday in Singapore.

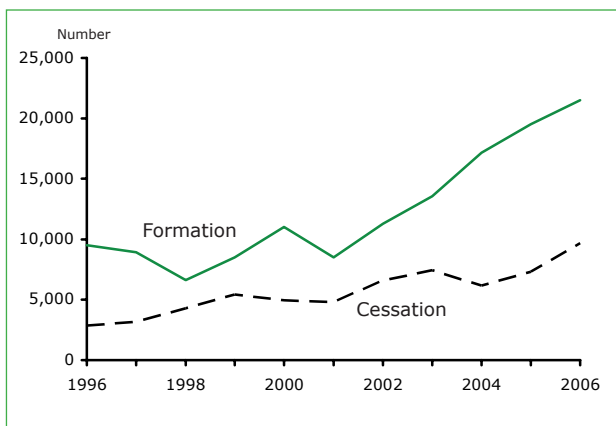
Formation and Cessation of Companies and Businesses, 2006

Companies

There were 21,490 company formations in 2006, representing an increase of 10 per cent from 19,500 in the previous year. Most major industries recorded increases in company formation, with significant growths coming from real estate, rental & leasing services (52 per cent), financial & insurance services (28 per cent) and hotels & restaurants (24 per cent). Conversely, there were declines in the number of new companies formed in administrative & support services (-16 per cent), and education, health & social work (-11 per cent).

In 2006, 9,680 companies ceased operations, an increase of 32 per cent compared with 2005. All major industries recorded increases in company cessation, ranging from 7.7 per cent for real estate, rental & leasing services to 58 per cent for administrative & support services.

CHART 1 FORMATION AND CESSATION OF COMPANIES

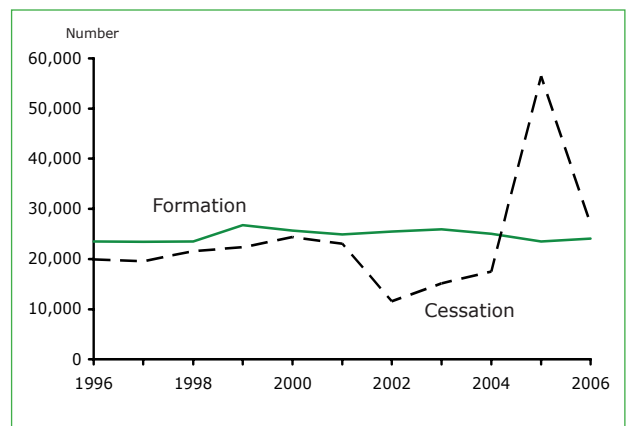


Businesses

The number of new businesses formed increased by 2.5 per cent, from 23,490 in 2005 to 24,080 in 2006. The most significant increase in business formation was observed in the real estate, rental and leasing services (47 per cent), followed by financial & insurance services (25 per cent) and information & communications services (21 per cent). In contrast, declines in business formation were recorded in administrative & support services (-18 per cent), hotels & restaurants (-3.7 per cent) and wholesale & retail trade (-2.0 per cent).

In 2006, the number of business cessations declined by 53 per cent to 26,790. This was due to a high base in 2005 when a large number of business cessations was recorded after the Accounting and Corporate Regulatory Authority (ACRA) issued batch cancellation notices to businesses which had failed to renew their business licences after the expiry dates.

CHART 2 FORMATION AND CESSATION OF BUSINESSES



Overseas Visitors

The Singapore Department of Statistics (DOS) received the following visitors in the past six months.

Topics discussed include Singapore's statistical system and organizational structure, the development and promotion of national statistical standards in Singapore, data collection methods for General Household Survey 2005 (including the use of Personal Digital Assistant [PDA] for enumeration), surveys on the services sector (including electronic modes used in the submission of survey returns), as well as coverage, data sources and maintenance of the Business Register.

Overviews of DOS' time series retrieval system (namely, the SingStat Time Series [STS] Online) and the Singapore Standard Industrial Classification were also presented.

Other topics of interest included compilation of national accounts, gross fixed capital formation, foreign direct investment and

international trade in services statistics, the dissemination of economic time series and the latest developments in economic statistics in Singapore.

China

– *National Bureau of Statistics*

- Mr Xu Xianchun
Deputy Commissioner

Officials from the Statistics Board of Guangxi Autonomous Region also visited DOS.

Dubai

– *Statistics Centre of Dubai Municipality*

- Mr Arif Obaid Al Mehairi
Director
Statistics Centre
- Mr Saeed Ibrahim Abdullah Hosani
Head
Data Processing and Database Section
- Mr Juma Abdulla Alhosani
Head
Trade and Production Statistics Unit
- Mr Tariq Yousuf Al Janahi
Head
Quality and Support Unit

Japan

- *Ministry of Internal Affairs and Communications*
 - Prof Yasuto Yoshizoe
President
Statistics Council
Government of Japan
 - Mr Hiromi Kuwabara
Director for Statistical Clearance
Office of Director-General for Policy
Planning on Statistical Standards
 - Mr Hideki Koizumi
Section Chief
Statistical Clearance Division
- *Research Institute of Construction and Economy*
 - Mr Oshima Hiroshi
Executive Fellow
 - Mr Tsuyoshi Yamada
Researcher
- *Mizuho Information and Research Institute*
 - Mr Toru Shimizu
Consultant

United Nations (UN)

- Dr Paul Cheung
Director
UN Statistics Division

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DOS Publications are Free Online

The Singapore Department of Statistics (DOS) publishes data and analyses in the form of statistical reports, analytical or technical papers, and newsletters. Since Jun 2006, softcopies of publications released on the SingStat website are available for free downloading. This initiative to make statistical publications more accessible to the public is in line with DOS' effort in promoting greater use of statistics and statistical information for research, studies, decision-making and business planning.

Over the past few months, the January 2007 and later issues of the following publications have been made available for free downloading from the SingStat website :

Monthly Digest of Statistics

- 👍 Contains a wide range of current statistical information on the Singapore economy and society.

Monthly Consumer Price Index (CPI)

- 👍 Analyses the changes in CPI over the previous months as well as corresponding periods of the previous year.
- 👍 Statistical tables and charts on the CPI at group and sub-group levels are included.

Monthly Report on Retail Sales and Catering Trade Indices (RSI)

- 👍 Analyses the changes in RSI at current prices.
- 👍 Detailed indices at current and constant prices, as well as seasonally-adjusted data, are included.

The next title to be released for free access is :

Quarterly Wholesale Trade Index (WTI)

- 👍 Analyses the changes in domestic and foreign WTI.
- 👍 Detailed indices at current and constant prices are included.

For the list of latest editions of DOS publications, please visit the SingStat website at

<http://www.singstat.gov.sg/pdtsvc/catalog.html>