

## Growth of Research and Development in Singapore : 2000–2005

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### Introduction

This article analyses the trends in research and development<sup>1</sup> (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

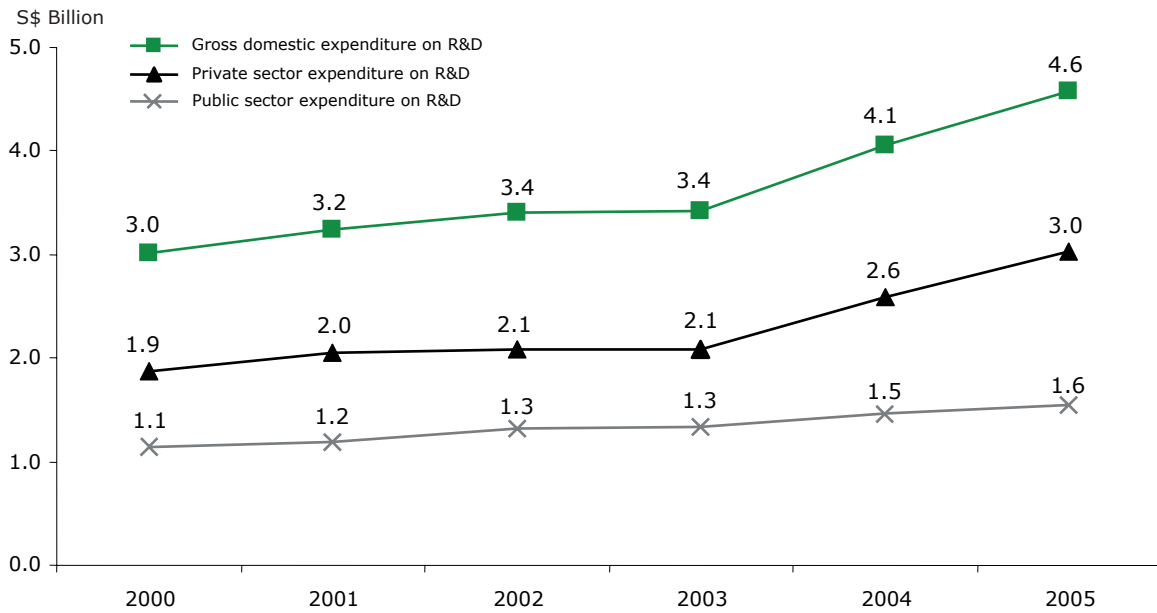
Gross expenditure on R&D (GERD) increased from S\$3.0 billion in 2000

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.*

<sup>1</sup> 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.

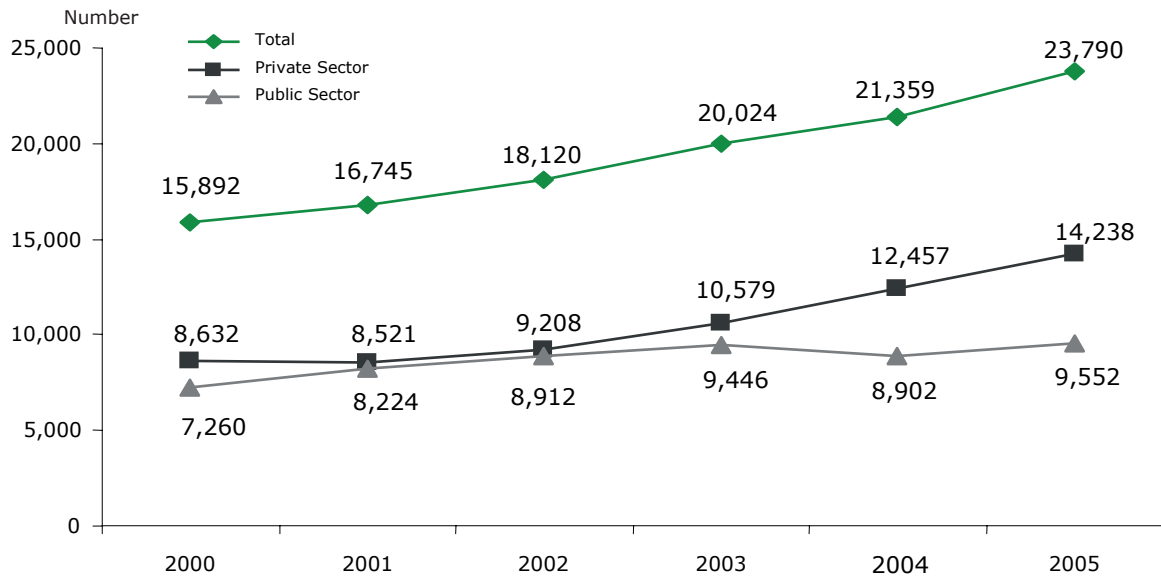
In terms of full-time equivalence (FTE), the FTE number of researchers in Singapore increased from 15,892 in 2000 to 23,790 in 2005, representing an increase of 8.4 per cent per annum during 2000-2005 (Chart 2). Analysis on R&D manpower for the rest of the article would be based on FTE number of researchers.

### 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

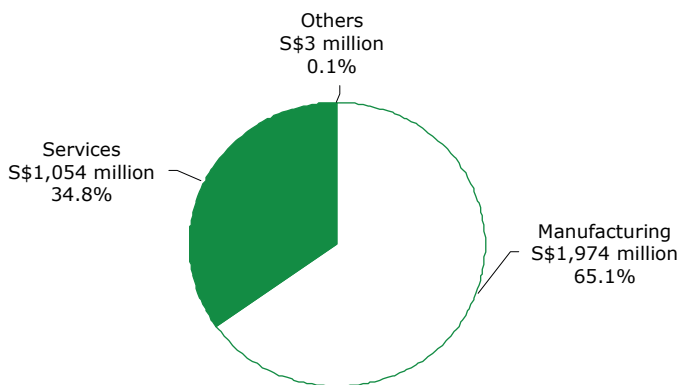
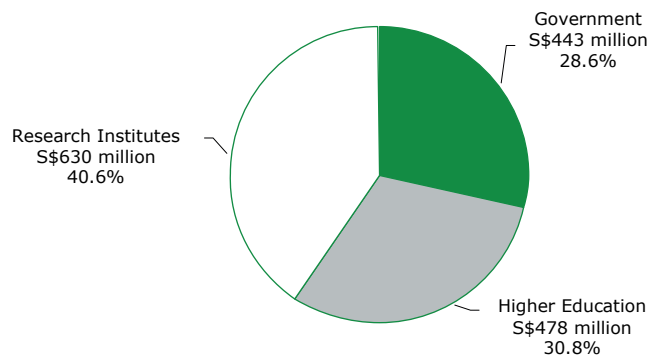


CHART 4 BREAKDOWN OF R&D EXPENDITURE IN THE PUBLIC SECTOR, 2005



### 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).

*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.*

### 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).

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

<b>TOTAL</b>	<b>3,718</b>
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).

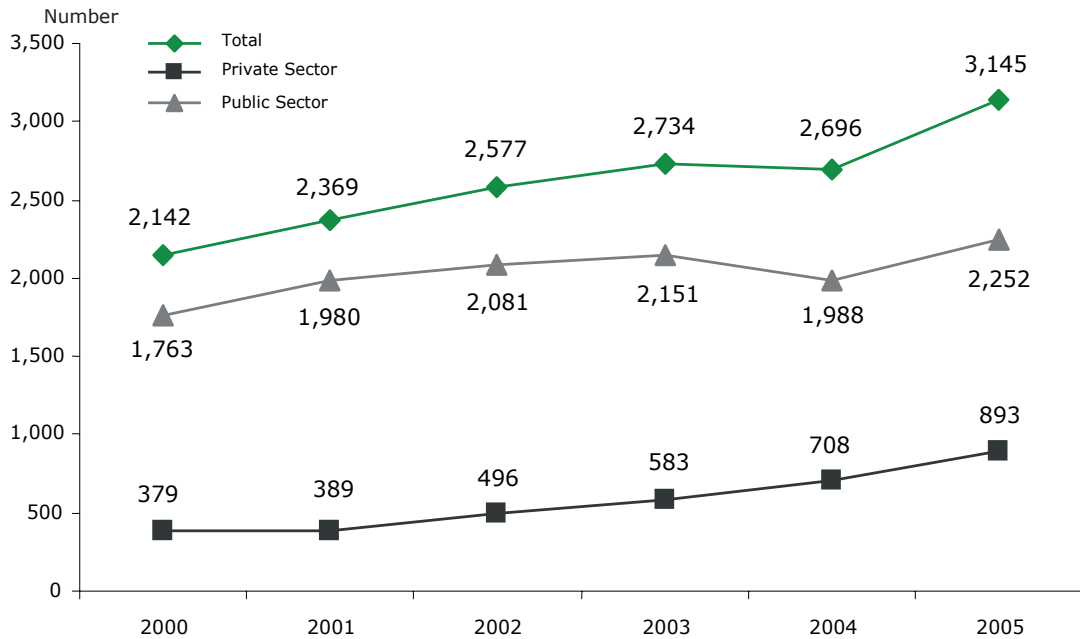
PhD holders formed the largest group of researchers employed in the public sector (excluding full-time postgraduate students) in 2005. They accounted for 39 per cent (or 2,252) of researchers employed.

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

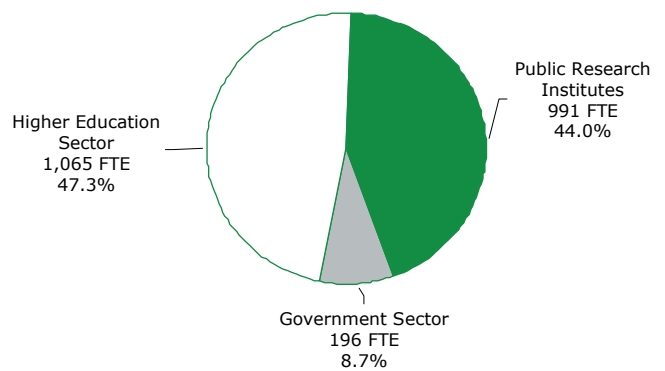
Researchers who are PhD holders formed the smallest group of researchers (excluding full-time postgraduate students) at the overall level (16 per cent). However, this group had grown rapidly over the last five years, increasing from 2,142 in 2000 to 3,145 in 2005, or an increase of 8.0 per cent per annum (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

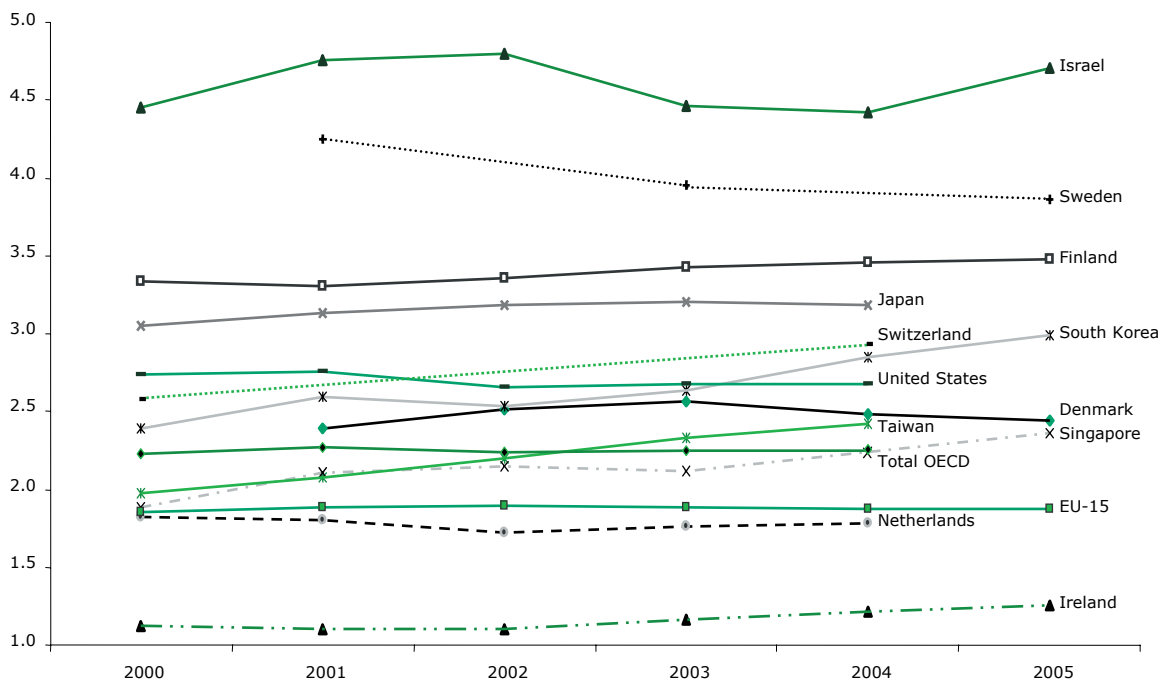
With GERD at 2.4 per cent of GDP in 2005, Singapore's R&D intensity<sup>2</sup> was ahead of the EU-15<sup>3</sup>'s average (1.9 per cent) and had surpassed the Organisation for Economic Co-operation and Development's (OECD) average (2.3 per cent) (Chart 7). However, Singapore's R&D intensity was still 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

<sup>2</sup> R&D intensity refers to the R&D spending as a percentage of GDP.

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