RESEARCH & DEVELOPMENT
IN INFORMATION SCIENCE AND TECHNOLOGY
IN THE MAJOR INDUSTRIAL COUNTRIES

STATISTICAL ANALYSIS OF
R & D INVESTMENT

VOLUME 1: SUMMARY OF THE DATA
AND ANALYSIS OF THE 9 OECD COUNTRIES

Canada, South Korea, the United States, Japan, the European Union
(including Germany, Finland, France, the United Kingdom, and Sweden)
and **Non-OECD Countries**

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Introduction

This report, and its appended documents is the update of the November 2005 edition of the study Research and Development in Information and Communication Technologies (ICT) in the Major Industrial Countries: Statistical Analysis of Investments, Regulatory and Tax Aspects, and Competitiveness Indicators. The earlier edition was also an update of a study conducted for the Strategic Advisory Board on Information Technologies (CSTI, *Conseil Stratégique des Technologies de l'Information*) in 2003.

The purpose of the updated consolidation of the statistical base is threefold:

1) Compile an estimate of private and public ICT R&D investments volumes and trends in the major industrialised countries, which is as broad, as fine-tuned and as updated as possible.

2) Consolidate the methodology that was designed during the previous years to estimate ICT R&D investments as accurately as possible. It should be pointed out that compiling a comparative ICT R&D database, with broad geographic coverage (9 studied countries) from the series published by national or international statistical institutes (series that have not been designed for this type of assessment) poses formidable methodological problems. Reliable data can only result from an iterative process, reflected in the two previous studies. Using the iterative process, methodological difficulties are gradually apprehended and hypotheses are fine-tuned, thus lowering the uncertainty of the *reasoned estimates* underlying our analyses. **Indeed the figures in this report should absolutely not be confused with direct statistical measurements (that are produced by sample surveys, for instance).** Even – indeed mainly – when the data provides specific orders of magnitude (primarily monetary units), the data in this report are not direct measurements but indicators, even if they obviously meet the requirements that ensure that the **indicators** have a meaning in terms of 'intelligibility tools' and analysis supports.

For want of any other possible approach, the figures have been entirely built on a "set of hypotheses" based on a pre-existing statistical base, i.e., the R&D data corpus developed by the OECD and its member countries, within a standardised methodological framework. **The implicit goal of this study has been to reduce the uncertainty of 'indicator' data. Thanks to these efforts, residual uncertainty would only be about 15% of the displayed magnitudes.** However, as the uncertainty impacts all the studied countries in the same way and to the same extent, it does not affect country ranking or observed trends over a 7-year period (2000 to 2006).

The methodological complexity may be simply illustrated by the question regarding the scope of the study. What does one '*Information and Communication Science and Technologies*', the sector for which R&D investment is being measured, actually mean? The only standardised international definition is based on a set of OECD papers and defines the ICT sector using 5 activity codes taken from United Nations' international ISIC/ICTI3 activity classifications. The activities that make up the ICT sector, as defined by OECD definition, are:

- Division: 30 **–** Manufacture of office, accounting and computing machinery

- Division: 32 **–** Manufacture of radio, television and communication equipment and apparatus

- Division: 33 **–** Manufacture of medical, precision and optical instruments, watches and clocks

- Division: 72 **–** Computer and related activities

- Division: 64 **–** Post and telecommunications, group 642 – Telecommunications.

The first three divisions mainly pertain to the manufacturing industries and the two last to the service industries.

The codes and their subdivisions are far from providing a full description of today's entire ICT field, and therefore the extent of ICT R&D is not fully defined either. Some ICT R&D sectors, and specifically anything related to 'embedded' digital control applications, are excluded from the OECD field of definition. Likewise, software R&D that is not conducted by software and computing services companies, software package publishers' R&D (except in the US case), and the ICT R&D activities of independent engineering firms are not included in our approach due to the limits inherent to the OECD definition. Whatever the obvious limits of the definition, we would fail our purpose if we strayed outside the scope of the definition. *Without consistent entrenchment in a well-tested comparative statistical base (namely the OECD "R&D" series), this type of study would have no chance of succeeding,* given that the methodological traps of international statistical comparisons are treacherous indeed.

More than the issue of defining the ICT sector, which delimits the scope of the study, the true methodological difficulty of this intellectual undertaking has turned out to be, *within the same analysis framework, the tricky 'reconciliation' of the data series on BERD (business-enterprise expenditure on R&D) that refer to activity classifications (however unsatisfactory) with the data series on public funding that are currently broken down into large-scale socioeconomic targets (defence, the environment, energy, and so on). Currently available national or international statistical series can in no way directly solve this contradiction.*

One of the paradoxes highlighted by the study is that, whereas statistics (as the etymology of the term so informs) help devise the best policies for a given sector (here, the support to ICT), the statistical analysis of budget appropriations for R&D has even less appropriate frames of reference that the statistics on private R&D funding do.

The detailed methodological note, which is included in this report (see appendixes), points out that the improvement of statistical measurement instruments for R&D and innovation in general, and ICT R&D in particular (improvement that the statistical organisations themselves would like to see) runs into considerable operational as well as political constraints that an isolated limited approach cannot overcome.

Last, in our study, the monetary values are expressed in PPP$ (dollar at parity of purchasing power). Indeed international comparisons must be based on an approach using the parity of purchasing power and not on nominal currency units (dollars or euros) and take into account the real strength of a currency. Ideally, it would be preferable to refer to data in constant monetary units (so that comparisons are not affected by an inflation gap) or to reprocess the data and cancel out the effects of currency exchange. This was not done because reprocessing the data is too complex. In fact, most of the OECD comparative statistical series are in dollars at parity of purchasing power (PPP$) as the measurement is considered as reliable enough for establishing sound comparisons. As this is a study designed for a French and European public, the discriminating reader might remark that monetary units expressed in euros at parity of purchasing power would have been preferable. This was not possible because, to our knowledge, Eurostat does not publish conversion tables to switch from data expressed in any current monetary unit to data in PPP€ for long statistical series (our series covers 2000 through 2006) and within a broad geographic framework (which would take into account countries such as South Korea and Canada that are examined in our study). Therefore, the OECD conversion tables between local currencies and PPP$ that have been published for many years and for more than 25 countries are the only possible foundation for expressing data *at parity of purchasing power*.

The October 2003 study had a part on tax incentives for R&D in general and for ICT R&D in particular. The update of this part was not on the agenda for the 2005 and 2006 editions. And yet the general table of tax incentives keeps changing. The French case is a case in point with its far-reaching changes of the tax credit rules applying to business R&D, in 2004. It should be pointed out that tax credits and variations thereof are major instruments of the public effort for ICT R&D, in some cases. In 2003, we estimated that this form of indirect public funding, i.e., ***tax relief, accounted for more than a third of direct budget appropriations for the ICT R&D in the United States and for more than 43% in Canada.*** When reading this study, one should keep in mind that the measurement of direct investment in ICT R&D is but an *approximate measure* of a nation's overall effort for ICT R&D. In 2003, we did point out a fact (that was still true in 2005) that tax incentives *widened* the performance gaps between the public funding for R&D (compiled for this study) of the different developed countries and never narrowed it. Most of the observations in this study are, therefore, valid even without the update of the part on 'tax and regulatory aspects' in the October 2003 study.

The data in this study are affected by two major albeit conflicting factors.

- The first factor is purely methodological. The OECD statistical apparatus, which serves as the starting point for our measurements, keeps changing. Whereas the R&D of service activities (except for the United States and France) could only be roughly measured based on the statistics published in 2003, the analysis of this sector can be fine-tuned based on the 2005 and 2006 series. This has entailed a re-evaluation of the ICT R&D effort for some countries (Japan and the United Kingdom).

- The second is linked to a structural factor. Since 2000, global companies, and specifically Anglo-Saxon firms, have been relocating R&D activities to countries (India and China) with low-cost intellectual labour. ICT firms are spearheading this R&D internationalisation policy. As a result, the ICT R&D of these firms is harder to apprehend via OECD series. Indeed the BERD (business-enterprise expenditure on R&D) that we have relied on (see methodological note) to measure the ICT R&D financed by business is primarily 'contract-based' data and, true to its name, a measurement of the R&D effort within the scope of a given country. Thus, business funding for R&D is underestimated when a considerable share of business research activities is conducted abroad. Admittedly, the business-financed R&D that is performed in a third country should be mirrored in the OECD statistics on the performing country under the heading 'business-performed BERD financed by abroad'. However, analysing this item so as to allocate the relevant share of R&D financed by business in a given country to the said business is not possible as things now stand with statistics. Also, the countries where the relocated R&D is performed (India, China, Taiwan, Singapore and Israel) are still outside the design framework of OECD statistics. Potentially, the R&D relocation factor, which is slated to grow, may have a substantial impact on our data. Relocation certainly has a decisive impact on the drop (at a pace of 2% per year) affecting the R&D volumes of US business, reported in our study.

Regardless of its limitations, this report asks questions that were already framed in 2003 and 2005 and they deserve further study. We shall mention a few.

- What are the eventual economic, geopolitical, and societal consequences of the overwhelming and growing dominance of the United States in ICT R&D?

- Europe has now been left behind whereas its human potential marks it as a virtual "major power" in ICT R&D. Thus, on the scale of a continental economy, can Europe gather its scattered R&D efforts together and harness them to an industrial project with growth potential, as countries as different as Finland and South Korea have managed to do?

- Can the non-optimum equilibrium between public funding and private funding be improved in Europe, and in France particularly, and if so, with what leverage?

- What policies, which would use the appropriations resource sparingly and bank on an array of direct and indirect support, are likely to trigger a virtuous circle where current R&D effort for ICT would guarantee tomorrow's market shares and geopolitical autonomy, in France and in Europe?

This study does not claim to answer these questions, merely ask them. They are grounded in diagnostics that are based on data reflecting orders of magnitudes and trends fairly well, in an international comparative framework. Our goal will be reached if this study spurs the far-reaching discussion that its conclusions urge, a discussion that doesn't quibble about the figures but uses them as key input.

1. Summary of the Data for the Major Economic Zones of the ‘Triad’:

the United States, Japan, and EU-25

1.1. Sharply different ICT R&D intensity between Europe, Japan, and the United States

One important fact (which was raised in the earlier studies) remains patently topical. Whatever parameter is used to measure the intensity of ICT research and development, the gap between the European Union of 25 member countries (EU-25) and the two other major economic zones (Japan and the United States) of the triad is very wide, with Europe – where ICT R&D intensity is relatively weak – on one side and Japan and the United States – where ICT R&D intensity levels are comparable – on the other. In ***absolute value*** (see table 1.1 and indicator 1.1 below), ***total ICT R&D investment on US soil (PPP$ 70.8 billion in 2005) amounted to 2.2 times the reported investment for EU-25*** (PPP$31.9 billion in 2005). Furthermore, whereas Europe was slightly ahead of Japan until 2001, it now lags behind Japan (with a gap to the order of PPP$3 billion) for total ICT R&D volume. The gap between Europe on the one hand, and the United States and Japan, on the other, is also very clear if one looks at two ICT R&D *relative intensity* parameters.

Thus, comparing the ratio of *'Total expenditure on ICT R&D as a % of GDP'* (see indicator 1.2. below) highlights a blatant intensity deficit to the detriment of EU-25. In 2004 (latest actual data, not estimates), the ratio was 0.56% for the United States and 0.84% for Japan whereas it was a mere 0.25% for EU-25. ***The ICT R&D effort as a % of GDP in the United States and in Japan is more than twice as high as in Europe.*** Furthermore, the gap is widening since, in 2000, the same figures were 0.83% for Japan, 0.69% for the United States, and 0.32% for EU-25.

The intensity gap to the detriment of EU-25 is also very striking when looking at the indicator for *'Total Expenditure on ICT R&D per capita population (PPP$)'* (see indicator 1.3. *infra*). ***This figure stands at PPP$244.6 per capita in the United States and at PPP$248.7 per capita in Japan, meaning that the two countries invest nearly three times more than the EU-25 does (PPP$79.6 per capita).***

Table 1.1. – Total ICT R&D investment (million PPP$)

	2000	2001	2002	2003	2004	2005	2006
United States	67,280	69,432	67,302	67,953	69,675	70,792	71,213
Japan	27,298	28,779	30,146	30,132	31,635	33,389	34,150
Europe	32,069	34,734	29,565	27,319	30,214	31,973	31,973

Indicator 1.1. – Total ICT R&D investment

Total ICT R&D investment)
(billion PPP$)

The United States
Japan
Europe

Indicator 1.2. – Total expenditure on ICT R&D as a % of GDP

Total expenditure on ICT R&D as a % of GDP

The United States
Japan
Europe

1.2. A sharper difference for ICT R&D than for Gross Domestic Expenditure on R&D (GERD)

Of course, a share of the ICT R&D investment intensity difference reflects the often-underscored gap in the overall R&D effort between the United States, Japan, and EU-25. ***However, the difference between the three zones is much sharper for the reported ICT R&D gap than for overall R&D*** (see tables 1.2 and 1.2-A *infra*).

Indicator 1.3. – Total expenditure on ICT R&D per capita population

Total expenditure on ICT R&D per capita population (PPP$)

The United States
Japan
Europe

The examination of the indicator for "Gross Domestic Expenditure on R&D per capita" shows that, in 2005, the United States spent twice as much on R&D per capita, inclusive of all sectors, than EU-25 did. That same year, the United States spent nearly three times more on ICT R&D per capita than EU-25 did. In other words, **whereas the R&D intensity difference (measured by expenditure per capita) is in favour of the United States by a 1:2 ratio, for ICT R&D the ratio stands at more than1:3**.

The same is true, albeit slightly attenuated, when comparing EU-25 with Japan. In 2005, Japan's gross domestic expenditure on ICT R&D per capita was 3.12 times more than EU-25's gross domestic expenditure on ICT R&D per capita.

Table 1.2. – GERD in the USA and GERD in Japan compared to GERD in EU-25
(calculation based on gross domestic expenditure on R&D per capita population)

	2000	2001	2002	2003	2004	2005	2006
United States/EU-25 ratio	2.17	2.10	2.38	2.52	2.29	2.15	2.20
Japan/ EU-25 ratio	2.61	2.59	3.21	3.37	3.22	3.17	3.33

Table 1.3. – ICT GERD in the USA and ICT GERD in Japan compared to ICT GERD in EU-25
(calculation based on gross domestic expenditure on ICT R&D per capita population)

	2000	2001	2002	2003	2004	2005	2006
United States/EU-25 ratio	2.89	2.72	3.07	3.33	3.07	2.95	2.97
Japan/ EU-25 ratio	2.53	2.46	3.03	3.29	3.12	3.12	3.19

1.3. European 'Lag' Continues to Grow

Aside from the simple fact underscoring the very sharp difference in the R&D intensity effort of the ICT sector between three zones of the triad, the gap was clearly widening, still to the detriment of Europe, from 2000 to 2006. Indicators 1.4, 1.5, and 1.6 (see *infra*) illustrate this fact; with, however, an additional negative factor, i.e., that the gap with Japan, which was not apparent until 2001, is now very clear.

In absolute value, **from 2000 to 2006, the ICT R&D gap between the United States and EU-25 (indicator 1.4) jumped from PPP$35 billion to PPP$39 billion, peaking at PPP$41 billion in 2003, in favour of the United States.** When comparing the figures with Japan, the difference, which was still in Europe's favour through to 2001, swung the other way in 2002, with Europe falling to an estimated minus PPP$1.4 billion in 2005.

The analysis of the index clearly depicts the decline of Europe's situation compared to Japan's. Whereas for gross domestic expenditure on R&D (GERD) (inclusive of all sectors) the trend in the Triad countries was quite similar, for ICT R&D expenditure the United States and Europe moved at comparable paces (but starting from very different levels of absolute value), while Japan stepped up its R&D effort for ICT, going from index 100 to index 125.

Indicator 1.4. – ICT R&D investment gap

ICT R&D investment gap (billion PPP$)

USA/EU-15 gap
Japan/EU-15 gap

Indicator 1.5. – Index of GERD (inclusive of all sectors)

Index of GERD (inclusive of all sectors)

The United States
Japan
Europe

Indicator 1.6. – Index of ICT GERD

Index of ICT GERD

The United States
Japan
Europe

Notably, in the United States and in Europe, ICT R&D did not rise as quickly as GERD (inclusive of all sectors) whereas in Japan, the index of ICT R&D increase was in line with the rise of GERD (inclusive of all sectors). In Europe, ICT R&D was 35 points lower than the overall GERD index and in the United States 14 points lower. Therefore, the 'lag' between overall GERD and ICT GERD increases was quite patent in Europe. In the United States, it seems that the current growth driver of the national expenditure on R&D, which had long been fuelled by the ICT sector, is now life sciences.

1.4. Funding structure (relative share) is not the explanatory variable

In the three economic core-zones of the 'triad', direct business funding for ICT still accounted for more than 80% of total ICT R&D investment (in 2003, 78.7% in the United States; 84.7% in EU-25; 90.7% in Japan). *From 2000 to 2006 and in the three zones, because of its share in total funding, ICT R&D private funding was the decisive factor impacting the absolute value level and yearly increase of gross domestic expenditure on ICT R&D* (see chapter 1.6 *infra*). However, the relative share of private ICT R&D funding tended to dwindle while the relative share of ICT R&D financed by budget appropriations tended to grow, thus amplifying a trend that was already patent in the earlier studies.

Also, whereas European business contributed less than its US counterpart to gross domestic expenditure on R&D (with a 7 to 8 point difference), business-spending levels for ICT GERD were comparable in the United States (80% mean from 2000 to 2006) and in Europe (85% mean from 2000 to 2006).

Indicator 1.7. – ICT R&D funding structure in the United States

ICT R&D funding structure in the United States

% ICT R&D financed by the federal government and others
% ICT R&D financed by business

Indicator 1.8. – ICT R&D funding structure in Europe

ICT R&D funding structure in Europe

% ICT R&D financed by public funding
% ICT R&D financed by business

Indicator 1.9. – ICT R&D funding structure in Japan

ICT R&D funding structure in Japan

% ICT R&D financed by public funding
% ICT R&D financed by business

1.5. Business-financed ICT R&D

The absolute values (PPP$ billion) of private business investment in ICT R&D can be found in indicator 1.11 below. Whereas from 1997 to 2003, the figures for Europe and Japan were close, to the order of PPP$25 billion, the 2000 to 2006 series highlights the fall-off of European business (which allocated PPP$26 billion to ICT R&D in 2005) compared to its Japanese counterpart (which invested $PPP31 billion that same year). US figures ranged from PPP$53bn to PPP$59 billion (reported peak in 2001), i.e., consistently more than twice the reported figures for EU-25. This histogram is very similar to the one in indicator 1.1 that shows the absolute values of total ICT GERD. Their similarity can be explained by the fact that as business funding for ICT R&D accounts for the lion's share (from 80% to 90%), it sets the pace for the total investment in ICT R&D.

As is the case of total ICT R&D funding, the absolute value levels cover strong differences in relative intensity of business expenditure on ICT R&D, when measuring the intensity as a % of GDP or measuring it per capita of the studied country (ratio per capita, see values in table 1.4. below). The intensity gap between the effort of European business on the one hand, and Japanese or US business, on the other, is wide. European business's ICT R&D effort as a % of GDP was more than twice as low as the reported effort in the two other countries. And ICT R&D intensity per capita in Europe was three times lower.

Table 1.4 - Relative intensity of business ICT R&D in the United States

The United States

Business expenditure on ICT R&D	2000	2001	2002	2003	2004	2005	2006
Business expenditure on ICT R&D as a % of GDP	0.69%	0.69%	0.64%	0.62%	0.60%	0.57%	0.56%
Business expenditure on ICT R&D per capita (PPP$)	212	215	200	194	193	194	195

Japan

	2000	2001	2002	2003	2004	2005	2006
Business expenditure on ICT R&D as a % of GDP	0.64%	0.67%	0.71%	0.74%	0.76%	0.73%	0.68%
Business expenditure on ICT R&D per capita (PPP$)	199	208	218	216	225	238	243

EU-25

	2000	2001	2002	2003	2004	2005	2006
Business expenditure on ICT R&D as a % of GDP	0.24%	0.24%	0.26%	0.26%	0.26%	0.25%	0.22%
Business expenditure on ICT R&D per capita (PPP$)	75	81	66	60	67	72	72

The lower relative intensity of business ICT R&D is the explanatory factor for the reported differences between the United States, Japan, and EU-25. It partially reflects the different industrial structures in the three zones. In EU-25, the relative share of ICT business in total value added of the manufacturing industries was 52% lower than the reported share for Japan and 46% lower than the reported share for the United States, as can be seen in indicator 1.10 below.

Indicator 1.10. – Share of ICT sector value added as % of total business value added

Share of ICT sector value added as % of total business value added

Europe
Japan
The United States

The data in indicator 1.13 above also highlights this structural factor. Whereas the ICT R&D ratio of total R&D financed by business accounted for a 21% mean from 2000 to 2006 in EU-25, the ratio was 30% in the United States and 35% in Japan.

Indicator 1.11. – Total business ICT R&D investment

Total business ICT R&D investment (billion PPP$)

The United States
Japan
Europe

Indicator 1.12. – Yearly growth rate of business investment in ICT R&D

Yearly growth rate of business investment in ICT R&D

The United States
Japan
Europe

Indicator 1.13. –ICT R&D ratio of total R&D financed by business

ICT R&D ratio of total R&D financed by business

The United States
Japan
Europe

The data in indicator 1.14 below, which shows the difference in R&D investment between US and European business in 6 sectors, also highlights that the ICT R&D investment gap reflects industrial specialisations in the triad countries. The electronics and computing sector is the only one where the gap between the two economies is so huge, in the United States' favour.

Indicator 1.14. – R&D investment gap between EU-25 and the United States, by sector

R&D investment gap between EU-25 and the United States, by sector (2004, billion PPP$)

Aerospace & defence
Auto-making
Chemicals
ICT
Oil industry
Pharmaceuticals
Source: OECD, ANBERD database

As can be seen in indicator 1.15,[1] European ICT business is less 'R&D intensive' than its US and Japanese counterparts. This factor should be added to the different industrial structure factor that accounts for half of Europe's negative ICT R&D intensity gap versus the United States and Japan. Compared to the overall value of production of ICT firms, total R&D investment of the said firms

[1] Here the comparison is based on 2000 values because since 2001 the data in absolute values for industrial production have no longer been updated in the OECD databases. The ICT R&D / ICT production value ratio (indicator 1.15) may seem small. This can chiefly be explained by the fact that the turnover of ICT services (which includes telecommunications operators' very high sales figure) is included in production value. Because ICT service operators' R&D volumes are low, including the ICT services mechanically triggers a lower ratio in indicator 1.15. However, they have to be included if the consistency of ICT field, as defined by the OECD and used throughout this study, is to be maintained. However, it should be pointed out that if only the ICT manufacturing industries were taken into account when calculating the ratio, the resulting values would be: the United States: 14.7%; Japan: 10.2%: EU-25: 10.3%. Thus Europe's lag remains even if only the manufacturing industry is counted, even if Europe and Japan have the same figures.

accounted for 3.3% of the production value in the United States and Japan versus a mere 2.1% in Europe.[2]

Indicator 1.15. – Business expenditure on ICT R&D as a % of ICT production value

Business expenditure on ICT R&D as a % of ICT production value (2000 data)

The United States
Japan
EU-15

The product of both factors - the European economic structure's lesser industrial ICT specialisation and ICT firms' lower R&D intensity - accounts for Europe's above-mentioned negative gaps.

From the standpoint of the trend over time (yearly growth rate, see indicator 1.12), although business R&D evidences the same responsiveness to cyclical factors (investments curbed after the 'Internet bubble' burst) in the triad countries, the reported trends in each of the three zones reflects that cyclical related slowdowns are more blatant in Europe. In Japan, although the growth of business ICT R&D effort was still positive (except in 2004 where it was nought), growth slowed steadily from 2000 to 2006. From 2000 to 2002, ICT firms' R&D in the United States slowed much more than it did in Japan, before levelling off at a minus 2% decrease per year.

Compared to the clear (downward) trends in the United States and Japan, the behaviour of European firms seems much more erratic. They apparently put the brakes down hard on ICT R&D investment during the poor 2002-2003 economic cycles and then clearly resumed their R&D effort. However, the growth gain from 1999 to 2005 was negative (-3% in seven years).

Overall, despite noteworthy differences in the reported trends for each of the triad countries, a new and important fact, which did not emerge in the previous studies, should be underscored, i.e., ICT firms' expenditure on R&D tended to level off in current terms (meaning an erosion in real terms, due to inflation) in the United States and in Europe and to rise in Japan. Although the remark is outside the scope of this study, it should be pointed out that the fall-off of the R&D effort coincides with a time when the margins of the ICT firms were under strong constraints. The amounts of expenditure on R&D seem to be locked into the 'operational profitability' variable.

Table 1.5. – Each triad zone's relative share of global business expenditure on ICT R&D

	2000	2001	2002	2003	2004	2005	2006

[2] This fact does not conflict with the statement in chapter 1.4 underscoring the similarity of funding structures, broken down into ICT R&D public funding and private funding, between Europe and the United States. Although funding structures are comparable in the two zones despite the lower R&D intensity in European ICT firms, public funding is also lower in Europe, as will be seen further down.

United States	49.4%	48.1%	45.8%	45.6%	44.4%	43.7%	43.2%
Japan	21.5%	21.3%	22.6%	22.8%	23.2%	24.0	24.0%
Europe	24.1%	24.7%	20.6%	19.0%	20.7%	21.6%	21.2%

The triad's slackened ICT R&D effort entailed a sharp decline of the United States and Europe's relative share of global business-financed ICT GERD. This factor confirms the hypothesis of business R&D's substantial relocation move to third countries with low-cost labour and of the build-up of business ICT R&D in countries (South Korea, etc) that do not belong to the triad. The eroding position of developed countries (not including Japan) is particularly clear in the United States that has lost 6.2 points of relative share and, to a lesser extent, in Europe that has lost 2 points whereas on the contrary Japan (due to its competition/collaboration with South Korea?) has managed to increase its relative share by 2.5 points.

The analysis can be fine-tuned by studying the index of the financial envelopes that the firms in each of the three zones have allocated to their ICT R&D. The index trend is compiled in table 1.6 below. The decline of the United States and Europe's relative global position is linked to the eroding investment of their firms in ICT R&D. Over seven years (1999 to 2005), European ICT firms' R&D volumes dropped from index 100 to index 97, US ICT firms' R&D rose from index 100 to index 123 and Japanese ICT firms' R&D from 100 to 123. Combined with the reported decline of the United States and Europe's relative share of ICT R&D, the index-based analysis shows that the ICT R&D envelope financed by business in the United States and Europe is rising more slowly than the envelope of the reference frame (9 countries). It should be pointed out that the reference frame is limited to the countries covered by the study. The trend of the relative share of each country is measured against total private ICT R&D funding in the nine countries. ***The decline of the United States and Europe's relative share would undoubtedly be even greater if the reference frame (including countries such a India and China) was more closely tailored to the actual scope of the global economy.***

Table 1.6. – Index of business funding for ICT R&D

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
United States	100.0	103.0	96.8	94.9	95.3	95.8	96.4
Japan	100.0	105.0	109.9	109.3	114.4	120.8	123.2
Europe	100.0	108.7	89.0	81.0	91.0	96.9	96.9

1.6. Budget appropriations for R&D allocated to business

The above data compiles the R&D investment of ICT firms *financed by business own capital*. Budget appropriations for business performed (but not financed) ICT R&D should be added to business funding to measure accurately the ICT R&D controlled by the private sector. Here the comparison will only address the United States and Europe.[3]

In absolute value, US federal budget appropriations for R&D allocated to ICT firms soared to $8.5 billion from $5.6 billion, i.e., a 44% increase, from 2000 to 2006. Although the increase of this budget item slowed somewhat, budget appropriations for R&D allocated to US business were still very high and continued to increase. We shall see that the amount of 'defence' appropriations account for this fact. At the same time, European budget appropriations for ITC business research went from PPP$2.2 billion to PPP$2.4 billion, i.e., a 13.5% increase.

Indicator 1.16. – Budget appropriations for ICT R&D allocated to business

Budget appropriations for ICT R &D allocated to business (million PPP$)

The United States
EU-25

The index of budget appropriations for ICT R&D allocated to business jumped from index 100 to index 151 in the United States. In Europe, the index crept from 100 to 109 during this period. Not only was the rise lower, but also the index was not as steady in Europe where it dropped in 2002 and 2003.

Notably in the United States, the index of budget appropriations for ICT R&D allocated to business was much higher than the index of total US ICT R&D investment during this period (see indicator 1.6 *supra*). From 2000 to 2006, the total ICT R&D investment went from index 100 to index 106, i.e., 45 points less than budget appropriations for ICT R&D. The decoupling was even more striking between the positive trend of budget appropriations for ICT R&D allocated to business on the one hand, and the ICT R&D financed by business own capital, on the other. The latter dropped from index 100 to index 96 as was noted above (see table 1.6 *supra*). It is as if the steady strong increase of budget appropriations allocated to business was compensating for the decline of R&D investment financed by business own capital, in the United States. Given the strong reported correlation in the United States between 'military appropriations for ICT R&D' and 'budget appropriations for ICT R&D allocated to business' on the one hand, and the above-mentioned hypothesis that the relocation move partly explains the negative growth of R&D financed by business own capital on the other, one wonders whether our figures haven't captured *a twofold trend of the ICT R&D budgets of US business*, viz., 'current' non-strategic R&D that can easily be outsourced and/or relocated on the one hand, and strategic long-term R&D (massively parallel architectures, signal

[3] Public funding for R&D allocated to business is very low in Japan (less than 1% of total business expenditure on R&D, inclusive of all sectors) and especially low in the ICT sector (see chapter 3, analysis of Japan).

processing, bioinformatics, optronics, and so on) that is extensively financed by public procurement contracts, on the other. The increase of public support to business ICT R&D also explains the observable trend of the private-public structure of funding sources for ICT R&D in the triad (see indicator 1.7 *supra*). Only in the United States did the amount of budget appropriations grow in such proportions (from 14.3% to 21.9%) within this funding structure, from 2000 to 2006.

At the same time, in Europe, budget appropriations for ICT R&D allocated to business went from index 100 to index 109, viz., slightly higher than the trend of total R&D that remained at an index level oscillating around 100 and than the trend of the 'ICT R&D financed by business own capital' (that fell to index 97 from index 100). Whereas in Europe budget appropriations for ICT R&D allocated to business 'go with the flow' of budget appropriations for R&D, in the United States, federal appropriations clearly replace/complement US business's ICT R&D effort.

Indicator 1.17. – Index of budget appropriations for ICT R&D allocated to business

Index of budget appropriations for ICT R &D allocated to business

The United States
EU-25

The above fact is mirrored in the growing share of budget appropriations in total US business-performed (and not merely financed) ICT R&D from 1999 to 2005 (see table 1.7 below). The relative share of federal appropriations in overall volumes of US business performed ICT R&D went from 10.5% to 13.2%, i.e., a 2.7% gain in relative share. From 2000 to 2006, the relative share of budget appropriations in total volumes of European business performed ICT R&D levelled off overall, going from 8.4% to 8.2%, and slumping in 2000-2001.

Table 1.7. – Share of budget appropriations for business performed or outsourced ICT R&D

	2000	2001	2002	2003	2004	2005	2006
United States	10.5%	11.0%	12.8%	13.2%	13.2%	13.2%	13.2%
Europe	8.0%	8.2%	8.5%	8.5%	8.5%	8.5%	8.5%

1.7. Trend of budget appropriations for R&D allocated to the ICT sector: the United States, Japan, and EU-25

The absolute values of budget appropriations for ICT R&D (wherever it is performed) are shown in indicator 1.18 below. The ranking between the triad countries is different than overall ICT R&D investment or business investment. Japan ranks last for the amount of budget appropriations for ICT R&D, which reflects the relative weakness of budget appropriations for research allocated to technologies for industrial purposes.[4] The reported levels are 1.8 times lower for this indicator in Japan than they are in Europe. However, EU-25 in turn lags behind (ratio to the order of 1:3) the United States (although the size of their economies are comparable).

Indicator 1.18. – Budget appropriations for ICT R&D

Budget appropriations for ICT R &D (billion PPP$)

The United States
Japan
Europe

In the United States, the publicly funded R&D effort in the ICT sector is also growing much faster than it is in Japan, and even faster, in EU-25. The index of the volumes of ***budget appropriations*** for ICT R&D in the US soared to index 164 from index 100 from 1999 to 2005, jumped from index 100 to index 146 in Japan, and from index 100 to index 120 in EU-25. Notably within the triad, the budget appropriations for ICT R&D grew faster than total ICT R&D investment in the United States (going from index 100 to index 113) and in Europe (going from index 100 to index 111). However in Japan, although the ‘budget appropriations’ item picked up speed, it was more in line with the trend of total ICT R&D investment (going from index 100 to index 127) as well as with investment financed by business own capital (going from index100 to index 126).

In Europe, the increase of the ‘budget appropriations for ICT R&D” item was slightly higher than gross domestic expenditure on R&D (the former reaching index 127 and the latter index 120, at the end of 2006) and was much higher than the increase of the ‘ICT R&D financed by business own capital’ item (at index 108 at the end of 2006). To a lesser extent than in the United States but very

[4] The only noteworthy exception is the space industry.

clearly all the same, in Europe the increase of budget appropriations provided support to overall ICT GERD despite the limited rise of ICT GERD financed by business own capital.

Table 1.8. – Index of total budget appropriations for ICT R&D (inclusive of all performance sectors)

	2000	2001	2002	2003	2004	2005	2006
United States	100.0	104	120	140	157	164	164
Japan	100.0	110	116	123	133	139	146
Europe	100.0	106	115	115	118	120	120

The different increase rates of public expenditure on ICT R&D in the United States and Japan, which was consistently more dynamic that the increase of R&D funds from the private sector in these countries, perhaps mirrors pro-active public policies that take account of the long-term stakes involved in ICT R&D.

Although this fact is true in the United States and in Japan, the ‘interactions’ between publicly funded ICT R&D and privately funded R&D are, however, radically different. Whereas direct support to business ICT R&D provided by federal funds is high (see *supra*), it is inexistent in Japan, at least as contract and monetary flows.

The gap between public investment in R&D (inclusive of all sectors) in the United States and in Europe was consistently in favour of the United States and went from 2.5 to 36.3, from 2000 to 2006 whereas the gap between budget appropriations for ICT R&D in the United States and Europe did increase, but only by a factor of 1 to 2. *Unlike what was observed in 2003, the gap between Europe and the United States is now widening faster in the area of overall public effort for R&D than in the area of public support to ICT R&D.*

The gap between EU-25 and Japan is in favour of Europe, whatever the parameter. However, while the gap was fairly constant at about PPP$-1.7 billion for budget appropriations for ICT R&D, it is widening (by PPP$7 billion from 2000 to 2006) for total government budget appropriations or outlays for R&D (GBAORD). Japan’s budget effort to support ICT R&D remained level with Europe’s budget effort whereas the gap for total GBAORD between Japan and Europe tended to widen in favour of Europe.

Indicator 1.19. – Gap between budget appropriations for ICT R&D

Gap between budget appropriations for ICT R&D (billion PPP$)

USA/EU-25
Japan/EU-25

The 1:2 increase of the gap between budget appropriations for ICT R&D in the United States on the one hand and in Europe on the other can be explained by the fact that year after year the growth of budget appropriations is consistently higher in the United States than it is in Europe, as can be seen in indicator 1.20 below.

Although European budget appropriations for ICT R&D showed positive growth rates (except in 2003 where growth was nought) from 2000 to 2006, the growth rates of US budget appropriations (which also started from a much higher absolute value) were often higher. The already dramatic difference of absolute value reported in 1997 could only rise since the increase of US budget appropriations for ICT R&D was always greater than the reported increase for EU-25 from 2000 to 2006.

Importantly also, the growth of budget appropriations for ICT R&D was often higher in Japan than it was in Europe.[5]

Indicator 1.20. – Yearly growth rate of budget appropriations for ICT R&D

Yearly growth rate of budget appropriations for ICT R &D

The United States
Japan
Europe

1.8. Military appropriations in the Budget Outlays for ICT R&D: a key factor of ICT R&D volumes financed by public funds

The analysis of budget appropriations for ICT R&D can be further fine-tuned by distinguishing civil appropriations on the one hand and 'defence' appropriations on the other. This approach presents the advantage of highlighting that the reported gap between the total volume of budget appropriations for ICT R&D in the triad countries (with the United States clearly in the lead) can chiefly be explained by the incomparable amounts of US defence appropriations for ICT research funding, as can be seen in indicators 1.21 and 1.21-A below.

If only civil appropriations for ICT R&D were taken into account, ranking between the triad countries would be radically altered, i.e., with more than PPP$3.4 billion (2004 figure), Europe would leave the United States and Japan at the starting block. The US Administration's strong mobilisation on 'information society' issues as early as 1998 and 1999 entailed an ongoing, nearly

[5] That is why the index value of Japanese budget appropriations for ICT R&D jumped from 100 to 131 whereas the European index went from 100 to 115. In absolute values, this still does not mean that Japanese budget appropriations for ICT R&D have caught up with European budget appropriations as Japan started from a level twice as low as the reported EU-25 level for this parameter.

50% rise of civil appropriations for ICT R&D from 2000 to 2006, in the United States. For civil appropriations for R&D, EU-25's positive gap with the United States levelled off (at about PPP$1,500 million) from 2000 to 2006.

Indicator 1.21. – Civil budget appropriations for ICT R&D

Civil budget appropriations for ICT R &D

The United States
Japan
Europe

Indicator 1.21-A. – Military budget appropriations for ICT R&D

Military budget appropriations for ICT R &D (billion PPP$)

The United States
Japan
Europe

Notably, even Japan is ahead of the United States in the area of civil appropriations for ICT R&D.

The table is radically reversed if one looks at the trend of military appropriations for ICT R&D (indicator 1.21-A). Soaring to $11.9 billion in 2006 from $7.2 billion in 2000, Department of Defense appropriations for R&D were immeasurably greater than the reported defence appropriations in Europe. In 2005, military appropriations for ICT R&D accounted for nearly 84% of the US public effort for ICT R&D. It is the very size of the military appropriations for ICT R&D in the United States that is the primary factor underlying the reported gap between the volumes of budget appropriations for ICT R&D with the other triad countries.

This sharply underscores the fact that, in the United States, military appropriations are the main driver of public ICT R&D, a driver of unheard-of magnitude in any other country and probably in few other sectors.[6]

[6] The major role of military appropriations may be found only in the nuclear, aeronautics and space industries.

2. Comparison between the 9 countries

2.1. The United States and Japan's durable ascendancy, South Korea's build-up and Europe's relative decline

During the entire studied period, the ascendancy of the United States and Japan compared to any other national economy remained unchallenged in terms of the volumes of public and private funds allocated to ICT R&D. The ascendancy can be seen in the absolute value of ICT GERD (indicators 2.1 and 2.2, table 2.1) as well as in the relative value compared to the global expenditure on ICT R&D (indicators 2.3 and 2.3-A).

Indicator 2.1. – Volumes of total ICT R&D funding

Volumes of total ICT R&D funding (million PPP$)

The United States
Japan
South Korea
Germany
France
Canada
The United Kingdom
Finland
Sweden
EU-25

Table 2.1. – Global investment in ICT R&D in the 9 countries

Unit: million PPP$

	2000	2001	2002	2003	2004	2005	2006
United States	67,280	69,432	67,302	67,953	69,675	70,792	71,213
Japan	27,298	28,779	30,146	30,132	31,635	33,389	34,150
South Korea	7,279	8,881	9,450	10,561	12,433	12,876	13,429
Germany	7,970	9,039	8,971	8,855	9,175	9,496	9,756
France	6,679	7,375	7,911	7,381	7,468	7,499	7,611
Canada	5,976	5,873	5,449	5,081	5,244	5,305	5,696
United Kingdom	4,928	5,358	5,826	5,510	5,234	5,378	5,443
Sweden	2,936	3,281	3,030	2,613	2,858	2,934	3,055
Finland	2,060	2,118	2,230	2,422	2,565	2,585	2,659
Total	*132,405*	*140,137*	*140,315*	*140,509*	*146,288*	*150,255*	*153,012*
EU-25	32,069	34,734	29,565	27,319	30,214	31,973	31,973

However, the noteworthy fact for the period, as seen in the table of the changing index (2000=100) of total expenditure on ICT R&D in a given country (table 2.2 below) is perhaps the different trends within the group of the 9 studied countries.

Whereas from 2000 to 2006 and for all these countries, the index rose 16 points (going from 100 to 116), the index rose higher than the average rate in some countries. As was underscored in the previous reports, this was the case for South Korea (that went from index 100 to index 184) and for

Japan (that went from index 100 to index 127). However, the most relevant fact is undoubtedly that US ICT GERD (that went from index 100 to index 106) as well as the European ICT GERD (index oscillating around 100) did not rise as fast as it did in the reference frame (9 countries).

Table 2.2. – Trend of the ICT R&D investment index in each country

	2000	2001	2002	2003	2004	2005	2006
United States	100	103	100	101	104	105	106
Japan	100	107	112	112	117	124	127
South Korea	100	122	130	145	171	177	184
Germany	100	113	113	111	115	119	122
France	100	110	118	111	112	112	114
Canada	100	98	91	85	88	89	95
United Kingdom	100	109	118	112	106	109	110
Sweden	100	112	103	89	97	100	104
Finland	100	103	108	118	125	125	129
Together	*100*	*106*	*106*	*106*	*110*	*113*	*116*
EU-25	100	108	92	85	94	100	100

Table 2.3. – Trend of each country's relative share of global ICT R&D investment

	2000	2001	2002	2003	2004	2005	2006
United States	50.8%	49.5%	48.0%	48.4%	47.6%	47.1%	46.5%
Japan	20.6%	20.5%	21.5%	21.4%	21.6%	22.2%	22.3%
South Korea	5.5%	6.3%	6.7%	7.5%	8.5%	8.6%	8.8%
Germany	6.0%	6.5%	6.4%	6.3%	6.3%	6.3%	6.4%
France	5.0%	5.3%	5.6%	5.3%	5.1%	5.0%	5.0%
Canada	4.5%	4.2%	3.9%	3.6%	3.6%	3.5%	3.7%
United Kingdom	3.7%	3.8%	4.2%	3.9%	3.6%	3.6%	3.6%
Finland	2.2%	2.3%	2.2%	1.9%	2.0%	2.0%	2.0%
Sweden	1.6%	1.5%	1.6%	1.7%	1.8%	1.7%	1.7%
Total	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*
EU-25	24.2%	24.8%	21.1%	19.4%	20.7%	21.3%	20.9%

Several countries (Japan, France, and Germany) have values approaching the global mean (index 110). But Canada displays the most surprising trend with a total volume of ICT R&D dropping 5 points from 2000 to 2006. We could hypothesize that the downswing is perhaps due to a distinctive trait of Canada, i.e., until 2000 the country was an R&D outsourcing 'platform' for US firms in the ICT (and other) sectors. Canada's R&D volumes are thus determined by non-Canadian decision-making centres that are now relocating their R&D activities to countries with lower cost labour (the 2003 study highlighted that Canada's appeal for US business R&D was chiefly tied to the exceptional R&D tax relief effort deployed by the Canadian Federal government and the provinces). If this hypothesis were true, it would confirm the much-touted idea that R&D activities governed by outsourcing or relocation rationales are extremely fragile.

Indicator 2.2. – Trend of each country's relative share of ICT R&D

Trend of each country's relative share of ICT R &D (%)

The United States
Japan
South Korea
Germany
France
Canada
The United Kingdom
Finland
Sweden
EU-25

2.2. Economies where ICT R&D intensity is extremely variable

Table 2.4 below reveals another important fact, viz., ICT R&D intensity (total expenditure on ICT R&D as a % of GDP in a given country) sharply varies within the nine countries: by a 1:5.5 ratio between the country (the United Kingdom) with the lowest ICT R&D intensity and the country (Finland) with the highest.

Whereas the overall arithmetic mean was 0.72% in 2006, only 4 countries (Finland, South Korea, Japan, and Sweden) exceeded the mean. Except for the Scandinavian countries, all the European countries are less 'ICT R&D intensive' than the economy of the reference frame (9 countries). Not only did South Korea rank second for this intensity indicator but it was also the country that saw the fastest rise of its ICT R&D intensity indicator.

Table 2.4. – Total expenditure on ICT R&D as a % of GDP

	2000	2006
Finland	1.55%	1.55%
South Korea	0.95%	1.30%
Sweden	1.23%	1.04%
Japan	0.83%	0.84%
United States	0.69%	0.56%
Canada	0.69%	0.52%
France	0.43%	0.41%
Germany	0.37%	0.40%
United Kingdom	0.33%	0.28%
EU-25	0.32%	0.25%

2.3. A key explanatory factor: ICT R&D financed by private funds

Indicator 2.3 below shows the 1999-2005 trend of private ICT R&D funding. The indicator looks remarkably like indicators 2.1 and 2.2. This merely reflects the fact that, as in every major economy private ICT R&D funding accounts for more than 80% of total funding, private funding is the driver for all ICT R&D funding.[7]

Indicator 2.3. – Volumes of private funding allocated to ICT R&D

Volumes of private funding allocated to ICT R &D (million PPP$)

The United States
Japan
Germany
South Korea
France
Canada
The United Kingdom
Sweden
Finland
EU-25

[7] Funding from firms whose head office is in the given country or from firms whose head office is abroad, i.e., 'intramural' funding of ICT R&D in a given country regardless of the fund provider's nationality.

Table 2.5. – Volumes of business investment in ICT R&D

	2000	2001	2002	2003	2004	2005	2006
United States	57,683	59,413	55,849	54,732	54,951	55,280	55,612
Japan	25,072	26,331	27,565	27,392	28,681	30,287	30,893
Germany	7,053	8,115	8,010	7,876	8,175	8,486	8,741
South Korea	6,629	8,140	8,620	9,678	11,480	11,788	12,235
France	5,791	6,380	6,843	6,257	6,313	6,263	6,326
Canada	5,676	5,572	5,136	4,754	4,904	4,943	5,324
United Kingdom	4,183	4,519	4,856	4,532	4,275	4,267	4,309
Sweden	2,815	3,158	2,874	2,425	2,672	2,739	2,851
Finland	1,911	1,964	2,067	2,257	2,387	2,398	2,461
Total	*116,814*	*123,592*	*121,820*	*119,902*	*123,839*	*126,451*	*128,752*
EU-25	28,139	30,583	25,052	22,797	25,593	27,265	27,265

Table 2.6. – Each country's relative share of global private ICT R&D investment

	2000	2001	2002	2003	2004	2005	2006
United States	49.9%	48.1%	45.8%	45.6%	44.4%	43.7%	43.2%
Japan	21.5%	21.3%	22.6%	22.8%	23.2%	24.0%	24.0%
Germany	6.0%	6.6%	6.6%	6.6%	6.6%	6.7%	6.8%
South Korea	5.7%	6.6%	7.1%	8.1%	9.3%	9.3%	9.5%
France	5.0%	5.2%	5.6%	5.2%	5.1%	5.0%	4.9%
Canada	4.9%	4.5%	4.2%	4.0%	4.0%	3.9%	4.1%
United Kingdom	3.6%	3.7%	4.0%	3.8%	3.5%	3.4%	3.3%
Sweden	2.4%	2.6%	2.4%	2.0%	2.2%	2.2%	2.2%
Finland	1.6%	1.6%	1.7%	1.9%	1.69%	1.9%	1.9%
Together	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*	*100.0%*
EU-25	24.1%	24.7%	20.6%	19.0%	20.7%	21.6%	21.2%

Notably, albeit clearly dominant the United States' share is dwindling fast. The relative share of ICT R&D financed US business own capital accounting for 49.4% in 2000 (and for 50% in 1998) declined steadily from 2000 to 2006, down to 43.2% (estimate) in 2006. It should be pointed out that, rather than a decline of US business ICT R&D, the United States' eroding relative share can probably be explained by the relocation rationale for some ICT R&D activities combined with the drive of private expenditure on ICT R&D in the countries (chiefly Japan and South Korea) for whom intramural performance of R&D is still the rule.

The index values for private funding (see table 2.7 below) clearly highlight the gap between countries where the trend of business financed (and intramural performed) ICT R&D is growing, and countries where it is stagnating. Whereas the parameter rose 10 points (going from index 100 to index 110) in all the studied countries taken together, in three zones (the United States, Canada and EU-25), the index fell, reflecting a decline in current value of the ICT R&D financed by business (i.e., an even sharper drop in real terms, if these figures were deflated). On the other hand, the trend in all the other countries was near the reported mean of the reference frame. Four countries clearly stand out from the rest in the area of increased expenditure on ICT R&D financed by private funds, viz. South Korea (going from index 100 to index 178), Finland (going from index 100 to index 125), Japan (going from index 100 to index 121), and Germany (going from index 100 to index 120). Germany's move to catch up is especially noteworthy given that, in the previous study, Germany belonged to the group of countries where private investment in ICT R&D was the lowest. France's performance is perfectly in line with the global mean (108). The fact that France has remained within the main group of studied countries for the 'ICT R&D financed by business' parameter seems to be a sign that the French business share of global volume of business financed ICT R&D in the developed economies has stopped declining.

Table 2.7. – Trend of the private ICT R&D funding index

Trend of the business financed ICT R&D index

Trend of the business financed ICT GERD index

	2000	2001	2002	2003	2004	2005	2006
United States	100	103	97	95	95	96	96
Japan	100	105	110	109	114	121	123
Germany	100	115	114	112	116	120	124
South Korea	100	123	130	146	173	178	185
France	100	110	118	108	109	108	109
Canada	100	98	90	84	86	87	94
United Kingdom	100	108	116	108	102	102	103
Sweden	100	112	102	86	95	97	101
Finland	100	103	108	118	125	125	129
Total	*100*	*106*	*104*	*103*	*106*	*108*	*110*
EU-25	100	109	89	81	91	97	97

2.4. Budget appropriations for ICT R&D reflecting policies that are more or less pro-active and more or less in touch with local industrial reality

The United States' dominant role is also very clear when looking at the other component of ICT R&D funding, i.e., budget appropriations. For this item, the United States' domination was even greater since no other developed country accounted for more than 15% whereas the United States accounted for 61% of the budget appropriations envelope at the end of 2006. Furthermore, the 'budget appropriations for ICT R&D' rose dramatically (index going from 100 to 164) in the United States, having reached exceptionally high volumes compared to the volumes of the other countries in the sample at the start of 2000.

Table 2.8. – Relative share of budget appropriations for ICT R&D

Trend of each country's relative share of total budget appropriations for ICT R&D

Trend of each country's relative share of total budget appropriations for ICT R&D

	2000	2001	2002	2003	2004	2005	2006
United States	58.0%	56.9%	58.6%	61.2%	62.7%	62.1%	61.0%
Japan	15.6%	16.2%	15.2%	14.4%	14.3%	14.2%	14.7%
Germany	6.4%	6.1%	5.7%	5.1%	4.8%	4.6%	4.6%
France	6.2%	6.6%	6.3%	5.9%	5.6%	5.7%	5.8%
United Kingdom	5.2%	5.5%	5.7%	5.1%	4.6%	5.1%	5.1%
Canada	4.6%	4.9%	4.9%	4.6%	4.6%	5.0%	5.4%
South Korea	2.1%	2.0%	1.8%	1.7%	1.6%	1.7%	1.7%
Finland	1.0%	1.0%	1.0%	0.9%	0.9%	0.9%	0.9%
Sweden	0.8%	0.8%	0.9%	1.0%	0.9%	0.9%	0.9%
EU-15	27.5%	27.4%	26.5%	23.8%	22.3%	21.5%	21.2%

Europe's relative position for budget appropriations was in line with its position for total funding since the EU-25 budget appropriations effort accounted for one-third of the United States' effort. However, Europe share of total funding accounted for 40% of total ICT GERD in the United States and for 41.2% of business-financed ICT R&D. Europe's relative share of the total envelope of budget appropriations for ICT R&D accounted for 0.28:1000 in 2000 and for 0.21% at the end of 2006.

Europe's relative position declined despite the drive of budget appropriations for ICT R&D from 2000 to 2006. The upswing did not, however, enable Europe to catch up with the United States since the envelope of US federal budget appropriations for ICT R&D rose at an even faster pace.

Whereas in 2000 France was on much the same footing as Germany, it widened the gap by nearly PPP$250 million with its German neighbour, ranking third worldwide (behind the United States and Japan) for the volumes of public funding for ICT R&D at the end of 2006.

Despite the country's sustained effort from 2000 through 2005 (the index rose from 100 to 139, during that time), France's relative share of the overall envelope of budget appropriations for ICT R&D levelled off at 0.61:1000. During that time, US budget appropriations grew at such a pace that the United States was the only country to register an increase and improve its relative position for this indicator whereas every other country's relative position remained stable, on the whole.

In the case of the United States, the gap between the rise (+7%) of the country's relative share of public ICT R&D funding and the drop (-12.5%) of its relative share of private funding is very striking. It is as if the inflation of budget appropriations for R&D is compensating for the deflation of private ICT R&D funding.

Indicator 2.4. – Volumes of budget appropriations for ICT R&D

Volumes of budget appropriations for ICT R &D (million PPP$)

The United States
Japan
Germany
France
The United Kingdom
Canada
South Korea
Finland
Sweden
EU-25

Table 2.9. – Volumes of budget appropriations for ICT R&D (million PPP$)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
United States	8,282	8,616	9,959	11,628	12,993	13,559	13,559
Japan	2,225	2,449	2,582	2,740	2,954	3,102	3,257
Germany	917	924	961	979	1,000	1,011	1,015
France	887	996	1,068	1,124	1,155	1,236	1,286
United Kingdom	745	840	969	978	958	1,111	1,134
South Korea	650	741	830	883	953	1,088	1,194
Canada	300	301	313	327	340	362	372
Finland	149	154	163	165	178	187	198
Sweden	121	122	156	188	186	196	204
Total	*14,276*	*15,142*	*17,000*	*19,014*	*20,718*	*21,852*	*22,219*

EU-25	3,930	4,151	4,513	4,522	4,621	4,708	4,708

Table 2.10. – Trend of the index of budget appropriations for ICT R&D (million PPP$)

	2000	2001	2002	2003	2004	2005	2006
United States	100	104	120	140	157	164	164
Japan	100	110	116	123	133	139	146
Germany	100	101	105	107	109	110	111
France	100	112	120	127	130	139	145
United Kingdom	100	113	130	131	129	149	152
South Korea	100	114	128	136	147	167	184
Canada	100	100	104	109	113	121	124
Finland	100	103	109	111	119	126	133
Sweden	100	101	129	155	154	162	169
Total	*100*	*106*	*119*	*133*	*145*	*153*	*156*
EU-15	100	106	115	115	118	120	120

The gap between the reported trend of each country's relative share of total ICT R&D financed by private funds on the one hand, and by public funds on the other, can be explained by the fact that, to different degrees, the public administrations are rolling out pro-active ICT R&D policies through instruments special to each country.

2.5. Budget appropriations for ICT R&D allocated to business

The size of US public support to ICT R&D hugely benefits US-based firms, in proportions unmatched elsewhere, in absolute value, of course, but also and chiefly in relative value.

Indicator 2.5 vividly depicts the size of budget appropriations for ICT R&D allocated to the US industrial structure, appropriations that soared from 1999 to 2005 after an already dramatic increase the years before. In this case, the size of military appropriations was decisive.

Indicator 2.5. – Trend of budget appropriations for business-performed ICT R&D

Trend of budget appropriations for business-performed ICT R &D

The United States
Japan
South Korea
Germany
France
Canada
The United Kingdom
Finland
Sweden
EU-25

For this parameter (volume of public funds invested in ICT R&D and allocated to business), France ranked second, Germany third and the United Kingdom fourth (see table 2.11).

Table 2.11. – Volumes of budget appropriations for ICT R&D allocated to business

	2000	2001	2002	2003	2004	2005	2006
United States	5,641	5,764	5,196	6,213	6,904	7,106	8,510
Japan	434	374	420	389	378	399	407
South Korea	499	717	589	542	566	581	603
Germany	487	544	497	480	499	518	533
France	623	686	736	673	679	673	680
Canada	125	155	137	127	131	132	142
United Kingdom	404	441	349	554	475	474	479
Finland	69	71	73	77	81	82	84
Sweden	170	190	173	149	175	175	177
Europe	2,210	2,371	2,212	2,006	2,252	2,399	2,399

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