RESEARCH AND DEVELOPMENT IN INFORMATION SCIENCE AND TECHNOLOGY IN LARGE INDUSTRIALISED COUNTRIES

STATISTICAL ANALYSIS OF INVESTMENTS

SUMMARY REPORT

Canada, South Korea, the United States, Japan, the European Union, including Germany, Spain, Finland, France, Italy, the Netherlands, the United Kingdom, Sweden

October 2005

A study commissioned by the

Ministère délégué à l'enseignement supérieur et à la recherche

(French Ministery for Research and Higher education)

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M.V. Études et Conseil

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Conseil stratégique des technologies de l'information (CSTI)

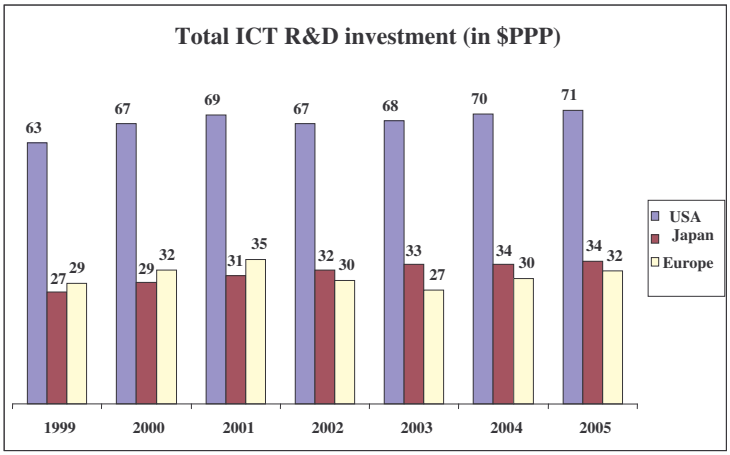
(French Government Strategic Committee on ICT policies)

Notes to the following figures and comments:

- **all monetary values are expressed in $ PPP** (dollar at purchase power parity), a conventionnal unit which allows to compare monetary agregates between various countries, without distortions induced by the differences in purchase power. Tables of conversion between the local currency and the $ PPP are established by the OECD Statistics Directorate on a yearly basis.

- **When refering to European Union, we intend the European Union of 15 member** states, not the European Union of 25 member states which exists since 2005, with the full inclusion within the EU of 10 new member states.

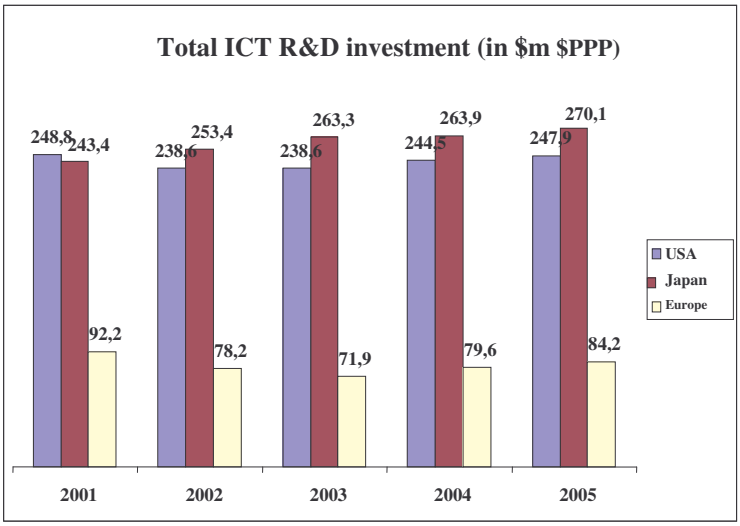
1 – In absolute value, ICT R&D investment in the United States is twice that of Europe and Japan



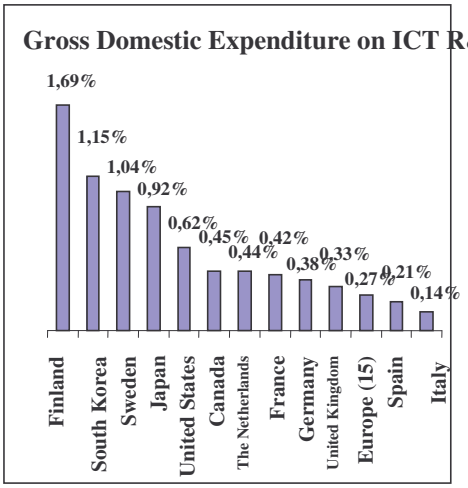
➔ In absolute value, the total investment in **ICT R&D in the United States** ($63 bn in 1999, **$71 bn in 2005**) is **consistently twice that the one in Europe** (15 members) ($29 bn in 1999, **$32 bn in 2005**)

Between 1999 and 2005, the gap between the United States and Europe increased by over 13%.

2 – In relative figues, Europe is three times less "ICT R&D intensive" than Japan and the USA in terms of R&D expenditure per inhabitant, and two times less if R&D is expressed as a percentage of GDP



➔ **Japan and the United States spend between $230 and $270 per inhabitant in ICT R&D, as against about $72 in the European Union (2003 data).** Moreover, while this expenditure per head rose in the United States and in Japan between 1999 and 2003, in Europe the 2005 value for this parameter is inferior to the 1999 value ($92). The same divergence can be observed for the **ICT R&D ratio with GDP but here the relation is 1 to 2 between Europe and the two other global economies.**

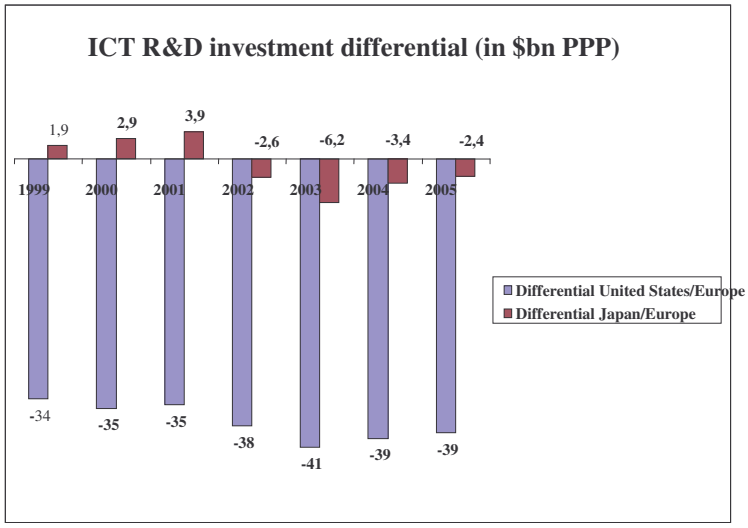


➔ When expressed as a fraction of GDP, the ICT R&D investment ratio differs greatly from one country to another, particularly within Europe: whereas the average European ratio is low (0,27%), Finland (1,69%) or Sweden (1,09%) ranks among the 3 countries which have a ratio higher than 1%, above the ratio noted in countries like Japan or the USA. Europe appears as a very heterogeneous area, as far as the "ICT R&D intensity" is concerned.

3 – The gap between Europe and the USA is greater for ICT R&D investments than for R&D as a whole

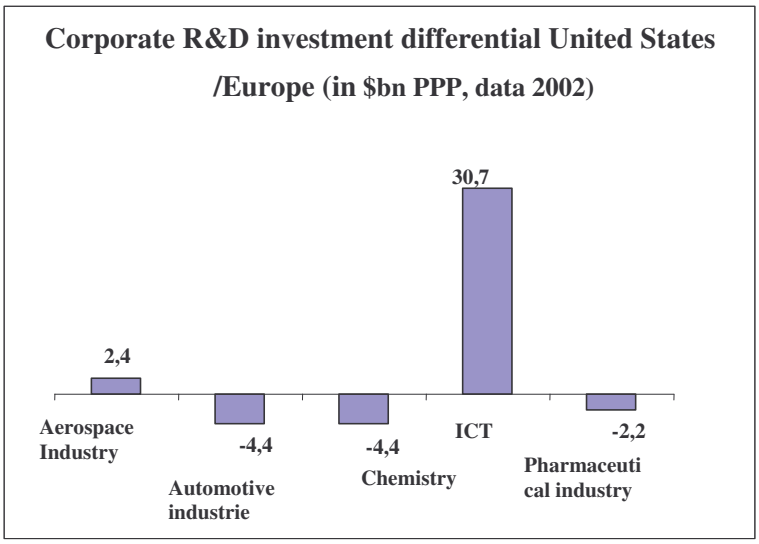
➔ There is a greater gap between the United States, Europe and Japan at the level of the ICT R&D differential than the gap existing is for R&D as a whole. The intensity differential (measured in expenditure per inhabitant) is 1 to 2 in favour of the United States for overall R&D. It is 1 to 3.3 for ICT R&D. The same can be observed when Europe is compared with Japan.

4 – The gap in ICT R&D expenditure is widening between Europe and the two other global economies



➔ The differential between American and European investments in ICT R&D is gradually widening, since in absolute figures it has **grown from –34 to –39 billion dollars.** The difference between Japan and Europe was positive in favour of Europe in 1999 ($1.9 bn), it has become negative since 2002 and the estimated value is $-2.4 bn in 2005.

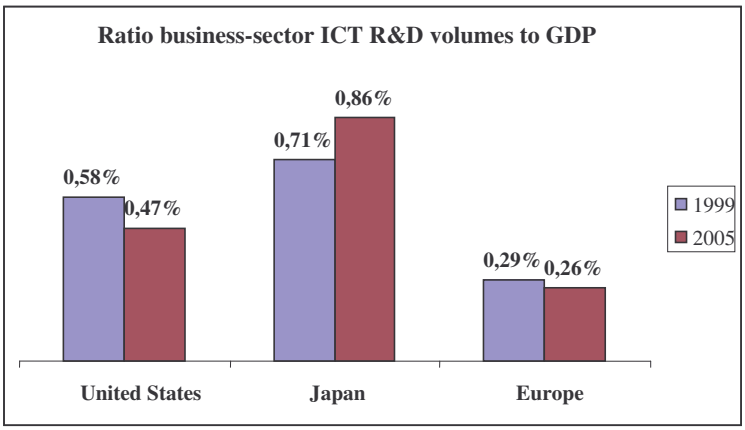
5 – ICT R&D is the only sector in which such a huge difference can be observed between Europe and the USA.



➔ **In no other industrial sector such a huge negative difference can be observed**, despite the fact that ICT are "empowering technologies" which have a direct impact on performance in all sectors of activity.

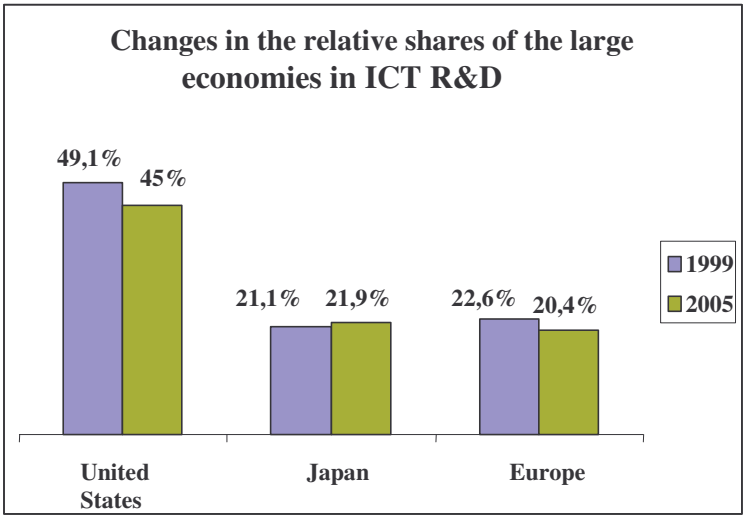
Moreover it should be noted this hierarchy in the balance of R&D investments is a fairly accurate reflection of the external trade balance between Europe and the USA.

6 – Insufficient investment in ICT R&D by European companies as a whole is the main factor behind these differences.



➔ The structure of investment in ICT R&D in the United States closely resembles that of Europe, with private sector spending amounting to 82% as against 18% for governement spending. In Japan State subsidies is even lower. However, despite the similar structures, European businesses invest two times less in ICT R&D than those in the United States, and three times less than Japanese businesses.

7 – Japan and the emergent countries are the main beneficiaries of the erosion of the European and American shares of global investment in ICT R&D



➔ The fall in the relative share of total investment in ICT R&D between 1999 and 2005 is significant (4,1 points loss) for the Unites States and Europe (-2.2 points). Japan increases slightly its relative share (by 0,8 pts.). But the emergent countries, like Korea, (but probably also India and China) are the main benficiaries of this trend. The decrease in the USA relative share of ICT R&D undoubtedly reflects an emerging phenomenon of ICT R&D delocalization.

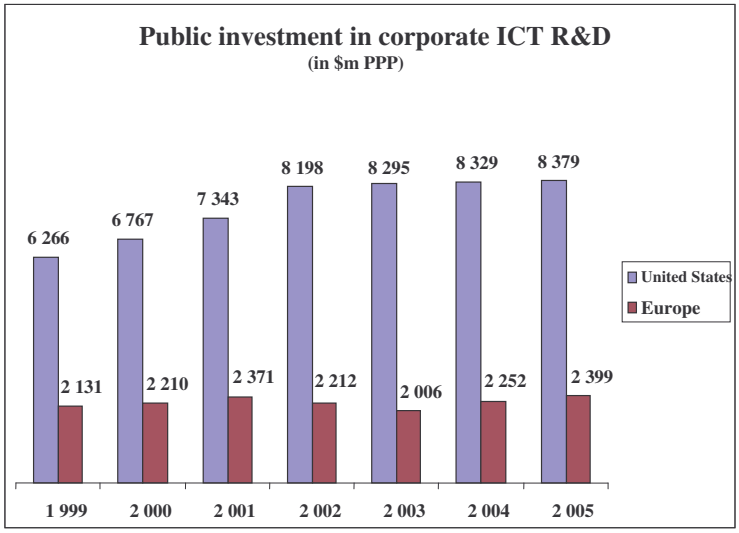
8 - The ratio between the volume of ICT R&D expenditures and the value of the ICT sector production reflects very different performances of national industries

Figures in M $, 2002 data			
	A : Total ICT R&D investments	B : Value of ICT production	Ratio B/A
Canada (1)	4 463	28 798	**6,5**
Sweden	3 138	21 503	**6,9**
USA	67 302	484 976	**7,2**
Netherlands	2 104	18 950	**9,0**
Finland	2 299	21 245	**9,2**
Japan	32 163	316 021	**9,8**
France	7 881	92 890	**11,8**
UK	5 822	81 328	**14,0**
Spain	1 725	31 197	**18,1**
EU15	29 565	545 960	**18,5**
Germany	8 743	164 108	**18,8**
Korea	9 520	185 607	**19,5**
Italy	2 248	69 790	**31,0**

(Canada : 2001 data for the value of ICT production)

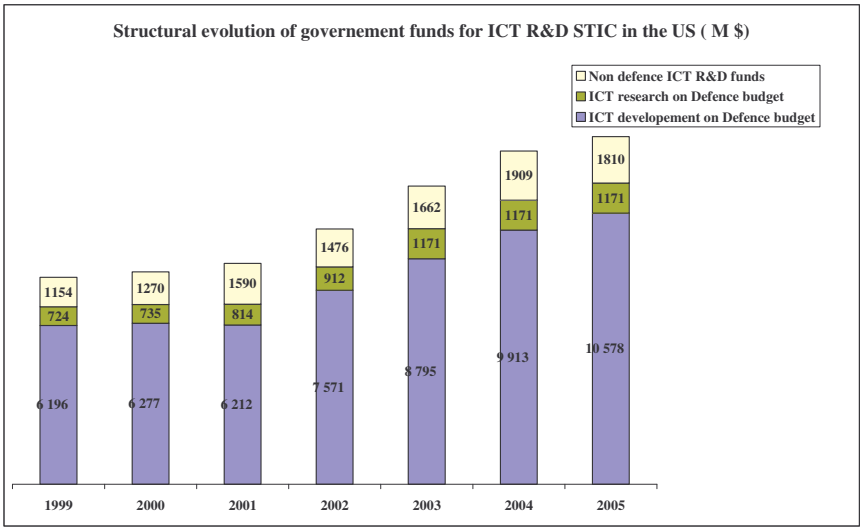
➔ The ratio between the ICT R&D expenditures and the value of the ICT sector production for each country shows important variations from one country to another. The lowest value (6,5) is noticed for Canada, which reflects the important role of Canada as an ICT R&D platform for foreign firms. The USA with a ratio of 7,2 (2002) also shows a low value which can be explained by two factors : 1) the ICT Sector production value reflects only in part the industrial impact of the ICT R&D which is also an input of the very important US defence industry, which is not taken in account here ; 2) the US ICT sector firms might delocalize their industrial production in low labour cost countries, but in the same time maintain there R&D activities in the USA. At the upper end of the ratio range, Italy (ratio : 31) exemplify a situation in which ICT manufacturing activities are largely disconnected from a specific ICT R&D effort. Japan (9,8), France (11,8) and Finland (9,2) have ratios which are close to the average value (10,3). Korea, with a ratio of 19,5, and Germany (18,8) are probably the countries where a strong effort in ICT R&D is converted in the highest value of ICT goods production. The ratio for Europe is not really significant as it is the average value between countries showing very different performances on this criteria.

9 – The public funds for ICT R&D accruing to American companies are four times larger in the United States than in Europe.

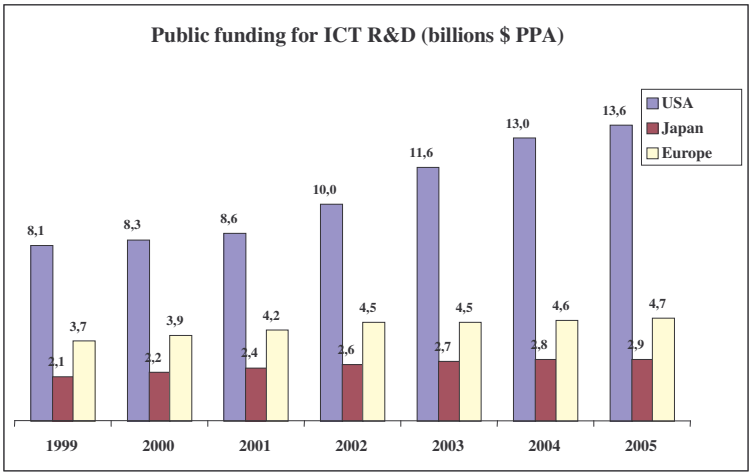


➔ The amount of public funding for ICT R&D performed by American companies is nearly four times bigger than the one noticed in Europe. This is mainly due to the importance in the USA of Defence related R&D contracts, of which a large part goes to ICT R&D. The Defence R&D budget has always been a key contributor to the American R&D effort, especially in the ICT sector. But the growth of this source of fundings has been nearly flat in recent years.

➔ *However, the fact that Japanese investment in ICT R&D is high without important public funding of private R&D, shows that the American model is only one scenario among others for the complemetarity between private and public R&D funding and that the massive public funding of private ICT R&D is a specificity of the USA reflecting the importance of Defence R&D in this country..*

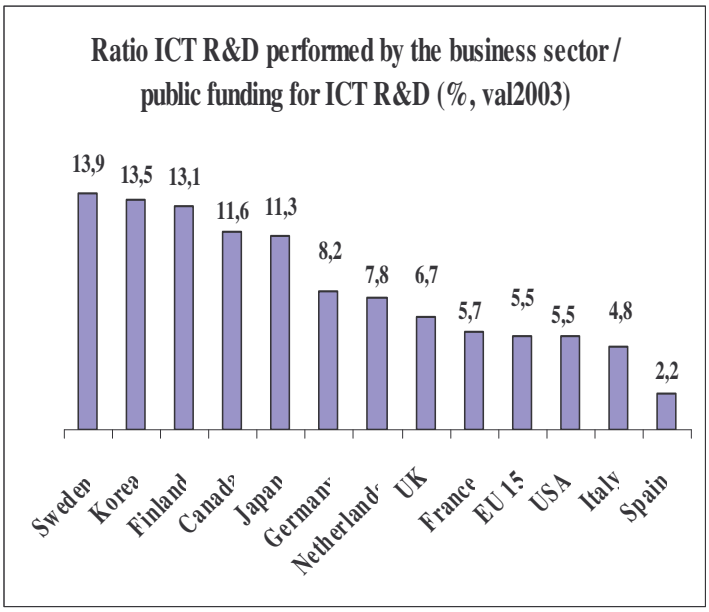


10 – Public investment in ICT R&D: Europe performs better, but the basic scenario remains the same



➔ If we compare the amount of public spending in ICT R&D, the hierarchy between the three main economic areas is rather different than the one noted for ICT R&D as a whole. Because public investments in industrial technologies R&D (with the exception of aerospace R&D) is low, Japan falls to the third rank. However, if Europe performs better on this criteria, there is still a 41% difference in ICT R&D public spending between Europe and the United States.

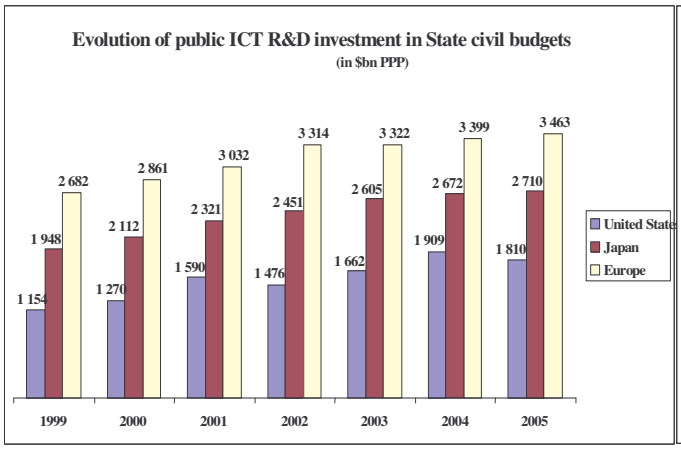
11 – The leverage effect of public ICT R&D funding on private funding is relatively insufficient in Europe, except in Finland and Sweden.

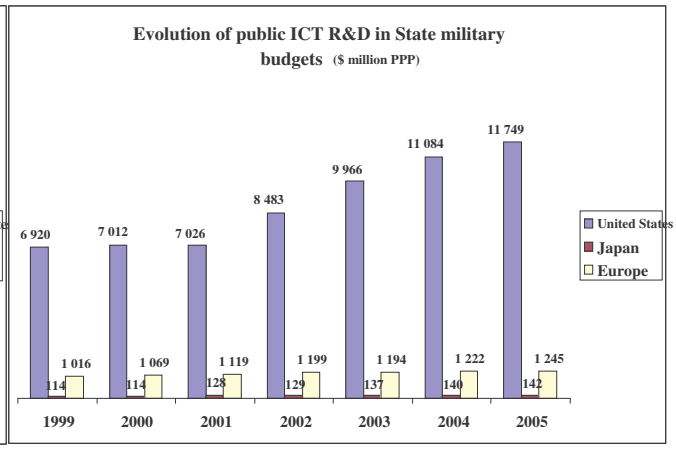


➔ While public investment in R&D is supposed to stimulate private R&D investment, the ratio between the volume of public spending in ICT R&D and the volume of ICT R&D executed by companies shows important variations: there is $11.3 of private investment in Japan for every $1 of public investment in ICT R&D, while in Europe and the USA, this value is around $5.5 are invested in the United States and Europe, respectively.

But it should be underlined that very close values can reflect very different situations: in the USA this low value is the mere arithmetical consequence of the fact that the volumes of Government fundings for ICT R&D are very important. On the contrary, in Europe, (where public funding in ICT R&D is comparable to the one noted in Japan), the same value reflects a comparatively low volume of private investments.

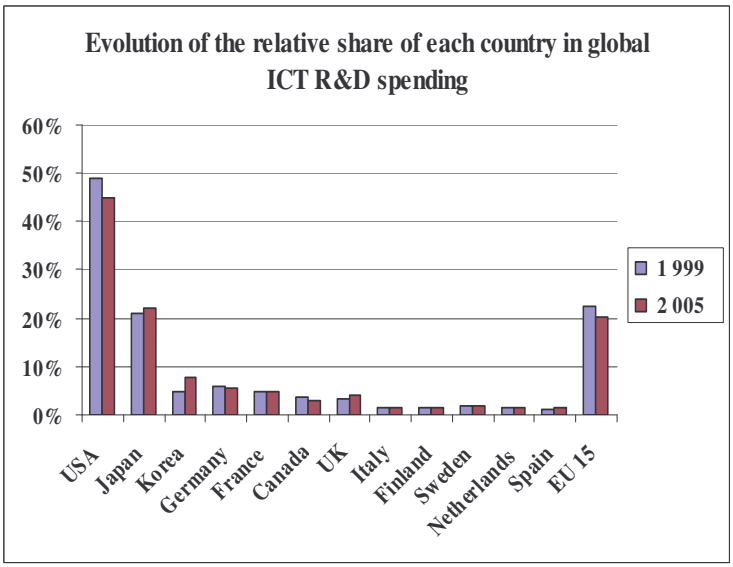
12 – The governments ICT R&D funding in civil budgets are twice larger in Europe than in the United States, but the government ICT R&D funding on defense budgets are 10 times larger in the United States than in Europe.





13 – ICT R&D types which differ greatly from one country to another

➔ **Outright leaders:** these are, of course, Japan and the United States. The United States accounts for a 45% relative share of world investment in ICT R&D in 2005, a decrease of 5 points over the period: the cause is probably the delocalization by American companies of part of their ICT R&D activities. On the contrary, Japan's relative share remains stable.



	1 999	2 005
USA	49,1%	45,0%
Japan	21,1%	21,9%
Korea	4,8%	7,8%
Germany	5,8%	5,7%
France	4,6%	4,7%
Canada	3,8%	2,8%
UK	3,4%	4,0%
Italy	1,6%	1,5%
Finland	1,4%	1,6%
Sweden	1,8%	2,0%
Netherlands	1,4%	1,4%
Spain	1,1%	1,5%
EU 15	22,6%	20%

➔ **The rest of the pack** is formed by all other countries, which relative share of is under 10%. However, the profile of this group is not homogeneous. The large continental European economies (France and Germany) relative shares are steady on the 1999-2005 period. Other countries, such as the United Kingdom with an increase of 42% over 7 years, South Korea (+98%), Spain (+65 %), Finland (+47%) scored between 20 and 62 points more than the average increase for the 12 countries. Italy is an exception: its ICT R&D investment decreases in real value. The relative share in the ICT R&D investment of the 4th European economy is now almost at the same level that the share of Spain or the Netherlands and below the share of Finland.

14 – Contrasted public policies for ICT R&D in the twelve countries

➔ The public funds allocated to ICT R&D increased by an average 58% between 1999 and 2005 in the twelve countries studied, but by only 27% in the European Union. In some countries (including France, the United States, the United Kingdom and Europe as a whole) there was a distinct discrepancy between the relative good health of State-funded R&D and the paucity of private investment, as shown right.

➔ **Countries with average value**: only France, Canada, Finland and Japan were near the 12-country average increase (+58 %) in ICT R&D public funding.

➔ All the other countries were **lagging behind**: Germany (+6%), the Netherlands (+ 9%), Italy (+23%) recorded figures distinctly below the average growth in State ICT R&D budgets.

The figures in the table below measure for each country the difference between the relative share of this country in the total public expenditure in ICT R&D and its relative share at the level of business-sector investments. A positive indicator means that there is an imbalance between public and private ICT R&D volumes.

United States	3,3%
Japan	-6,3%
South Korea	-2,3%
Germany	-0,5%
France	3,1%
Canada	-1,6%
United Kingdom	1,4%
Italy	1,6%
Finland	-0,6%
Sweden	-0,6%
The Netherlands	0,3%
Spain	2,4%

European Union	9,0%

Changes in public investment in ICT R&D

	1999	2000	2001	2002	2003	2004	2005
United States	100	103	107	123	144	161	168
Japan	100	108	119	125	133	136	138
Germany	100	102	103	105	109	106	106
France	100	102	115	123	133	136	142
United Kingdom	100	133	177	171	163	173	183
Italy	100	103	122	124	124	124	123
Canada	100	100	114	117	132	136	137
South Korea	100	119	147	164	181	195	211
The Netherlands	100	103	116	114	116	109	109
Spain	100	107	138	152	158	163	168
Finland	100	103	106	112	114	123	131
Sweden	100	137	151	170	209	232	244
Total	*100*	*105*	*114*	*126*	*141*	*152*	*158*
European Union (15)	100	106	112	122	122	125	127

➔ **Some countries have a very voluntaristic public policy for ICT R&D support**: these are the countries with growth above the average increase in public investment in ICT R&D. In this group of front runners are Korea with a 111% increase of governement funding, Sweden (+144%), the United States (+68%) and the United Kingdom (+83%).

➔ In the previous study, UK belonged to the lagging group: in the recent years a very volontaristic British public policy regarding ICT R&D has produced remarkable results.

15 – The volume of public funding of ICT R&D benefiting to firms is lower in Europe

➔ The governements policies for ICT R&D funding can also be analyzed taking in account the amount of these fundings which support private ICT R&D activities. The United States are the front runner both in terms of absolute value (way ahead of all other countries taken together) and in terms of progression of this parameter. But Korea, Finland, Spain and the United Kingdom also show important increases on the 1999-2005 period in ICT R&D funding performed in the private sector. All the other countries, including France, where the business sector investments in ICT R&D have stagnated or fallen, a significant increase in public funding for ICT R&D has not counterbalanced this loss as public funding has benefited mostly to State research institutions.

Volume of government ICT R&D funding performed by the business sector

	1999	2000	2001	2002	2003	2004	2005
United States	6266	6767	7343	8198	8295	8329	8379
France	548	623	582	765	523	618	611
Germany	535	487	544	497	467	492	499
United Kingdom	432	404	442	349	359	401	471
South Korea	425	508	625	697	767	829	895
Italy	215	252	303	249	244	244	240
Canada	110	146	111	107	107	110	120
The Netherlands	78	95	101	80	72	96	97
Spain	74	83	109	109	120	125	138
Finland	63	74	75	70	71	76	82

Changes in government ICT R&D funding performed by the business sector

	1999	2000	2001	2002	2003	2004	2005
United States	100	108	117	131	132	133	134
France	100	114	106	140	95	113	111
Germany	100	91	102	93	87	92	93
United Kingdom	100	94	102	81	83	93	109
South Korea	100	119	147	164	181	195	211
Italy	100	117	141	116	114	113	112
Canada	100	133	100	97	97	100	109
The Netherlands	100	122	130	102	92	123	125
Spain	100	113	148	148	162	169	186
Finland	100	118	119	111	113	121	129

16 – Important new trends can be identified through comparison with the previous study

Important new trends can be evidentiated if we compare the 2005 results with the results reported in the previous study (2003).

➔ Countries such as Korea, Finland and Sweden continue volontaristic policies aiming to specialize their R&D in the ICT-related fields. In these countries, both the public and the business sector increase their investments in ICT R&D. Over the period, South Korea has become the third country if measured by its contribution to the global ICT R&D effort, just behind the United States and Japan.

However in Korea, the business sector expenditure on ICT R&D increases less than the private R&D effort in other sectors, which indicates that Korea has begun to diversify its R&D investments.

→ The large developed economies (France, Germany, the United Kingdom, Japan), which have an old tradition of ICT R&D but seemed to lag behind the other countries in terms of ICT R&D volumes in the previous study, seem to react by sticking more closely to the average evolution in recent years. But this reactivity is noted only at the level of government fundings for ICT R&D, not for the business sector fundings. In the previous study, the United Kingdom belonged to the lagging group, but it now clearly belongs to the volontaristic group, showing the positive results of a volontaristic public policy focused on ICT R&D.

→ In the United States, we can notice a clear inversion of the previous continuous trend of growth of the business sector investment in ICT R&D. Since 2003, these investments have followed a negative trend of - 2%/year, which probably measure a trend of R&D activities delocalization towards countries like India, China or Brazil. On the contrary, the government fundings for ICT R&D performed by American companies (a large percentage, 85% of which is related to defence contracts) continue to increase firmly.

→ This explains the structural changes in the composition of the volumes of ICT R&D performed by the business sector: the part of government funds in the total ICT R&D performed by companies increases from 12.9 to 19.1%. However, the ratio of *intramuros* ICT R&D volumes (funded both by the government or the private sector) to GDP decrease from 0.69 to 0.60% over the period. This phenomenon is not noticed in the volumes of R&D investments in other sectors: the ICT R&D is no more the growth engine of R&D expenditures in the United States.

→ The 2005 study reveals the erosion of the relative shares of the developed countries in the total ICT R&D funded by the business sector. This phenomenon is particularly strong in the case of the United States (- 6 points loss of relative share between 1999 and 2005). The erosion of European and American relative share in the global ICT R&D investment would have been undoubtedly worse, if the coverage of the study had included countries like India and China. It seems indeed that the American companies in the ICT sector have undertaken a strong movement of delocalization of part of their ICT R&D activities in emerging countries, which explains the fast erosion of the volumes of ICT R&D funded by companies and performed *intramuros* (which is the only parameter measurable through existing OECD R&D statistics).

→ In the same time, the ICT R&D public fundings benefiting to American companies increase by 34%. There seems to be a dual evolution of the ICT R&D investments of American companies: on one hand a non strategic R&D, which can be easily externalized and/or delocalized; and on the other end a strategic R&D (treatment of the signal, bioinformatics, optronics...) largely financed by public funds, which still has to be performed intra muros.

→ **Canada** is the only country where the business sector funding for ICT R&D show a sharp recession (-12%). The reason is probably to be found in a specificity of this country, which has developed an incentive fiscal policy for R&D investments: Canada, until 2002, became an important R&D platform for American companies in the ICT sector. But as American firms delocalize further some of their non strategic R&D activities towards emerging countries with lower labor costs, Canada is strongly impacted by this relocation, on a global scale, of R&D activities.