A report commissioned by the OECD and the Dutch Ministry of Economic Affairs

Statistics Netherlands

P.O.Box 4000
2270 JM Voorburg
The Netherlands

Data for intangibles in selected OECD countries

M.M. Croes

The views expressed in this paper are those of the author and do not necessarily reflect the policies of Statistics Netherlands.

Project: *OECD and Dutch Ministry of Economic Affairs 2000: International Comparable Data on Intangibles; Directorate STI/EAS contract JA00004385 ; Dutch Ministry of Economic Affairs, contract ES/ATB/IB/00044007*

Date: *December 2000*

Contents

Abstract and conclusions

This report provides international estimates for intangible investments based on the data for fifteen OECD countries for the years 1985-1997. Here intangible investments are defined as expenditures on five areas: R&D, software, education, marketing (advertising) and payments for foreign technology (royalties and license fees). Additionally this report discusses some issues concerning a better coverage of intangibles in official statistics.

Intangible investments are considered to be crucial factors that determine the competitiveness of nations. They are strongly linked to knowledge and consist of interrelated activities and rights on four main areas: technological innovation, marketing, information technology and training and education. Estimating total intangible investments is hampered by differences of definitions, overlap between the categories of intangibles and coverage of the data.

Notwithstanding these measurement difficulties, total intangible investments makes up between 8 and 10 percent of GDP for most of the observed countries. The lowest percentage is found for Italy (6 percent) while Sweden scores highest (12 percent).
The largest component of intangible investments is public expenditure on education, which makes up 4 to 6 percent of GDP. Total R&D expenditure and total software expenditure normally ranges between 1 to 2 percent of GDP. All other components make up less than 1 percent of GDP. This means that the expenditures on education have a large impact on the total figures for intangible investments.

When educational expenditures are excluded from the totals, the estimates indicate that the amount of money spend on intangible investments have increased considerably compared to the expenditures for tangible investments. Additionally the figures indicate that the pace of growth of intangible investments is higher than that for tangible investments. Moreover, according to the data used here, both the level and the pace of growth of intangible investments differ per country. Sweden, for example, is moving rapidly towards becoming a knowledge-based economy, while Japan is not.

Can solid conclusions be made on basis of figures on intangible investments as presented in this report ? Probably not, because not all intangibles can be measured in terms of money. Moreover, for the compilation of new indicators for intangibles that are not expressed in financial terms there is simply not enough official data available.

In the meantime policymakers have taken a serious interest in the matter. The European Commission for example has introduced a proposal for more indicators on the knowledge-based economies. However, due to the heterogeneous and unpalpable nature of intangibles, it is advisable to put more time in thinking about why and which intangibles should be measured on a structural basis for policy purposes. Especially because many intangibles are affected by products from policy makers. And as soon as an international agreement is reached a new set of indicators for intangibles will become available. Hopefully this will happen in the near future, because at the end of the year 2000 data on intangibles is still scarce.

Therefore the author wishes to thank both the OECD and the Dutch Ministry of Economic Affairs for their effort to generate more information on intangibles.

1. Intangible investments

Total investments comprise tangible and intangible investments. While tangible investments are well defined (land, equipment and buildings) intangible investments or intangibles are not. Intangibles are by their nature difficult to define: they cannot be seen, they are heterogeneous and they are often described in different ways. Additionally the reasons to define them differ. Accountants, managers, policy makers and statisticians would define them differently, but all would agree that intangibles are non-physical by nature and that they are valued in some way by the owner.

Partly as result of a lack of consensus on definitions for intangibles little is known on the size of total intangible investments in a country. This is a weakness of the current official statistics, especially because intangible investments are closely related to knowledge-based economies.

This report is aimed at generating internationally comparable figures on intangible investments. It builds upon a report from 1999[1] that was commissioned by the OECD to Statistics Netherlands. Additionally this report includes some new parts: time series for intangible investments, the extent in which these data indicate that countries are moving toward knowledge based economies and finally some policy issues on measuring for new indicators for intangibles.

Defining and classifying

Here intangibles are defined for statistical purposes as:
"Expenditures for all new goal-oriented activities within a country or disembodied tools used in a country. These activities and disembodied tools are aimed at a quantitative change or extension of existing knowledge, or at the acquisition or improvement of existing goods, or aimed at the acquisition of completely new knowledge. The results are assets concerning the stock of knowledge, power on the market or strength of the internal organisation[2]."

If intangibles refer to both activities and disembodied tools, how can they be classified ?
In the literature several classifications have been suggested. Some are focussed on intangibles as capital, while others are oriented towards the types of activities.
An example of the first one would be the division between human capital, organisational capital and intellectual capital. Other distinctions for intangible capital are for example human, market and structure capital. In these classifications the term "capital" is used to stress the end result of certain types of activities or of rights. R&D, for example, is an activity that can lead to an increase of the intellectual capital. In the above mentioned definition the concept of capital is replaced by the concept of assets, because the term "capital" is too strongly connected with a financial valuation of the intangible assets.

In general R&D and other activities and rights can all be captured by three core bundles of intangibles: technology, marketing (including advertising) and organisation.
As result of the specific impact of information technology (IT as a specific part of "technology") it should be counted as a separate fourth bundle. Training and education can be considered part of the organisational bundle, but can also be considered as a fifth bundle in a

---

[1] Croes, M.M., Intangible investments in fifteen OECD countries, Statistics Netherlands, Voorburg 1999.
[2] Based on definition in: Croes, M.M., Intangible investments: Definition and data source for technological, marketing, IT and organisational activities and rights, LNM-reeks 9803, Statistics Netherlands, Voorburg 1998.

matrix relation with the other four components. In fact this indicates the three main areas of overlap between the categories of intangible investments considered in the estimates here: software with R&D, and education with R&D as well as education with software.

Ordering

In order to minimise overlap a hierarchical approach should be followed. The approach as followed in this report is distilled from the Frascati family of manuals[3]: first innovation and R&D, then marketing, followed by information technology (software) and ending with education. Education, for example, should ideally be categorised according to the goal for its purchasing or internal production (e.g. was it for the purpose of innovation, R&D or marketing). Only when this is not the case, these 'free' education categories should be assigned as an educational activity.

Totalising

If all intangibles can be classified, ordered and measured in terms of money a total expenditure figure on intangibles would arise. However, to what extent does such figures reflect these assets as mentioned above ? This question leads to at least three separate questions.

Firstly the goal of summing up the items should be considered. For example in the framework of National Accounts expenditure figures on software and rights are treated in the same way as tangible investments. They are counted yearly, they are amortised and the results are stock figures on intangible fixed assets. This report pursues a different goal. By adding up expenditure figures on intangibles more insight can be given into the relative importance of intangibles in a country by comparing them with some general economic indicators.

Secondly, there is a question on the extent in which the separate expenditure items of intangibles reflect comparable financial values of assets or capital. In other words, can a certain amount of expenditure on R&D be financially valued in the same way as the same amount of money used to purchase a certain type of software or as the same amount of money used for brand advertising ? For this problem there is no straightforward answer. Accountants for example, use not one but at least half a dozen methods to assess the value of brands. Moreover intangibles may cause spillover effects[4] that are difficult to quantify. Also some studies (e.g. Bresnahan, Brynjolfsson, and Hitt, 2000[5]) indicate that generating the highest assets may be a question of mixing the right intangibles. Although it is not unlikely that information on effects of intangibles can be derived from macro-economic data, this report is confined to describing a few input factors for intangibles.

Finally there is a question on interpreting growth information when totalising intangibles. As will be shown later, public expenditure on education makes up about half of all total intangibles. This implies that drastic changes in these expenditures have a disproportionate large effect on growth figures such as indexes.

[3] Oslo Manual on innovation, Frascati manual on R&D, Patent manual on technological rights, Technology Balance of Payments Manual on international transfers of technology, and Canberra manual on human resources devoted to science and technology.

[4] Knowledge is generally characterised by its non-exclusivity and its non-rivalry. Other features of knowledge are its potential to generate new knowledge, as well as its potential to absorb and to utilise other knowledge.

[5] Timothy F. Bresnahan, Eric Brynjolfsson and Lorin M. Hitt, "Technology, Organization, and the Demand for Skilled Labor", in Margaret M. Blair and Thomas A. Kochan, eds. The New Relationship: Human Capital in the American Corporation, Brookings, 2000, p.175-178.

2. Which data ?

Data sources can be divided in supply-side data (e.g. turnover and sales figures of the computer services sector) and demand-side data (e.g. total expenditure of purchased software and expenditure for the internal production of software). Demand-side data is preferred for the measurement of intangible investment, primarily because it provides more possibilities to take into account the structural differences in an economy.

Another reason to prefer demand-side data is that, if measured correctly (definition, coverage, etc.), it increases the international comparability of intangible investment expenditures. For example supply-side data normally excludes internal production, whereas demand-side data normally includes internal production. However when no demand-side data is available, supply-side data can provide some insight on the expenditures within a country for certain (professional) services.

The international data sources cover the five aspects of intangibles: R&D and innovation, payments for foreign technology, software, education and marketing. In most cases demand-side data is available.

R&D and innovation

The Frascati family of manuals[6] defines R&D as creative work done to increase the stock of knowledge that will be used to think out new applications. Basically R&D consists of basic research and further development. R&D, together with activities such as industrial design, marketing for new products and training directly linked to the innovative processes is counted as innovation. Although all intangible parts of innovation are intangible investments, only R&D is included in the total figures.

Official international comparable (demand-side) data for R&D is obtained from the OECD. For the purpose of these estimates data on three R&D categories are used: business enterprise R&D (BERD), higher education R&D (HERD), and total R&D expenditure (GERD - Gross Domestic Expenditure on R&D). Additionally data on capital investments in land, buildings and equipment are used.

Additionally some innovation expenditure data is presented for selected countries that participated in the Second Community Innovation Survey (CIS2)[7].

Payments for foreign technology

Finally country-figures[8] are included on the payments for royalties and licenses. These are collected by both the OECD and the International Monetary Fund (http://www.imf.org). The data is acquired mostly from the central banks and include money paid for the use of patents, licenses, trademarks, design, know-how and closely related technical services and for industrial R&D carried out abroad. The data normally is collected according to the standard definitions from the OECD's manual on Technology Balance of Payments (TBP).

---

[6] Frascati manual 1993, 57-58, see also Oslo manual on innovation 1992

[7] Countries for which data on both the services and the manufacturing sectors is available include: Belgium, Germany, Denmark, France, Ireland, the Netherlands, Austria, Portugal, Finland, Sweden, UK and Norway. Data refers to 1996, except for Norway and Portugal (both 1997).

[8] For Japan estimates have been made for missing values for the period 1985-1990. For Denmark no data is available, while Canadian data starts at 1995.

Software

According to OECD's Frascati manual software is 'the mandatory set of instructions for digital instrument operations'. These comprise system software, tools software and application software. Investments in software comprise software purchased from third parties and internally produced software.

A market source for international software data is the International Data Corporation (IDC) [9]. Their demand-side statistics for software expenditures include packaged software, purchased IT services and internal IT services.
Additionally some countries[10] have recently published official national estimates on software investments. These estimates are in the framework of the United Nations System of National Accounts (SNA).

Education and training

Education and training comprises three main categories: (1) public and private spending on formal education, (2) spending by enterprises on job-related training programmes and (3) spending by private households.

Only the two first categories can be measured properly and here only direct public expenditures for primary, secondary and tertiary education is counted as intangible investment. Direct public expenditure include (a) spending directly by governments to hire educational personnel and to procure other resources and (b) amounts provided by governments to public or private institutions for use by the institutions.

International data used here to calculate expenditure for education and training comes from the OECD. The data used here refers only to public direct expenditure (a). Additionally some figures on public subsidies to households and private entities and private payments to educational institutions are presented.

Data on vocational training is available for countries that participated in the Vocational Training Survey of the European Union. However, the data is not completely comparable due to differences in definitions, coverage and reference periods in relation to enterprise-based training[11].

Marketing

Marketing consists of several activities aimed at offering and exchanging products of value with others in order to fulfil the needs and wants of individuals and groups. They include activities such as market research, advertising, promotion, sponsoring and direct marketing[12].

Demand-side data for advertising comes from the NTC that collects expenditures on advertising and media for several European countries and for Australia, Canada, Japan and the US. The data includes estimates on classified advertising (small adds), the level of discount obtained against rate card value (production costs, agency commission) and "elements of the equation" that appear in some countries' figures[13].

---

[9] Digital Planet; The Global Information Economy, World Information Technology and Services Alliance, IDC/WITSA, 1999.
[10] Countries that have published estimates for software investments are Australia, Belgium, Finland, France, Italy, the Netherlands and the US. Germany has compiled total figures on intangible fixed asset, excluding a breakdown into separate items.
[11] OECD, Human capital investment, Centre for Educational Research and Innovation, OECD, Paris, 1998.
[12] See: M.M. Croes, Intangible investments: measuring for SBS, Statistics Netherlands / Eurostat, Voorburg / Luxembourg, 1999.
[13] The definition used here is from the European Advertising Tripartite. Additionally several assumptions are made for the share of marketing expenditures via certain media such as newspapers, television and cinema on the total marketing expenditure.

The Federation of European Direct Marketing and the European Association has provided supply-side figures on direct marketing and market research for Opinion and Market Research.

Comparability issues

The quality of the R&D data is generally considered to be good, as most OECD countries have a long tradition of measuring according to the Frascati Manual. However, international comparability may be hindered in some cases (e.g. because of differences in methods for selecting the statistical to be covered etc.). Similar coverage issues play a part in the CIS2-data on innovation and the TBP-data.

As R&D and TBP data is not always available for all the fifteen countries for the years under observation, estimates were made[14].

Due to changes in the reporting practises educational data may not be fully comparable over time (e.g. since 1992 the data include public subsidies which are not attributable to household payments for educational institutions).

As the most recent IDC software data set only includes annual figures for the period 1992-1999, estimates were made for the period 1985-1991. The estimates for both packaged software and purchased professional IT services, are partly based on earlier published material that is brought into line with the latest figures. For internally produced professional IT services data for 1985-1991 were calculated by using information derived from the 1992-1999 series and the US and Italian estimates on software investments produced on own account.

As most of the figures presented here are expressed in percentage of GDP it should be noted that, in compliance with the revised system of National Accounts, several countries have revised the figures on GDP. The effect of the revised GDP figures differs per country. For example for the Netherlands the revision raised the GDP with 4 percent, while the average change for countries of the European Union is only 2 percent.

Overlap issues

As mentioned earlier there are three main areas of overlap between the categories of intangible investments considered in the estimates here: R&D with software, R&D with education and education with software.

Software is not only a tool included in the total R&D expenditure, but also it may be the subject of R&D (software R&D). Especially in the latter case the expenditures may be large and software R&D should be subtracted when estimating the investments in software. Unfortunately software R&D is not measured separately in R&D surveys and cannot be separated from IDC's software figures. Available R&D data for the computer services sector indicate that software R&D range between 1 and 9 percent of BERD. Other national studies, that include all sectors, indicate that this percentage may be much higher, between 25 and 40 percent[15].

[14] These estimates were normally made according to a simple adjacent year's method: e.g. estimates for 1990 is an average of available data for 1989 and 1991.

[15] A Dutch study found that almost 25 percent of R&D by firms (BERD) can be labelled as software R&D. (See:R&D en software-onderzoek bij bedrijven in Nederland, CBS/ Statistics Netherlands, Voorburg, maart 2000.) Canadian R&D survey data even indicates that this percentage may rise as high as 36 percent of BERD. (See: Software Research and Development (R&D) in Canadian Industry 1995, Service Bulletin Science Statistics, Vol.21, nr.6, July 1997.)

It should be noted that overlap between software R&D and other software is only a problem when internally produced software is taken into account. Due to a lack of data no corrections can be made for this overlap in this report.

Additionally it can be noticed that data for internally produced software for National Accounts purposes, as estimated by some national institutes, do not completely correct for software R&D. Not completely, because the national figures are not corrected for software R&D in other than the computer services sector.

Another major overlap issue is that public educational expenditure includes a part of R&D expenditure already included in GERD. An OECD publication[16] showed that subtracting R&D expenditure in Higher Education (HERD) from total public educational expenditure is acceptable for Germany and Sweden. For the three other countries, France, the Netherlands and the UK, subtracting HERD results in a considerable underestimation of total public educational expenditure[17]. Unfortunately no corrections can be made for the series as presented in this report.

Finally data on packaged software includes purchases by educational institutes, thus creating a double counting. In the figures presented here no corrections are made for this double counting, but available data indicate that double counting is marginal[18]. Additionally when expenditure on vocational training is taken into account, expenditure on training that are related to for example the introduction of new software might lead to an overestimation of educational expenditures.

---

[16] See for detailed information: OECD, Separating teaching and research expenditure in higher education, Paper from Group of National Experts on Science and Technology Indicators, Paris, 1998.

[17] Despite the fact that the OECD study clearly showed that subtracting could lead to underestimation for investments in education it was chosen to subtract HERD for all countries. It is known that for France, the UK and the Netherlands this will lead to an underestimation ranging between 0.4 and 1.4 percent of GDP.

[18] According to the EITO 1997 report 2% (data for 1995) of the software market is accounted to consumer applications. This small share is confirmed in data from the US Bureau of Economic Analysis indicating that 3% (data for 1992) of the custom and pre-packaged software is purchased by private households.
IDC country data on the number of installed pc's, suggests that between 40 and 60 percent of the installations are by private households. Less than 10 percent of total installations are in the education market.

3. Estimates for intangible investments

Estimating R&D as intangible investments

Here total R&D expenditure (GERD) is considered intangible investments by subtracting capital expenditure. For two reasons capital expenditure is subtracted:

(1) From a theoretical point of view intangible investments and tangible investments should be separated.

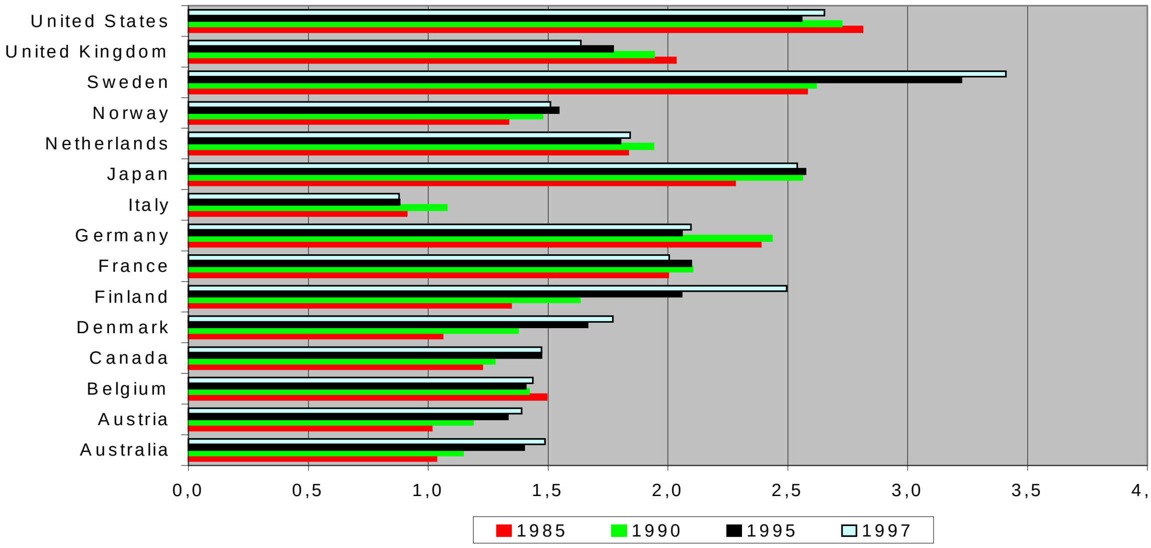
(2) From a practical point of view for comparing figures on intangible investments with those from tangible investments.

Available data for the fifteen countries show a *gradual decrease* in the share of capital expenditure between 1985 and 1997, on average from 14 to 10 percent. It should be noted that for some countries subtracting capital expenditure might lead to an underestimation of GERD. For example capital expenditures in the US data are hard to pinpoint[19].

Trends in R&D

For most countries GERD corrected for capital expenditure ranges between 1.4 and 2.3 percent of GDP. Low percentages are found for Italy, while Sweden, the US and Japan score high. Of the fifteen countries included here, six are showing a steady increase.

Figure 1: GERD as percentage of GDP, corrected for capital expenditure



Source: OECD

Innovation

As mentioned earlier innovation comprises a range of activities including R&D. When both manufacturing and services sectors are considered, CIS2 data show that between 2 and 8 percent of GDP is spent on innovation (see table innovation). Part of these expenditures is for machines and equipment and should be counted as capital expenditures (see table innovation: item machines and equipment). For most of the countries capital expenditure amount to around 10 and 40 percent of total innovation costs.

[19] Nevertheless it was chosen to use the recorded percentage of capital expenditure in GERD for the period 1985-1990 (2 percent of GERD) for the years 1991-1997 for which no data is available. For country specific information on R&D data see: OECD, Main Science and Technology Indicators, 2000/1, Paris, 2000. For information on capital expenditure in R&D see: Annex C of this document.

For other separate innovation items, such as training and marketing, the expenditures are less then one percent of GDP.

When comparing total expenditures on innovation and the corrected GERD figures, the overall picture is not straightforward: the BERD (enterprises only) estimates for Norway and Belgium are almost as high as total expenditures for total non-machines items in innovation (enterprises only). On the other hand the German total innovation expenditures for non-machines are almost four times as high as the BERD corrected for capital expenditures.

Table 1: Innovation expenditures as percentage of GDP, 1996 (Norway 1997)

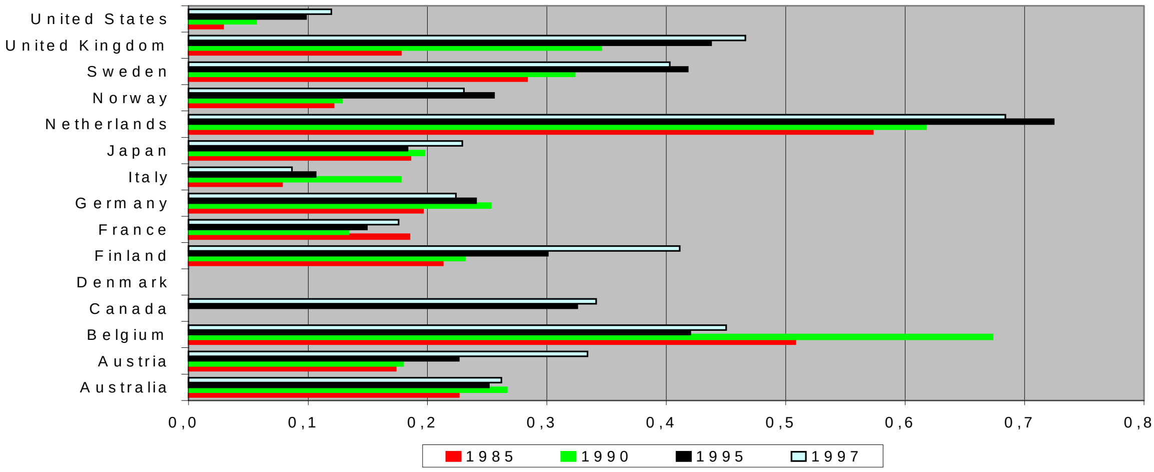
				non-machines						machines & equipment
	A1	A2	B	C	D	E	F	G	H	I
	Total GERD corrected for capital expenditure 2)	Total BERD corrected for capital expenditure 1)	Total innovation (C+I) 1)	Total non-machines (D+E+F+G+H)	industrial design	training	marketing	external technology	other	Total machines & equipment
Austria	1,4	0,8	2,3	1,5	0,1	0,1	0,2	0,2	1,0	0,7
Belgium	1,4	1,1	1,7	1,1	0,2	0,0	0,1	0,1	0,7	0,5
Denmark	1,7	1,2	3,0	1,9	0,2	0,1	0,3	0,2	1,0	1,1
Finland	2,3	1,8	3,4	2,5	0,1	0,0	0,4	0,1	1,8	0,9
France	2,1	1,4	2,1	1,9	0,1	0,0	0,1	0,1	1,6	0,2
Germany	2,1	1,5	6,7	5,8	0,3	0,1	0,2	0,4	4,8	0,9
Netherlands	1,8	1,1	2,5	1,6	0,1	0,2	0,1	0,1	1,1	0,9
Norway	1,5	1,0	1,7	1,1	0,1	0,1	0,1	0,1	0,7	0,6
Sweden	3,3	2,8	7,7	6,5	0,6	0,2	1,0	0,8	4,0	1,2
UK	1,7	1,2	3,1	2,0	0,4	0,2	0,2	0,4	0,8	1,1
1) Includes only enterprises										
2) Total economy										

Source: Eurostat, Second Community Innovation Survey (CIS2)

Estimating intangible investments in knowledge from abroad

Expenditures for foreign technology belong, together with R&D and innovation expenditures, to the technological component of intangibles. Here only data for payments for royalties and licenses are taken into account. Expenditure data for the fifteen countries normally do not exceed 0.4 percent of GDP, except for the Netherlands and Belgium where these investments are much higher. Dutch 1997 data show that it is almost 0.7 percent of GDP.

Figure 2: Payments for foreign technology as percentage of GDP



Source: OECD, IMF

Estimating intangible investments in software

As mentioned before the software data includes expenditure figures on packaged software, purchased IT services and expenditures for internal IT services. It should be noted that IDC provides a separate set of figures for expenditures on hardware and therefor no corrections are necessary for capital expenditure.

Not all expenditures on packaged software should be counted as intangible investments. Not only because of the overlap issues between R&D and education. Purchases for software upgrades with minor new changes and small maintenance related to packaged software are not investments but operational expenditure. Itemised figures for these expenditures are not available and therefore the investments in packaged software is overestimated.

IT services comprise both purchased services and internal services. However some IT services are clearly operational and should be subtracted. Fortunately IDC provides separate figures for purchases of investments in professional IT services (defined as consulting and implementation[20]) and purchases of operational IT services (e.g. hardware support services). Data for the period 1994-1999 on the shares of IT professional services indicate that in general the share of professional services ranges between 30 and 60 percent of total services[21]. Shares for the period 1984-1993 are calculated by a linear regression on the shares available. Unfortunately the data series do not include similar itemised information for “professional internal services”. Therefore it is assumed that the annual shares of “professional internal services” equals the annual estimated shares on “purchased professional services”[22].

Trends in software

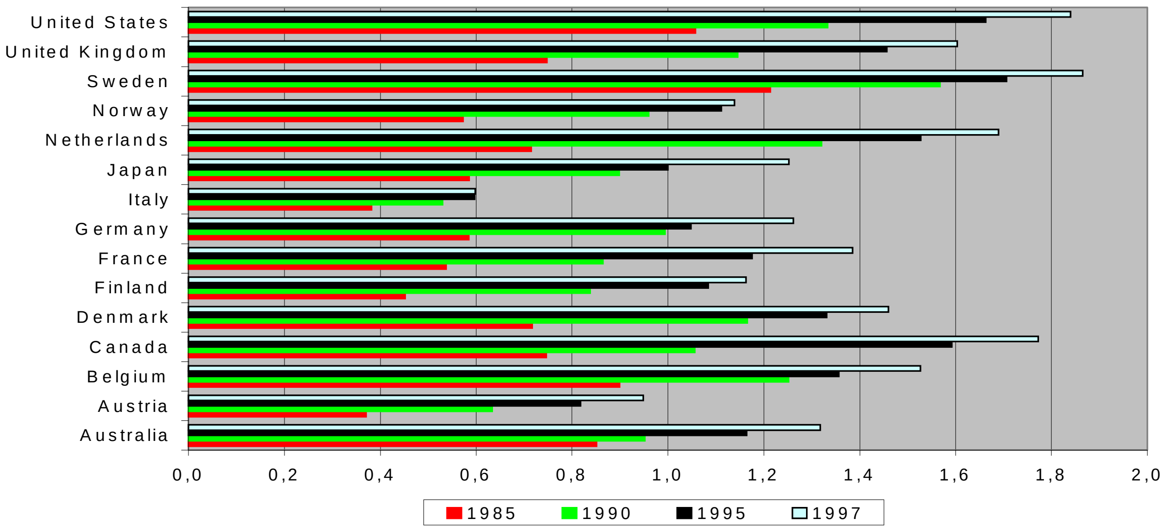
In general expenditure of total software investments represent less than two percent of GDP. In 1997 the differences between the countries are large. Austria and Italy have low investment levels in software (less than 1.0 percent) whereas for other countries (e.g. Sweden and the US) the percentages are twice as high.

[20] These items include business process reengineering, process improvement, external customisation of software and IT training and education.

[21] In this report the estimates for professional services are calculated by using the shares as found in the EITO publication. Unweighted average shares were used for countries (Australia, Canada, Japan, USA) for which no specific information is included in the EITO publication.

[22] See Annex A for information on the estimates for software investments.

Figure 3: Estimated investments in software, as percentage of GDP



Source: IDC

Comparing software estimates and data from national statistics

The idea here would be to investigate to what extent the calculations based on IDC data correspond with estimates made by national institutes in the framework of SNA. Notwithstanding the differences in methodology it may be expected that the broad picture would be more or less the same.

At least seven countries have published estimates on total software investments. Additionally only three countries (Italy, the Netherlands and the US) are able to provide separate data on purchased software and software produced on own account. In the following table comparisons are presented for the estimates based on IDC data as calculated for this report and national figures as calculated in some OECD countries.

For four countries (Australia, Finland, Italy and the US) the absolute level of total software investments in 1997 as estimated here is relatively on the same level as the National Accounts estimates. For the other countries the estimates presented here are almost twice as high.

Itemised figures for the Netherlands and the US indicate that this may be caused by an overestimation of purchased software. The estimates for expenditures on internally produced software also indicate an overestimation, especially between 1985 and 1990. However, the difference in the 1990-1997 growth of the software figures as estimated here and those from the National Accounts is small for the countries that have a good match between the absolute figures of IDC and National Accounts (Australia, Finland, Italy and the US).

Table 2: Comparison between estimates based on IDC data and estimates from National Accounts

									Index 1990=100	
	1985 2)	1985 2)	1990	1990	1995	1995	1997	1997	1997	1997
	Estimates / IDC	National Accounts	Estimates / IDC	National Accounts	Estimates / IDC	National Accounts	Estimates / IDC	National Accounts	Estimates / IDC	National Accounts
Total software										
Australia	2,1	2,4	3,8	5,7	5,9	6,7	7,5	7,6	197	132
Belgium	44,1	.	82,5	.	110,3	59,1	133,0	64,6	.	.
Finland	1,5	2,4	4,4	5,7	6,1	6,7	7,4	7,6	169	132
France	25,6	23,7	57,2	27,9	91,1	35,7	113,9	52,5	199	188
Italy	3,1	2,8	7,0	8,0	10,7	10,3	11,8	12,3	169	153
The Netherlands	3,6	2,7	6,8	4,6	10,2	5,3	12,4	6,9	182	152
USA	42,8	34,6	74,1	66,3	117,1	108,0	144,3	137,4	195	207
Purchased software										
Italy	1,9	1,8	4,9	5,5	7,9	7,5	8,7	9,3	176	171
The Netherlands	1,3	1,9	3,2	3,6	5,7	3,9	6,6	4,4	207	123
USA	21,0	17,8	40,1	37,2	73,4	65,0	98,5	90,0	245	242
Own account software										
Italy	1,2	1,0	2,0	2,5	2,8	2,8	3,1	2,9	152	116
The Netherlands	2,3	0,8	3,6	1,0	4,5	1,4	5,8	2,5	160	254
USA	21,8	16,7	33,9	29,1	43,6	43,0	45,8	47,4	135	163
1) Except for Italy: in trillion										
2) For the Netherlands: 1986 data										

Estimating intangible investment in education and training

Public spending is often a total payment for the complete educational sector. It includes investments in "teaching and education" as well as expenditures for other tasks not considered an intangible investment. An example of the latter is support services such as maintenance and administration. Additionally capital expenditure in education should be excluded, but due to lack of data it is not possible to correct for support services and capital expenditure. Available information on capital expenditure suggests that the largest part of education spending comprise salaries paid to teaching personnel[23].

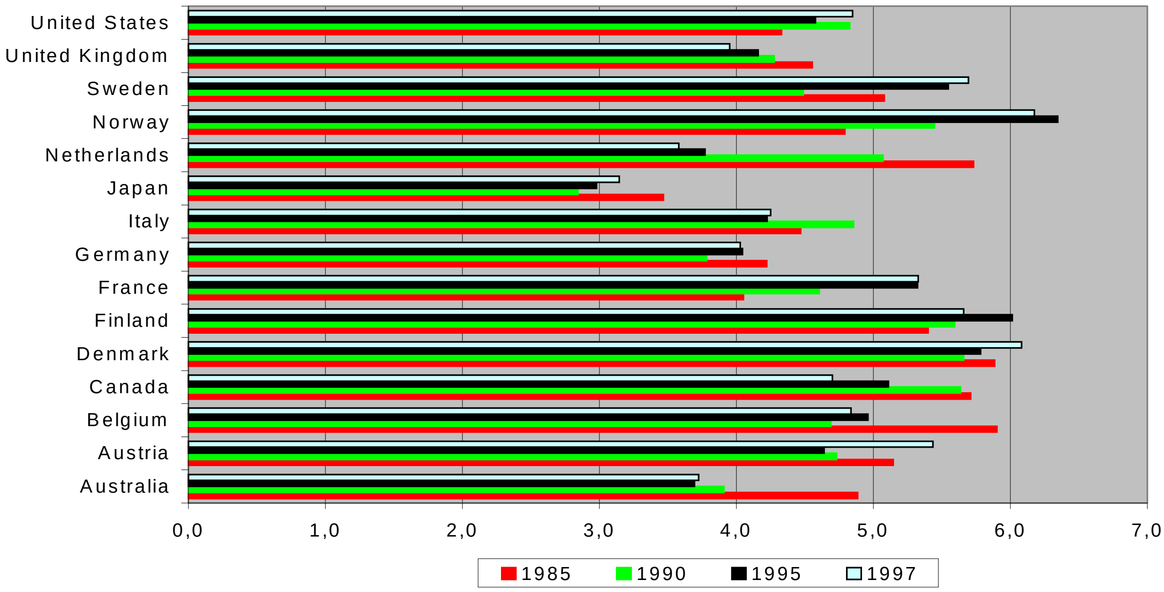
Trends in public expenditure on education

Compared to the other components of intangible investments the investments in education are large, namely between 4 and 6 percent of GDP.
Although these percentages give an idea about investments in education, they do not cover the whole picture. Low or high percentages can be a reflection of differences in the educational

[23] Data for the Netherlands indicate that capital expenditure amounts to about 4% of total public expenditure for education according to the Dutch definition. A report presented to the OECD suggests a lower percentage (1%). In this report no corrections are made in the estimates for the capital expenditure part of public spending on education.
See: OECD, Separating teaching and research expenditure in higher education, Paper from Group of National Experts on Science and Technology Indicators, Paris, 1998.

system in the countries as well as socio-economic factors (e.g. rate of participation in education and size of the youth population) [24].
Between 1985 and 1997 public investments in education have not increased much, except for France and Norway (both more than one percent of GDP). A considerable decrease is found for Australia, Canada and the Netherlands.

Figure 4: Estimated intangible investments in public education as percentage of GDP



Source: OECD

Other expenditures on education and training

As seen above, public expenditures on education are large. However, intangible investments in educational and training are underestimated, as they should ideally also include other public expenditure, private expenditure[25] and training effort done by firms (vocational training). Available data indicate that the amount of money spent on these items is large and probably ranges between 0.5 and 3.0 percent of GDP.

In several countries more than one percent of GDP is spent through private payments to educational institutions. The reporting of private sources of expenditure (excluding public subsidies to households and other private entities) varies across countries which makes a direct comparison only possible for a limited set of countries. However, the available data indicate that private payment to educational institutions ranges from around 0.1 to 1.7 percent of GDP.

Public subsidies to households and private entities for education make up between 0.1 to 1.4 percent of GDP. Although the OECD is able to provide data for the period 1992 to 1997 it was chosen to present the figures for 1997 in the following table, but not to add them to total public expenditure on education.

The quantity of money spent on vocational training by enterprises is similar to that of the private payments to educational institutes. Unfortunately data on firm based training is scarce.

[24] OECD, Human capital investment, Centre for Educational Research and Innovation, OECD, Paris, 1998.
[25] Final private spending includes tuition fees and other private payments to educational institutes, but excludes transfers to households and other private institutes.

Available data suggest that firms spend about two percent of total labour costs on vocational training, which amount to about one percent of GDP. However when comparing these figures with the training expenses on innovation from CIS2 the picture becomes less straightforward. Training expenditures incurred for innovation makes up around 30 percent of total expenses on vocational training in the Netherlands, while the corresponding figure for Belgium is no more than 6 percent. The large differences between countries indicate a certain amount of bias in the measurements for training expenses incurred for innovation.

Table 3: Other expenditures for education and training as percentage of GDP for selected OECD countries

	Vocational training 1)	Training for innovation 2)	Priv payments to educational institutes 3)	Public subsidies to households & others 3)	Total, excl training for innovation 3)
Belgium	0,5	0,03	-	-	0,50
Denmark	1,2	0,13	0,32	1,44	2,96
France	-	0,02	0,52	0,25	0,77
Germany (new Länder)	0,8	0,09	0,82	0,29	1,91
Netherlands	0,6	0,17	0,36	0,65	1,61
United Kingdom	1,3	0,18	-	0,41	1,71
United States (1996)	1,0		1,72	0,27	2,99
1) Source:					
Waterreus, Scholing van werkenden: een vergelijking tussen landen, Max Groote Rapport,1997					
Figures are not completely comparable to other data due to changes in GDP.					
2) Source: Eurostat					
3) Source: OECD					

Estimating intangible investment in marketing

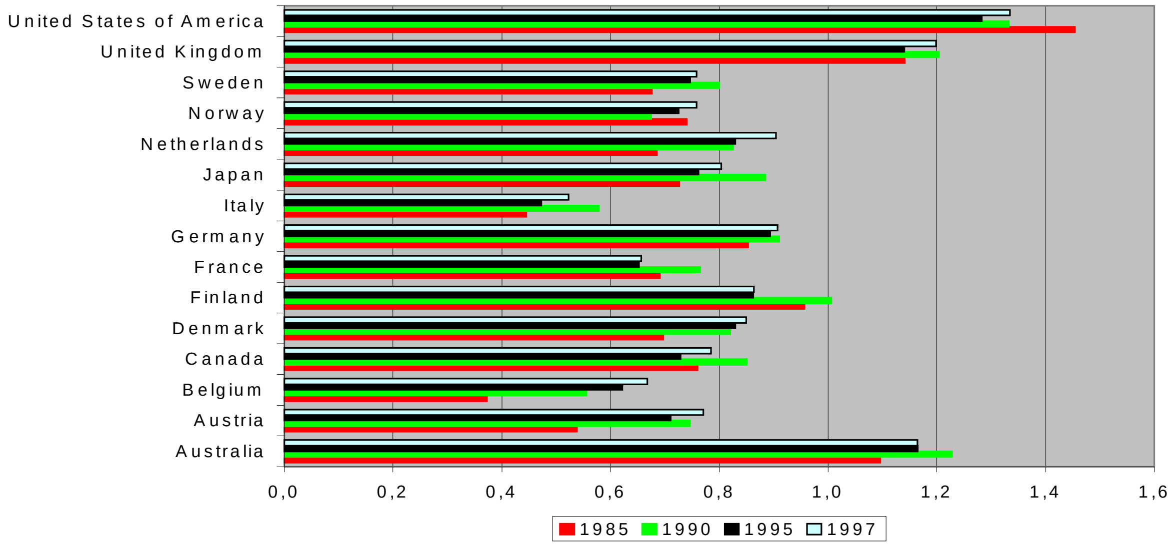
The estimates for intangible investments in marketing include only advertising expenditures. Although the investing property of advertising is heavily debated, here it is considered as part of total intangible investment for several reasons. There is some evidence that advertising has the potential to reach target markets, that it leads to knowledge about consumer needs and trends and that it increases the market power[26]. In the European system of Structural Business Statistics (SBS) marketing is included as one of the intangible investments. However, this view is not followed in the SNA or in other international accounting systems.

[26] Comanor, W.S. and Wilson, T.A. Advertising, Market Structure and Performance, Review of Economics and Statistics, 49, 423-440, 1967. (See also: quote in 1966 paper by same authors in: Backman J., Advertising and Competition, New York University Press, USA, 1967.) Comanor, W.S. and Wilson, T.A., The effect of Advertising on competition: A survey, J.E.L., 17, 453-476, 1979.
Clarke, D., Econometric measurement of the duration of advertising, Journal of Marketing Research, 13, 345-357, 1976.
Brown, R., Estimated advantage to large scale advertising, Review of Economics and Statistics, 60, 428-437, 1978.

Trends in advertising

The data indicate that advertising expenditures normally lie between 0.6 and 1.0 percent of GDP. For most countries an increase is reported between 1985 and 1997. Although the US shows a decline in that period, it is still the largest investor in advertising.

Figure 5: Expenditure for media advertising



Source: NTC publications Ltd.

Other marketing expenditures

Advertising is only one part of the intangible investments in marketing. Other intangible investments in this area are knowledge intense activities such as direct marketing and market research. Direct marketing for example includes the use of database activities and other information technology, while market research includes the collection of information and the use of this knowledge in marketing strategies.

Turnover figures on both marketing items indicate that they amount to between 0.1 and 1.2 of GDP. If counted as intangible investments, total marketing makes up around one fifth of total expenditure on intangibles (including education).

Table 4: Turnover figures direct marketing and market research as percentage of GDP

	Market research, 1998	Direct marketing, 1996	Total
Australia	0,08	-	-
Austria	0,04	0,65	0,70
Belgium	0,05	0,25	0,30
Canada	0,04	-	-
Denmark	0,05	0,45	0,50
Finland	0,05	0,61	0,66
France	0,06	0,60	0,66
Germany	0,06	1,13	1,20
Italy	0,03	0,06	0,09
Japan	0,02	-	-
Netherlands	0,07	0,32	0,39
Norway	0,05	-	-
Sweden	0,10	0,41	0,51
United Kingdom	0,11	0,83	0,94
USA	0,06	0,70	0,76
OECD average[1)]	0,06	0,55	0,61
[1)] Only the countries for which data is available			

Sources: For Direct Marketing "NTC publications Ltd", for Market Research "ESOMAR"

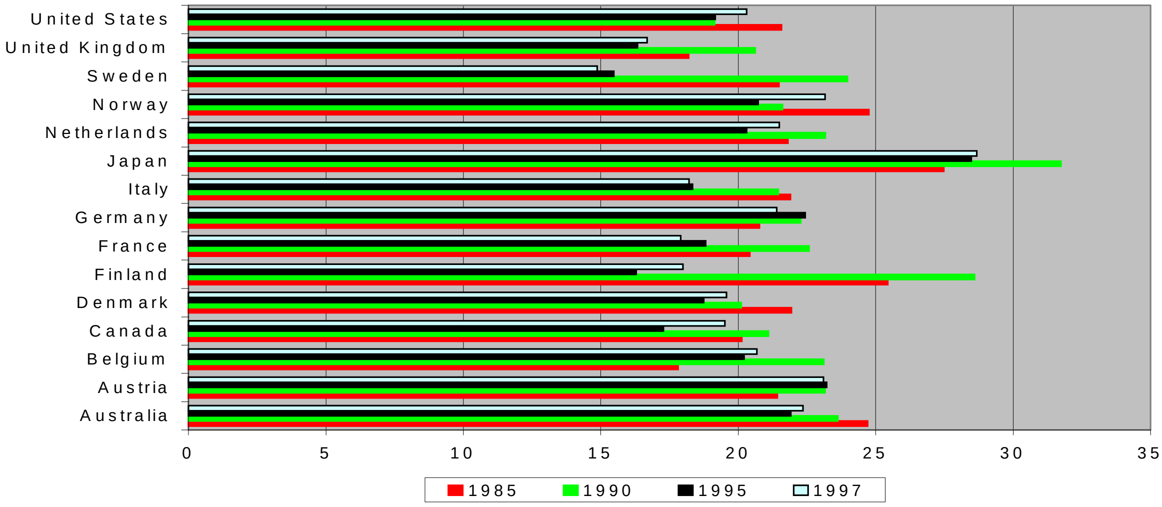
4. Towards knowledge-based economies ?

To what extent are the countries considered here becoming "knowledge-based" economies ? In order to get an idea figures on intangible investments can be compared with those of tangible investments[27]. Additionally the data on these two areas can be linked.

Changing levels

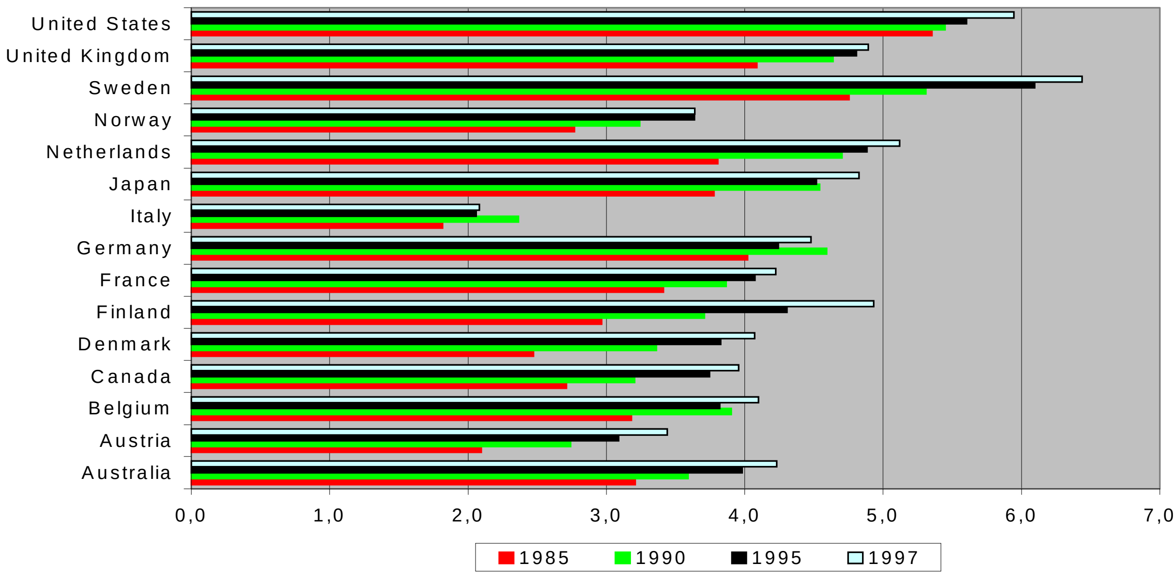
For most of the fifteen countries the level of tangible investments has dropped between 1985 and 1997. While in 1985 almost all the countries considered here showed percentages of more than 20, in 1995 this was the case for just less than half the countries. Throughout the period 1985-1997 Japan is a high tangible investor while Sweden is gradually becoming a low tangible investor.

Figure 6: Gross fixed capital formation as percentage of GDP



Source: OECD

Figure 7: Intangible investments, excluding education, as percentage of GDP



Source: OECD

[27] These are data on Gross Fixed Capital Formation (GFCF) that are derived from the OECD. In the framework of the revised SNA GFCF for some countries include intangible investment such as software.

Data for total intangible investments, including education, as percentage of GDP ranges between 6 and 11 percent. Austria, Japan and Italy score low, while the Scandinavian countries, France and the US score high. Between 1985 and 1997 intangible investment as percentage of GDP have decreased for some countries. However this picture is dominated by public investments in education. When this item is excluded all countries show an increase in that period (see figure 7).

When comparing 1997 growth figures on both intangible and tangible investments, all countries show a higher growth rate of intangibles compared to tangible investments. Especially the Scandinavian countries are moving rapidly towards a knowledge-based economy (see table 5).

Table 5: Comparing indexes for tangible and intangible investments (excluding education), current prices 1985=100

	1990	1990	1990	1995	1995	1995	1997	1997	1997	1985	1985 2)
	GFCF 1)	Intangible	Difference	GFCF	Intangible	Difference	GFCF	Intangible	Difference	GFCF	Intangible
Australia	153	179	26	181	254	72	206	300	94	61	8
Austria	143	173	30	188	255	67	199	303	104	293	29
Belgium	174	160	-14	188	193	5	206	221	15	873	160
Canada	146	163	16	143	231	88	174	265	91	96	13
Denmark	123	182	59	140	254	114	162	299	137	135	15
Finland	174	193	20	107	242	135	133	313	180	86	10
France	153	157	4	150	194	44	151	213	62	974	163
Germany	143	152	9	209	204	-5	207	224	17	379	73
Italy	160	212	53	185	250	65	203	280	77	177	15
Japan	155	161	6	156	180	24	165	202	37	88	12
Netherlands	129	150	21	146	201	55	170	232	62	93	16
Norway	116	155	39	143	224	81	187	263	76	135	15
Sweden	175	175	0	142	254	111	145	283	138	186	41
United Kingdom	177	177	0	181	236	55	208	271	63	64	15
United States	122	140	18	154	182	28	182	215	33	873	217
Unweighted average											
15-OECD	150	169	19	161	224	63	180	259	79		
1) Gross Fixed Capital Formation											
2) Absolute figures in billion National Currency, for Italy and Japan trillion											

Changing ratio

An interesting indicator is the ratio tangible – intangible investments. Here a lower ratio means that relatively more money is spent on intangible investments as opposed to tangible investments. For the fifteen countries this ratio ranges between 2 and 9. This ratio affirms the trend mentioned by Mortensen et al[28] by showing a decrease for all countries between 1985

[28] Mortensen et al (1997) concluded that in ten years time (1974 -1984) intangible investments had grown more rapidly than the gross fixed tangible investments. For the EU the gross fixed tangible investments declined from about 23% of the gross domestic product (GDP) in the sixties to some 20% in the nineties. Therefor the character of investments seems to be shifting from material (or fixed) to immaterial assets. See: Mortensen J., C. Eustace and K. Lannoo, Intangibles in the European Economy, Centre for European Policy Studies, Edited Discussion Draft, Brussels, January, 1997.

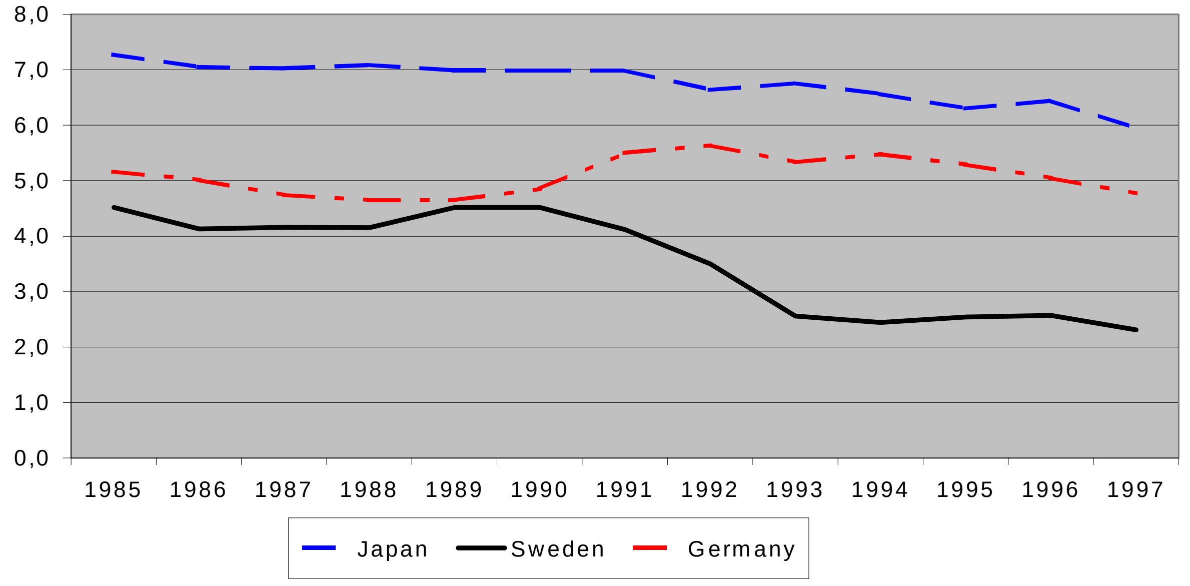
and 1997. Countries with high ratios are Austria, Italy and Norway, while Sweden has the lowest ratio.
Since the beginning of the nineties for all countries the level of tangible investments has dropped (considerably) compared to that of intangible investments. The only exception is Germany, where relatively more money was spent on tangible investments. Between 1985 and 1997 the ratio for Finland shows the largest decrease from 9 to 4 points. In Sweden the ratio decreased in almost the same way from 5 to 2 points.

Table 6: Ratio tangible vs. intangible investments, excl. education

	1985	1990	1995	1997
Australia	8	7	6	5
Austria	10	8	8	7
Belgium	5	6	5	5
Canada	7	7	5	5
Denmark	9	6	5	5
Finland	9	8	4	4
France	6	6	5	4
Germany	5	5	5	5
Italy	12	9	9	9
Japan	7	7	6	6
Netherlands	6	5	4	4
Norway	9	7	6	6
Sweden	5	5	3	2
United Kingdom	4	4	3	3
United States	4	4	3	3
Unweighted average				
15-OECD	7	6	5	5

Source: OECD

Figure 8: Ratio tangible – intangible investments for Japan, Sweden and Germany, excluding public spending on education



Source: OECD

5. Need for more indicators

The OECD has and will continue to be engaged in setting measurement standards on intangible investments. One of the mayor difficulties however, is that international data collection is often voluntary.
Also there is a growing demand for figures on intangibles. Nowadays it is not only the accountant, the investor or the manager that desires more information or more "transparency" on intangibles. Partly influenced by the market needs, policy makers have started to take a serious interest in the matter.

According to a report by the Brookings Institute[29] there are "substantial costs to society from not being able to identify and measure the intangibles input into wealth creation". Not knowing leads to the use of inadequate metrics at all levels, to less informed decisions at governmental level, to benchmarking difficulties at sectorial level and to disclosure problems at firm level. Several examples are provided in this report. The US Federal Reserve Board (FRB) was concerned at the end of the millennium about the rapid growth rate of the GDP together with the low levels of unemployment and the high capital utilisation rate. In order to prevent an increase of the inflation, FRB took actions to increase interest rates. However, the authors argue that this response is questionable. The US economy may be capable of sustaining a much higher level of economic growth without inflation. Due to the failure to account for intangible investments in a macro-economic measurement like the GDP, a metric which otherwise would have been (much) larger, governmental decisions become less straightforward.

Another example is a policy paper[30] written by the Dutch Ministry of Economic Affairs at the request of the Central Government. In this paper it is claimed that more transparency is needed for firms in need of capital. This is especially the case for young innovative firms, often active in the business of creating intangibles that are not quoted on the stock exchange. According to this paper the Dutch have experimented in co-operation with accountants with some new disclosure methods. In another missive the Dutch stressed the importance of more statistical information on intangibles[31]. Unfortunately these papers do not contain a wish list of indicators, while an actual role for the government in the provision of indicators is left aside.

Role for governments

The Brookings report discusses two basic governmental roles in measuring intangible investments. Firstly there is a "public good" problem which means that, if the data once collected was made available to all, it is not in anyone's interest to expend resources to collect and develop the data. This problem could only be solved through some kind of collective action, via the government or via private associations of firms. Here the government is to be preferred, because of its historical involvement in setting standards.
Secondly, the government is strongly involved in the creation of intangibles. Products of the government include rules and regulations on areas of property rights, corporate management, labour relations, funding of research activities etc.

---

[29] Unseen wealth, Report of the Brookings Task Force on Understanding Intangible Sources of Value, Task force co-chairs: Margaret M. Blair and Steven M.H. Wallman, Prepublication Manuscript, October 2000. (See: www.brook.edu/press/unseen_wealth.htm)
[30] Waardering van immateriële activa, Ministerie van Economische Zaken, 's-Gravenhage, 1998. (Translation: Valuation of intangible assets, Ministry of Economic Affairs, The Hague, 1998.)
[31] Kabinetsstandpunt "Balanceren met Kennis", Ministerie van Economische Zaken, 's-Gravenhage, 2000. (Translation: Point of view of the government "Balancing with knowledge", Ministry of Economic Affairs, The Hague, 2000.)

Here only the first role is touched by two questions. Firstly, if more information is needed on intangibles, which information should be chosen and why ? Secondly, what could be the role of the government when the information needed is not there ?

European initiatives

The White Paper on Growth, Competitiveness and Employment by the European Commission[32] puts much emphasis on knowledge-based economies. This paper addressed several policy areas closely related to intangibles. Examples are the quality of training and education, R&D intensity and exploitation, the availability of service infrastructures and product quality. At that time no initiatives were made to start collecting a comparable set of data for policy purposes.

This changed in the beginning of 2000 when the European Council declared its intention to formulate a set of indicators for European policy on knowledge infrastructures, enhancement of innovation and economic reform, and modernising social welfare and education systems. This resulted in the so-called Broad Economic Policy Guidelines covering five main policy areas including the area of the development of a knowledge-based society.

Attached to these policy areas is a scoreboard that includes the most important driving forces of knowledge-based economy. These indicators measure performance in four areas:

- Human potential
- The creation of new knowledge
- The transmission and use of knowledge
- The financing of innovation, output and markets

Following these areas is a list of indicators such as R&D expenditure and internet penetration[33]. Apart from the view that some indicators are more important than others, no additional reasoning behind the choice of indicators is provided.

Which indicators ?

How to choose additional international comparable indicators ? There are some issues when looking for indicators for intangibles.

Firstly, empirical studies of intangibles have for a long time been confined to R&D and patents. Other intangibles such as brands, IT and vocational training are gradually being studied and the outcome is often that these intangibles are also important. Additionally there is some scarce evidence that intangibles are interrelated[34].

Secondly there are no new economic or business models that include different sorts of intangibles. And without a model it is difficult to choose amongst the heterogeneous items labelled “intangibles”. Some intangibles are input factors, some are produced and consumed simultaneously, some can be sold, some are volatile etc.

[32] White Paper on Growth, Competitiveness and Employment: The challenges ahead and the ways forward into the 21st century, COM (93) 700, European Commission, Brussel, 5 December 1993.

[33] Report by the Economic Policy Committee to ECOFIN on “Structural Indicators”, Economic Policy Committee of the European Commission, Brussels, 2000.

[34] See for example: M.M.Croes, Intangible investments: indicators for competitiveness, Statistics Netherlands / Eurostat, Voorburg, Luxembourg, 1999.

Finally there is this problem that measurement of intangibles in terms of money is not possible in all cases, whereas national and international business statistics are mostly expressed financially.

Notwithstanding these difficulties some indicators can be suggested on basis of their (1) policy relevance and the (2) current coverage of intangibles.

Policy relevance and current coverage

In general policy makers are inclined to prefer output-oriented indicators, which in this context are the intangible assets or capital. This does not mean that policy makers are only interested in output indicators, because in some cases output cannot be measured.
As discussed earlier many intangibles are the result of governmental rules and regulations. This applies especially on the area of property rights. This means that intangibles differ in the extent they are affected by policymakers.

Another policy issue for indicators on intangibles, are the differences in the economic structure and culture of countries. The indicators may not always capture these differences. For example, a country with a small biotechnology sector will normally have few patents in this area compared to a country with a strong biotechnology sector. Additionally cultural differences, such as governmental stimulation or proneness, can influence the number of patents in a country or sector. Another example is the country differences in external trade.

Thus policymakers should be aware of the goal of the indicators: is it for intervening, is it for the evaluation of policy, for sectorial benchmarking or is it for general benchmarking purposes ?

Choosing new indicators should ideally reflect issues or areas on intangibles currently not covered. As stated earlier, official indicators are often confined to the area of technology whereas indicators on the area of marketing and information technology are yet to be developed. In order to ease the process of choosing, indicators for intangibles should ideally be categorised.

Classifications for indicators

Many areas of importance for firms that have been indicated in the literature can be linked to intangibles either as assets or as activities. Here three examples are presented: one relating to investors, one to managers and one for policymakers. Components of these examples are used to pinpoint the areas not or not fully covered.

Mavrinac & Siesfeld[35] investigated non-financial indicators that investors view as the most crucial in their decision-making. Additionally PA Consulting Group[36] reported on the most important success factors according to managers.

---

[35] Mavrinac, S. and Siesfeld, A. Measures that matter. An exploratory investigation of investors' information needs and value properties. In: *Enterprise value in the knowledge economy.* OECD and Ernst & Young Center for Business innovation, Cambridge, MA, 1997.
[36] Leading into the Millennium, report by PA Consulting Group that includes results of interviews with more than five hundred managers in the one hundred best achieving firms in fifteen different countries.

Table: Important factors or items according to managers and investors

The ten most valued non-financial indicators by investors, starting with the most valued indicator	The most important factors for success according to managers, starting with the most important ones
1. Execution of corporate strategy	1. Human capital
2. Management credibility	2. Strategy & market
3. Quality of corporate strategy	3. Information technology
4. Innovation	4. International competition
5. Ability to attract employees	5. Marketing
6. Market share	6. Technology
7. Management experience	
8. Quality of compensation policies	
9. Research leadership	
10. Quality of processes	

As mentioned earlier the European Commission has come up with a list of indicators covering the areas of Human Capital and R&D and Innovation. This list divides the indicators in three classes: a top set list, a second set list and one indicator yet to be developed.

Scheme 1: Policy indicators as proposed by the EPC to ECOFIN of the European Commission.

Top set indicators	Second set indicators	To be developed
a) Total R&D expenditure	g) Public education expenditure	q) E-commerce as % of total sales
b) Venture capital as % of GDP	h) Lifelong learning indicator	
c) Level of internet access (active accounts per 100 inhabitants)	i) S&T graduates	
	j) Educational attainment	
d) ICT expenditure	k) Capitalisation of stock markets for high-growth companies	
e) Educational attainment of young population		
	l) Number of companies having received early-stage financing	
f) Total patents (previously patents in high-tech areas)		
	m) % of secondary schools connected to the internet	
	n) Use of mobile phones	
	o) Employment of the ICT sector	
	p) Exports of high-tech products	

According to an Eurostat report[37] intangibles can be divided for statistical purposes into four main areas: technology (e.g. R&D, innovation and payments for foreign technology), marketing (e.g. advertising and market research), information technology (e.g. software) and finally organisation (e.g. education). Measuring for indicators for intangibles differs from measuring for investments in intangibles, because unlike figures on intangible investments indicators for intangibles are (1) not necessarily expressed financially, (2) can include tangible investments and (3) can include operational activities. As result of the fact that measuring for intangible indicators is not the same as measuring for intangible investments, IT is changed to ICT[38].

The Brookings report introduces a managerial classification for the different types of intangibles "in order to support, improve and promote business reporting models" that can be

[37] Michel M. Croes, Intangible investment; Definition and data source for technological, marketing, IT and organisational activities and rights, LNM-reeks, Statistics Netherlands / Eurostat, Voorburg / Luxembourg, 1998.
[38] A personal computer (pc) is not an IT intangible investment, because the software cannot be separated from the hardware. On the other hand a pc can be counted without any hesitation to ICT investments.

used as a framework to include indicators for intangibles. In this report three different levels of intangible assets are distinguished.

Three levels for intangible assets according to Brookings report:

- Level 1

Intangibles that can be sold. They are relatively clear to define and market exists (e.g. patents, copyrights, brands and trademarks). *This level can be applied to indicators for intangibles and would additionally include purchases of knowledge.*

- Level 2

Intangibles that cannot be sold. They are in a certain way controlled by firms but cannot be separated from other intangibles for measurement or valuation purposes (e.g. business processes and reputation). *This level can be applied to indicators for intangibles and would include several types of expenditures for specific activities and other general indicators that are not specifically attached to a knowledge area. Control criteria is not relevant (see level 3).*

- Level 3

Intangibles that cannot be sold. They are not controlled and they cannot be separated from other intangibles (e.g. human capital and organisational capital). *This level cannot be applied to indicators for intangibles, because it consists of items that are not measurable. Also the control criterion only applies to the firm level and therefore is not relevant for indicators for intangibles for policy purposes.*

It should be noted that the division suggested only ranks output indicators and not the activities and rights leading to these assets. In general only property rights can be separated clearly and sold to third parties. This means that all activities leading to these property rights are level 2 and 3 indicators. Finally the “control” criteria as used in level 2 and 3 are only useful for indicators at firm level or sectorial level, because policymakers are normally more interested in the skill and experience of the labour force and less interested in the fact that some employees can quit their jobs. Moreover level 3 includes mainly issues in the organisational area, which are in general difficult to measure.

When levels 1 and 2 are linked to the three main areas of intangibles (technology, marketing and ICT) a total of eight classes for indicators appear for which indicators can be constructed. These are the class A up to class H as presented in the table below.

On both levels a class is discerned for indicators that are not necessarily linked to just one of the main areas. Consequently the suggested indicators by EPC can be inserted into these classes, providing information on the blank spots. Most indicators proposed by EPC fall in classes G and H and none fall in classes A, C, D and F. As the table shows, EPC does not include any indicators on the area of marketing. Additionally it should be noted that almost none of the indicators in class G are based on internationally comparable official data.

Considering the information in the following table, three feasible indicators can be suggested. One on the area of ICT (class G) and two on the area of marketing property rights (class C).

Table 7: Scheme for indicators for policy purposes, between brackets the EPC items

<table>
<tr><th></th><th>Technology</th><th>Marketing</th><th>ICT</th></tr>
<tr><td rowspan="2">First level:

Indicators that refer to property rights and other knowledge that can be sold and purchased. They are generally created by the government for the exclusive use by others.</td><td colspan="3">Class A:
e.g. purchases of know-how and other professional services

(EPC: none)</td></tr>
<tr><td>Class B:
e.g. number of applications for patents, purchases of patents

(EPC: f)</td><td>Class C:
e.g. number of applications for registrations of design, licenses, trademarks

(EPC: none)</td><td>Class D:
e.g. number of applications for copyrights, purchases of databases

(EPC: none)</td></tr>
<tr><td rowspan="2">Second level:

Indicators that lead to assets in classes A to D. They are provided or stimulated by the government for general use.</td><td>Class E:
e.g. expenditure for R&D and innovation

(EPC: a)</td><td>Class F:
e.g. expenditure for advertising and market research

(EPC: none)</td><td>Class G:
e.g. software expenditure, ICT expenditure

(EPC: c, d, m, n, o)</td></tr>
<tr><td colspan="3">Class H:
e.g. expenditure on education and training, number of firms in professional services sectors

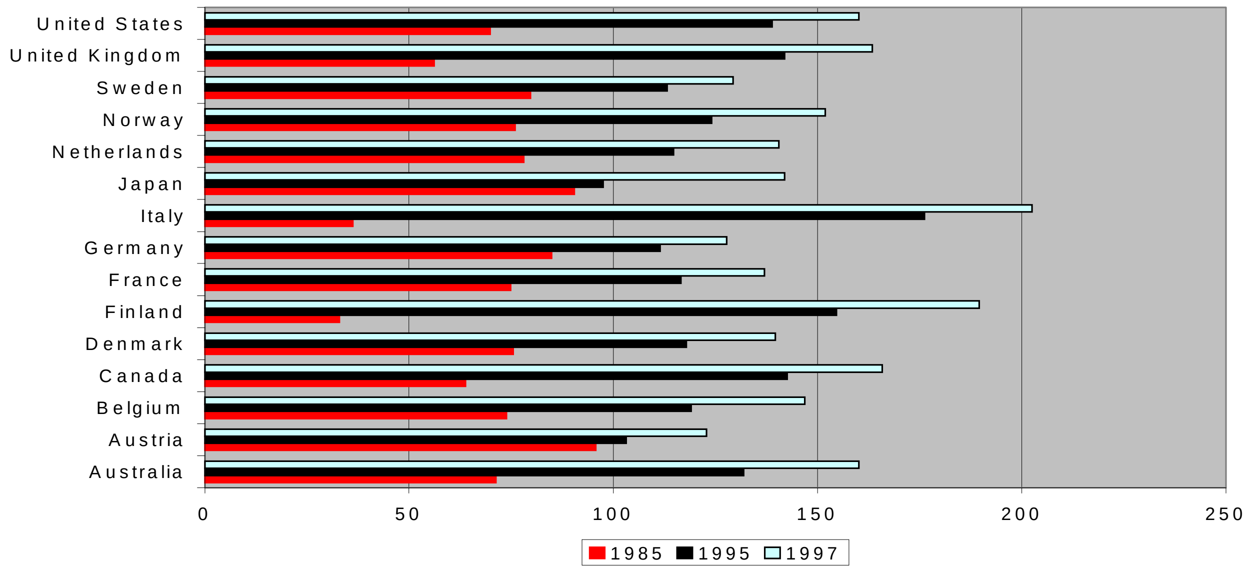
(EPC: b, e, g, h, i, j, k, l, p, q)</td></tr>
</table>

Intangible indicator for ICT

In 1997 total ICT expenditures for the fifteen countries considered here, consists of between 15 to 25 percent of the estimated intangible investments in software. The other ICT expenditures include operational expenditures such as maintenance and capital expenditures such as computers.

According to data from IDC, Italy has the highest growth rate of all countries. The 1997 expenditures in Italy are compared to data for 1990 twice as high. During this same period Austria, Germany and Sweden show a less drastic growth (less than 30 percent).

Figure 9: Growth of ICT expenditure, 1990=100[39]



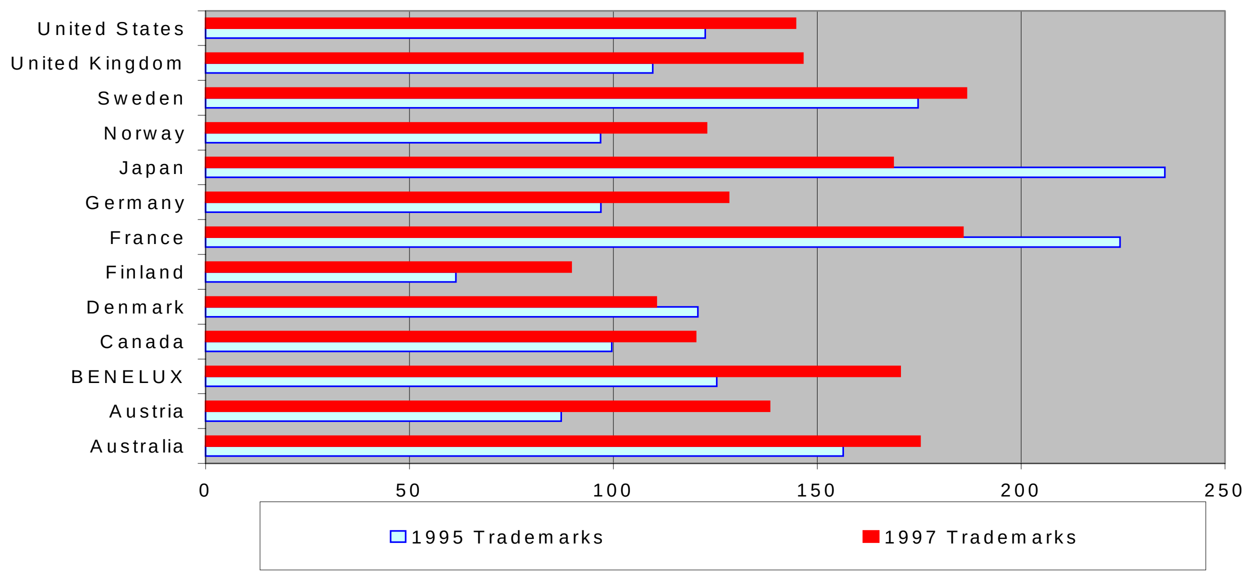
Source: IDC

Intangible indicators for property rights

Two indicators for property rights refer to total resident applications for trademarks and industrial design. Per 100 thousand of total labour force France and Sweden have the highest rates on the number of trademarks. For only three countries the number of applications for trademarks have decreased (Japan, France and Denmark) between 1995 and 1997.

The number of applications for industrial design is much lower than the number of applications for trademarks. Austria and Japan have the highest rates (more than fifty). However for several countries (Australia, Canada, Japan and Norway) the number of applications for industrial design have declined.

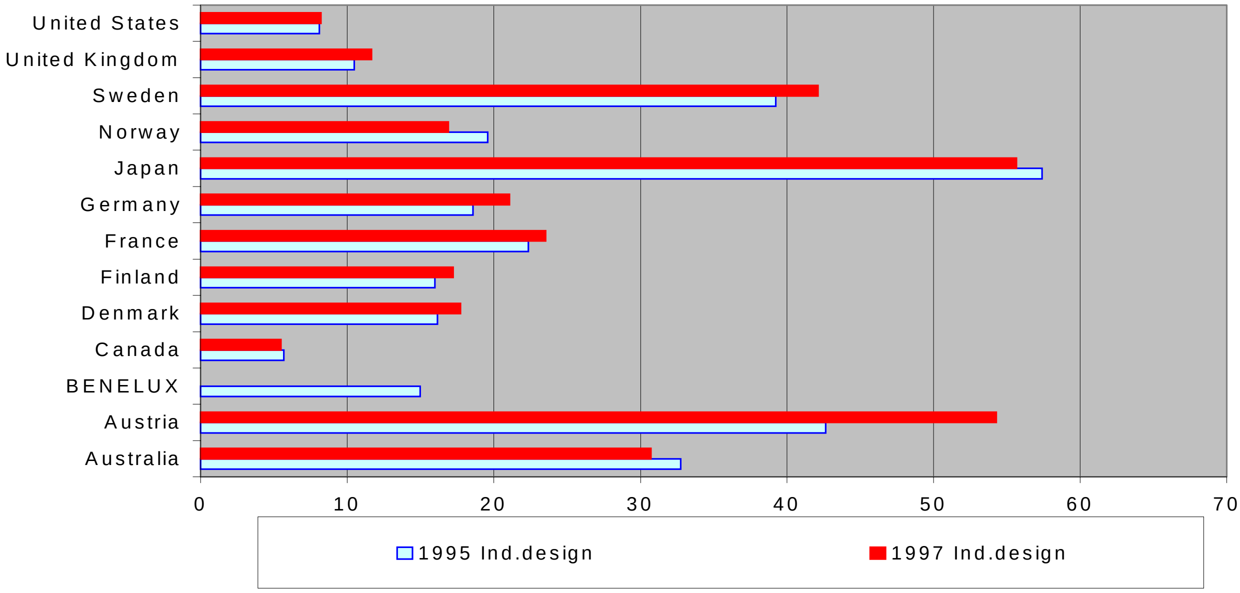
Figure 10: Number of resident applications for trademarks, per 100 thousand of the total labour force



Source: World Intellectual Property Rights Organisation, WIPO

[39] Estimated on basis of two separate IDC data series.

Figure 11: Number of resident applications for industrial design, per 100 thousand of the total labour force



Source: World Intellectual Property Rights Organisation, WIPO

Suggestion for policymakers

As previously mentioned, governments have an important role in creating indicators for intangibles. However, despite the governmental initiatives on this area, the hazard of not knowing, the general interest in the subject, the growing empirical evidence on the importance of intangibles and the numerous congresses and experiments, international comparable data needed to create indicators for intangibles is still scarce in the year 2000.

How could policymakers enhance the collection of data and / or improve the creation of a broad spectrum of indicators for intangibles that are internationally comparable ?
Considering the framework of this report, only one research suggestion can be made based on the international orientation, the role of NSO's and the setting of a standard.
One should start with creating a list of indicators, including the arguments for choosing them, consult a number of experts in different areas (scholars, managers, accountants, policymakers, statisticians, professionals working in the area of technology, marketing or ICT) standardise the metrics and introduce them in a number of countries. If the indicators are chosen well, other countries will eventually follow.

- International orientation: An international study should be aimed at producing a list of indicators (both financially and non-financially) that cover the whole area of intangibles. Because many countries would want the indicators for benchmarking purposes, it is advisable to start this research in several countries. Note that these kinds of projects are already going on, but until now they are primarily aimed at generating management information on intangibles.

- Countervailing role of National Statistical Offices (NSO): The term countervailing role reflects both the independence nature of NSO's and the ability of NSO's to evaluate propositions for new data collection by their durability. In most countries NSO's are independent governmental institutions. NSO's stand for quality and continuity and some have even compiled some figures on intangibles. However, in general NSO's should be stimulated much more than is the case now. The production of statistics is by its nature a rigid and static process. Especially the new terms used to depict intangibles (e.g. knowledge-based economies, new economy, intellectual capital) make NSO's cautious and hinder the collection of entirely new data. For example why should NSO's collect data on the number of firms with internet access, if in a few years all firms would have internet access ? And besides, in some cases it may be preferred to acquire information by other methods than by collecting data for statistics. Another problem hampering the collection of data, is the fact that intangibles cover a variety of data that are collected at different departments within the individual NSO's.

- Faster standardisation of indicators internationally: Much effort is put into the co-ordination of international data by organisations such as the OECD, Eurostat, IMF etc. However, as with many decisions, more slows down. For example, despite the ubiquity of ICT products in modern society there is still not a general consensus on what should be counted as an ICT product or service. Until no standardised metrics are introduced governments have to rely on commercial data or on no data at all. Moreover countries that find it difficult to collect "regular" statistics are likely to loose interest for collecting data in new areas.

ANNEX A: Software & ICT

Due to changes in the different time series as published by IDC it is not possible to compile a single time series for the period 1985-1997. However, by using several sources of information, estimates can be made for the three separate series of investments in software: (1) packaged software, (2) purchased professional services and (3) internal professional services. Additionally estimates can be made on total ICT expenditures.

For the purpose of estimating investments in software the following aspects should be considered:

- Linking information available in the time series.
- Generating of the shares for professional services on basis of the data on total purchased IT services. Here the idea is to exclude operational expenditures included in the IT services.
- Calculating of own account software investments on basis of estimates on shares of professional services, data on total internal IT services and available information from the estimates on software investments from National Accounts.
- Linking of series on expenditures for IT with series on expenditures for ICT, on basis of the fact that IT is a component of ICT.

1. Estimating for packaged software

For packaged software there are two time series available: an old one and a new one. For the overlapping years 1992-1995 percentages were calculated in order to get insight in the difference between the series. Here only one step is needed: linking the series.

Series I – (WITSA) IDC, total for packaged software
Coverage: World

Series in previous issue:	1985-1995 (old series)
Series in 1999 issue:	1992-1999 (new series)
Overlapping years:	1992-1995

For the US and Canada the difference between the series is (almost) zero percent of the new data; For Australia, Austria, Belgium, Finland, France, Germany and the Netherlands the old series were corrected downward; For all other countries the old series were corrected upward.

For almost all the countries the difference (as percentage of the new series) was the same in 1992, 1993 and 1994. Therefore it was concluded that it is possible to link the new series by adapting the old series. The most extreme adaptations had to be made for Norway (plus 9 percent of new data) and Finland (minus 15 percent of new data). See figures A1 and A2.

Finally the old series were corrected by applying the growth figures of the old series (1985-1992, 1992=100) to the absolute data for 1992 from the new series. Thus the old series is either raised or lowered to the level of the new series without loosing growth information from the old series.

Figure A1: Comparison of two series for packaged software for Norway, in million US $

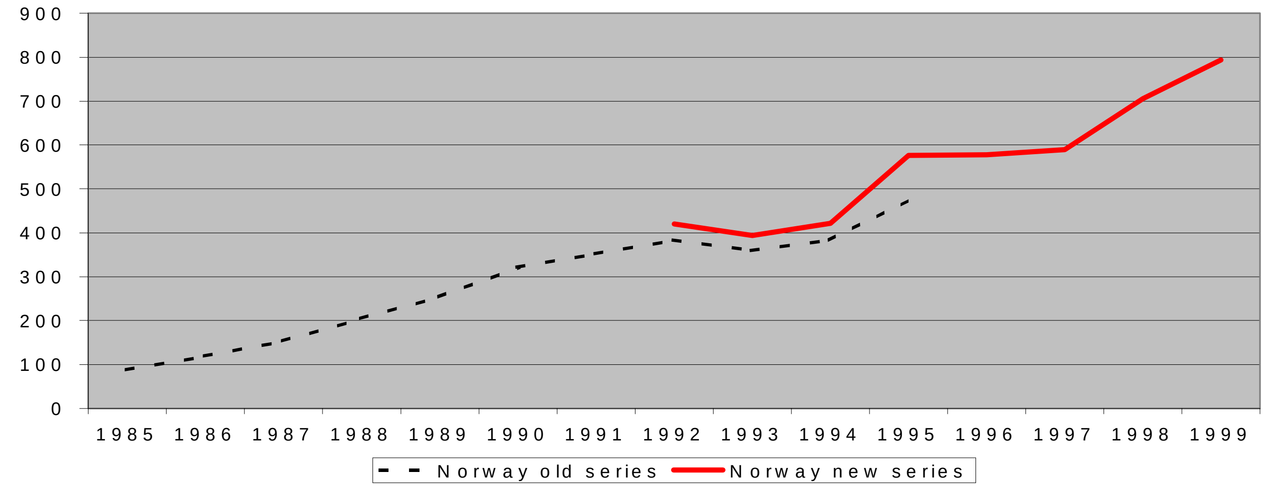
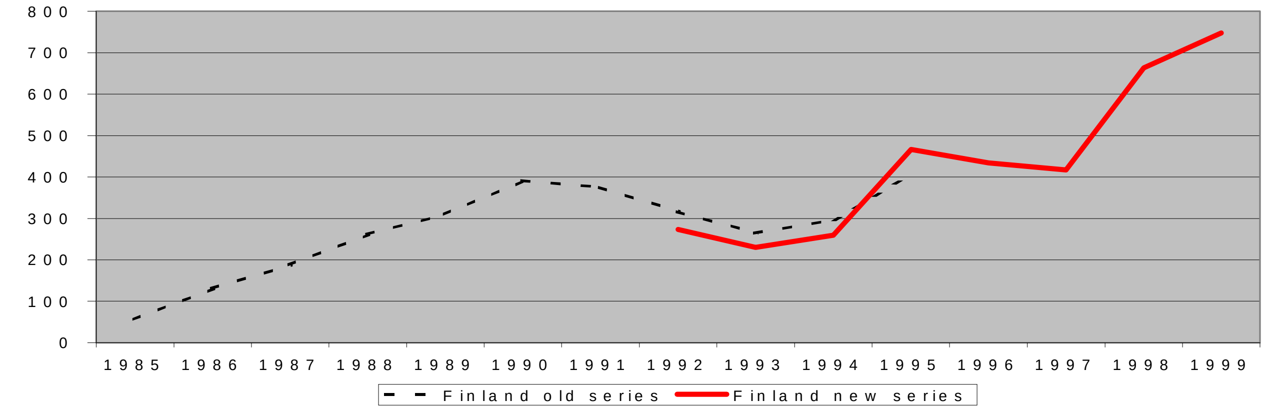


Figure A2: Comparison of two series for packaged software for Finland, in million US $



2. *Estimating share of professional services*

EITO publications provide information on professional services in total purchases of services. In this report professional service comprises the items “consulting” and “implementation”. EITO publications of 2000 and 1998 were used to calculate the share of these items in total services. As the EITO focuses on European countries only, shares for other countries were estimated.

Two steps are needed to calculate estimates on purchases of professional services: (1) joining the series and (2) calculating the shares of own account.

Series I – WITSA (IDC), total for software services
Coverage: World
Series in previous issue: 1985-1995 (old series)
Series in 1999 issue: 1992-1999 (new series)
Overlapping years: 1992-1995

Series II – EITO (IDC), breakdown for software services
Coverage: European countries
Series in 1998 issue: 1994-1999 (old series)
Series in 2000 issue: 1997-2001 (new series)
Overlapping series: 1997-1999[40]

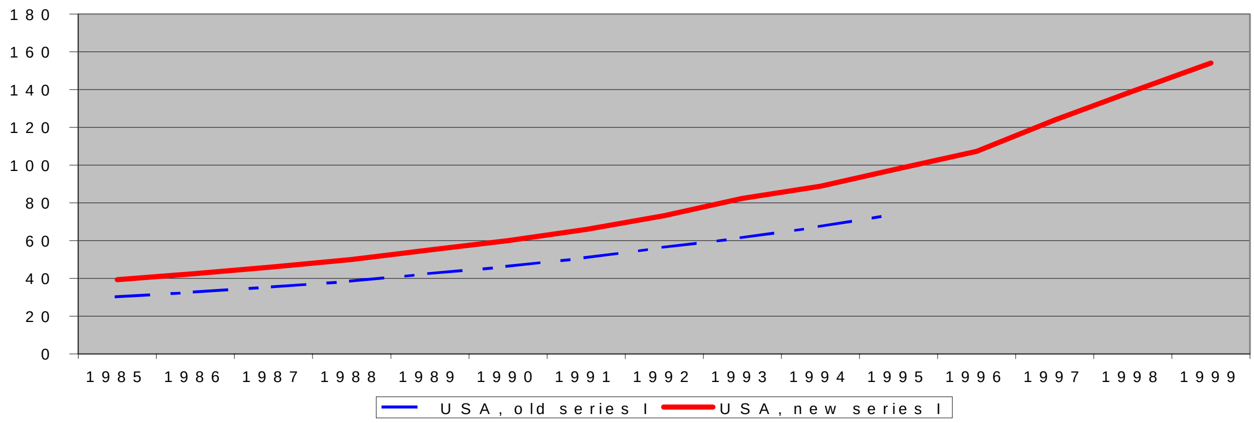
[40] Share of professional services in overlapping years is problematic for two countries, these are Spain and Germany.

Step 1: join series I

The new series show for all countries and for all years *higher expenditure levels* of purchased IT services in the overlapping years (see example in figure A3) 1992 to 1995. During this period these differences vary between 6 and 41 percent of the new data.

Firstly the old series were adapted upward to the new series. However a confrontation with available data from countries that estimated software investments in the framework of SNA, showed that the total figures were too high. Therefore it was chosen to reverse the linkage, by *adapting the new series to the expenditure level from the old series.* This was done by applying the growth figures of the new series (1992-1999, 1992=100) to the absolute data for 1992 from the old series. Thus the new series is lowered to the level of the old series without loosing growth information from the new series.

Figure A3: Difference between new and old series for total purchases of IT services in billion US$ for USA



Step 2: calculate shares in series II

A. Estimates for 1995-1999 on basis of *average shares* for adjoining years (e.g. share 1998 is average of shares 1997-1999). Shares are calculated by dividing total “professional services” by total IT services.
B. Estimates for 1985-1994 via *linear regression* on average share data 1995-1999. The regression formula gives a yearly growth factor and a constant factor.
C. Separate estimate shares for *Australia, Canada, Japan and USA*, by using average of growth factor and average of constant factor.

Figure A4: Shares of professional services in total purchased IT services 1985-1999 for Belgium, Denmark, Finland, the Netherlands, Norway and Sweden

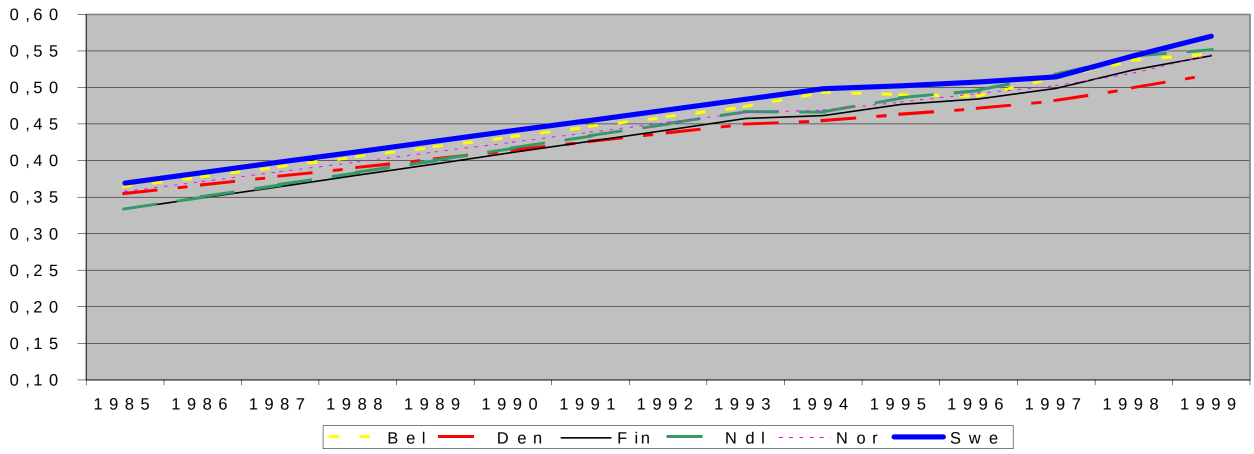
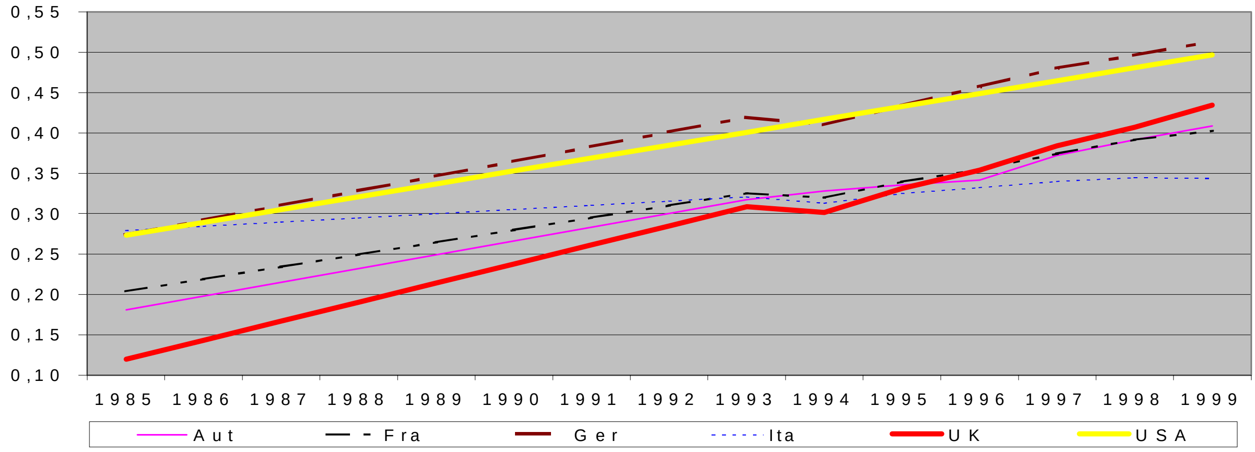


Figure A5: Shares of professional services in total purchased IT services 1985-1999 for Austria, France, Germany, Italy, UK and USA (Australia, Canada and Japan identical to USA)



3. Estimating own-account software investments

IDC provides data on internal spending for IT. According to WITSA this heading comprises the internal spending on IT as opposed to the purchases for IT (e.g. IT services and packaged software). These expenditures cannot be attributed to a vendor and include for example the internal spending budget and internal customisation of software.

The internal spending is used to calculate software investments produced on own-account. Due to lack of data before 1992, estimates were made for each country for the period 1985-1991. Additionally available information from estimates by NSO[41] is used.

Thus here three steps are undertaken to generate the estimates for own account software investments: (1) estimating the missing years 1985-1991, (2) calculate the investments portion of total internal spending and (3) comparing this with the information on own account investments from the NSO.

Series I – WITSA (IDC), total for internal software services
Coverage: World
Series in 1999 issue: 1992-1999 (new series)

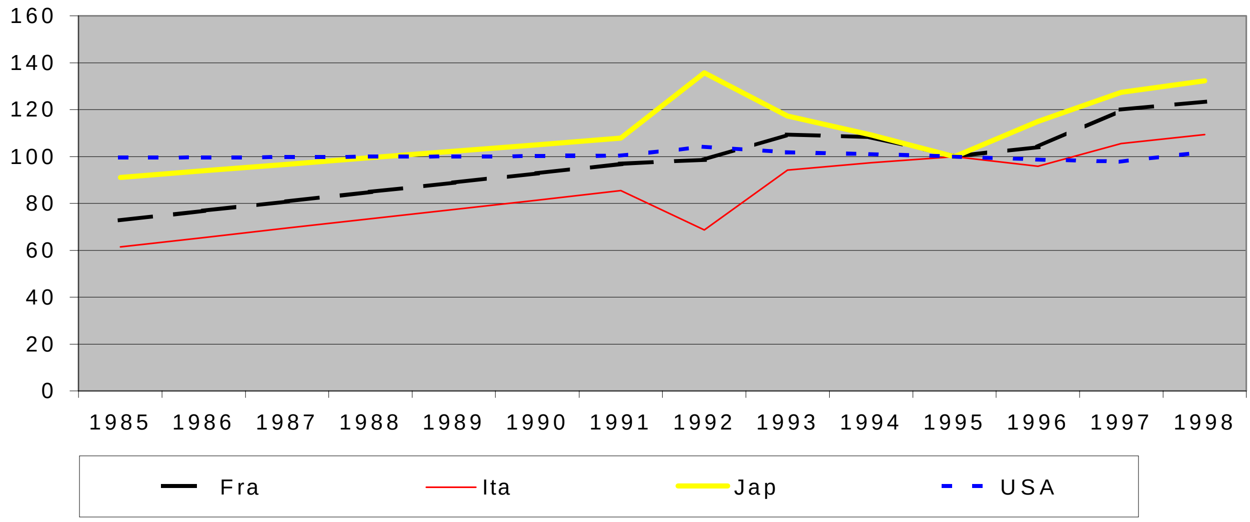
[41] National Statistical Offices

Series II – Shares of professional services
Coverage: OECD-15
Series: 1985-1999 (estimates)

Step 1: estimates for missing period 1985-1991, total internal software

A. The estimates were made by using *growth figures* (1992-1999, 1995=100) for the IDC data on internal IT services. These growth figures were then converted into three-year moving average figures (e.g. data for 1993 is average of 1993, 1994 and 1995 data).
B. Next *a linear regression* is applied on the moving average figures. This analysis provides information to be used on the missing period 1985-1991. When applying this information, it provides for example for 1985 index figures ranging between 61 and 99 (1995=100).
C. These index figures are then applied on the internal expenditure data of IT services from IDC for the year 1995. The missing financial data can be compiled for 1985-1991. This results in an estimated time series 1985-1999 on *total internal services*.

Figure A6: Trend for total internal software services for four countries (1995=100) estimates figures for 1985-1991, IDC data for 1992-1998



Step 2: calculate shares of own account software

This is done by using the shares of purchased "professional services" as found earlier. The assumption is that the components of "purchased total IT services" and "internal total IT" services are similar. In other words they both consist of the same share of services with an investment character.

Step 3: compare with share of own account with similar information of National Account

A. Time series information on own account is available for the Netherlands, Italy and the US. For both *Italy and the US* it showed that the course of the shares between 1995-1998 are comparable. However for both countries the shares of own account software as estimated from IDC data were too high in the period 1984-1990. The Dutch series on own account had neither comparable course, nor a comparable level. Therefore the Dutch data were not used to create correction factors.
B. It was chosen to *correct the shares of own account* estimates, by using the information from the US and Italian series. Estimates for 1985-1994 are compiled via linear regression on the average (for Italy and the US) difference of the own account shares for 1985-1998.

This formula gives a growth factor and a constant factor, and according to the factors the shares on own account for the years 1985-1992 should be decreased.

C. The *average difference* in the share of own account for 1985 for Italy and the US is 20 percent. The linear regression formula results in a 14 percent difference, meaning that 6 percent difference is not corrected for. In order to further decrease this difference, a second regression was applied on only the years 1985-1990. This resulted in an additional set of correction factors, which were applied to all countries.

Table A1: Correction factors for shares of own account software

	1985	1986	1987	1988	1989	1990	1991	1992
Correction factors	21	17	13	9	7	5	3	1

Figure A7: Shares for "own account" on total software investments according to three estimates, USA 1985-1998

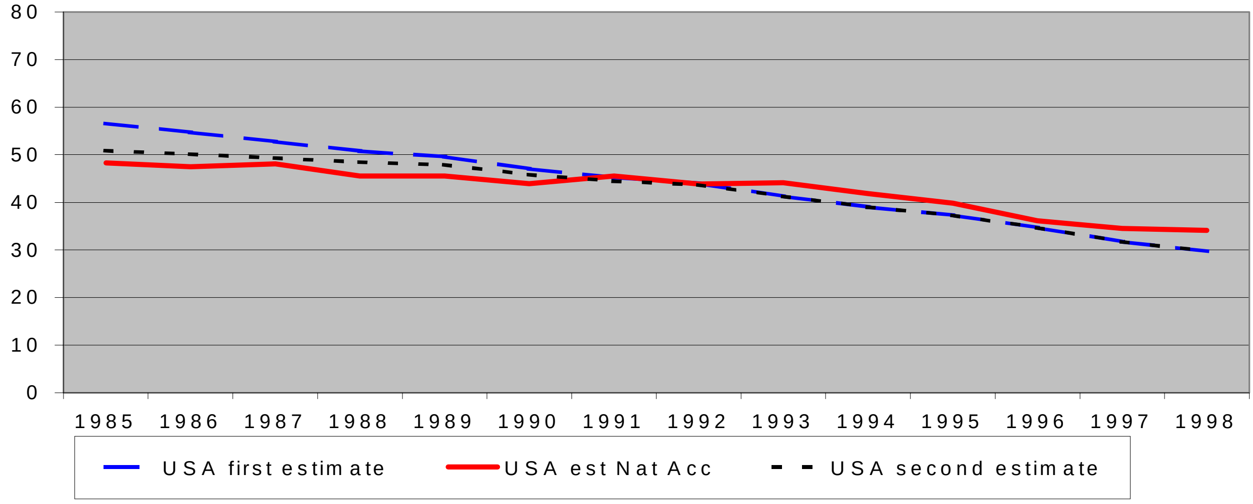


Figure A8: Shares for "own account" on total software investments according to three estimates, Italy 1985-1998

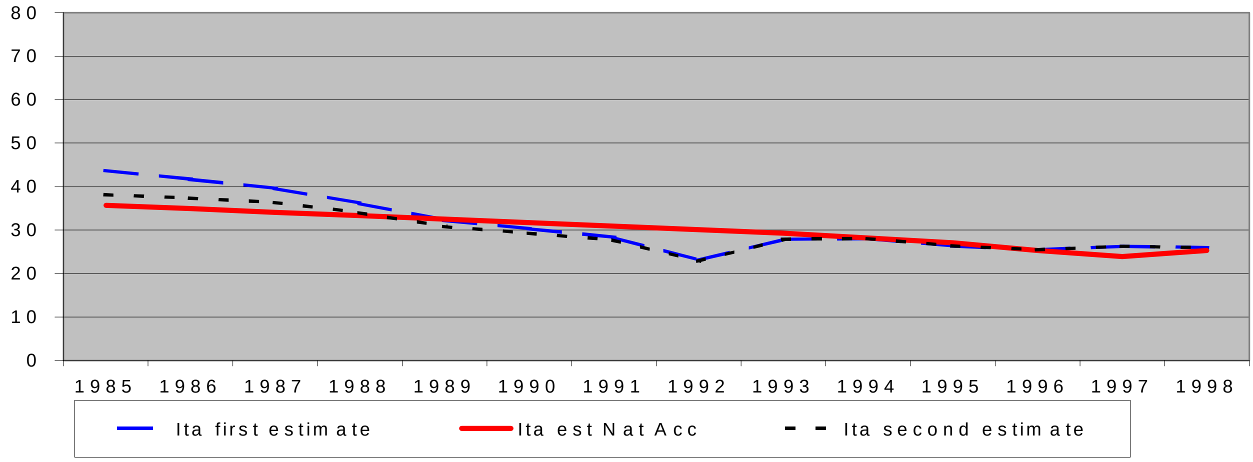


Figure A9: Shares for "own account" on total software investments according to three estimates, the Netherlands 1985-1998

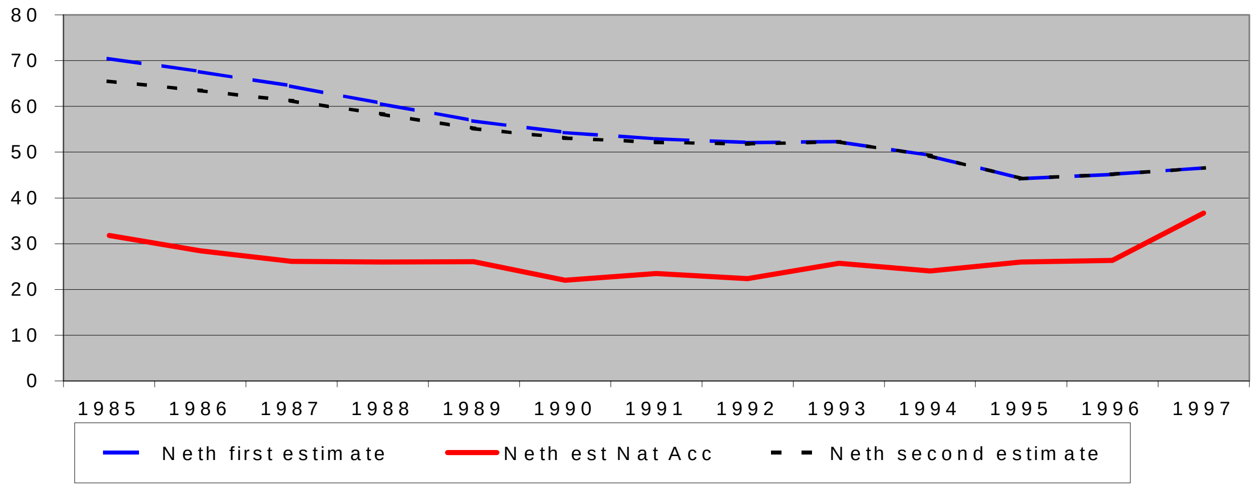


Table A2: Shares of own account investments in software according to estimates 1985-1997, percentage of total software investments

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Aus	61	61	59	58	57	56	55	57	51	47	46	42	38
Aut	47	48	48	47	48	48	47	47	47	45	39	41	43
Bel	50	50	49	47	47	47	46	46	48	47	43	43	45
Can	71	70	69	67	64	61	57	52	50	49	47	44	41
Den	66	64	61	58	57	56	56	57	59	57	50	51	52
Fin	65	53	51	48	46	46	48	48	54	53	42	43	43
Fra	55	55	56	53	53	51	51	51	53	51	44	45	47
Ger	56	57	57	54	52	50	49	48	50	47	43	44	46
Ita	38	37	36	34	31	29	28	23	28	28	26	25	26
Jap	63	63	60	60	58	55	54	61	60	58	54	55	56
Nl	65	63	61	58	55	53	52	52	52	49	44	45	47
Nor	52	52	51	48	45	45	45	45	47	45	39	39	39
Swe	63	61	59	56	55	55	55	50	57	56	52	50	50
UK	50	51	52	50	50	50	50	47	52	49	45	43	41
USA	51	50	49	48	48	46	44	44	41	39	37	35	32
Average	57	56	55	53	51	50	49	49	50	48	43	43	43

<u>Share of own account according to national estimates</u>

Apart from Italy, the Netherlands and the US, Belgium and Germany provided information on own account software investments according the SNA/ESA.

The Belgian estimates have the highest proportion of own account software investments (around 60 percent). Unfortunately the German information is not specific enough.

The Italian and US figures show a steadily decline of the proportion of own account software investments (between 1985 and 1997 a decrease of more than 10 percent). The Dutch data suggests an increase since the midst of the nineties.

Table A3: Share of own account investments in software according to estimates by National Accounts, percentage of total software investments

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Nl	32	28	26	26	26	22	24	22	26	24	26	26	37
USA	48	47	48	46	46	44	46	44	44	42	40	36	34
Ita	36	35	34	33	33	32	31	30	29	28	27	25	24
Bel	.	.	.	.	.	.	.	.	.	.	62	61	63
Ger	.	.	.	.	.	.	Around one third						

4. Estimating ICT expenditures

Note that all previously discussed categories for software are included in total IT and total ICT expenditure. In this IT is a part of ICT.

Both an old series on total IT expenditures and a new series on total ICT expenditure are used here. For the overlapping years 1992-1995 percentages were calculated in order to get insight in the difference between the series.

Series I – (WITSA) IDC, total for packaged software
Coverage: World

Series in previous issue:	1985-1995 (old series on IT)
Series in 1999 issue:	1992-1999 (new series on ICT)
Overlapping years:	1992-1995

Based on the two series it can be concluded that for the fifteen OECD countries the share IT in total ICT is around 30 percent and that this percentage is increasing slowly. Between 1992 and 1995 the average change increases from 29 to 32 percent. Country level data normally show an increase in that same period. France (zero change) and Italy (negative change) are exceptions to this rule.

There is a large relative difference between IT expenditures and ICT expenditures: around 70 percent. Therefore it was chosen to regress the absolute differences instead of regressing percentages or the actual IT or ICT data.

The absolute figures for 1992 to 1995 also show a steady increase in the difference between IT expenditures and ICT expenditures. Exceptions are Austria and Japan, where the absolute difference diminishes in that period. The regressed figures for the absolute differences show the same pattern. Applying the formula from the linear regression provides extrapolated estimates for the period 1985-1991.

An additional check on the extrapolated figures show that for two countries (Finland and Italy) the shares of the absolute difference between IT expenditures and ICT expenditures are less than 45 percent for 1985, 1996 and 1987. For these three years it was chosen to count IT expenditures as 50 percent of ICT expenditures. Thus total ICT expenditures were double in size compared to total IT expenditures.

Table A4: IT expenditures as percentage of ICT expenditures

	1992	1993	1994	1995	Average 1992 - 1995
Aus	26	27	30	33	29
Aut	27	28	32	33	30
Bel	32	33	33	33	33
Can	32	33	33	36	34
Den	24	24	27	28	26
Fin	30	30	29	31	30
Fra	28	27	28	28	28
Ger	29	28	30	33	30
Ita	33	30	27	26	29
Jap	29	29	31	32	30
Nl	29	29	31	33	31
Nor	26	27	30	31	28
Swe	24	24	27	30	26
UK	27	27	28	29	28
USA	34	35	36	38	36
OECD-15	29	29	30	32	30

Concluding remarks on estimating software investments
Lack of data makes it difficult to make international comparable estimates on software investments that are based on official figures only. However by using several sources of information estimates can be made. These sources are: both new and old data series from IDC, information on estimates on software investments by National Accounts from the NSO, and some assumptions.

It can be noted that, although several NSO's have made estimates, the international comparability of figures is hampered by the fact that it is often not clear how countries have made their estimates. For example, only three countries are able to provide a series for own account software investments. Therefore NSO's should be encouraged to provide separate information on purchased software investments, including a breakdown for (pre)packaged software and customised software.

Figure A10: Extrapolating ICT estimates for Australia, in million national currency

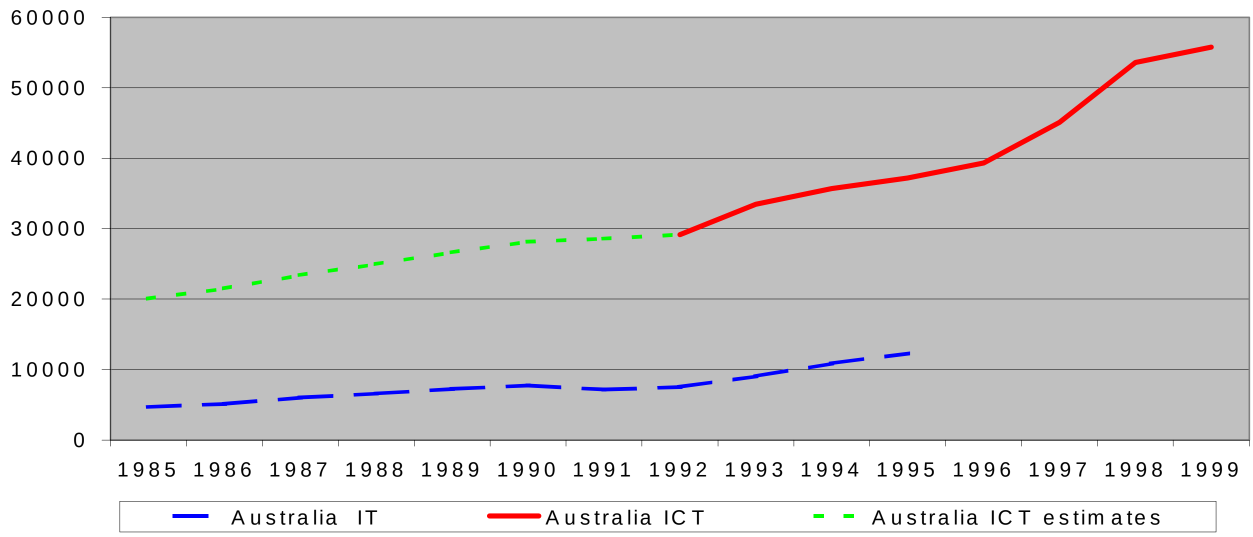


Figure A11: Extrapolating ICT estimates for Italy, in billion national currency

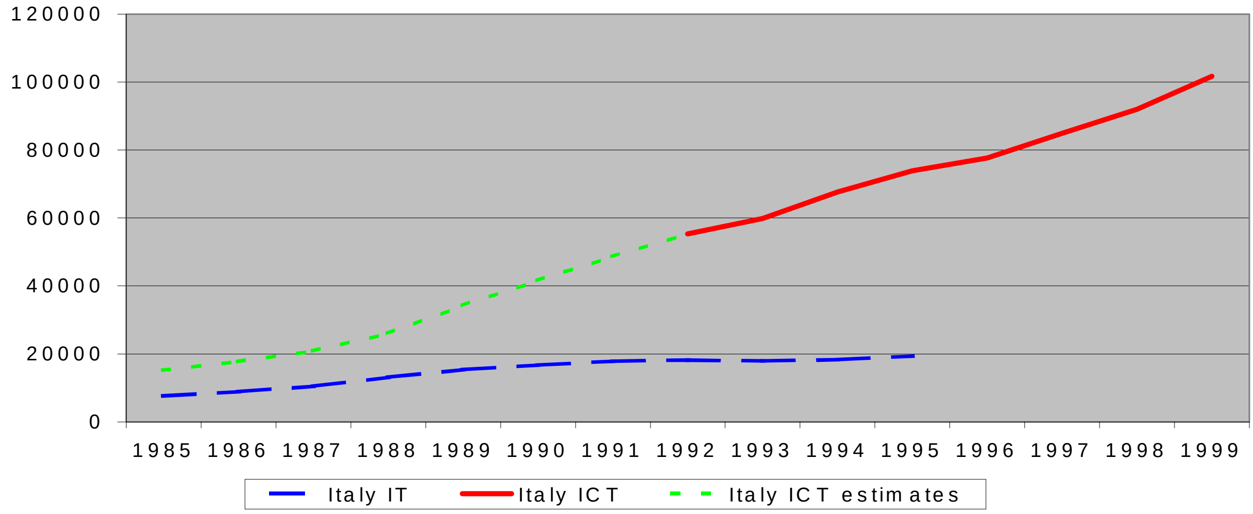
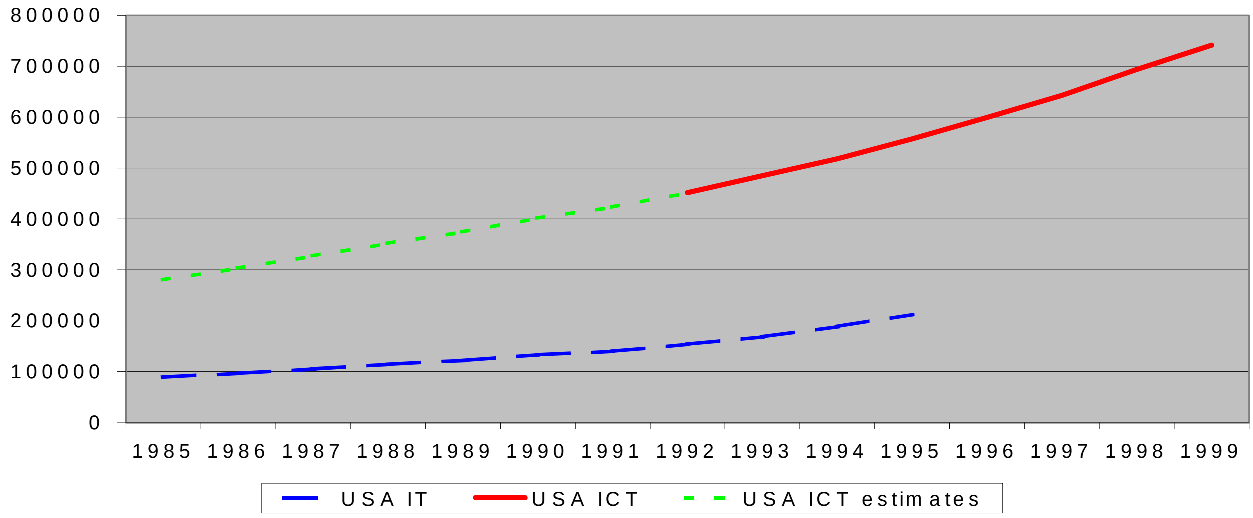


Figure A12: Extrapolating ICT estimates for USA, in million national currency



ANNEX B: Education

When investments on education and training are calculated, there are two overlap issues with R&D to be considered. One concerns the general aspects and another one concerns only a part of total educational investments, namely the expenditures for higher education.

R&D and education in general
Training can be an additional effect of R&D, because it can be a spin-off or result of other intangible investment activities which means that R&D employees are likely to experience learning by figuring things out. However, the Frascati manual clearly states that all education and training expenditures in connection with the introduction of new products or processes (such as retraining) should be excluded from R&D (excluding research done by a post graduate students). In practice training can only be distinguished from R&D activities in cases of highly structured processes.

In other cases such as software development, training is considered to be a precondition. According to the Frascati manual training is an integral part of Human Resource Development (HRD), because through training employees are expected to achieve certain organisational goals.

Some of these issues are also discussed in OECD's training manual. The OECD's training manual describes in five paragraphs some demarcation problems with other intangible investments, specifically R&D and Human Resource Development (HRD).

R&D in Higher Education:
As indicated in the R&D section there is an overlap between public educational expenditure and R&D expenditure in higher education (HERD). For this double counting a correction is not possible when the aim is to compile time series data.

Training is strongly related to other activities that imply the transfer or creation of knowledge. Therefore it linked to almost every other intangible. Some of these boundary issues have already been described in this report. Here special attention is given to the overlap issues with R&D.

1. Subtracting R&D in Higher Education

One major overlap issue is that public educational expenditure includes R&D expenditure that are already included in GERD. An important source for information about this overlap issue is an OECD publication[42], that contains an evaluation of 1995 data from two databases (DSTI database for HERD and INES database for public educational expenditure) for five countries.

This paper proved that subtracting R&D expenditure in Higher Education (HERD) from total public educational expenditure is acceptable for Germany and Sweden. For the three other countries, France, the Netherlands and the UK, subtracting HERD results in an underestimation of total public educational expenditure.

Despite the fact that the OECD study clearly showed that subtracting could lead to underestimation for investments in education it was chosen to subtract HERD for all

[42] For specific perusal see: OECD, Separating teaching and research expenditure in higher education, Paper from Group of National Experts on Science and Technology Indicators, Paris, 1998.

countries. For France, the Netherlands and the UK the subtracted amount results in an underestimation in the public spending as a percentage of GDP (in 1995 for France an underestimate of 1.4 percent, for the UK an underestimate of 0.7 percent and for the Netherlands an underestimate of 0.4 percent).

As result of a lack of information on similar data for other years and other countries, the estimates for the time series for the period 1985-1997 were not corrected for this bias. This means that the estimates on investments in education are underestimated for at least France, the UK and the Netherlands.

2. How is public expenditure for education underestimated ?

The previously mentioned OECD publication[43] compared 1995 data from two databases (DSTI database for HERD and INES database for public educational expenditure) for five countries. Three options were considered:
Method 1: education expenditure per student not corrected for R&D
Method 2: education expenditure per student by excluding R&D (subtraction of HERD)
Method 3: education expenditure per student by excluding corrected R&D (subtraction with correction factor of HERD)

The first method leads to the highest overestimation of education expenditure per student (EES). The largest overestimation is found for Sweden (EES about doubles here compared to the second method), the smallest for France (about one third compared to the second method).

Method 3 includes a correction factor for specific coverage differences that are not dealt with in method 2. For two countries (Germany and Sweden) no corrections are necessary: both method 2 and 3 result in the same value for EES. For the other countries (France, the Netherlands and the UK) a correction factor proved necessary in order to balance out the underestimation from method 2.

Method 2 underestimates for three countries in differing degrees: France 25 percent, the UK 15 percent and the Netherlands 9 percent. The most important problem areas that cause this underestimation are the funds from private sources, an item excluded from “public spending” but included in HERD. Additionally, the underestimation reaches serious levels for France due to the fact that in this country borderline research institutes perform a substantial amount of R&D. The expenditure figures from these institutes (Centre National de la Recherche Scientifique /CNRS) are included in DSTI’s HERD and not in INES’ “public spending”.

Thus the conclusion can be set:

- Not subtracting HERD leads to an overestimation of public educational spending.
- Subtracting HERD leads to an underestimation for some countries.
- Correction for other countries with similar bias or for other years for all countries in order to compile time series is not possible due to lack of in depth information.

Thus HERD is completely subtracted for all countries, including France, the Netherlands and the UK. For these countries the subtracted amount that is not corrected for biases results in an underestimation of total investments in education (public spending as a percentage of GDP). In 1995 France is underestimated by 1.4 percent, the UK is underestimated by 0.7 percent and the Netherlands is underestimated by 0.4 percent.

[43] See for more information: OECD, Separating teaching and research expenditure in higher education, Paper from Group of National Experts on Science and Technology Indicators, Paris, 1998.

Table B1: Overview of overlap issues between Public Education expenditure (from INES database) and R&D expenditure in Higher Education (from DSTI database)

Categories of coverage		Items	In DSTI ?	In INES?	Consequence for INES's indicator "expenditure per student"
Types of institutions	1	Educational institutions	Some French Grande Écoles	No	For France: 1% lower
	2	University hospitals	Clinics/departments with training/teaching character	No	The Netherlands and the UK: 2% res. 1% lower
	3	Borderline research institutes	French CNRS-institutes Dutch overlap between teaching and research	No Yes	France: 20% lower The Netherlands: 1.5% higher
Types of activities	4	Research activities of non-higher education institutions	Yes, except for the Netherlands and France	Yes	The Netherlands: 2% higher France: 1% higher
	5	Funds from private sources (e.g. research contracts)	Yes	Yes, except for the Netherlands, UK, France	UK: 17% lower The Netherlands: 5-13% lower France: 3-6% lower
	5a	Post-graduate education	Yes, for the Netherlands and Germany	Partly for France, Sweden and the UK	Bias unknown
Types of expenditure	6	Capital expenditure	For UK no capital expenditure	No	UK: 2% higher
	7	Current expenditure; staff	For the Netherlands: social insurance and payments included	No	Negligible
	7a	Expenditure on central facilities (e.g. general administration, inspection, evaluation)	Not included	Yes, except for Germany and France	Rough estimate: 1-2% higher

3. Comparing education and R&D expenditure for Higher Education

Differentiated data on educational expenditures for higher and basic education comes from the OECD cd-rom version of "Education at a Glance" (EaG). Unfortunately this publication only contains data for the year 1995.

The data from EaG is available for all the fifteen countries considered here for higher education (ISC567) and the lower levels of education (ISC0123). For Belgium 1995 data available only includes the Flemish Community[44].

The figures on higher education can be compared to R&D data on higher education (HERD). For fourteen OECD countries HERD comprises on average 41 percent. On country level, Canada, Finland and Norway have percentages of around 30 percent. According to the data Japan spends more money on HERD than the total amount for public higher education (PEEH).

[44] For Belgium the share of HERD in total public expenditure for higher education for the Flemish Community was applied to the estimated total public expenditure on education for all levels. This estimate on total public expenditure for education refers to the whole country but is also based on data for the Flemish Community only.

However in general differences between HERD and PEEH may be caused by differences in statistical units (e.g. the Netherlands only measures R&D at universities, while R&D at high schools are excluded). Finally differences occur when countries have to make indirect estimates (e.g. the proportion of time spent on R&D in higher education).

Table B2: Comparison between total higher education expenditures and R&D expenditures in higher education, 1995 in million national currency

	Total public expenditure on education (PEE)	Total public expenditure on higher education (PEEH)	HERD	HERD as percentage of PEEH
Australia	20.803	5.542	2.032	37
Austria	123.815	22.033	13.618	62
Belgium 1)	438.222	79.556	34.954	44
Canada	43.791	11.469	3.180	28
Denmark	62.939	12.629	4.544	36
Finland	36.486	9.141	2.541	28
France	442.757	74.297	30.234	41
Germany	156.912	34.249	14.444	42
Italy 2)	79.969	11.917	4.468	37
Japan 2)	17.382	2.099	2.996	143
Netherlands	28.912	7.302	3.796	52
Norway	63.101	13.568	4.179	31
Sweden	108.069	25.721	13.021	51
United Kingdom	32.350	5.240	2.708	52
United States	350.325	80.328	28.154	35
OECD-14 (excl. Japan)	-	-	-	41

1) Belgium: estimates on education (PEE and PEEH) are based on data from the Flemish Community.
2) In billion national currency.

ANNEX C: R&D

The quality of the R&D data collected by the OECD is generally considered to be good, as most OECD countries have a long tradition with measuring according to the Frascati Manual. However, international comparability may be hindered in some cases (e.g. because of differences in statistical units used and size classes covered, etc.). R&D expenditure data include capital expenditure.

The OECD divides R&D expenditure data into five sources of funds: business enterprise, government, higher education, private non-profit institutions and from abroad. Expenditure data comprises both costs of in-house production financed by own funds and for the purchase of R&D from third parties. Also in the R&D-surveys separate data are collected on labour costs, other current costs and (capital) investments in land, buildings and equipment.

Industrial R&D surveys are addressed essentially to the producers (performers) of the R&D rather than the users though most also include questions on "extramural" payments for R&D to third parties.

As data is not always available for all the fifteen countries for the years under observation, estimates were made. These estimates were made according to a simple adjacent year's method: e.g. estimates for 1990 is an average of available data for 1989 and 1991.

1. Correcting for capital expenditure in R&D

In most studies total R&D expenditure (GERD) is considered intangible investments. However, R&D expenditure comprises both current and capital expenditure, and only current expenditure should be counted as intangible investments.

For countries that already have an innovation or R&D system, capital expenditure ranges between 7 to 12 percent. Both GERD and BERD (Bussiness Enterprise R&D) expenditure data shows that this is the case for most of the fifteen countries. Capital expenditure should preferably be left out, as it is already included in figures of tangible fixed capital formation. Thus in this report R&D tangible investment expenditures in the year of observation is treated as a proxy for the use of tangible fixed assets in that particular year. One problem of this method may be that large variation in tangible investment to be used to produce R&D result in relatively large variations in the data for intangible investment in R&D.

Underestimation of GERD

Another question would be that GERD probably does not measure all R&D activities in the different countries. Underestimation may occur when firms performing R&D are not included, for example when they don't have R&D departments or full time R&D personnel. So although some underestimation of GERD may occur on a systematic basis for small firms, the comparability of figures is not affected.

Capital expenditure in GERD

Constructing a time series for the shares of capital expenditure on basis of the data collected by the OECD is not easy. For some countries data is completely lacking (Belgium, Canada and the UK), for others data is missing in certain periods, for other countries the last available information on capital expenditure is some years ago. In 1997 for example, data is available

for only four countries of the total of fifteen. For the US, for example the share of capital expenditure (2 percent) data is only available for the period 1985-1990 for GERD.
For both Canada and the UK the shares of capital expenditure from BERD were applied. For Belgium yearly averages for the countries for which data is available were used. In these averages US available (1985-1990, 2 percent) data on shares were excluded, because of the large difference with the shares from the other countries (average of 13 or 14 percent for other countries).

Capital expenditure in BERD
BERD makes up about 50 to 70 percent of GERD, making it the most important category of total R&D expenditures. As with GERD, costs for BERD can be divided into current costs and capital expenditure. Shares of BERD capital expenditure are available for some of the fifteen countries considered here. Estimates were made for missing data.

It should be noted that for some countries subtracting capital expenditure might lead to an underestimation of GERD. For example the OECD[45] states that the Swedish R&D figures in the Higher Education sector excludes capital expenditure.

Figure C1: Percentages used to subtract capital expenditure from GERD

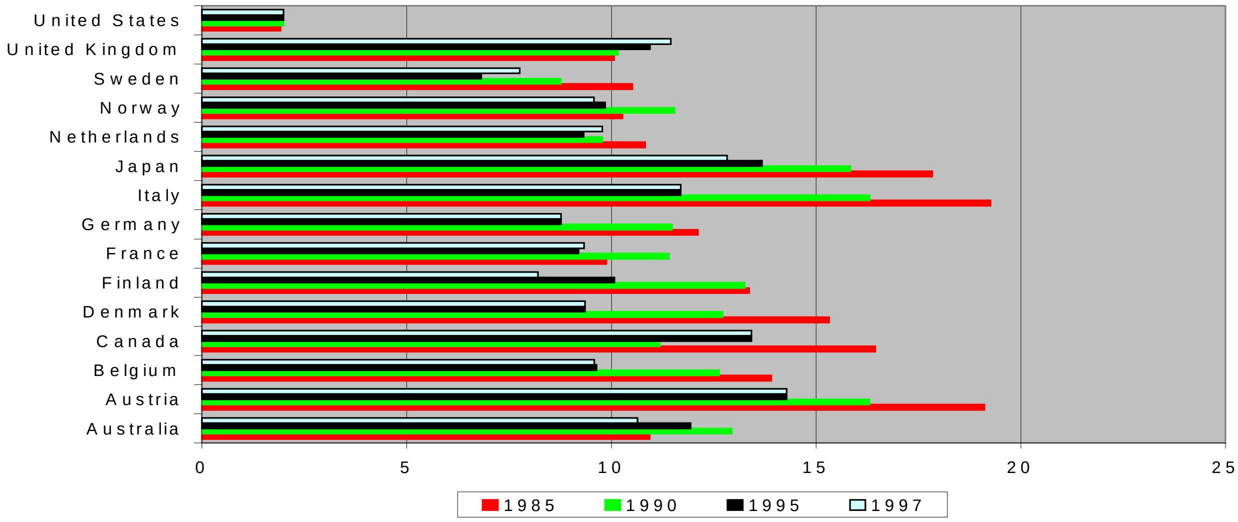
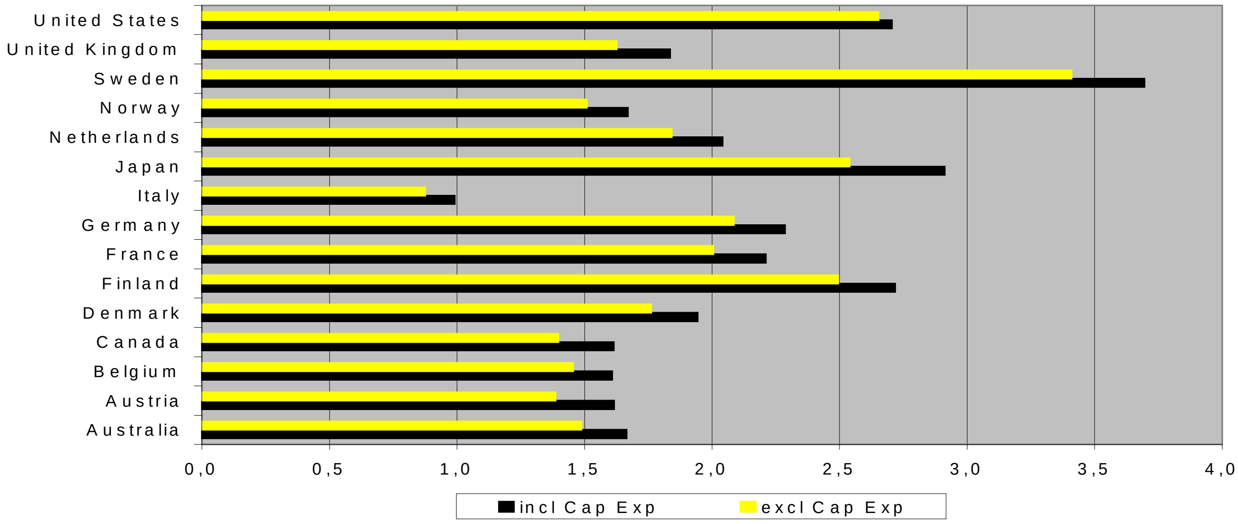


Figure C2: GERD as percentage of GDP, including capital expenditure and excluding capital expenditure, 1997



[45] OECD, Main Science and Technology Indicators, 1998/2, Paris, 1998.

2. Boundary issues R&D and software

In several paragraphs the Frascati manual describes boundary issues between R&D and software as one of the "other related scientific and technological activities", routine software activities are excluded from R&D. When total software investments is not corrected for R&D it creates an overestimation of total software investments, because of two overlap issues:

- Software R&D performed in the computer services industry.
- Software R&D performed in other industries.

In both cases software R&D should be subtracted from software investments, as it is already included in R&D expenditures.
Frascati provides examples of software not to be counted as R&D[46]:

1. supporting existing systems;
2. converting and/or translating computer languages;
3. adding user functionality to application programmes;
4. de-bugging of systems;
5. adaptation of existing software;
6. preparation of user documentation that do not involve scientific and/or technological advances, are not classified as R&D.

In the estimates presented in this report no corrections were made for software R&D due to a lack of available information that can be applied to time series estimates.

What is software R&D ?
Formally a software development project is considered R&D when its completion depends on the development of a scientific and/or technological advance[47]. Also the goal must be "the resolution of a scientific and/or technological uncertainty on a systematic basis". Thus R&D associated with <u>software, as an improved end product</u> must be classified as R&D.

However it is often difficult to identify the R&D component in software development, because it is hard to say when software an improvement is according to the formal definition. Frascati is not very clear on this. Simply using software for new applications or purposes is not an advancement. And upgrades, additions or changes to an existing programme or system may only be classified as R&D if "it embodies scientific and/or technological advances, which result in the increase of the stock of knowledge".

Moreover software is not only R&D when the activities are sufficiently novel, but also <u>when they are an integral part of an R&D project</u>. Thus the purchase of a standard software package for use in a project is a legitimate expenditure on R&D.

Unfortunately preventing double counting is hampered by a lack of specified information about the R&D expenditures for software. Looking at R&D figures of the computer and related services sector and other sectors can provide some information about the magnitude of software R&D.

R&D in computer services
R&D in the Business Enterprise sector (BERD) can be divided roughly into manufacturing and <u>services and related sectors</u>. According data for 1995 the contribution of the total services

[46] Frascati, 1993, par.71-72
[47] Frascati, 1993, par.105-110

sector normally ranges between 10 and 30 percent of BERD. However *coverage differences of the services sector* may cause large variations between countries. For example Japan scores low (3 percent), while Norway scores high (44 percent). Another more general problem may be caused by *reclassification of R&D performing firms* (as a result of merger or new main industrial activity).

BERD in services can be further divided into computer and related services and other services such as transport and communication services. The share of R&D performed in the computer services industry varies. In countries for which data is available the computer services industry performs 7 to 9 percent of BERD. Low percentages are found in France, Italy, the Netherlands and Sweden.

Table C1: R&D in computer services as percentage of BERD

	1987	1990	1994	1995
Australia		6	9	8
Belgium			6	6
Canada	5	4	6	6
Denmark	1	4		8
Finland			5	3
France			2	3
Italy	1	2	1	1
Netherlands				1
Norway				6
Sweden				2
United Kingdom	5	5	8	7
United States			7	9

Source: OECD, DSTI

Although "computer and related services" comprises software services and other computer services, scarce data indicate that the former is usually the main R&D performer (Young, 1996)[48]. The amount of R&D reported for the computer services industry can be *seriously affected by the definitions used by the reporting countries.* Software R&D by firms labelled as "computer services" should be included in the latter, while software R&D by firms in other industrial sectors should be counted to the industry concerned. This underestimation for the computer services sector was confirmed in a 1994 mini-survey by the OECD (Young, 1996). At this occasion Japan and the Netherlands reported that their survey did not include any firms labelled as "computer services".

IT-R&D in other sectors

Except in the computer services sector, software R&D is performed in other services sectors as well as in the manufacturing sectors. Data indicate that the share of software R&D in the other services is high and increasing. Compared to the services, less software R&D is undertaken in the manufacturing sector. However in some manufacturing sectors it is not negligible.

According to Young (1996) in Japan and Italy about 40 percent of services firms undertake some form of IT R&D, which is considerably higher than in the manufacturing sector[49]. Naturally IT R&D comprises both hard- and software.

[48] Young, A., Measuring R&D in the Services, STI Working Papers 1996/7, OECD, Paris, 1996.
[49] Between 5 and 15 percent

Danish data indicate that in the services industry hardware R&D is small, while no less than 25 percent of total services R&D is related to software. Within the services, software related R&D is predominant in the sector "computer services" as well as in "other services sectors[50]". Within manufacturing this is the case for the business machines sectors. And all sectors combined result in about 10 percent of total intramural R&D expenditures that can be counted as software R&D.

In 1997 Statistics Canada published figures on software R&D[51]. Between 1991 and 1995 software R&D almost doubled from 1.5 to 2.8 billion Canadian dollars. These figures also indicate a relative increase of the share of Canadian software R&D in BERD (from 27 to 37 percent of BERD). The separate contribution to total software R&D by the manufacturing and the services sector is in 1995 equal (about 50 percent each[52]). Compared to Denmark, more software R&D is reported in the manufacturing sector, especially the business machines sectors and in the telecommunications sectors.

A Dutch study[53] found that almost one fourth of R&D by firms (BERD) can be labelled as software R&D. This study used two different methods that resulted in the same conclusions: 24 percent of R&D in firms is software R&D in 1998. Also the results of this study indicate a yearly increase of 1 percent for the period 1996-1999.
Basic Dutch data on total R&D expenditure indicate that IT R&D in services is large (more than one third of all R&D is related to IT in 1997) and rapidly growing (in 1997 total expenditures on IT tripled compared to 1995).

[50] Services sector excluding trade and repair, transport and communication, computer services, R&D, technical services and institutes.
[51] Statistics Canada, Software Research and Development (R&D) in Canadian Industry, 1995, Service Bulletin Science Statistics, vol.21 no.6, 1997.
[52] For earlier years smaller shares of software R&D are found for the manufacturing sector. The increase of software R&D in total manufacturing in 1995 is especially the result of an increase of R&D in the telecommunication sector.
[53] See:R&D en software-onderzoek bij bedrijven in Nederland, CBS/ Statistics Netherlands, Voorburg, maart 2000.