Capitalising R&D

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Abstract
Treating R&D as an investment rather than an expense will effect the calculations of GDP (Gross Domestic Product) and increase it. The effects need to be further analysed and evaluated before this is implemented in the National Accounts. The greatest impact will be on figures for the business sector, but the government sector will also be affected to some extent.

Intangible assets, or knowledge based capital of the firm, are comparable in importance to physical capital such as factories and equipment. New ways to count all capital investments, not only tangibles, in the National Accounts will be good for productivity analyses of the economy, especially multifactor productivity.

A first draft calculation to link R&D statistics and the National Accounts for Sweden (2003) show a production value amounting to SEK 127 billion or 5 percent of GDP. However, this includes acquired R&D for own production, that is not the case in official R&D/GDP ratios. Furthermore, it includes all public R&D and hence R&D that may be counting as freely available R&D in the final bridge table, depending on recommendations in the ongoing revision on SNA (Systems of National Accounts).

As a small open economy, Sweden actively interacts with foreign markets. Internationalisation of Swedish R&D has been studied a bit closer in this paper with a case study of seven big multinational enterprise groups in Sweden and the results are striking. Swedish R&D is dominated by a few groups in some R&D intensive industries. All of these groups have very different R&D structures, but most of them work globally on R&D.
**Current findings**

The present manual for the National Accounts treat R&D as follows:

SNA definition (1993)\(^1\): *The value of research and development (R&D) should be determined in terms of the economic benefits it is expected to provide in the future. This includes the provision of public services in the case of R&D acquired by government. In principle, R&D that does not provide an economic benefit to its owner does not constitute a fixed asset and should be treated as intermediate consumption. Unless the market value of the R&D is observed directly, it may, by convention be valued at the sum of costs, including the cost of unsuccessful R&D."

…but this is not the case in the present National Accounts.

All the costs and investments a firm undertakes during a year are counted in the national accounts: some are costs such as gas bills, others are investments in form of plants and equipment. The problem is that only tangibles are treated as investments (and more recently also software investments), but intangible investments in knowledge, R&D and other human capital investments are still missing. To put capital spending on R&D in the same category as gas bills is not a useful way for qualified analyses of the economy, e.g. to measure multifactor productivity.

Conceptually it is not hard to argue for a capitalisation of R&D and other intangible assets.\(^2\) But in practice it is associated with bridging and methodological problems that need to be managed. Statistics Sweden had studied two of those issues. Firstly, a draft bridge table was constructed for the year 2003. Secondly, a study was done of internationalisation of Swedish R&D and a case study of eight MNE (Multinational Enterprises) and their R&D and related activities. I will return to the Swedish contribution later in this paper.

Besides the measurement problem of R&D, the frequency of R&D surveys (every second year in Sweden) and the lack of long time series in the service industries, it is still important to measure intangible assets and investments in R&D. To leave them out will lead to a big underestimation of the total investments of the business enterprises. Both a British and an American study\(^3\) show the importance of intangible investments. The researchers find that for every pound or dollar that businesses are investing in physical assets they are spending another building up intangible assets, i.e. the investments in intangible assets are as high as the investments in tangibles, but only tangible investments are included in the

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1 Aspden (2007)
2 Corrado (2005), Business Week (2006), The Economist (August 2007)
National Accounts. Moreover, the intangible investment has been increasing much faster than tangible assets and than the rest of business output. For example, the ten biggest companies in the US have increased their investments in R&D by 42 percent since 2000. At the same time, investments in tangibles only increased by two percent. The researchers show that when the US GDP was adjusted for knowledge investments the economy looks more powerful with faster growth rates, the high consumption figures decrease and the low saving rate will increase.

As a result, growth occurs in both output and productivity. As Mr Haskel says, “There’s a ton more investment going on and lots more GDP.”

**Bridge table for Sweden**

A first draft calculation to link R&D statistics and the National Accounts for Sweden (2003) show a production value amounting to SEK 127 billion or 5 percent of GDP. However, this includes acquired R&D for own production, that is not the case in official R&D/GDP ratios. Furthermore, it includes all public R&D and hence R&D that may be counting as freely available R&D in the final bridge table, depending on recommendations in the ongoing revision on SNA (Systems of National Accounts).

Calculations for the Swedish economy on aggregate level show R&D amounted to SEK 97 100 million. This is all R&D conducted on its own account (Intramural R&D). Then we add all acquired R&D to be used as input of R&D output (Extramural R&D or contract R&D). This is an important item amounting to SEK 25 658 million. Reductions for depreciations of capital goods owned by R&D producers and used in R&D production need to be done, amounting to SEK 7 552 million. At the same time we need to deduct for capital expenditure for tangibles already included as an investment in the National Accounts, amounting to SEK 5 630 million. Furthermore, to come to the R&D output measure we need to adjust for production taxes less subsidies, amounting to minus SEK 717 million, and add an operating surplus on R&D to the cost based R&D figures to arrive at an output measure. The way of calculating operating surplus on R&D can be discussed but not in this paper.

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4  Ibid

5  The draft bridge tables in table 1 below show an overview of total effects that the capitalisation will cause. A more detailed table for each sector has also been constructed but is not included in this paper.

Statistics Sweden
Table 1: Draft bridge table to compare FM\textsuperscript{6} and SNA data on R&D, total for all sectors\textsuperscript{7} in Sweden 2003, SEK millions

<table>
<thead>
<tr>
<th></th>
<th>FM</th>
<th>Bridging values</th>
<th>SNA</th>
<th>Data sources</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. OUTPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. FM’s GERD MEASURE</td>
<td>97 100</td>
<td></td>
<td></td>
<td>R&amp;D survey</td>
<td></td>
</tr>
<tr>
<td>1. minus Increase of inventories of materials purchased during the period and intended to be used as inputs of R&amp;D activities</td>
<td>0</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>2. plus Acquisition of R&amp;D to be used as input of R&amp;D output</td>
<td>25 658</td>
<td></td>
<td></td>
<td>R&amp;D survey</td>
<td>Extramural R&amp;D</td>
</tr>
<tr>
<td>3. plus Depreciation of capital goods owned by R&amp;D producers and used in R&amp;D production</td>
<td>7 552</td>
<td></td>
<td></td>
<td>National Accounts</td>
<td>We are working on PIM calculations. Here with a mark-up on GERD wages and intermediate cost for research, calculated for each industry.</td>
</tr>
<tr>
<td>4. plus Operating surplus contained in R&amp;D output measured at basic prices</td>
<td>3 139</td>
<td></td>
<td></td>
<td>National Accounts</td>
<td>For 2003, the surplus was zero or negative for R&amp;D industry (NACE 73). Here calculated with a surplus on wages and intermediate consumption.</td>
</tr>
<tr>
<td>5. plus Other taxes on production less other subsidies</td>
<td>-717</td>
<td></td>
<td></td>
<td>National Accounts</td>
<td>Taxes associated with compensation of employees are included in GERD. Other taxes are usually very small and difficult to attribute to R&amp;D. Subsidies to R&amp;D are included.</td>
</tr>
<tr>
<td>6. minus Capital expenditures</td>
<td>5 630</td>
<td></td>
<td></td>
<td>R&amp;D survey</td>
<td>Land, buildings, instruments and equipment</td>
</tr>
<tr>
<td>7. Software R&amp;D</td>
<td>16 425</td>
<td></td>
<td></td>
<td>R&amp;D survey</td>
<td>Including all software related costs in BERD</td>
</tr>
<tr>
<td>B. R&amp;D OUTPUT BY SNA93 DEFINITIONS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>127 102</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


\textsuperscript{7} Bridge tables on sector level have been released in a separate paper, but no calculation has been done on an industry level.
One important issue is to avoid double counting of software R&D. Software that is already capitalised in the National Accounts. Due to the R&D survey 2003, all software related expenditure amounted to SEK 16 425 millions, including both own-account and acquisition of software. However, merely own-account R&D is a subject-matter of double counting in software and R&D capital.

**Internationalisation of Swedish R&D**

In general most corporate R&D is produced on the company’s account for internal use. But a small open economy such as the Swedish economy has considerable interaction with foreign countries. These transactions are a significant part of total corporate R&D and will be a challenge to face in the capitalisation process.

About 75 percent of all R&D in Sweden is performed by companies and a large amount is conducted by a few big multinational enterprises (MNEs). For example, 34 big MNEs account for 70 percent of total business enterprise R&D and more than 50 percent of total Swedish gross domestic R&D. These MNEs’ involvement in internationalisation of R&D is substantial compared to local firms and small groups. Furthermore, internationalisation of R&D in Sweden is highly concentrated to a few R&D intensive industries – pharmaceuticals, electronics and motor vehicles.

The MNEs play an important role regarding the capitalisation of R&D.

This part of the paper will give examples and explain how R&D is organised in Swedish companies by giving several examples of case studies of companies from the business world involved with R&D. We study the structure their FDI (Foreign Direct Investment) of R&D, foreign trade of R&D, contract R&D and R&D financed from abroad. A common characteristic of the case companies is that they are all very active in R&D in Sweden and in one of the following key industries: pharmaceuticals, electronics or motor vehicles. The case studies include both Swedish-owned and foreign owned MNEs.

Primarily, this paper is using the R&D survey for intramural (in-house) and extramural (contract) R&D, foreign trade of services for import and export of R&D and IPR (intellectual property rights), foreign direct investment survey for inward and outward R&D. It is also matched with the EU Industrial R&D Investment Scoreboard.

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8 BERD, business enterprise expenditure on R&D

9 GERD, gross domestic expenditure on R&D
Internationalisation – an increasing phenomenon

Internationalisation, or globalisation, is an increasing phenomenon all over the world. This is not only true for production and selling of goods, but also for other functions such as marketing and R&D. Big MNEs have affiliates in most countries and their profits are increasingly worldwide and in a lesser sense linked to the home country. Consequently, it is harder to identify the origin of profits, even for those at the companies responding to the survey. The problem to identify the origin of a certain business activity to a specific country is also true for R&D.

Per definition profit-making companies will optimise profits for their shareholders. Because tax levels and production costs differ among countries, companies are driven to fragment the value chain and do tax planning. One way to do tax planning is by inter-company transfer price, by letting the enterprises within the group trade, import cheaply and export expensively or vice versa, to distribute the profit to low-tax countries.

By trade liberalisation and new ways of using information technology to reduce distances, FDI and trade of R&D and other business functions in companies will be fostered. A large part of international transactions and trade of R&D is managed inside MNE. Incentives of this management are probably to reduce tax, spread knowledge by technology transfers, and benefit from cost reduction or the use of competence.

Case studies

The following part will describe the R&D structure in seven companies in Sweden. Together they will give a good picture of Swedish R&D in business enterprises, even if they all differ from each other. The reference year is 2005/2006.

Case company 1

This company is Swedish-owned. They perform half of their R&D in Sweden and half in 3 foreign countries. All R&D is financed within the enterprise and no R&D is outsourced on contract either in Sweden or abroad. They have no reported export or import of R&D, but they import IPR (patent, license, franchising etc.) from 17 countries. The IPR import amounted to three percent of total in-house R&D spent in Sweden, and has increased sharply during 2006. The part of the group located in Sweden primarily performs R&D. This company is involved with merchanting, i.e. they produce and sell goods abroad and the profit margin from the sales is transferred back to Sweden and pays for R&D costs etc.

Ownership of companies is another increasing problem to handle in a more internationalised world when more companies are becoming foreign-owned or changing nationality.
Case company 2
This company is Swedish-owned. They perform half of their R&D in Sweden and half in 18 foreign countries. Four fifths of the R&D performed outside Sweden is on contract from the home country (Sweden) and about one fifth from other companies abroad, outside the group of enterprises. The company has no R&D export, but they import a lot of R&D from all over the world (78 countries). This company exports IPR amounting to about half of their Swedish in-house R&D budget (to 70 countries) compared to IPR imports which amounted to only 1/16 of the IPR export (from 45 countries).

Case company 3
This company is Swedish-owned. They perform more than half of their R&D in Sweden. The remaining part is conducted in 15 countries from which 2 countries account for a big part. About 10 percent (in size) of in-house R&D is on contract abroad to enterprises within or outside the group of enterprises. Roughly 5 percent of in-house R&D is financed from abroad. Due to foreign trade statistics they have no or almost no R&D export or import. A fractional volume of IPR import and export was reported in the foreign trade statistics.

Case company 4
This company is foreign-owned. About 40 percent of the group’s total R&D is spent in Sweden. Approximately 2 percent of in-house R&D is on contract abroad to companies within and outside the group of enterprises. All R&D is financed by the company’s own funds. They export a little bit less than half of their R&D, mainly with the home country (location of head-office) and to another 4 countries. The volume of R&D import is about twice the size of R&D export, amounting to about 90 percent of R&D spent on in-house R&D. The R&D import comes from 37 countries where one country accounts for two-thirds (not the country of group’s headquarter). They also export IPR to 14 countries, even though 2 countries account for almost all of it, amounting to 70 percent of in-house R&D (not the country of group’s headquarter). Only 3 percent of IPR is imported (from 2 countries).

Case company 5
This company is foreign-owned. The size of contract R&D is about 27 percent of total in-house R&D. About 64 percent of contract R&D goes abroad to other enterprises. Only 0.1 percent of in-house R&D is financed from abroad. About 16 percent of the groups total R&D is spent in Sweden. The amount of export and import of R&D is high in proportion to in-house R&D performed. They import 112 percent and export 168 percent the size of in-house R&D performed.
in Sweden. The R&D foreign trade of service is mainly with the home country (location of head office). The trade with IPR is insignificant.

**Case company 6**

This company is foreign-owned. About 25 percent of the group’s in-house R&D is performed in Sweden. In contrast to the other case companies, they have a significant part of in-house R&D financed from abroad, 21 percent (mainly within their own group of enterprises). Only one percent the size of in-house R&D is on contract abroad. One fifth of this company’s contract R&D goes abroad and the remaining is on contract in Sweden. They export and import approximately 3 percent the size of total in-house R&D and the trading partners are located in about 10-15 countries. Regarding foreign trade of IPR, they import 9 percent the size of in-house R&D mainly from the home country (location of head-office). The IPR export amounts to only 0.4 percent.

**Case company 7**

This company is Swedish-owned. Almost all R&D is performed in Sweden while 4 percent is performed in a few other countries. They do not have any R&D on contract abroad. About 4 percent of in-house R&D is financed from abroad and is mainly from other enterprises. They have no foreign trade of R&D, no IPR export and a small amount of IPR import from many countries.

**R&D survey versus foreign trade of services**

This section compares import and export data on R&D from the foreign trade of services statistics with the R&D survey’s contract R&D from abroad (approximately equal to R&D import) and the amount of in-house R&D financed from abroad (compared with R&D export data). Of course this involves different data sources with different types of questions and is thus not fully comparable. In particular, the R&D financed from abroad is probably underestimated since most R&D is financed with the companies’ funds.

The results illustrated in figure 1 show a net import (export minus import) from both data sources used. The level of export and import is however almost double in foreign trade statistics compared to R&D statistics. This is exactly what to anticipate because the survey question captures more information in the foreign trade statistics.

Comparisons on micro-level data show that a handful of companies account for a big part of the R&D trade volume. Among the dominating firms some report export but do not get any funding from abroad (R&D finance with the company’s funds), some report import but do not have the same volume in contract R&D abroad (maybe these are transfers of R&D among affiliated enterprises). The net
import of R&D is due to two enterprises that account for more than half of R&D import.

**Pros and cons with each data source**
Differences exist between the two data sources as to population, survey design and definitions.

- Presumably there is underestimation of R&D exports in the R&D survey because this survey asked about R&D financed from abroad and not about R&D exports. Business enterprise R&D is to a large extent financed by a company’s funds and some of it may then export.

- Presumably there is underestimation of R&D imports in the R&D survey because this survey asked about contract R&D and not R&D import. Contract R&D is probably a part of R&D imports, but not all.

- The R&D survey is based on international definitions (Frascati Manual) which are not used in the foreign trade statistics. Moreover, the R&D survey is only about R&D and in many firms the head of the R&D department is involved in deciding what to include in the questionnaire. According to these aspects, the source of error risk may be larger in the foreign trade of services statistics.
Conclusions and future projects

Intangible investments like R&D, innovations or any other intangibles are for certain hard to measure but to ignore these intangibles would be to miss what the economy is telling us. It is surly also important to study the impact they will have on productivity measures.

The move to capitalise R&D is probably a good idea to improve the National Accounts in concept, but when it comes to practical aspects there seem to be difficulties in bridging R&D into the NA. Those difficulties need to be overcome.

The R&D survey is presumably the best adapted source to collect R&D internationalisation data (import and export). However, supplementary questions are needed to increase the quality for inclusion in NA. Otherwise, the foreign trade of services statistics can be used, but that implies an increased amount of quality checking of R&D and coordination with the R&D statistics.

According to the case studies, the chosen level of in-house R&D in relation to the level of contract R&D differs considerably among companies and industries, and so do flows of funds to/from abroad for R&D. Some of the included MNEs were largely involved in international activities of R&D, some where not.

Before implementation of R&D as capital formation in the National Accounts further investigations need to be done. One such example is to construct bridge tables for a couple of years concerning comparability over time and among industries. Moreover, these bridge tables should guarantee to not overlap with software R&D, because software is already capitalised. Furthermore, needs for investigate a range of alternatives to get R&D service lives (depreciation rates) for building up stocks of R&D capital.

In the present revision of SNA changes will be made and R&D will be treated as investment by 2011.
References

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Corrado, Hulten, Sichel (2005), Intangible Capital and Economic Growth, NBER, October 2005
SCB (2005), Research and experimental development in the business enterprise sector 2003, Stockholm
The Economist (August 2007), GDP redefined – Intangible measures, page 30, volume 384, number 8540
Statistikdatabasen, www.scb.se
### Table 2

R&D expenditure by industry 2005, SEK millions

<table>
<thead>
<tr>
<th>Industry (NACE)</th>
<th>Net sales</th>
<th>In-house R&amp;D (Intramural)</th>
<th>R&amp;D intensity</th>
<th>Contract R&amp;D total (extramural)</th>
<th>Contract R&amp;D abroad, within group of enterprises</th>
<th>R&amp;D financed from abroad</th>
<th>R&amp;D financed from abroad, within group of enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>5 606 718</td>
<td>76 949</td>
<td>1.4%</td>
<td>20 433</td>
<td>13 823</td>
<td>10 226</td>
<td>6 054</td>
</tr>
<tr>
<td>Pharmaceuticals (NACE 24.42)</td>
<td>64 915</td>
<td>12 421</td>
<td>19.1%</td>
<td>732</td>
<td>426</td>
<td>262</td>
<td>313</td>
</tr>
<tr>
<td>Electronics (NACE 30-33)</td>
<td>196 225</td>
<td>15 673</td>
<td>8.0%</td>
<td>12 654</td>
<td>10 449</td>
<td>8 707</td>
<td>434</td>
</tr>
<tr>
<td>Transports (NACE 34-35)</td>
<td>358 500</td>
<td>15 758</td>
<td>4.4%</td>
<td>1 903</td>
<td>1 233</td>
<td>102</td>
<td>760</td>
</tr>
<tr>
<td>All other industries</td>
<td>4 987 078</td>
<td>33 097</td>
<td>0.7%</td>
<td>5 144</td>
<td>1 715</td>
<td>1 155</td>
<td>4 547</td>
</tr>
</tbody>
</table>

### Table 3

A few typical enterprise groups' international R&D activities. percentage of in-house R&D performed in Sweden

<table>
<thead>
<tr>
<th>Case company</th>
<th>Ownership (Swedish/Foreign)</th>
<th>Contract R&amp;D</th>
<th>Contract R&amp;D abroad</th>
<th>In-house R&amp;D financed from abroad</th>
<th>Export of R&amp;D</th>
<th>Import of R&amp;D</th>
<th>Export of IPR</th>
<th>Import of IPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>6.1%</td>
</tr>
<tr>
<td>2</td>
<td>S</td>
<td>95.5%</td>
<td>79.8%</td>
<td>9.0%</td>
<td>4.7%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>3</td>
<td>S</td>
<td>0.1%</td>
<td>0.1%</td>
<td>1.1%</td>
<td>21.1%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>95.5%</td>
<td>79.8%</td>
<td>9.0%</td>
<td>4.7%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>6.2%</td>
<td>3.6%</td>
<td>0.0%</td>
<td>43.1%</td>
<td>84.3%</td>
<td>73.6%</td>
<td>3.4%</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>27.5%</td>
<td>17.7%</td>
<td>0.1%</td>
<td>168.7%</td>
<td>111.6%</td>
<td>0.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>5.0%</td>
<td>1.1%</td>
<td>21.1%</td>
<td>2.7%</td>
<td>3.2%</td>
<td>0.4%</td>
<td>9.3%</td>
</tr>
</tbody>
</table>

1. R&D survey in the business enterprise sector
2. R&D survey in the business enterprise sector
3. Foreign trade of services
4. Foreign trade of services