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PROBLEMS RELATED TO THE MEASUREMENT OF INTERNATIONAL R&D FLOWS

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Remarks:

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1. Introduction

According to new international national accounting guidelines (SNA 93 Rev.1)¹ expenditure on R&D will be recorded as gross fixed capital formation in stead of intermediate consumption. This new accounting convention implies that R&D expenditure will directly add to GDP which increases the importance of suitable data sources for R&D output and investment estimates.

In the Netherlands a large share of R&D carried out by private companies is concentrated in a restricted number of multinational companies. For these companies it appears very difficult to track down intra company flows of R&D services. It is not straightforward to determine within these companies the exact location of use of R&D capital services in production. The current Dutch R&D survey does not provide the information needed to determine which (foreign) company affiliates could be identified as the genuine economic owners of R&D. One may argue that economic ownership usually coincides with those business units that directly benefit from the returns to R&D investments. On the national level this lack of information may seriously hamper the measurement of R&D investment and subsequently R&D import and export flows.

This paper reviews recent experiences obtained in the Netherlands with adopting the new national accounting guidelines on capitalising R&D expenditure. Especially problems related to measuring R&D import and export flows are highlighted. The paper further reports on the outcome of interviews held with representatives of five multinational companies with the purpose of getting a better understanding of how they organise and fund their R&D programs. Finally, some first conclusions are drawn on how R&D surveys can be improved as a statistical source for national accounting purposes.

2. The robustness of R&D surveys in measuring import and export of R&D services

As a first attempt R&D import and export data were derived from the Dutch R&D surveys. The annual R&D survey provides information on the funding of R&D. One may assume that R&D financed by foreign entities represents in most cases export of R&D services. Reversely, financing by domestic entities of R&D carried out abroad may in most cases refer to import of R&D services.

¹ The new System of National Accounts is not finalized. However the registration of R&D as gross fixed capital formation has already been approved by the Statistical Commission. Here we refer to the draft version SNA 93 Rev.1.

Evidence from the R&D survey illustrates that the Netherlands is a net R&D exporter. This positive trade balance is shown in table 1. These trade surpluses seem to indicate that the Netherlands gains from beneficial conditions for carrying out R&D activities. Yet, the benefits of this R&D in terms of increasing profitability are likely to occur in foreign countries where this R&D is expected to contribute to product or process innovations. Reversely, R&D trade deficits (higher R&D import than R&D export) would indicate higher national R&D investment levels than shown in isolation by data on the domestic direct expenditure on R&D activities. In other words, an adequate assessment of R&D investment in the Netherlands requires correct measurement of both R&D export and R&D import.

Table 1
R&D balance of trade of the Netherlands, 2000-2004 (mln €)

	2000	2001	2002	2003
R&D export (% of GERD)	735 (9,6%)	763 (9,4%)	753 (9,4%)	755 (9,0%)
R&D import (% of GERD)	427 (5,6%)	659 (8,2%)	541 (6,7%)	519 (6,2%)
R&D balance of trade (% of GERD)	308 (4,0%)	104 (1,3%)	212 (2,6%)	236 (2,8%)

1) All figures derived from the R&D survey.

2) GERD: Gross expenditure on R&D according to Frascati guidelines (Frascati Manual 2002, OECD, Paris).

It is important to stress that the Dutch R&D survey does not explicitly ask for R&D sales and purchases nor import or export of R&D services. This is a weakness since funding of R&D may also include donations or subsidies and these should be excluded from transactions concerning goods and services in the National accounts. In addition, the general focus of R&D surveys on solely R&D performers may lead to under reporting of R&D import.

Furthermore, it seems that R&D may be transferred within multinational companies without the presence of countervailing money flows. In other words, even if an R&D survey would explicitly ask for R&D sales and purchases, it is questionable whether multinational enterprises would actually report all exchanges of R&D services with (foreign) affiliated enterprises. For those multinational companies with many foreign affiliates it may be very complex to indicate the exact destination of all internal R&D services. Especially for smaller open economies such as the Netherlands it appears not straightforward to determine the amount of R&D services that actually accumulate as knowledge capital in the domestic economy.

To further investigate the plausibility of the R&D survey data on R&D export, a small study was carried out in which various data sources were examined. The study focused on eight multinationals that together represented in the year 2005 46% of all business expenditure on R&D (BERD). Due to confidentiality requirements the figures of each of these eight multinationals cannot be shown individually. Therefore in this report only aggregate figures of these eight multinationals are shown. Data on turnover, number of employees, R&D personnel and R&D expenditure were collected to evaluate data from the R&D survey. Data for the entire multinational (worldwide) were collected from the annual business reports.

Data for only the Dutch establishments were obtained from the R&D survey and the Financing of Corporations survey.

The number of employees working in the Netherlands as a proportion of total worldwide employees was taken as an indication of the share of company wide production carried out in the Netherlands. Information about turnover (and profit) was also available in most cases. However, since most annual reports only contain information on consolidated profit and loss accounts, it is less obvious how to interpret the share of worldwide turnover generated in the Netherlands. However, when the proportion of the consolidated worldwide turnover generated in the Netherlands is taken as a measure of the proportion of the entire company's production concentrated in the Netherlands, the conclusions presented below remain basically the same (results not shown).

Of the eight multinationals almost 13% of all their personnel worldwide was in 2005 employed in the Netherlands, whereas for R&D personnel this share was 34%. These results indicate that the R&D activities of these companies are to some extent concentrated in the Netherlands. Data on R&D expenditure in the Netherlands compared to R&D expenditure worldwide suggest a similar concentration. These results are not surprising. Each of these investigated eight multinationals is of Dutch origin. Their headquarters are still situated in the Netherlands. Historically R&D activities of these companies are located in the direct neighbourhood of the headquarters.

This concentration of R&D activities in the Netherlands suggests that these companies would export fair amounts of R&D services to foreign company divisions. However, only one out of eight multinationals reported a substantial amount of R&D export (more than 90% of their BERD). The other multinationals reported zero R&D export (three multinationals) or very small amounts (around 4% of BERD by four multinationals). These results strongly suggest that the export of R&D services is being under reported in the Dutch R&D survey. Therefore it appears quite difficult to determine the amount of gross fixed capital formation of R&D in the Netherlands that should accumulate on the nations' national balance sheet. Problems in measuring the R&D service flows within multinational companies are not new. However, they become much more crucial at the moment R&D investment directly adds to GDP.

3. Alternative options to measure international R&D flows

Two other sources were investigated to get a better notion of the size of intra company flows of R&D services. These are discussed in this section.

3.1 Trade on services statistics

Statistics on the international trade of services comprise another possible source for the estimation of R&D imports and exports. However, statistics on the international trade of services do not seem to accurately reflect R&D exports either. Only when the observed financial flows comprise payments of R&D services, the statistics on international trade of services are a reasonable source for the estimation of an R&D trade-balance. However, it is unlikely that trade statistics are able to capture all the intra-concern transfer of R&D services.

3.2 Interviews with multinational companies

As indicated earlier, in the Netherlands observation problems related to intra company R&D only exist for a limited number of large companies that are together responsible for a large part of total domestic R&D expenditure. A custom made surveying approach may lead to a better understanding of these international intra company R&D services and subsequently to a better estimation of the size of R&D export flows. Statistics Netherlands invited a number of these large R&D performing multinational enterprises to discuss the idea of capitalisation of R&D and the measurement problems involved.

3.2.1 Organisation of discussions

The first round of discussions took place on 20th of March 2007 and was organised as a roundtable meeting with four multinationals. On 28th of March 2007 a bilateral discussion took place with a fifth large multinational of Dutch origin. The conclusions as presented below are therefore based on discussions with five multinationals, which together represent almost one third of the R&D expenditure of the Dutch business enterprise sector.

The discussions concentrated on the following issues:

1. Which company wide cost accounting methods related to R&D are used?
How is this method being applied to the costs of basic research?
2. Do company affiliates directly pay for R&D services provided to them?
3. Do licenses to use R&D exist within the enterprise group?
4. How is ownership of (patented) knowledge determined within the enterprise group?
5. Looking at the new IFRS accounting standards, is R&D capitalised on the enterprise balance sheet? And if so, what valuation and depreciation methods are being used?

3.2.2 Outcome of the interviews

The organisation of R&D appears to differ considerably between multinationals. In one case all R&D is concentrated in one separate R&D unit within the multinational enterprise. This unit performs all R&D assignments from the other business units

but may also take on external assignments from outside the enterprise. The business units pay this R&D unit directly for the services provided. In addition the R&D unit also performs own-account R&D not initiated by a customer.

In contrast, in another company the performance of R&D is totally decentralised. The different business units carry out themselves all the R&D required for their own businesses. However, basic research is carried out at headquarters (corporate level).

Other models exist as well. In some companies R&D units can be found at various locations not necessarily in the neighbourhood of business units that profit from this R&D. Company wide R&D programs may be carried out on a world wide scale, in close cooperation with various R&D units around the world. Especially for these fully globalised companies the recording of intra R&D flows becomes very problematic.

With regard to the funding of R&D within the interviewed multinationals the following conclusions can be drawn:

- a. The decision on how much to spend on R&D is in most cases taken at the corporate level. These decisions are regarded as being of a strategic nature and periodically re-evaluated but usually not every year. Surprisingly, estimations of returns to R&D do not seem to play a key role in decisions about the company wide R&D programs. R&D is simply found fundamental for the continuation of the business on the longer term.
- b. The general principle, at least for the Development component of R&D, seems to be that responsibility for R&D budgets lies at the corporate level (in the Netherlands). The different business units of the multinational are invoiced by headquarters for a certain amount of R&D costs. The applied R&D cost redistribution system differs considerably between multinationals:
 - I. *On the basis of (expected) benefits*: those business units that (may) benefit from the R&D are paying for concomitant R&D costs;
 - II. *More or less related to (expected) benefits*: in one case an index of the R&D intensity of different products was used for intra company cost redistributions;
 - III. *Unrelated to (expected) benefits*: sometimes a fixed percentage of turnover or profit of each business unit is invoiced.

Only when multinationals employ a direct invoice principle, where R&D costs are shared by beneficiary units, surveying intra company R&D service flows on a country by country basis seems to make sense. The results of these surveys can be used for R&D import and export estimates. One of the multinational enterprises that follows such a direct invoice principle indicated that they could provide figures with regard to invoiced R&D on a country by country basis. Such financial flow figures can be used to estimate an R&D trade balance on the national economy level.

In order to estimate import and export of R&D separately (in stead of a balance) multinationals have to provide figures with regard to who performed R&D for whom on a country by country basis. From the interviews it seems clear that this

kind of detailed information cannot be provided by the multinational enterprises. What can be provided is information on the size of the R&D 'bill' by each company affiliate on a country by country basis.

Unfortunately, the other types of cost accounting methods (II and III) do not provide these possibilities. However, one multinational that employs a direct cost accounting method indicated that their billing-system was considered refined by other multinational enterprises in their branch. It was mentioned that other companies considered adopting similar kind of direct R&D cost accounting systems in the near future. Obviously this would be very beneficial from a national accounting point of view.

c. The figures that multinational enterprises are providing in response to questions in the R&D survey on funds received from abroad do not necessarily address all cross-border transfers of R&D services. As indicated by at least one multinational enterprise, their response refers to funds received from abroad at a 'lower' level within the enterprise group. Their response only referred to R&D that was outsourced by Dutch R&D units to foreign R&D units. In other words, these flows were largely unrelated to company R&D cost allocations to the various business units. In this particular case reported funds received from abroad underestimated the actual intra company export of R&D services to foreign affiliates.

d. The funding of basic research differs from the funding methods for experimental development and applied research. In some cases funds available for basic research are simply based on a fixed percentage of the entire company wide R&D budget. In other instances the different multinational units are invoiced for basic research expenditure performed at the corporate level based on connected turnover.

Regarding the use of licenses the outcome of the interviews was rather unambiguous. Payments via licences and royalties are unusual within an enterprise group. In general, the legal ownership of all R&D lies at the corporate level (in the Netherlands). However, from the interviews a tentative conclusion can be drawn that the multinational enterprises subscribe the point of view that in fact the business units that gain the benefits are usually the economic owners of this R&D. Generally one may conclude that import and export of R&D services should address the transfers of R&D investments rather than R&D capital services (being the service flows derived from R&D capital).

As far as the capitalisation of R&D is concerned a very straightforward conclusion can also be drawn. Each of the investigated multinationals does not enter R&D as assets on their balance sheets unless purchased from other parties. The same holds for ownership of patents. A few companies experimented with capitalisation of R&D in their company records but according to their opinions this led to unsatisfying results.

4. Conclusions

It seems reasonable to conclude that survey questions on foreign R&D funding are expected to result in a considerable under reporting of R&D export flows. One first recommendation is that purchases and sales of R&D should be explicitly addressed in survey questions. However, for comprehensive R&D import and export estimates (or even their balance) additional information is needed about the possible existence of intra company R&D services. Attention to the recording of intra R&D flows is particularly needed in the case of multinational companies.

The interview results clearly show that the management of R&D and R&D funding systems may differ considerably between multinational enterprises. Although multinational enterprises are able to provide information on R&D performance at the national level, they often cannot provide information on the use of R&D services at the national level.

In those cases in which multinationals follow direct invoice methods, R&D funding questions in surveys may be helpful to estimate R&D import and export. However, a correct interpretation of survey responses requires a good understanding of the funding method followed by a company. From a statistical point of view it would be very helpful if direct invoice methods would be implemented in much more multinational companies. Also from a company's perspective there seems to be a need to bring R&D costs in close relationship to the benefits of R&D.

For companies following indirect R&D funding mechanisms, funding questions in surveys will not lead to satisfying results. In these cases the only way out is to ask which parts of domestic R&D expenditure is expected to benefit foreign affiliates. This will provide an indication of the amount of R&D that is being transferred to foreign affiliates. Reversely, in these cases surveys should include questions on the domestic appliances of R&D carried out by foreign affiliating R&D units. This may provide an indication of the R&D transferred from abroad to the domestic economy.

Generally, due to ongoing globalisation many national statistical offices are implementing special monitoring systems to coordinate the surveying of the largest, usually multinational, companies. Recently such a 'top 250' project was started at Statistics Netherlands. This project aims to scrutinize data from the biggest 250 enterprises in the Netherlands to make sure that all statistical surveys are mutually consistent and deliver comprehensive results on the national economy level. It seems that complete harmonisation requires in most instances custom-made surveying methods. It seems highly desirable to make the observation of R&D flows part of these custom made observation programs for the largest companies.