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Statistics on Tangible Capital Stock
Direct Observation at Statistics Netherlands

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Statistics on Tangible Capital Stock	2
Introduction	2
Direct Observation of Capital Stock: History	4
Measuring tangible capital stock: theory	5
<i>Accuracy of Direct Observation Stock Estimates</i>	7
<i>Accuracy of the Between-benchmark Estimating Procedure</i>	7
Investment Statistics	7
Problem of the Standard PIM?	8
<i>Inter-industry Transfers</i>	9
Corresponding Transfers of Investment Series	9
<i>Comprehensive Assessment of all the Enquiries</i>	9
Measuring tangible capital stock: practical implementation in the Netherlands	9
<i>Capital Enquiry</i>	10
Form of Enquiry	10
Enquiry Procedure	10
DOC Accuracy	10
Accuracy in practice	11
<i>Annual Investment Enquiry</i>	11
<i>Discard Enquiry</i>	12
<i>Sectors not (completely) covered via direct enquiries</i>	12
<i>Mining and Quarrying</i>	12
<i>Manufacturing Industry</i>	13
Short description of the method	13
Enquiring	14
Raising	14
Updating	14
Discards	15
Some results	16
Conclusions and future research	20
References	21

Statistics on Tangible Capital Stock

This paper will review the problems related to measuring tangible capital stock. Besides a general description of methods that can be used, we will also give a detailed description of the method used by Statistics Netherlands (SN). In writing this report we used the reports of Lock (1985), Frenken (1992), Jaffey (1995), and Van den Hove (1995) as our starting point.

Introduction

It is not easy to get a picture of the volume or value of capital stock. Tangible capital stock is in the first place a theoretical concept, not well-known as such in the practical world of business accounting. Tangible capital can simply be defined as those tangible means that contribute to production for more than one year. Then we may start our investigation at any plant and count the things that fit to this definition. We will probably find land, buildings, cars, tools, tables, machinery and computers. Quickly we will get aware of the first problem: you cannot add them. It is not possible to add computers with cars. Even the addition of cars with cars makes hardly sense for economic analysis, for the vehicles in capital stock will have different construction years and different technical qualities. Therefore an idea of the total volume of the tangible assets cannot be easily given.

Many Statistical Agencies are struggling to calculate accurate estimates of capital stocks. The method most widely used by Statistical Agencies is the Perpetual Inventory Method (PIM). PIM calculates capital stocks as a result of gross domestic fixed capital formation (GDFCF), assumptions on the length of asset lives and the pattern of retirements of these assets.

The charm of PIM lays in its low burden to the budget. If the wanted statistics are available, PIM is a cheap way to estimate the capital stock. The more detailed the data from the available statistics, the broader the description of the stock of tangible assets. This great advantage of PIM is also under other circumstances its weakness. The characteristics and limitations of the underlying statistics determine (delimit) the features of the statistics on stock of capital goods that are derived from them.

Capital stock data in the PIM are constructed by adding investments and subtracting discards to the existing tangible capital stock. PIM makes use of existing investment series (so called secondary data). As statistical data on disinvestments (disposals/scrap) are lacking, they have to be estimated. Therefore crude assumptions are necessary. The department of National Accounts of Statistics Netherlands for example thus far only uses PIM to estimate capital stock figures. Those estimates are used to calculate depreciation as a part of *gross* domestic product. These figures are also used in the national balance sheets produced by the National Accounts department.

In general the above also applies to the international scene of producing capital stock data. Secondary material and supplementary assumptions are used to estimate the capital stock. Limited budgets and loaded working programs have forced statisticians very often to choose for this indirect way, and not to choose the direct way (costly enquiries). The consequences of this forced choice have to be emphasised. Because the data on capital stocks produced by the indirect way depend on assumptions concerning the lifetimes of capital goods, the accuracy of the overall results is questionable. Also the structure of the stocks by vintage is the result of the assumptions concerning the lifetimes and of the mortality function chosen¹

Determining the tangible capital stock using the PIM method involves a lot of assumptions. Since the early eighties at Statistics Netherlands therefore research into an alternative method was initiated. This resulted in the direct observation of capital stock in certain economic sectors of the Dutch economy. The main aim of the Statistics on Capital Stock is describing the production capacity: measuring the productive capacity of the actual users of tangible fixed assets. Besides this, these statistics form the basis for calculating service lives.

We will start with a description of the history of this direct observation of capital stock in the Netherlands. Then we will give some theoretical background on the concept tangible capital stock, and possible ways to measure this stock. Next we will give a technical description on the specific features of the functioning of the Statistics on Stocks of Capital Goods. After that, we will show some of the results obtained so far. We will end this paper mentioning areas for further research.

¹ However, as Maddison (1992) points out: Judging by the evidence available for countries where alternative assumptions have been tested [...] estimates of the level and growth of capital stock are not very sensitive to plausible variations in the retirement pattern [...]. Assumptions on mortality functions are therefore less crucial than estimated service lives.

Direct Observation of Capital Stock: History

Looking for an alternative for the PIM method, research into the direct observation of capital (DOC) started round about 1980 at Statistics Netherlands. Lock (1985) announced in his article the start of a project that aimed at the direct observation of capital stock. Two experimental investigations were carried out to test the possibility of direct measurement of capital goods. The first study concerned the capital stock in the cigar industry in the Netherlands at January 1st, 1980. It started in that year and was completed three years later. The other study took place in the packing machinery industry. Behind the initiative was the realisation that the standard method, the perpetual inventory method (PIM), has serious shortcomings.

Therefore, the two studies mentioned above formed the basis for further enquiries in the Netherlands. Statistics Netherlands developed a system for the direct observation that nowadays seems to have found its mature stadium. An important milestone was reached when statistics on tangible capital stock in manufacturing industry as a whole were completed. That was the stock at the beginning of the year 1986. This year marks the start of series on tangible capital stock figures. The figures cover the division by industry sections, vintage years, value in actual and constant prices, and type of goods. Besides Manufacturing Industry also figures on Agriculture, Mining and Transport have become available. However, these figures on capital stock are partly obtained from direct enquiries, and partly computed by combining several data sources. For other economic sectors estimates for the stock of capital stock are not obtained by direct observation, but are computed by the National Accounts department, using the PIM.

After starting with a classification of 200 types of goods, and later reduced to 34 types, Statistics Netherlands now is using the same classification as the Statistics on Fixed Capital Formation uses since 1988 with eight types of goods.²

1. sites (only purchase and sale of sites)
2. industrial buildings (examples are factory-buildings, offices, shops, garages and sheds),
3. civil engineering (including site improvements), (examples are roads, pipelines for oil transport)
4. external means of transport (for example excavators, dredging machines),
5. internal means of transport (cranes, pulleys, assembly lines),
6. computers (data processing machines that are freely programmable including peripheral devices; this excludes machinery with embedded software), (examples are personal computer, printers),
7. other machinery and other equipment (hydraulic and pneumatic installations, communication equipment, measurement equipment, control equipment),
8. other tangible fixed assets (furniture, freight containers, silos).

² In fact, ten types of goods can be distinguished, because two extra types are used for specific sectors: for figures on the dwelling stock: dwellings (such as residences, student house-boats) and for figures in agriculture: live stock raising. Furthermore, for two sectors, certain type of goods are further split-up: in the sector Agriculture for example specific agricultural machinery is detailed, and for the sector Transport more detailed information on several means of transport are available.

Because of the unusual demands placed on company personnel by direct observation, personnel of Statistics Netherlands (SN) visit the companies and consult the company records themselves. The visiting staff members make use of checklists containing all special points of attention, as there are

- valuation,
- capital repair and alteration (revision, large maintenance),
- rent and operational lease,
- second-hand goods,
- instruction.

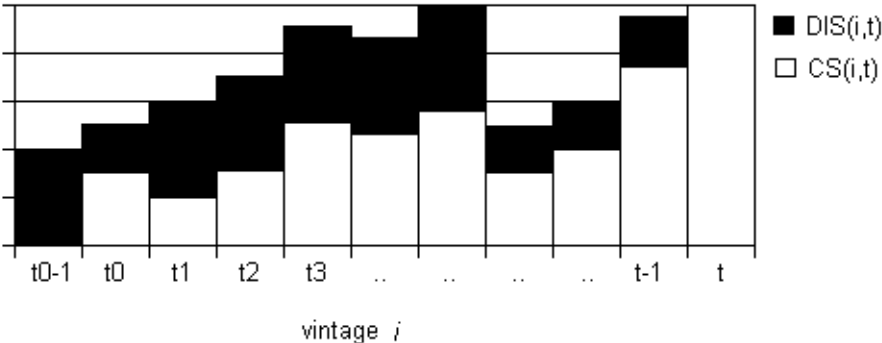
Valuation for example is an important (and difficult) issue in measuring capital stocks. In general different concepts of valuation are needed for different purposes (Ward, 1976). The basic concept in the Dutch Statistics on Stock of Capital Goods is the gross actual value. In the interviews however staff members gather the historical costs of the various capital goods. This policy is due to the fact, that companies value their capital assets in different ways. At Statistics Netherlands these historical costs are uniformly converted into actual prices by means of price index numbers. These Laspeyres price index numbers give for every type of good mentioned above the weighted price index number for the reference period.

DOC is used only for periodic benchmark estimates (mainly because of the expenses). Originally, the annual between-benchmark estimates were made with the conventional PIM, using assumed service lives. The large drifts, discovered when the next benchmark was made, confirmed PIMs inaccuracy. If there had been no drift, DOC would have been shown to be unnecessary. Originally there was considerable scepticism on the practicability of the methodology. And although other agencies showed interest in the method, this scepticism still is present in some areas. The main reason for this scepticism is because there is doubt if the results balance the costs. We think they do, however we very well realise that we have to keep alert, and look for ways to improve our methods, and improve application of the resulting data.

Measuring tangible capital stock: theory

Measuring the stock of a certain type of capital good is difficult as was already mentioned in the introduction. The main components determining the stock of a certain type of capital good are the value that is invested in this good, and the amount of these investments that have been discarded during the years. The composition of a certain type of capital good in a certain point in time, t , graphically can be depicted as is done in Figure 1.

Figure 1 Composition of the stock of a capital good at 1 January of year t



Where

t_0 oldest vintage of the capital good remaining on the first of January year t .
 $CS(i, t)$ remaining stock of capital good of vintage i on the first of January of year t .
 $DIS(i, t) \equiv \begin{cases} DIS(i, t-1) + \Delta_{DIS}(i, t-1) & \text{for } i \leq t-2 \\ DIS(t-1, t) & \end{cases}$ cumulated discards of vintage i at 1 January of year t

$\Delta_{DIS}(i, t-1)$ total discarded value of vintage i during year $t-1$.

$I(i) \equiv CS(i, s) + DIS(i, s)$, s is arbitrary: total investments in the capital good in year i .

$D(t) \equiv \sum_{i=-\infty}^t \Delta_{DIS}(i, t)$, total discards of the capital good in year t .

$K(t) \equiv \sum_{i=t_0}^t CS(i, t)$, total value of the tangible capital stock at January 1st of year t .

The last three definitions give rise to an alternative definition of the capital stock of a certain capital good:

$$K(t) = K(t-1) + I(t-1) - D(t-1)$$

Determining the capital stock of a certain type of good in a year boils down to determining the stock of the remaining vintages of the capital good. Assuming that we want to determine the monetary value of the stock of capital good, we will discuss the following three possible ways (among many others) of determining the value of the capital stock of a certain type of good at the first of January of year t .³

1. Gathering data on investment ($I(t)$) and making assumptions on the discard pattern (used to compute estimated figures on $DIS(i, t)$): the Perpetual Inventory Method (PIM).
2. Gathering data on capital stock ($CS(i, t)$) every five year, and using data on investment and estimates on discards (as in 1.) for in-between years: Direct Observation of Capital Stock (DOC) until 1991 at Statistics Netherlands.
3. Gathering data on capital stock every five years, and using data on investment, and gathered data on discards for in-between years: current method of DOC at Statistics Netherlands.

Most countries possess good official statistics on investment, however statistics on discards are rare. Therefore hypotheses about lifetimes of tangible assets and their distribution form a crucial part in the application of the PIM method. This is an essential weak spot in PIM. There is firm reason to believe that lifetimes differ for the diverse types of goods and even differ for the same goods as they are applied in different economic activities. One might even imagine that lifetimes change over time, correlated with technical progress and business cycles. Most PIM studies do not incorporate hypotheses that include these specifications and correlations.

Research independently performed by Statistics Netherlands (Lock, 1985; Frenken, 1992), the UK-National Institute of Economic and Social Research (Mayes and Young, 1994) and Statistics Canada (Jaffey, 1990) has proved that the conventional PIM method gives unsatisfactory results. One of the shortcomings of PIM is the fact that assumptions need to be made on the means of asset-lives. Attempting to arrive at accurate asset lives is usually given as the most difficult part of the PIM method. Determining lives through evaluation of their actual disposal gives serious difficulties (Ward 1976). But more than the pattern of retirements, the average service lives of capital assets primarily dominate the value of capital stock calculated, when using the PIM method.

3 One of the problems therefore will be the fact that the three statistics (capital stock, investments and discards) have to be valued the same way, that is to say prices have to be on the same basis.

Sources used by OECD countries to obtain information on asset service lives are (see OECD, 1993): tax authorities, company accounts, surveys, expert advice, and other countries estimates. Using this information, and assumptions on mortality functions, PIM estimates can be made. In general, estimates of average service lives and of mortality functions are less well-based than most types of economic statistics published by statistical offices. As is pointed out in the publication of the OECD (1993), these assumptions however determine the resulting estimated capital stock:

- The choice of mortality functions can have an important impact on the growth and level of the measured capital stock.
- Changes to estimated service lives obviously affect the estimated size of the capital stock. Less obviously, they also affects the rate of growth, because service lives act like weights. An upward revision to the service life of a particular asset increases the share of that asset in the total stock. An upward revision to a faster (slower) growing component of the stock will raise (lower) the growth rate of the capital stock as a whole.

Accuracy of Direct Observation Stock Estimates

In theory, the most accurate feasible method for determining the tangible capital stock is direct observation of this stock. In practice, despite some sources of inaccuracy, it must be more accurate than other methods which depend on the same data material: the company fixed asset accounts at cost, before depreciation. While DOC uses these in their full vintage detail, the standard PIM does so only partially and unsystematically, with arbitrary assumptions to fill gaps.

In practice, while absolute proof can come only through a physical inventory, a good indication is given by examining the several data sources for consistency. Some of such comparisons already indicate quite high accuracy, but a definitive judgement must wait upon the comprehensive assessment in a few years time. For a few economic divisions this assessment is already possible.

Accuracy of the Between-benchmark Estimating Procedure

The annual estimate is made by adjusting the stock by the annual changes:

$$+ \text{investment} \text{ discards } +/- \text{ inter-industry transfers.}$$

Much effort is now being given to improving the procedure, by increasing the accuracy of each of the three data items. Their problems are discussed further on. Some difficulties remain with the investment values, despite adoption of a new definition of investment in 1988 (the user criterion is used: not the owner, but the user of a capital good records investing in a capital good). Discard data are being improved through a discard enquiry implemented in 1991. How well these efforts succeed will be known from the comprehensive assessment in the near future.

Also important in the process of updating is determining the right price indices, to capture changes in quality (pseudo volume changes). At present, data from statistics on producer prices are used for determining price index numbers.

Investment Statistics

Annual capital investment can be defined in two ways:

1. The national accounts definition (in terms of expenditure), where construction and large equipment work-in-progress, for facilities many of which will enter the stock only in future years, are incorporated.
2. The capital stock definition (the annual addition to the in-service stock), where transfers of

completed facilities from the work-in-progress inventory (an event, not an expenditure) are added.

An important characteristic of SN Statistics on Investment, as it is of the Statistics on Capital Stock, is that a user, rather than an owner⁴, rule is followed. The same categories are used as are given later on for the capital enquiry.

Problem of the Standard PIM?

The discard enquiry was also instituted to meet a secondary purpose, as an extra parameter for the determination of service lives. In 1994 SN started researching ways for improving service lives estimates, combining gathered data on capital stock, investments and disinvestments. In the near future the first results of this research will become available. Estimates of service lives play an important role in capital stock measurement. Consider the main ways of measuring capital stock:

- 1) through life assumptions used in the PIM;
- 2) through direct observation, used by the SN for the gross stock (this does not require service lives);

In order to get the lives necessary to estimate capital consumption and the net stock, SN aims to develop a life model that, infers the lives from the full fixed asset accounts. Lives can be determined in two ways:

- 1) By observation of particular capital goods that have died or been disposed of;
- 2) By model inference.

Attempting to arrive at good life assumptions is usually given as the most serious difficulty of the PIM method⁵. There are, in fact inherent difficulties in determining lives through consideration of actual disposals, well explained by Ward (1976).⁶

An additional problem is the fact that large maintenance by enterprises sometimes is seen as working-expenses. Chemical industries for example know in advance that after a certain number of years, part of their installation cannot be used for certain periods because large maintenance activities have to be performed. This is already taken into account far before the actual maintenance takes place.

⁴ The National Accounts department for example also needs estimates according to the owner criterion for their input/output tables.

⁵ For example Estimates of economic lives are regarded as the weakest aspect ... In most countries no recent, comprehensive and empirically based set of estimates of capital asset lives has been compiled (Michael Ward, 1976).

⁶ Since buildings and machines will often undergo many additions, renovations, alterations and modifications during their lifetimes, it is difficult to attach any great precision to average asset lives. The life of a capital good is a composite of the lives of the component parts which have either been added to or replaced in the capital since its initial construction. In some cases very little may be left of the initial capital good other than its basic framework or superficial structure.

Inter-industry Transfers

These are determined by the Capital Stock and Investment Group. The capital stock estimates at SN are on an enterprise basis, companies being classified under the main activity involved. The companies or parts of companies are transferred within the Business Register when activities are changed. For small companies, the transferred stock is calculated as the product of the number of employees transferred and ratios of capital stock per employee of the large companies. Heerschop (1993) showed that these ratios are quite accurate given the available data.

Corresponding Transfers of Investment Series

These transfers are not now determined. For the between-benchmark stock estimates, it is only the transfers of parts of the stock of capital that are required. The models to determine lives, however, discussed later on, require both the benchmark stock, and the past investment values embodied in this stock. Thus when capital transfers occur, the corresponding investments should also be transferred.

A feasibility study is planned at SN on Microdata storage. If adopted, this could solve this problem. Data are stored on an enterprise basis. Both investment and capital data are stored this way. By this means, when capital assets are transferred, the corresponding past investments can be transferred with them.

Comprehensive Assessment of all the Enquiries

An important test of accuracy of the actual DOC method will be possible when updated data could be compared with benchmark data. A first comparison involves confronting the updated 1991 benchmark (by adding investments and subtracting disinvestments) with the new benchmark in 1996. However this comparison will be obscured as a result of the new industry classification first adopted for the capital enquiries of 1 January 1993. Therefore a complete assessment will only be possible from 1 January 1998, because from that moment on, the old and the new benchmark will be based on the same 1993 classification of activities.

Measuring tangible capital stock: practical implementation in the Netherlands

The Statistics on Tangible Capital Stock publish data on four branches of economic activities:

- agriculture and fishery;
- mining and quarrying;
- manufacturing (except construction).
- transport, storage and communication.

Furthermore data and on dwelling stock are recorded.

From 1993, Statistics Netherlands introduced a new classification scheme to characterise companies according to their economic activity, the so called Standard Business Classification (SBC) 1993 (replacing the SBC of 1974). SBC 1993 corresponds to international classifications, especially to NACE (Nomenclature générale des Activités économiques dans les Communautés Européennes), revision 1, version 3 used in the European Union. Enterprises are allocated to different economic divisions, economic groups or economic classes as a result of this new classification.

Capital Enquiry

Capital enquiries of individual firms are the basis of the DOC benchmark estimates of the gross stock. All capital goods in use as of 1 January in the estimate year are tabulated by vintage. The enquiries are performed in the 19 manufacturing industries, and in the mining industry, for all large firms, of which there are about 1500. For a complete division of the SBC in the Manufacturing Industry, there is a five-year cycle. This implies that every year about one fifth of the industries gets a benchmark.

Form of Enquiry

The enquiry produces a table whose columns are vintage years, and rows are the eight asset classes mentioned above. The table is presented both in historic prices and at current values. Separate tabulations are made for each of three categories of goods in use: owned, on financial lease, on operational lease or rental. However, this only holds for the benchmark years. Updated capital stock figures do not have this categorisation according to owned, leased or rental⁷.

Enquiry Procedure

This is unlike most other enquiries at SN, in that the data are recorded by visiting personnel. Three full-time equivalent people are needed, companies being totally free of reporting burden for this enquiry. The time to perform individual enquiries has come down over the years from five days to one and a half day. Since five years the procedure was automated through the use of a laptop computer. Vintage account data are entered from the company accounts, which are at historic prices. These are then automatically converted to current values through the price indices stored in the computer. The laptop display allows comparison with the previous enquiry vintage results, and with the latest years investment, from the investment enquiry. Apparent inconsistencies are resolved with company personnel.

This process proceeds in principal from 1 January to 15 August. Weekly, the enquiry tabulations are dispatched, on diskettes, to the SN office in Voorburg for aggregation. Before the end of the year, the latest industry benchmark estimates, showing the capital stock as of 31 December of the previous year, become available.⁸

DOC Accuracy

The two main conditions relevant for DOC accuracy are:

- 1) The quality of company accounting procedures. The fixed asset accounts must show what is actually on the ground (including leased and rented items). Every capital good acquired must be entered into the accounts, and be shown at historic, market price, its vintage indicated. Second hand goods will, naturally, not be shown in their true birth vintage, at original price, but the latter information should be available if the capital stock is to be precisely measured. Every capital good discarded, that is physically removed in the production department, must also be removed from the accounts, in the accounting department.
- 2) The quality of the capital enquiry procedure, which should accurately capture this information. If these conditions are met, revaluation of the vintage accounts, with the price indices, will give a precisely accurate gross capital stock⁹ - apart from price index limitations, a separate topic.

⁷ However, this only holds for the benchmark years. Updated capital stock figures do not have this categorisation according to owned, leased or rental.

⁸ By choosing 31 December instead of 1 January the process of data gathering could be accelerated.

Accuracy in practice

There should be no serious difficulties with the second condition, capital enquiry procedures, and this appears to originate from consistency comparisons discussed later. It is with the accounting procedures that problems may lie.

For *acquisitions*, a possible difficulty is caused by second hand goods. Second hand goods come from purchases on the second hand market, and, possibly, from take-overs, mergers. As regards the former, overall they constitute only a small percentage, about three percent. The second hand goods are mainly buildings, which can easily be taken account of. Regarding taking over of enterprises: this only applies when enterprises are partly taken over. When an enterprise as a whole is taken over, this should be registered in the Business Register.

As for mergers, if the original historic price vintage data of the acquired companies is simply merged into the accounts, there is no problem. At present, considerable work may be required in the enquiry, to collect these original data. However, if through electronic data interchange, a direct link can be Another problem is large maintenance work not entered into the capital accounts of enterprises, but which is capital from a SN viewpoint: improvements that extend capacity, life, or efficiency, or are anti-pollution or safety measures. This gives a downward bias in the size of the stock indicated in the accounts. Another problem is mentioned though it is probably more theoretical than real, that any acquired capital item may fail to be entered into the accounts simply because of a breakdown in procedures.

As regards *discards*, there are two main possibilities:

- i) a replacement part may be capitalised, but the part it replaces not struck off the accounts, resulting in an upward bias in the stock shown in the accounts. While the situation may occur as a result of poor accounting procedures, in some cases it is difficult to avoid. Some items, though functionally removed from service, are difficult to remove physically (indeed even to delineate accurately, for example, a replaced roof or a road that is built over)
- ii) The reverse of this: a replacement part is charged to current expenses, while the part it replaces is removed from the capital account, producing a downward bias.

Annual Investment Enquiry

This is performed through a questionnaire enquiry. It uses the same asset class and use/ownership categories already described for the capital enquiry. It also distinguishes between new and second hand goods.

However, to close the triangular framework of the capital stock, definitions of the statistics on capital stock, investments and discards must match exactly. For example the user criterion that is used for the statistics on capital stock also must be applied for the statistics on investment (the definition the National Accounts uses, based on the owner criterion, therefore will not be appropriate). The importance follows from the fact that for example about 20 to 40 percent of the investments in external transport in Manufacturing Industry is obtained by rent or operational lease. For large enterprises this number sometimes even is higher. The use of means for external transport in these

⁹ Gross stock is defined as the value, new, at current prices, of the stock of capital assets. Subtracting from this, accumulated capital consumption at current prices, gives the net stock. The Capital Stock and Investment Group is researching possibilities for estimating survival curves that can be used to determine capital consumption. Especially the Dutch Central Planning Office is interested in such survival curves.

cases would be underestimated for a large percentage. Of all investments in Manufacturing Industry, about 5 percent is obtained in the form of rent or operational lease.

Furthermore, the capital stock definition of investment should be used: this means, investments should be recorded at the moment the capital good actual is taken into use. This is an important aspect, because it influences the composition of the capital good (see Figure 1). Consider for example the construction of a drilling platform that will take three years. If the investments are not recorded in

the year the capital good actually is taken into use, but when it is registered in the accounts, for platform is still under construction. However, when the oil company is visited for direct observation of the capital stock, the third year will be assigned as the vintage year of the drilling platform. This will cause a conflict with the investment series (just one third of the total investment in the drilling platform is recorded in the third year). Using the capital stock definition takes also into account the fact that wear and tear of a capital good starts not earlier as when it is actually taken into use.

Discard Enquiry

In order to improve the between-benchmark estimates, a discard enquiry was instituted in 1991. When a firm is visited for a capital enquiry, the discard enquiry for the particular year is handled at the same time (as are the investments). In the in-between years, the discard information is obtained by questionnaire.

Reference was made earlier to extensions to capital facilities which do not appear in the capital accounts because treated by companies as maintenance expense. The corresponding reported discard will therefore be missing these data. The discard enquiry should not try to replace the missing parts (to be consistent with the capital enquiries, it must show only what was in the accounts).

Sectors not (completely) covered via direct enquiries

For the sectors Agriculture and Fishery, Transport, Storage and Communication, and Dwelling Stock data partly are obtained by using external data sources. These external sources vary from other statistics to company accounts, to registers. Combining these data the part of the tangible capital stock can be estimated. Estimates for the capital stock in the sectors Transport and Agriculture are further obtained using investment figures, and estimated disposal.

Industry consists of the sectors Mining and Quarrying, Manufacturing Industry, Electricity, Gas and Water Supply, and Construction. The first two of these sectors are completely covered by direct enquiries. In these sectors, direct observation of the tangible capital stock (applying the user criterion) in every economic division is performed on a five-yearly basis.

Mining and Quarrying

The publication Stocks of capital goods 1989 contained the first results on the estimated value of the stock of capital goods in the branch of economic activity Mining and Quarrying. These results considered the benchmark date 1 January 1986. The capital stock is measured at the main contractor of the permit.

The results of the benchmarks in the following years are the result of enquiries on the one side, and extrapolations and estimations based on available secondary data on the other side. The enquiries imply direct observation for a number of important enterprises. Gathering data takes place by visiting the enterprises. The influence of additional extrapolations and estimations is small for this branch of economic activity. The enquired data constitute about 97% of the total value of the stocks of capital goods. For intermediate years (where no DOC visit took place), results are also available. For these years data on the increase (+ mutations) are added. Furthermore, the decrease (mutations) are incorporated. These data are based on figures on discards. In the next paragraph on the method in the Manufacturing Industry, we will go into more detail on the method for updating the figures for intermediate years.

Manufacturing Industry

Short description of the method

Data gathering and the presentation of results is done within the framework of the standard business classification (SBC) as a classification method for economic activities. 1992 was the last year under review using the SBC of 1974 as a basis. Within the branch of economic activity Manufacturing Industry this classification used 19 economic classes (two-digit code), subdivided in 114 economic groups (three-digit code).

From 1993, as a result of a regulation by the European Union (EU), all member states of the EU were obliged to harmonise their classification of activities with the NACE, used by the EU.

This resulted in the SBC 1993. Within this classification, Manufacturing is a section, subdivided in 23 subsections (2-digit code) and 103 groups (3-digit code).

Example:

Tabulation Category	Division	Group	Class	Title
D				Manufacturing
	15			Manufacture of food products and beverages
		151		Production, processing and preserving of meat and meat products
		152		Processing and preserving of fish and fish products
		153		Processing and preserving of fruit and vegetables
			1531	Processing and preserving of potatoes
			1532	Manufacture of fruit and vegetable juice
			1533	Processing and preserving of fruit and vegetables n.e.c.
	16			Manufacture of tobacco products
		160		Manufacture of tobacco products
	17			Manufacture of textiles
		171		Spinning, weaving and finishing of textiles

The business register is also used as a database with statistical units including the enterprise or the economic unit characterised to activity and size class. The main activity of a statistical unit determines the group to which this unit belongs. The size class is ascertained using the number of working people, measured in numbers of 'type of employees'¹⁰.

The importance of the economic groups, measured by the number and the size of the statistical units, or by the value of the stock of capital goods shows substantial differences between economic groups. Determining the value of the stock of capital goods is done using the following three steps:

- enquiring (data gathering and collating);
- raising;
- updating.

We will give a short description of the three steps.

Enquiring

Field enquiries are performed for direct observation (the direct method) of the stock of capital goods of certain economic groups. Personal interviewing is a relatively labour-intensive method of gathering and adapting data. The reason for not using a mail enquiry is the level of difficulty of phrasing. All enterprises enquired therefore are visited by employees of Statistics Netherlands.

Raising

Since the benchmark 1 January 1992 all large enterprises (100 or more employees) are visited. Before 1992, only the most important economic groups in an industrial divisions were enquired. The stock of capital goods for the small enterprises is estimated by raising the enquiry results for the large enterprises, and the number of employees of the small enterprise under consideration.

Before 1992, not only raising of the enquiry results was necessary, but also appraising the results to obtain the total value for an economic group (estimating the non-enquired economic classes). For this purpose, enquired data results were used in combination with results on investments. Heerschop (1994a) concludes in his research that given the available data and the pursued level of detail, PIM-estimates do not give satisfactory results in estimating tangible capital stock.

Contrary to the normal context, raising does not mean weighting the sampling data to make a statement on the total population. Estimations for the total population are obtained by using properties of the large enterprises. For this it is assumed that the value of the tangible capital stock per employee is the same for large enterprises is the same as for small enterprises. In a study on the methodology of the Statistics on Tangible Capital Stock, Heerschop (1993) concludes that, given the available data, the raising method used is satisfactory. However, whenever possible, it is advisable on a limited scale to observe smaller enterprises by sampling. In this way, combined estimators for the smaller enterprises could be used (partly based on model assumptions, partly based on the sample data).

Updating

Enquiries are not repeated yearly. On average a division, that is to say all large enterprises of economic groups within a certain division, is enquired once every five years. This is due to the labour-intensive character of data gathering. For the years between the benchmark years of two successive enquiries, the raised enquiry results are updated for every economic division¹¹.

¹⁰ One type of employee represents 260 paid working days.

¹¹ Due to the fact that until 1992 not all economic groups were covered, for these economic groups partly appraised values are updated (see the remark in the paragraph on raising).

This means that investments are added to and discards are subtracted from the measured stock of capital goods in combination with adjusting for price changes. Also incorporated are company transfers in industry, foundation of new enterprises or bankruptcy of existing enterprises. Investment figures are based on the Statistics on Fixed Capital Formation in industry. Discards are derived from the discard enquiry. Heerschop (1994b) points out the large emphasis this method puts on determining the individual estimations per benchmark year and per variable, neglecting the longitudinal aspect. Estimations for the discards and investments are determined separately, and at the end of the process balancing with the old gross actual value takes place. An extra problem is that only for investments enterprises with 10-100 employees also are observed.

Although data for small enterprises are available for some economic sectors from other statistics, research must be performed to see whether these figures can be used for estimating the tangible capital stock (see also the last paragraph of this paper).

Price indexation is done at the end of the updating process, because indexing only clouds the necessary checks that have to be made. Correcting for price development actually is only necessary for summing values over vintages.

Discards

Determining the stock of capital goods available for the production process in manufacturing, until 1991 also involved estimated discards. These estimates were based on mortality functions.

Analysing differences between the results of these estimates with results obtained by direct observation led to the conclusion that discards derived from mortality functions do not give a good representation of the fixed assets put out of use.

This resulted (from the year under report 1991) in enquiring the disposal of capital goods for all enterprises in Manufacturing Industry with 100 employees or more, using a postal enquiry. As Smeets and van den Hove (1994) already point out, the measurement of withdrawals serves several purposes.

1. In combination with investment data, withdrawal data will reveal if *replacement of old capital or addition to the capital stock levels* takes place. The observed fluctuations monitor the reaction to economic prospects, since durable production capacity is only destroyed under particular circumstances.
2. Besides being an indicator of increases or decreases of production capacity, discard data can be used as a basis for calculating depreciation periods. For that reason the factual *year of acquisition* is asked in the discard enquiry form for each capital good withdrawn.
3. Last but not least, accurate data on investments and discards can be used to obtain a reliable calculation of *tangible capital stock levels*. In the past data on level changes were frequently approximated, using assumptions on service lives and using mortality functions.

Discards are defined as the value of the tangible capital stock that is withdrawn from the production process during the period under review. The periods for which tangible capital is available to the production process can range from one year to many decades. Ultimately the use of a tangible capital good will result into withdrawal or disinvestment. Withdrawal occurs when the capital good is put out of use *definitely*, mostly demolition, scrap or physical disappearance through the second-hand market.

Together with the Statistics on Stock of Capital Goods and the Statistics on Investments, discards form a framework for linking the gathered data. This improves the accuracy of the results of these statistics. Furthermore, valuable information on behalf of determining the service life or productive life of capital goods becomes available.

Some results

Table 1 contains figures on the tangible capital stock in the different divisions of Manufacturing Industry. Table 2 also contains the same figures, but now categorised by vintage class. From these two tables one can already see that also other cross-sections of the data are possible. These two tables just serve as an illustration.

The types of capital goods in Table 1 are ranked in the same order as stated on page 3.

The vintages in Table 2 are classified in vintage classes for reasons of clarity. However, they are also available per vintage year. The category Does not apply refers to land which by definition has no vintage.

Table 1 Tangible Capital Stock per type of good in Manufacturing Industry, 31 December 1995.

mIn Dutch guilders	Total	1.	2.	3.	4.	5.	6.	7.	8.
Manufacturing Industry, Total	403733	23231	114690	13961	4870	11326	4633	215017	16003
Food, Beverages and Tobacco	83331	5316	25958	1536	1662	3014	618	40535	4692
Textiles	8411	510	3049	68	75	141	80	4224	263
Wearing apparel; Dressing and Dyeing of Fur	905	38	547	7	32	23	26	180	52
Leather and Leather Products (ex. Clothing)	1087	46	465	14	12	18	11	492	29
Wood and Wood products (ex. Furniture)	5125	422	2206	78	101	321	47	1788	163
Paper and Paper products	15701	606	4233	171	71	430	81	9892	218
Publishing, Printing, Reproduction of Recorded Media	20559	450	7586	78	354	330	659	10475	627
Products of Petroleum and Coal, Processing Nuclear Fuel	28010	1502	1976	2169	64	277	95	19618	2308
Chemical Products	83239	4160	16327	4677	395	1098	767	53108	2707
Rubber and Plastic Products	15600	803	4094	187	184	296	137	9258	641
Other Non-Metallic Mineral Products	18022	2626	4386	518	274	992	120	8539	568
Basic metals and Fabricated Metal Products	51350	2983	14955	1068	587	2062	603	28158	933
Machinery and Equipment	16861	1002	7032	188	411	509	431	6522	766
Office, Accounting and Computing Machinery	27743	1068	11569	430	334	517	637	12117	1071
Motor Vehicles, Trailers and Semi-Trailers	19093	1310	6693	2693	164	1069	214	6275	676
Furniture, Manufacturing n.e.c.	8695	389	3615	81	149	229	107	3835	290

Table 2 Tangible Capital Stock by vintage, 31 December 1995

mln Dutch guilders	Total	Does not apply	before 1960	1960-64	1964-69	1970-74	1975-79	1980-84	1985-89	1990-94	1995
Total Manufacturing Industry	403733	23231	27789	18780	28062	39019	38358	48812	80987	83678	15016
Food, Beverages and Tobacco	83331	5316	5958	2936	4799	6425	9170	11333	15972	18542	2880
Textiles	8411	510	1092	290	443	728	612	997	1599	1927	212
Wearing apparel; Dressing and Dyeing of Fur	905	38	93	36	68	62	31	102	221	212	42
Leather and Leather Products (ex. Clothing)	1087	46	223	93	79	32	111	76	200	207	20
Wood and Wood products (ex. Furniture)	5125	422	839	152	258	405	666	539	885	770	190
Paper and Paper products	15701	606	1201	880	659	1108	1476	1729	3779	3640	623
Publishing, Printing, Reproduction of Recorded Media	20559	450	736	709	698	1243	1291	3568	4307	6104	1453
Products of Petroleum and Coal, Processing Nuclear Fuel	28010	1502	1497	2054	2921	3082	1847	4388	7311	2963	445
Chemical Products	83239	4160	3416	2502	6173	10550	10176	9374	16333	18040	2515
Rubber and Plastic Products	15600	803	647	576	764	1125	1205	1924	4078	3884	594
Other Non-Metallic Mineral Products	18022	2626	898	1022	1468	1060	1691	1836	3020	3586	816
Basic metals and Fabricated Metal Products	51350	2983	3275	3360	5281	7718	4147	5196	8984	9097	1309
Machinery and Equipment	16861	1002	1330	1131	950	1335	1559	1773	3337	3724	720

Office, Accounting and Computing Machinery	27743	1068	2994	1585	2073	2151	2057	2745	5891	5935	1245
Motor Vehicles, Trailers and Semi-Trailers	19093	1310	2560	1011	1034	1529	1803	2411	3128	2641	1667
Furniture, Manufacturing n.e.c.	8695	389	1031	442	394	466	518	821	1943	2407	285

Conclusions and future research

During the years, many improvements have been made with respect to the methods used to measure tangible capital stock by direct observation. This however does not mean that we lean back and keep on working the way we do now. On the contrary, we keep looking for possible improvements. In this paragraph we will mention some of the research projects we are working on right now, and are planning to work on in the near future.

One of the main aims of the Statistics on Stock of Capital Goods was (and still is) to have a complete coverage of the whole economy. As we mentioned in this paper, right now only part of Industry is covered. In co-operation with the National Accounts department we are now looking at the possibilities for this complete coverage. In combining estimates from their department with direct observations, this may be realised. A restriction on a more complete coverage is our aim to keep total enquiry burden low. This could be reached by flashing in certain sectors which have not been covered by direct observation of capital up to now. In these new sectors the frequency of direct observation may be lower than it is in Manufacturing (that is, for these sectors a lower frequency than a five-yearly cycle could be sufficient). Our first priority is to extend our enquiries to the Electricity, Gas and Water Supply.

Although differences in the numbers from the National Accounts department and the Statistics on Capital Stock department can occur, these differences however only result from differences in definitions.

Concerning the investment questionnaire we intend to incorporate both the transaction (payment) and the period in which the capital goods are actually taken into use.

Another point of interest will be to use data from statistics on small enterprises. At the moment, these figures are estimated by extrapolation of data for large enterprises. Using data from other statistics, we hope to be able to improve these estimates.

Concerning data gathering, an improvement could be the Electronic Data Interchange (EDI) project. Linking company accounts to software provided by SN, the aim is to get data directly from company accounts. The investment enquiry is now participating in this project. Our visiting staff also is looking at the possibilities to link a special EDI module for the levels and flows of gross fixed capital stock to the asset accounts of enterprises. We hope this pilot study will be completed in the midst of 1997.

Furthermore the research on service lives still continues. First results of this research are planned at the end of 1997.

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