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MEASURING CAPITAL IN THE NETHERLANDS

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MEASURING CAPITAL IN THE NETHERLANDS*

Summary

At Statistics Netherlands the development of productivity statistics is addressed as a key field of interest. The recent national accounts revision at Statistics Netherlands was taken as an opportunity to improve capital stock and depreciation statistics. The Perpetual Inventory Method, as now applied at Statistics Netherlands, provides in a consistent way statistics on depreciation, the net capital stock, the productive capital stock and capital services. Further, much attention has been given to estimating average service lives and discard patterns of different asset types based on direct capital stock observations in the manufacturing industry. This paper presents the main features of this new system.

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1. Introduction

At Statistics Netherlands the development of productivity statistics is addressed as a key field of interest. The recently finalised national accounts revision resulted in several improvements which will allow for the construction of national accounts based productivity statistics in the near future. For instance, the measurement of labour volume in the labour accounts, as part of the Dutch national accounting system, was changed from full time job equivalents to hours worked. Further, the measurement of capital stock and depreciation was also improved considerably. The Perpetual Inventory Method (PIM), as now applied at Statistics Netherlands, generates in a consistent way statistics on consumption of fixed capital, net capital stocks, productive capital stocks and capital services (i.e. the capital inputs into production). This paper presents the main features of this new system.

In the past, the purpose of measuring capital at Statistics Netherlands was mainly restricted to the calculation of consumption of fixed capital. Following recommendations of the European System of Accounts (ESA-1995, Eurostat, 1996) consumption of fixed capital was estimated on the basis of a linear age-price profile. In addition, mortality functions were used to correct for the probability of premature asset discards. A disadvantage of this method was that, although premature discards were taken into consideration, no adjustments were made for assets with longer than average service lives. This asymmetry resulted in overestimating consumption of fixed capital.

In addition to solving this asymmetry problem, the revision of the Dutch PIM also entailed:

- The development of one single framework for the simultaneous estimation of net (wealth) stocks for fixed assets, productive capital stocks and ultimately the values and volume changes of capital services;
- A thorough reconstruction of investment time series in current and constant (t–1) prices by industry, institutional sector and asset type;

- An investigation of average service lives and decay patterns of various asset types in the manufacturing industry based on direct observations of capital stocks and the so-called capital discard survey;
- The consistent recording of purchases and sales of second-hand capital goods.

The revised PIM simultaneously provides the required statistics for compiling balance sheets (wealth stocks of fixed assets) and growth accounts (capital services in current and constant price). The underlying concepts of this PIM are derived from the OECD (2001) handbook on Measuring Capital. The next section of this paper presents its conceptual structure. The subsequent section discusses the use of direct capital stock observations in combination with the discard survey for estimating average services lives and discard patterns. Section four provides an overview of results while the final section sums up plans for future work.

2. Conceptual structure of the Dutch PIM

2.1 Measuring capital stocks

The OECD (2001) handbook on Measuring Capital provides the methodological underpinnings of capital related macroeconomic statistics such as consumption of fixed capital, net capital stocks and capital services. The handbook shows that these different statistics are interrelated and should be constructed preferably in a consistent way, based on one conceptual framework. Such a framework has been developed as part of the Dutch national accounts.

In this framework the following types of capital stocks are being distinguished:

- The framework starts off with the compilation of gross capital stocks on the basis of estimated discard functions. The gross capital stock represents the replacement value of all fixed assets used in production. Replacement value means that these assets are valued according to current market prices;
- The productive capital stock is subsequently derived from the gross capital stock. The productive stock reflects the level of capital services an asset is able to generate. The productive capacity of assets is postulated with the help of so-called age-efficiency profiles. It is assumed that the age-efficiencies of most assets decline over their service lives as a result of wear and tear. The total productive capital stock of a particular asset type is derived from aggregating assets of various vintages according to their transformation into efficiency units. Productive stocks are particularly useful for productivity measurement purposes;
- The net capital stock represents the actual market value of all fixed assets used in production. Since most capital goods are sparsely traded on second hand markets, market values are approximated on the basis of estimating the net present values of current and future capital services a capital good is expected to generate during its remaining service life. These expected flows of current and future capital services are being determined with the help of, the above mentioned, age-efficiency profiles.

So, these three types of capital stocks are interrelated and in the Dutch PIM derived as follows.

2.1.1 Gross capital stock

The replacement value $V_{j,t}$ in year t of assets newly purchased in year j (vintage j) is determined as follows.

$$V_{j,t} = I_j \prod_{i=j+1}^{t} P_i = V_{j,t-1} P_t \qquad (1)$$

Variable I_j denotes investments in historic prices and P_i denotes the corresponding price index of year i (where P_i =1 when prices in year i do not change). So, all investments are being re-valued at current prices.

The gross capital stock $GCS_{j,t}$ of the vintage j equals the replacement value of all capital goods newly purchased at j that are still used in production. Their gross capital stock is determined by multiplying the replacement value $V_{j,t}$ by a corresponding survival rate S_{t-j}. This survival rate denotes the fraction of assets of the age $t-j$ that is expected to be still into service.

$$GCS_{j,t} = V_{j,t} S_{t-j} = S_{t-j} I_j \prod_{i=j+1}^{t} P_i \qquad (2)$$

The total gross capital stock GCS_t is determined by aggregating over the various vintages j (assets of a particular asset type purchased at j.

$$GCS_t = \sum_{j=0}^{t} GCS_{j,t} \qquad (3)$$

2.2 *Productive capital stock*

The productive capacity of capital goods is determined by their age-efficiency AE_{t-j}. An age-efficiency function indicates the development of the productive capacity of assets over their service life. For most asset types it is assumed that their age-efficiency declines over time.

The age-efficiency parameter AE_{t-j} represents the *average* age-efficiency of all assets of the age $t-j$ that are still used in production. The age-efficiency may vary between 1 (when new) and 0 (at the end of an asset's service life). The age-efficiency parameter AE_{t-j} is a weighted average of individual age-efficiency profiles of all assets of the age $t-j$ that are part of the gross capital stock at time t. This average must be taken since assets of a particular vintage will have diverging survival probabilities.

The parameter AE_{t-j} indicates the average age-efficiency level of a particular capital stock of the vintage j compared to an identical brand new capital stock purchased at time t. The concomitant productive capital stock ($PCS_{j,t}$) is calculated as follows.

$$PCS_{j,t} = AE_{t-j} GCS_{j,t} \qquad (4)$$

The average age-efficiency profile is determined by describing the productive capital stock directly as a function of the replacement value ($V_{j,t}$) of all investments in year j. For this purpose the total age-efficiency profile TAE_{t-j} is introduced. The total age-efficiency profile entails the average of age-efficiency profiles of individual capital goods of the vintage j, weighted by their survival probabilities.

$$PCS_{j,t} = TAE_{t-j} V_{j,t} \qquad (5)$$

These individual age-efficiency profiles $A_{M,t-j}$ are assumed to be determined only by the age $t-j$ of the corresponding asset and its ultimate service life M. The variable L_M in the following equation denotes the probability of an asset to end its service life after M years.

$$L_M = -\frac{d}{dM} S_M \qquad (6)$$ [1]

The total age-efficiency then be determined as follows.

$$TAE_{t-j} = \int_0^\infty A_{M,t-j} L_M \, \mathrm{d}M \qquad (7)$$

It is assumed that the age-efficiency levels of discarded assets equal to zero.

The total productive capital stock is ultimately being determined by aggregating the productive capital stocks, as estimated above, for each of the different vintages *j*.

2.3 Net capital stock

The net (wealth) capital stock $NCS_{j,t}$, representing all assets of the vintage *j*, is determined by calculating the net present value of expected capital services (or rentals) generated by this group of assets.

$$NCS_{j,t} = \int_0^\infty \frac{R_{j,t-j+\tau} \, \mathrm{d}\tau}{(1+r)^\tau} \qquad (8)$$

The variable $R_{j,t-j+\tau}$ denotes the expected capital services in year $t+\tau$ (at current prices) derived from presently $t-j$ old assets. Variable r represents the real discount rate.

Developments in the volume levels of capital services are determined by the total age-efficiency profiles. This implies that the rentals in prices of year t derived from all assets of the vintage j can be described as a constant $C_{j,t}$ times the total age-efficiency profile TAE_{t-1}:

$$R_{j,t-1} = C_{j,t} TAE_{t-1} \qquad (9)$$

The net capital stock of all assets of the vintage *j* can then be determined as follows.

$$NCS_{j,t} = C_{j,t} \int_0^\infty \frac{TAE_{t-j+\tau} \, d\tau}{(1+r)^\tau} \qquad (10)$$

The so-called age-price profile AP_{t-j} represents the net value of vintage j stocks at time t as percentages of their replacement values. The age-price profile can be determined independently from the constant $C_{j,t}$.

$$AP_{t-j} = \frac{NCS_{j,t}}{NCS_{j,j}} = \frac{\int_0^\infty \frac{TAE_{t-j+\tau} \, d\tau}{(1+r)^\tau}}{\int_0^\infty \frac{TAE_\tau \, d\tau}{(1+r)^\tau}} \qquad (11)$$

1 For assets with relatively small service lives, using a discrete version of this equation may in certain cases lead to measurement inaccuracies. Therefore the continuous version is used instead for net capital stock calculations.

The so-called asset market equilibrium condition implies that the net present value of both past and expected capital services, as determined by the total age-efficiency profiles, derived from all asset of the age *t–j* equals their replacement value $V_{j,t}$. This condition is expressed by the following equation.

$$V_{j,t} = C_{j,t} \int_0^\infty \frac{TAE_\tau \, d\tau}{(1+r)^\tau} \tag{12}$$

The corresponding net capital stock at any point in time *t* can then be determined by substituting equations (12) and (11) into equation (10).

$$NCS_{j,t} = C_{j,t} \, AP_{t-j} \int_0^\infty \frac{TAE_\tau \, d\tau}{(1+r)^\tau} = V_{j,t} \, AP_{t-j} \tag{13}$$

As a result, the net capital stock of assets of the vintage *j* is determined by the replacement value $V_{j,t}$ times its corresponding age-price profile. The total net capital stock is simply derived by adding up the corresponding wealth stocks of all vintages.

2.4 Balance sheets

The former subsections illustrated how the gross, productive and net capital stocks are being derived in sequential order from investment time series in current and constant prices. Balance sheets are constructed to keep record in a systematic way of all changes in assets in the current year. The changes between opening and closing stocks entail the following entries:

- Asset price changes;
- Gross fixed capital formation;
- Consumption of fixed capital;
- Other changes in the volume of assets such as sales and purchases of second-hand assets, reclassifications and bankruptcies. Although sales and purchases are part of gross fixed capital formation, for practical reasons we have registered them as other changes in assets in the PIM framework.

Consumption of fixed capital D_t is, according to the SNA-1993 (Commission of the European Communities et al., 1993), defined as the negative change in the value of fixed assets used for production as a result of physical deterioration, normal obsolescence or normal accidental damage. Consumption of fixed capital is measured with reference to the average prices in the current year. This implies that holding gains and losses are not accounted for in terms of depreciation but as asset price changes. Catastrophic losses are equally excluded from depreciation but accounted for in terms of other changes in assets.

For assets newly purchased in year *j*, consumption of fixed capital is in the Dutch PIM determined as the annual change in the value of assets, measured in current prices, before the recording of fixed capital formation and the other volume changes in assets. Another way to estimate the consumption of fixed capital of assets belonging to vintage *j* is to multiply their replacement value with the corresponding change in the age price profile.

$$D_{j,t} = P_t \, NCS_{j,t-1} - NCS_{j,t} = V_{j,t} \left(AP_{t-j-1} - AP_{t-j} \right) \tag{14}$$

The other changes in assets include major sales of assets such as buildings, dwellings and transportation equipment (specifically related to the termination of automobile lease contracts). Two problems emerge when recording the sales and purchases of second-hand assets.

- In most cases the age of capital goods that change ownership is unknown. This information is obviously required and therefore assumptions about the average ownership of sold assets must be made;
- Due to existing differences in services lives, age-efficiency profiles and price developments between different industries, the recording of changes in ownership may lead to (usually small) discrepancies between gross, productive and net capital stocks. Since these discrepancies are usually rather small they are simply being ignored.

2.5 The construction of investment time series

A substantial amount of work in this project concerned the recovery of original source data on investments. The first year covered in the investment time series in current and constant (t–1) prices is 1953.[2] The time series were constructed at the level of 57 industry branches, 20 asset types and 18 institutional (sub)sectors. For the starting year 1952 a gross capital stock was derived from an inventory of capital stock that was still in operation after the Second World War (Korn and Van der Weide, 1960). Additional assumptions were made about its age structure.

Special attention was paid to the price indexes applied for (pre-packaged) computer software and compute hardware. The corresponding producer price indexes collected by Statistics Netherlands appeared to be unsatisfactory for two main reasons. Firstly, imports are currently not very well covered. This is a serious omission since the larger part of pre-packaged software and computer hardware purchases in the Netherlands originate from imports. Secondly, no adequate adjustments are being made for quality changes. As a result, price statistics from the US Bureau of Economic Analysis and the US Bureau of Labour Statistics are used alternatively. The extent to which US dollar-Euro exchange rate changes influence computer and software prices in Europe seems uncertain. Therefore, no corrections are being made for US dollar-Euro exchange rate changes.

3. Survival functions and other parameters

For the manufacturing industry, Statistics Netherlands has, in addition to the investment survey, two supplementary data sources available to estimate capital stocks: directly observed capital stock benchmarks and discard surveys. Both sources are based on similar classifications of assets and industries. The combined use of these sources allows for the estimation of average service lives and discard patterns of various asset types in the manufacturing industry. Such a research was earlier carried out by Meinen et al. (1998). The results presented here are derived from more detailed and refined estimations compared to their work.

Until 2003 Statistics Netherlands collected benchmarks of capital stocks by direct observations (on-site visits by enumerators). Unfortunately, these visits were recently ended as a result of budget constraints. The Capital Stock Survey was collected for all enterprises within the manufacturing industry (ISIC 15-36) with 100 or more employees. It was performed on a rotational basis in such a way that each division of the manufacturing industry (two-digit ISIC level) was surveyed every five years.

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2 See section 3 of Van den Bergen at al. (2005) (in Dutch) for a detailed description of used sources.

At least two benchmark years are available for each division (two-digit ISIC level) of the manufacturing industry. The Capital Stock Survey recorded all tangible fixed assets that were used by enterprises in their production processes, whether the assets were owned, rented or obtained by leasing contracts. The survey contained information on the following types of tangible fixed assets: industrial buildings, civil engineering works, external transport equipment, machinery and installations, computers and other tangible fixed assets (e.g. furniture, freight containers and silos).

The second data source available for asset service life calculations is the Survey on Discards that was introduced at Statistics Netherlands in 1991 (Smeets and Van den Hove, 1994). Discards in a particular year comprise all fixed assets which are no longer used in the production process. These assets have either been scrapped or sold on the second-hand market. The Survey on Discards is collected annually among all enterprises within the manufacturing industry (ISIC 15-36) with 100 or more employees. The total number of enterprises that actually respond is usually lower than with the Capital Stock Survey because the Discard Survey is a mail questionnaire while the Capital Stock Survey involved on-site visits by enumerators.

3.1 Estimating discard functions

The Capital Stock Survey was only carried out for enterprises with at least 100 employees. No observations were available for smaller enterprises. This implies that grossing up these survey results is not really possible. However, the survey proves its usefulness in the estimation of average service lives and discards patterns for various asset types in the manufacturing industry.

For this purpose, capital stock data from the Capital Stock Survey in year $t-1$ (at 31 December) were linked with data from the Discard Survey in year t at the enterprise level. This resulted in a database containing capital stock and discard data for all enterprises responding to both surveys. Data from 1993 onwards were used in order to ensure two fairly recent capital stock benchmarks for every industry and to avoid difficulties with the standard industrial classification conversion of 1993.

In the Survey on Discards a distinction is made between scrap and sales on the second-hand market. Fixed assets were considered to be discarded when withdrawn from the production process of a particular industry (at approximately 2-digit ISIC level) (meso point of view). For the asset types ‘other machinery and other equipment’ (including internal means of transport)’ and ‘other tangible fixed assets’ it was assumed that all sales on the second-hand market occur between enterprises within the same industry (at approximately 2-digit ISIC level). Therefore, only discards characterized as scrap were considered a discard in the estimation of average service lives. For all other types of capital goods it was assumed that all sales on the second-hand market occur between enterprises belonging to different industries (domestic or foreign) or between enterprises and households. Therefore, for these remaining categories of assets, scrap as well as sales on the second-hand market were considered to be discards in the analyses.

3.2 The applied model

A model was constructed that, for each industry (at approximately a 2-digit ISIC level) and asset type, connects data on discards with data on tangible gross capital stocks. This model is used to approximate for each vintage j a survival rate s_j. This rate is determined by the gross stock of assets newly purchased in the year j that are still being used at the beginning of a reference year t, minus the discard values of that vintage during the reference year, divided by the tangible stock of that vintage in use at the beginning of that reference year. The survival rate denotes the probability a capital good of a certain vintage to survive until it reaches age x given the fact it has reached age $x-1$, where $x=t-j$.

$$s_j(x) \equiv \frac{GCS_{j,t-1} - T_{j,t}}{GCS_{j,t-1}} \qquad (15)$$

where

$GCS_{j,t}$	=	gross capital stock of vintage *j* in use at 31 December of year *t;*
$T_{j,t}$	=	value of retirements of vintage *j* during year *t;*
$s_j(x)$	=	survival rate denoting the probability that a certain fraction of a population of capital goods of a certain vintage *j* survives until it reaches age *x* given the fact it has reached age x–1: $s_j(x) = P_t(X_j \geq x \mid X_j \geq x-1) \equiv \frac{GCS_{j,t-1} - T_{j,t}}{GCS_{j,t-1}}$.

It is assumed that the survival rate at a certain age *j* is equal for all vintages.

$$s_j(x) = s(x) \qquad (16)$$

From the survival rates, the survival function $S(x)$ can then be calculated as follows.

$$S(x) = \prod_{i=1}^{x} s(i) = s(x) \cdot S(x-1) \text{ with } S(0)=1 \qquad (17)$$

where,

$S(x)$ = The survival function, or the probability that a certain fraction of a population of capital goods reaches the age of *x* year, that is, the probability a fraction of capital goods is not discarded at an age younger than *x* year.

It is assumed that the survival function can be described by a Weibull distribution as presented in the following equation.

$$S(x) = e^{-(\lambda x)^{\alpha}} \qquad x \geq 0 \qquad (18)$$

In this function *x* denotes the age of the capital good, *α* the shape parameter and *λ* the size parameter. Given the Weibull distribution parameters, the expected service life $E(x)$ of an *x* year old asset can be determined as follows.

$$E(x) = \frac{1}{\lambda} \cdot \Gamma(1+1/\alpha) \qquad (19)$$

Here *Γ* denotes the Gamma-function and $E(x)$ the life expectancy.

3.3 Estimated service lives

The estimation of optimal parameter values of the assumed Weibull distribution was performed at the industry branch (at approximately 2-digit ISIC level) by asset type level. An adjustment for outliers, to avoid exaggerated tails, was made by means of an arbitrary cut off rule.[3] The highest asset-age was determined at which at least a 1% decline in survival was observed, after which five more years were added. Up until this age data were used for analyses. Within the 1993-2001 period, Capital Stock Survey data were available for two separate years for most industries. For these cases two separate survival functions were estimated.

A decision had to be made which results were considered reliable enough to be used as inputs for capital measurement purposes. This was done first of all by visually inspecting the fits of the estimated survival functions. If a fitted survival function had an acceptable shape and the estimated service life seemed reasonable, results were considered reliable. The bold figures in the annex represent robust results that were considered reliable enough. Other figures in the annex originate from other industry branches or based on expert guesses because of the low quality of the original estimates.

Whenever results were available for two separate years and both sets of results appeared reliable, the average of the two sets of estimated parameters was taken as the final result. When results were available for two separate years and one set of results was decided to be more reliable than the other set, the more reliable set of estimated parameters was taken as the final result. When all results within a certain industry branch (by asset type) were determined to be of low quality, parameters estimated within another (as closely related as possible) industry branch (by same asset type) were adopted instead.

The Weibull distribution functions were estimated on the basis of calculated discard fractions. These discard fractions were being translated in survival rates which are by definition declining in time. These by definition declining survival rates together with the flexible properties of the Weibull distribution function lead in general to robust estimates of the average service lives and distribution patterns.

Regarding their plausibility, the results give the impression that the observed discard values are at several cases rather low. In these cases it seems likely that some discards were missed by the Survey on Discards. A drawback of the method used to calculate the survival function is that missing observations of in reality large discards in a certain year t have an impact on the survival function as calculated for the years after year t. Data were not re-analysed on higher aggregation levels because this would not add any new information. Aggregation does not solve the problem in those cases where it is suspected that discards are missing. Instead, as shown in the annex, industry branches with lower quality data were assigned estimates based on those with higher quality data.

3.4 Determining service lives of assets in use outside manufacturing industries

Incidental information on directly observed capital stocks is available for crude oil and natural gas mining (ISIC-11) and the water distribution industry (41). For asset types such as industrial buildings, transportation equipment and computers this information could be used for estimating service lives.

Car register information was used for determining the service lives of road transport equipment. Service lives of airplanes were derived from company records of Dutch airline companies. The survival functions of the other industry-asset combinations have been derived from those found in the manufacturing industry. In some cases these were slightly modified when there were reasons to assume diverting service lives in the services industry compared to those found in the manufacturing industry.

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3 Exaggerated tails are expected to occur when discards remained unobserved by the Survey on Discards.

Where no comparable industry-asset combinations were available, survival functions have been based mostly on literature and company records.

3.5 Other parameters

3.5.1 Age-efficiency

Usually one may expect a declining performance of assets as a result of aging. The changing level of capital services an asset is able to produce over its entire service live is reflected by the asset's age-efficiency profile. Empirical information on the shape of age-efficiency profiles is scarcely available. In most cases assumptions must be made about the age-efficiency of various asset types. With regard to the general shape of age-efficiency profiles there are broadly two choices. A *geometric* profile is used by Statistics Canada. This profile assumes the largest absolute declines in service levels at the beginning of an asset's service life. At the Australian Bureau of Statistics and the US Bureau of Labour Statistics a *hyperbolic* profile is used, assuming that the largest absolute declines occur at the end of an asset's service life. Without the availability of any empirical evidence for the Netherlands, a hyperbolic profile is considered the most plausible one.

Hyperbolic age-efficiency profiles were postulated with the help of a so-called Winfrey function (OECD, 2001, par. 6.75). The β parameter in this function determines the initial efficiency losses at the beginning of an asset's services lives. The β parameter may vary between 0 and 1. A value of 1 indicates a constant level performance, also referred to as a 'one-horse-shay'. We selected a β value of 0.5 for asset types like machinery and installations and transport equipment, a value of 0.75 for industrial buildings and dwellings and a value of 1.0 for computers, software and other intangible fixed assets.

3.5.2 Rate of return

In section 2 it was explained how net asset stocks are determined on the basis of net present value calculations of expected future rental flows. The real rate of return used for these estimations is 4%. So-far no attention has been given to differences in expected risk premiums as they might lead to differences in the rates of return between industry branches.

4. Results

Table 1 provides a brief overview of adjustments in consumption of fixed capital and wealth stock estimates that result from the Dutch PIM update. The adjustments are divided into three main causes: revision of the investment time series, adjustments in expected service lives and methodological changes. The construction of a new investment time series and changes in price indexes give rise to positive adjustments of both consumption of fixed capital and the net capital stock. The substantial upward adjustment of the wealth stock, compared to depreciation, is due to the fact that before the revision only the latter was corrected for incidental changes such as second-hand trade in capital goods.

The newly estimated service lives of assets are on average a bit shorter than those used before the revision. This results in higher depreciation levels and lower net capital stock estimates. The net present value method leads in the year 2001 to a depreciation level that is 5.5 percent lower than when using a straight-line depreciation rate. At the same time, the net capital stock is 7.5 percent higher. So the net present value method appears to give on average lower depreciation rates than straight-line depreciation.

Table 1: Adjustments of consumption of fixed capital and the total wealth stock of fixed assets as a result of the revision, the Netherlands, 2001

	Consumption of fixed capital	Total wealth stock of fixed assets
	%	
Adjustments of investment and price data	1.7	9.8
Adjustments of service lives	4.4	-3.0
Methodological changes	-5.5	7.5
Total adjustment	0.6	14.3

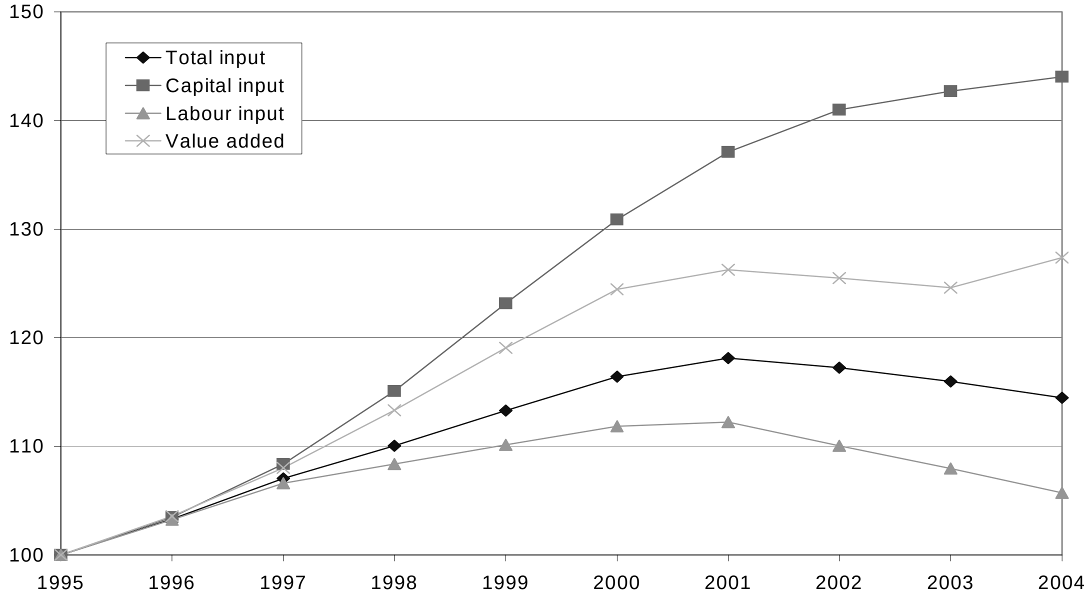
Table 2 presents the changes in the wealth stock of fixed assets in 2004, grouped into eight main asset categories. The increase in the value of assets was first of all due to asset price increases, the exception being computers. For most assets fixed capital formation surpassed depreciation. However, the values in constant prices of machinery and installations, other tangible assets and intangible assets declined in 2004 since for these asset categories fixed capital formation failed to keep up with depreciation. On the macro level the other changes in volumes of assets are particularly relevant for transport equipment. The negative change of 2.1 billion Euro mainly concerned sales of automobiles by lease companies to consumers. This macro presentation conceals the importance at the industry branch, or institutional sector, level of sales and purchases of dwellings and industrial buildings.

Table 2: A balance sheet of the wealth stock of fixed assets by asset type, the Netherlands, 2004

	Opening stock	Revalua-tion	Fixed capital formation	Depre-ciation	Other volume changes	Closing stock
	billion €					
Dwellings	729.6	22.5	29.8	-13.7	0.1	768.4
Industrial buildings	305.6	5.2	13.9	-12.9	-0.1	311.7
Other structures	255.0	1.1	10.4	-8.0	-	258.5
Transport equipment	43.4	0.7	11.0	-8.3	-2.1	44.7
Computers	10.5	-0.6	4.5	-2.9	-	11.5
Machinery and installations	146.3	0.8	12.8	-13.2	-	146.7
Other tangible assets	24.3	0.1	5.2	-5.3	-	24.3
Intangible assets	28.3	0.2	7.6	-7.8	-	28.4
Total	1543.0	30.1	95.3	-71.9	-2.2	1594.2

Figure 1 provides a tentative overview of recent macroeconomic developments. All data are derived from the Dutch national accounts and labour accounts. In this figure the annual volume changes of value added are compared with the annual volume changes of labour and capital inputs. The volume changes of capital inputs are estimated with the help of a volume index of capital services. This index refers to fixed assets only. So inventories and non-produced assets are not included. The combined labour-capital volume index is compiled with the shares of labour and capital in the total factor costs as weights. All indexes refer to the business sector. This means that industry branches dominated by non-marked producers, as well as dwelling services, are excluded.

Figure 1: Indexes of value added (volume), labour input (worked hours) and capital inputs (volume index of capital services) and a combined labour-capital volume index for the Dutch business sector



These preliminary results show a substantial increase of labour productivity in the period 1995-2004. This labour productivity gain seems to have been partly the result of a much higher growth of capital input in this period compared to labour (i.e. capital deepening). Since capital input growth even surpassed the volume increase in value added, capital productivity decreased in the period 1995-2004. The average annual multi-factor productivity in this period reached 1.2 percent.

5. Future work

The revised Dutch system seems to provide a solid basis for the annual compilation of balance sheets for fixed assets and the compilation of capital services in current and constant prices. It is planned to continue this work at Statistics Netherlands with the construction of balance sheets for land and possibly also for other non-produced assets (natural gas and oil). Recently, experimental estimates were made for knowledge capital resulting from Research and Development (De Haan and Rooijen-Horsten, 2004). There are plans to improve these estimations and to continue in 2006 the further development and regular construction of knowledge capital (satellite) accounts.

This year Statistics Netherlands is in co-operation with the Dutch Bureau of Economic Policy Analysis involved in the construction of a KLEMS (capital, labour, energy, materials, services) database. This work is carried out as part of the EU KLEMS project (Van Ark, 2004). Obviously, the achievements in the field of capital measurement will serve as one of the main building blocks of the KLEMS database for the Netherlands. It is expected that is work will lead in the near future to the frequent publication of productivity statistics on the macro and industry branch level as part of the annual national accounts publication of Statistics Netherlands.

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Annex – Expected service lives and discard patterns for the manufacturing industry

Figures printed in bold represent real estimates (at the industry by asset level). Figures that are not printed in bold are estimates borrowed from another industry or imputed figures based on expert guesses because of the low quality of the original estimates. Gross fixed capital formation in 2001 is added as an indication of the relative significance of a particular industry branch.

Table A1 - Industrial buildings

Industry	e.s.l. (years)	alpha	lambda	Capital formation 2001 (mln euro)
Manufacture of food products, beverages and tobacco	**42**	**2,16**	**0,022**	186
Manufacture of textile and leather products	42	2,16	0,022	8
Manufacture of wood and wood products	42	2,16	0,022	27
Manufacture of paper and paper products	42	2,16	0,022	34
Publishing and printing	42	2,16	0,022	59
Manufacture of petroleum products	**36**	**1,30**	**0,025**	22
Manufacture of basic chemicals, chemical products and man-made fibres	**41**	**1,77**	**0,022**	142
Manufacture of rubber and plastic products	41	1,77	0,022	43
Manufacture of building material	42	2,16	0,022	57
Manufacture of basic metals	31	1,01	0,033	22
Manufacture of fabricated metal products	**31**	**1,01**	**0,033**	77
Manufacture of machinery and equipment n.e.c.	**44**	**1,34**	**0,021**	94
Manufacture of office machines and computers	30	1,33	0,050	15
Manufacture of (other) electronic machinery and equipment	30	1,33	0,050	20
Manufacture of audio-, video- and telecommunication equipment	30	**1,33**	**0,050**	50
Manufacture of medical instruments and equipment	30	1,33	0,050	14
Manufacture of cars and trailers	**36**	**2,21**	**0,024**	27
Manufacture of transport equipment (other than cars and trailers)	36	2,21	0,024	26
Other manufacturing	42	2,16	0,022	86

Table A2 - External transport equipment

Industry	e.s.l. (years)	alpha	lambda	Capital formation 2001 (mln euro)
Manufacture of food products, beverages and tobacco	**6**	**1,41**	**0,173**	53
Manufacture of textile and leather products	**5**	**1,13**	**0,210**	5
Manufacture of wood and wood products	5	1,47	0,193	10
Manufacture of paper and paper products	**5**	**1,27**	**0,231**	3
Publishing and printing	5	**2,12**	**0,235**	14
Manufacture of petroleum products	**5**	**1,09**	**0,220**	1
Manufacture of basic chemicals, chemical products and man-made fibres	**7**	**1,30**	**0,154**	9
Manufacture of rubber and plastic products	5	1,47	0,193	7
Manufacture of building material	5	1,47	0,193	21
Manufacture of basic metals	**7**	**2,00**	**0,134**	3
Manufacture of fabricated metal products	**5**	**1,47**	**0,193**	36
Manufacture of machinery and equipment n.e.c.	5	**1,79**	**0,251**	28
Manufacture of office machines and computers	5	1,47	0,193	1
Manufacture of (other) electronic machinery and equipment	5	1,47	0,193	5
Manufacture of audio-, video- and telecommunication equipment	5	1,47	0,193	1
Manufacture of medical instruments and equipment	**6**	**1,46**	**0,189**	5
Manufacture of cars and trailers	5	1,47	0,193	9
Manufacture of transport equipment (other than cars and trailers)	5	1,47	0,193	3
Other manufacturing	**7**	**1,21**	**0,163**	24

Table A3 - Machinery and installations (including internal transport equipment)

Industry	e.s.l. (years)	alpha	lambda	Capital formation 2001 (mln euro)
Manufacture of food products, beverages and tobacco	**27**	**1,75**	**0,033**	946
Manufacture of textile and leather products	**35**	**2,50**	**0,025**	72
Manufacture of wood and wood products	30	1,52	0,030	61
Manufacture of paper and paper products	27	1,75	0,033	205
Publishing and printing	**35**	**1,53**	**0,026**	295
Manufacture of petroleum products	**22**	**1,49**	**0,041**	99
Manufacture of basic chemicals, chemical products and man-made fibres	30	**2,18**	**0,020**	957
Manufacture of rubber and plastic products	30	2,18	0,020	244
Manufacture of building material	**30**	**1,52**	**0,030**	279
Manufacture of basic metals	33	2,50	0,027	176
Manufacture of fabricated metal products	**33**	**2,50**	**0,027**	295
Manufacture of machinery and equipment n.e.c.	33	2,50	0,027	343
Manufacture of office machines and computers	**21**	**1,83**	**0,043**	30
Manufacture of (other) electronic machinery and equipment	18	1,54	0,055	62
Manufacture of audio-, video- and telecommunication equipment	**18**	**1,54**	**0,054**	361
Manufacture of medical instruments and equipment	**15**	**1,27**	**0,062**	49
Manufacture of cars and trailers	30	**2,11**	**0,074**	107
Manufacture of transport equipment (other than cars and trailers)	30	**1,29**	**0,025**	34
Other manufacturing	30	1,52	0,030	129

Table A4 - Computers

Industry	e.s.l. (years)	alpha	lambda	Capital formation 2001 (mln euro)
Manufacture of food products, beverages and tobacco	**12**	**1,50**	**0,076**	59
Manufacture of textile and leather products	**14**	**1,57**	**0,066**	5
Manufacture of wood and wood products	8	2,05	0,115	4
Manufacture of paper and paper products	**6**	**1,32**	**0,150**	14
Publishing and printing	**8**	**1,52**	**0,119**	81
Manufacture of petroleum products	**8**	**2,84**	**0,109**	6
Manufacture of basic chemicals, chemical products and man-made fibres	**12**	**2,03**	**0,074**	42
Manufacture of rubber and plastic products	12	2,03	0,074	12
Manufacture of building material	8	2,05	0,115	12
Manufacture of basic metals	8	2,05	0,115	7
Manufacture of fabricated metal products	**8**	**2,05**	**0,115**	33
Manufacture of machinery and equipment n.e.c.	**12**	**1,43**	**0,077**	89
Manufacture of office machines and computers	6	1,55	0,143	11
Manufacture of (other) electronic machinery and equipment	6	1,55	0,143	14
Manufacture of audio-, video- and telecommunication equipment	**6**	**1,55**	**0,143**	16
Manufacture of medical instruments and equipment	6	1,55	0,143	18
Manufacture of cars and trailers	5	**1,14**	**0,268**	6
Manufacture of transport equipment (other than cars and trailers)	5	1,14	0,268	9
Other manufacturing	**10**	**2,25**	**0,092**	23

Table A5 - Other tangible fixed assets

Industry	e.s.l. (years)	alpha	lambda	Capital formation 2001 (mln euro)
Manufacture of food products, beverages and tobacco	12	**1,01**	**0,042**	166
Manufacture of textile and leather products	12	**2,69**	**0,030**	10
Manufacture of wood and wood products	12	1,99	0,028	8
Manufacture of paper and paper products	12	1,01	0,042	15
Publishing and printing	12	1,01	0,042	55
Manufacture of petroleum products	12	1,01	0,042	8
Manufacture of basic chemicals, chemical products and man-made fibres	12	1,01	0,042	65
Manufacture of rubber and plastic products	12	1,01	0,042	14
Manufacture of building material	12	**1,99**	**0,028**	21
Manufacture of basic metals	12	**1,50**	**0,030**	3
Manufacture of fabricated metal products	12	1,50	0,030	36
Manufacture of machinery and equipment n.e.c.	12	1,50	0,030	28
Manufacture of office machines and computers	8	2,63	0,108	10
Manufacture of (other) electronic machinery and equipment	8	2,63	0,108	13
Manufacture of audio-, video- and telecommunication equipment	**8**	**2,63**	**0,108**	35
Manufacture of medical instruments and equipment	12	**2,50**	**0,072**	14
Manufacture of cars and trailers	11	1,43	0,081	15
Manufacture of transport equipment (other than cars and trailers)	**11**	**1,43**	**0,081**	11
Other manufacturing	12	1,99	0,028	33