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Explanation of symbols

.	= data not available
*	= provisional figure
x	= publication prohibited (confidential figure)
–	= nil or less than half of unit concerned
–	= (between two figures) inclusive
0 (0,0)	= less than half of unit concerned
blank	= not applicable
2007-2008	= 2007 to 2008 inclusive
2007/2008	= average of 2007 up to and including 2008
2007/'08	= crop year, financial year, school year etc. beginning in 2007 and ending in 2008
2005/'06–2007/'08	= crop year, financial year, etc. 2005/'06 to 2007/'08 inclusive

Due to rounding, some totals may not correspond with the sum of the separate figures.

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Measuring inventories in the Dutch national accounts

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Abstract

In order to complete the national accounts, Statistics Netherlands is in the process of developing complete balance sheets for the non-financial assets. These non-financial assets will be used in the estimation of multi-factor productivity statistics which requires exhaustive statistical information about all inputs of the production process. Besides fixed assets, another important part of the non-financial assets are the inventories. This paper presents in detail the methods used as well as the underlying assumptions needed to compile complete balance sheets for inventories.

Keywords: inventories, non-financial assets

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1. Introduction

The measurement of productivity is of particular interest at Statistics Netherlands. Productivity measurement is an important tool for understanding economic growth and developments. The more complete the information about the inputs of the production process is, the better productivity can be measured. A complete set of non-financial assets provides crucial information on these inputs. Moreover, statistics on inventories and inventory changes are useful inputs in the compilation of supply and use tables. Measures of inventories directly increase the quality of the national accounts.

The project with the goal to construct complete non-financial balance sheets started in 2007 as part of the larger project on productivity measurement and the knowledge economy. Other assets covered in this project are oil and gas resources and land. This paper discusses the measurement of inventories only.

Complete balance sheets of inventories have been compiled for the years 1995-2004. These balance sheets are produced at the level of industries, individual commodities and institutional sectors. Information on inventories at the level of commodities is particularly useful for compiling supply and use tables and for measuring appropriately revaluations of inventories. Inventories in agriculture are excluded from this research, since the inventories for this industry have already been estimated in the national accounts for several years.

In the Netherlands business surveys turn out to be the most important source for conducting inventory estimations. For the years 1995-1999 business surveys are available for each industry, from the year 2000 onwards these statistics are joined in one single survey system called “Impect”. The survey results on inventories are not at the level of commodity groups, so for this purpose alternative estimation methods based on supplementary information are needed.

In addition to data issues, this paper further deals with some methodological questions, for example:

- whether values in opening balance sheets should be in prices of the previous year or the current year;
- whether the opening balance sheet of the inventories should be divided into commodities on basis of data of the previous or the current year;
- whether to allow statistical discrepancies between the subsequent years.

This paper contains the following sections. The methods used to determine the inventories are discussed in section 2, followed by sensitivity analyses presented in section 3. The final results are presented in section 4. Finally, the conclusions are presented in section 5.

2. Determining the inventories

The measurement of inventories requires complete balance sheets, divided by industries and commodities. A complete balance sheet consists of an opening balance sheet, revaluation, changes in inventories and a closing balance sheet. Section 2.1 presents the methods used to determine the inventories by industries. Estimates at the level of commodities are discussed in section 2.2.

2.1 Inventories by industry

In the Netherlands business surveys are directed to kind-of-activity units. Three types of inventories are surveyed: inventories of materials and supplies, inventories of finished products and inventories of goods intended for resale without further processing by wholesalers and retailers. The survey contains questions about the opening as well as the closing balance sheets. The business register determines the industry branch of each activity unit in the survey. So annual information on inventories opening and closing balance sheets by industries can directly be derived from the survey.

Besides possible revaluations, the closing balance sheet of year T-1 is by definition equal to the opening balance sheet of year T. In practice this equality does not hold due to the fact that the data are derived from a random sample. These discrepancies will be further discussed in section 3.

For the years 1995-1999 no business survey data are available for the industry "Trade, maintenance and repair services of motor vehicles and motorcycles; retail trade services of automotive fuel" (NACE code 50). For these years the balance sheets of this industry are derived from the so-called 'Corporations finance survey'. This survey only provides information on the closing balance sheets. The growth rate of these closing balance sheets are used to determine the closing balance sheets of this industry. It is further assumed that the opening balance sheet of year T is equal to the closing balance sheet of year T-1.

2.2 Breakdown of inventory data by commodities

Inventories are only surveyed as a whole and the results are not subdivided into different commodities. Nevertheless, the measurement of inventory changes in the supply and use tables requires that inventory stocks are also classified by commodity. Estimates at the level of commodities are individually carried for the manufacturing industry, for the trade sector and for all other industries.

2.2.1 Manufacturing industry

Inventories in the manufacturing industry of finished product and products intended for resale can be divided into commodities by using the so-called Prodcom statistics. Prodcom statistics list the sales of companies by product groups (CPA) which are in turn linked to commodities. The assumption is made that the ratio of sales per product group also applies to inventories. It may be that products intended for resale

do not necessary correspond to the product output, however, no other information is available. The Prodcom survey is carried out for the larger companies only (size category 5 to 9). Therefore it is implicitly assumed that the smaller companies have the same product division as the larger companies. Prodcom does not cover the petroleum industry (NACE 23). Issues related to this industry are discussed in section 2.2.3.

If an activity unit does not specify its turnover by product group, ratios of others with similar activities and size were used instead as a proxy. In cases in which such corresponding activity units were not found in the sample, units with similar activities but of different size were used instead as a proxy.

Response for the Prodcom survey in a category "other products" were not taken into account as this category cannot be linked to a specific commodity. For the sake of consistency, the category 'other products' is reallocated to all other product groups.

Inventories of materials and supplies are allocated to commodities using the ratio by product group of intermediate purchases as derived from the business surveys. The output of the petroleum industry is also divided to commodities using this method. The methods used for inventories of materials and supplies to solve problems related to non-response and the response category 'other products' are similar to those applied for finished products.

2.2.2 Trade

Net turnover data are used to classify data on trade inventories by commodities. The Dutch business survey provides information on the total net turnover as well as turnover by product groups. This classification of product groups is less detailed than the classification of commodity groups. Besides that, the classification of product groups may differ between industries. The net turnover by product group is divided to commodity groups by using fixed ratios. It is assumed that commodity net turnover shares correspond to commodity inventory shares.

Respondents tend to use the category "other products" in case they are uncertain about the exact classification. Therefore, the category "other products" is removed from the data, simply because we cannot link this category to specific commodity groups. For this purpose the net turnover of the rest of the product groups is grossed up to the original total. Especially in the wholesale trade however, the category "other products" may refer to specific known commodities. In these cases the category "other products" is linked directly to these commodities. This is because a few large specific trade companies dominate this industry.

In cases of non-response ratios were imputed from other companies with the same kind of activity and size. In case this information was not available the information was derived from similar companies but from a different size class.

After these consistency checks, the net turnover data by product groups are translated to commodity groups. For each product group a ratio is determined to

subdivide product groups into commodity groups. The same ratios are used for all examined years.

For some commodity groups, inventories are unlikely to exist. For example, a daily newspaper has no value the day after. Also, the inventories of some fresh vegetables and milk are negligible. Besides that, inventories in second hand products are not allowed, because these products have already reached the final stage of the product process, so it is not desirable to adopt inventories of these kinds of products[4]. These commodities are excluded. After these corrections, the other commodity groups are grossed up to the original turnover totals.

In the next step the inventories can be determined by commodity groups by using the commodity based net turnover data. This is done at industry level. For the manufacturing industry this allocation is often done on the company level. In the trade industry, company level data is usually not robust enough.

2.2.3 Other industries

Data on intermediate consumption is used to subdivide inventories of materials and supplies of the construction industry into commodity groups. However, only commodity groups which can actually be held in stock are taken into account, like windows, window frames, doors, nails, central heating boilers, etc. So for example concrete is excluded. By convention the construction industry does not keep inventories of finished products since all output is directly recorded as investment.

For the petroleum industry output data are used as a proxy to classify inventories of finished products by commodity groups. Here, only product groups like coke, refined petroleum products and nuclear fuel (CPA code 23) are taken into account. The inventories of materials and supplies are subdivided in a similar way as the rest of the manufacturing industry.

For the other industries, especially in the business services, no data were available for the reallocation of inventories of goods intended for resale to commodity groups. Generally, these inventories are relatively small and therefore changes are negligible. As a practical solution the inventories of these industries are not subdivided into commodity groups.

To compose a complete balance sheet, the revaluation has to be determined. Unfortunately, there is no specific deflator available since there is no information about the division to commodities for these industries. Therefore, the consumer price index is used to determine the revaluation for these industries.

[4] This would lead to negative consumption. Although this may be justified from a theoretic perspective, from a practical viewpoint the effort seems not worth it.

Table 1: Brief summary of the available sources for determining inventories at the level of product groups

	Inventories of materials and supplies	Inventories of finished products	Inventories of goods intended for resale
Manufacturing industry	Net turnover to commodities from business surveys	Prodcom	Prodcom
Petroleum industry	Net turnover to commodities from business surveys	Production of the SUT	Production of the SUT
Construction	Use from the SUT	-	Use from the SUT
Trade	-	-	Net turnover to commodities from business surveys
Other industries	Not divided	Not divided	Not divided

3. Methods used

3.1 Revaluation

To complete the balance sheet of inventories, a distinction has to be made between changes in inventories and revaluation. The revaluation of inventory stocks can be determined by using price indices derived from the supply and use tables for each commodity group. Revaluation can take place at different places in the balance sheet, depending on how the opening balance sheet is valued. When the opening balance sheet of year T is valued in prices of year T-1, the revaluation takes place after the opening balance sheet of year T. When the opening balance sheet of year T is valued in prices of year T, the revaluation takes place between the closing balance sheet of year T-1 and the opening balance sheet of year T[5]. The survey does not provide explicit information on whether to value the opening balance sheet of year T in prices of year T-1 or in prices of year T. Therefore both options are examined, with special attention for resulting statistical discrepancies between the closing balance sheet of year T-1 and the opening balance sheet of year T and the changes in inventories.

Table 2 illustrates the results of the revaluation analysis by considering both options.

[5] It is assumed that the closing balance sheet is valued correctly.

Table 2: Average absolute value of the statistical discrepancy and changes in inventories

	Statistical discrepancy		Changes in inventories	
	Average absolute value	Percentage opening balance sheet	Average absolute value	Percentage opening balance sheet
Revaluation after opening balance sheet				
	mln euro	*%*	*mln euro*	*%*
Finished work	336	2.1	509	3.3
Materials and supplies	473	4.5	238	2.3
Goods for resale	497	1.4	1226	3.8
Revaluation before opening balance sheet				
	mln euro	*%*	*mln euro*	*%*
Finished work	421	2.7	685	4.4
Materials and supplies	444	4.4	393	3.8
Goods for resale	702	2.0	1433	4.4

The results in table 2 show that statistical discrepancies are in most cases smaller when the assumption is made that the opening balance sheet is in previous year's prices. Furthermore, in this case changes in inventories seem larger compared to the alternative in which the opening balance sheet is assumed to be in current year's prices.

Apart from macro results, micro data on the level of local kind-of-activity units show that the closing balance sheet of single companies of year T-1 often corresponds to the opening balance sheet of year T. This implies that no revaluation has taken place yet between the closing balance sheet of year T-1 and the opening balance sheet of year T. This means that in these cases the opening balance sheet is in previous year's prices.

Reviewing these results, the general assumption is made that opening balance sheets of year T are in prices of year T-1.

3.2 Measuring opening balance sheets by product groups

As already mentioned in section 2, product group's shares and commodities' shares in the total net turnover are used as proxies to breakdown inventories at the level of commodities. For the opening balance sheet either shares of year T or T-1 may be used. Looking at the opening balance sheet, it seems plausible to assume that year T-1 share may fit better. This also may lead to a better match of balance totals on the level of product groups between the opening balance sheet of year T and the closing balance sheet of year T-1. After all, for both totals the same shares are then used. On the other hand, when the shares of year T are used, the changes in inventories may be more plausible than when the T-1 shares are used. So a choice has to be made between two options: to get the best estimates of the statistical discrepancies or of the changes in inventories.

Again, the outcomes of the two possible options (T versus T-1 shares) were examined on the basis of absolute values of statistical discrepancies and changes in inventories per product group (of course total values would be the same for both options since we are only examining the plausibility of a commodity breakdown). In table 3 the results are presented for the wholesale trade. The opening balance sheet is in previous year's prices. This table shows the statistical discrepancies and changes in inventories for the years 2002-2004. The results are shown when using either year T shares or T-1 shares for the breakdown of the opening balance sheet by commodity groups. Absolute values as well as a percentages of the opening balance sheet (obs) are shown.

Table 3: Statistical discrepancy and changes in inventories when the ratio of year T or year T-1 is used

	Statistical discrepancy				Changes in inventories			
	T Shares		T-1 Shares		T Shares		T-1 Shares	
	Abs[1]	% obs[2]	Abs[1]	% obs[2]	Abs[1]	% obs[2]	Abs[1]	% obs[2]
	mln euro	*%*	*mln euro*	*%*	*mln euro*	*%*	*mln euro*	*%*
2002	2226	10.5	1666	7.9	1826	8.6	2161	10.2
2003	4840	23.2	3440	16.5	1411	6.8	3675	17.6
2004	3086	14.9	2043	9.9	2071	10.0	3425	16.6

1) Abs.: absolute value
2) obs.: opening balance sheet

For every industry and for every year the same pattern arises: the absolute value of the statistical discrepancy is smaller when previous year shares are used, and the absolute value of the changes in inventories is larger compared to those derived from current year shares[6].

Since the changes in inventories by commodity is of greater importance than the balance sheet by commodity, the ratio of the net turnover of year T is used to divide the opening balance sheet of year T to commodities. Moreover, a part of the difference in the T versus the T-1 shares is caused by a statistical discrepancy. For this reason it also seems fair to determine the changes in inventories as best as possible instead of using T-1 ratios.

The commodity breakdown of inventory stocks and changes is particularly important for the compilation of supply and use tables. For the publication of

[6] A small difference can arise due to a difference in revaluation, but this is neglected in this analysis.

balance sheets inventories will be compiled only by industry and institutional sector and not on the level of commodities.

3.3 Recording of statistical discrepancies

Conceptually, the closing balance sheet of year T-1 should equal the opening balance sheet of year T. In practice this identity does not necessarily hold. Therefore the treatment of discrepancies is a point of concern.

One option is to insert an entry in the balance sheet for statistical discrepancies. Another option is to simply ignore them. From this perspective it seems interesting to examine whether the balance sheet values will change when no statistical discrepancies are allowed. As a base year, 2001 is chosen. The revaluation and changes in inventories are kept the same while assuming that the closing balance sheet of 2000 must equal the opening balance sheet of 2001 and so on. Using this linking mechanism it is easy to calculate the total difference in the opening balance sheet of 1995 compared to the balance sheet set up including statistical discrepancies.

The differences in stock totals are illustrated in table 4. When statistical discrepancies are allowed, the balance sheet of the year 2002 is determined following the method presented in section 2 allowing for a statistical discrepancy between the closing balance sheet of a certain year and the opening balance sheet of the subsequent year. When no statistical discrepancy is allowed, the opening balance sheet is kept exactly the same as the closing balance sheet of the previous year.

Table 4: Example of the wholesale trade for the year 2002 with or without allowing a statistical discrepancy

	Closing balance sheet 2001	Statistical discrepancy	Opening balance sheet 2002	Revaluation 2002	Changes inv. 2002	in Closing balance sheet 2002	Statistical discrepancy	Opening balance sheet 2003
	mln euro							
With stat. discrepancy	20939	283	21222	-173	-228	20821	22	20843
Without stat. discrepancy	20939	0	20939	-173	-228	20538	0	20538

No large distinctions appear in the case of inventories of goods intended for resale and finished work. The largest difference (8,3%) emerges in 2004. Apparently statistical discrepancies are sometimes positive and sometimes negative which net each other out. This is encouraging. However, for the years 1995-1999 there are remarkable large differences between the closing balance sheet of the inventories of materials and supplies. These are caused by a large discrepancy between the closing balance sheet of 1999 and the opening balance sheet of 2000 which affect all subsequent years. In 2000 the business surveys were joined in one single survey

system. Apparently due to this conversion discrepancies arose. For this reason, for the inventories of materials and supplies, the closing balance sheet of 1999 is set equal to the opening balance sheet of 2000. For the previous years, a correction of the same relative size as in 1999 is made.

Finally, it was decided to explicitly address statistical discrepancies in the balance sheets for inventories (except for the inventories of materials and supplies between the closing balance sheet of 1999 and the opening balance sheet of 2000).

Table 5: Percentage of difference of the closing balance if no statistical discrepancy is allowed and the opening- and closing balance sheet of 2001 are hold on

	Finished goods	Materials and supplies	Goods intended for resale
	%		
1995	-2.8		3.5
1996	-3.1	5.6	0.7
1997	0.5	5.1	0.2
1998	1.1	4.7	1.2
1999	3.6	-0.4*	-1.0
2000	0.4	-0.4	-1.6
2001	0	0	0
2002	-0.1	-2.2	0.1
2003	1.8	0.0	-0.1
2004	8.3	4.6	3.8

* The closing balance sheet of 1999 is set equal to the opening balance sheet of 2000.

4. Overview of results

In the next tables the results are shown for the three inventory types in 2004[7]. The majority of inventories are situated in the trade industry. The manufacturing industry also holds a great deal of inventories, especially finished work. The other industries, for which no estimates are available at the level of commodity groups, hold only a small part of the total inventories. They are responsible for about 2% of all changes in inventories.

[7] Since this method was created after the supply and use tables for 2004 were made, the changes in inventories in 2004 do not equal the changes in inventories from the supply and use tables.

Table 6: Inventories of goods intended for resale by industry, 2004.

Industry	Closing balance sheet 2003	Statistical discrepancy	Opening balance sheet 2004	Revaluation	Changes in inventories	Closing balance sheet 2004
	mln euro					
Manufacturing industry	2435	-169	2266	15	-42	2239
Petroleum industry	18	-16	2	0	0	2
Construction	71	9	80	1	-2	80
Trade	36782	-1291	35491	108	894	36492
Other industries	239	-56	183	2	-30	155
Total	39544	-1522	38022	125	820	38968

Table 7: Inventories of finished goods by industry, 2004.

Industry	Closing balance sheet 2003	Statistical discrepancy	Opening balance sheet 2004	Revaluation	Changes in inventories	Closing balance sheet 2004
	mln euro					
Manufacturing industry	17713	-1123	16590	197	-90	16696
Petroleum industry	396	45	441	66	-69	438
Construction	0	0	0	0	0	0
Trade	0	0	0	0	0	0
Other industries	32	-5	27	0	-2	26
Total	18141	-1083	17058	263	-161	17160

Table 8: Inventories of materials and supplies by industry, 2004.

Industry	Closing balance sheet 2003	Statistical discrepancy	Opening balance sheet 2004	Revaluation	Changes in inventories	Closing balance sheet 2004
	mln euro					
Manufacturing industry	9792	-401	9391	199	346	9936
Petroleum industry	651	9	660	7	-38	628
Construction	1413	-160	1253	17	88	1358
Trade	1	-1	0	0	0	0
Other industries	70	-8	62	1	7	69
Total	11927	-561	11366	223	402	11992

Table 9: Total inventories by industry, 2004.

Industry	Closing balance sheet 2003	Statistical discrepancy	Opening balance sheet 2004	Revaluation	Changes in inventories	Closing balance sheet 2004
	mln euro					
Manufacturing industry	29940	-1693	28247	411	214	28871
Petroleum industry	1065	38	1103	73	-107	1068
Construction	1484	-151	1333	18	86	1438
Trade	36783	-1292	35491	108	894	36492
Other industries	341	-69	272	3	-25	250
Total	69612	-3166	66446	612	1062	68120

Table 10: Total inventories by institutional sector, 2004.

Industry	Closing balance sheet 2003	Statistical discrepancy	Opening balance sheet 2004	Revaluation	Changes in inventories	Closing balance sheet 2004
	mln euro					
S.11	62516	-2854	59662	593	916	61171
S.12	6	-1	7	0	0	6
S.13	327	-9	318	5	-18	304
S.14	6763	-303	6460	14	165	6638
Total	69612	-3166	66446	612	1062	68120

5. Summary and conclusion

This paper presents the results of inventories in the Netherlands estimated for the years 1995-2004. For inventories complete balance sheets are set up including entries for changes in inventories. The business survey is the key underlying source for these estimates: for the years 1995-2000 in the Netherlands the business survey called the “Production Statistics” is used and from 2001 onwards “Impect”. A division of the inventories into commodity groups is needed for the corresponding entries in the (supply and) use tables. However, the surveys do not provide information on inventories on the commodity level. Therefore, a range of methods are used to breakdown inventories by commodity groups. The most important industries for which a product breakdown of inventories is needed are the manufacturing industry and trade. For the manufacturing industry the Prodcom statistics are used as the main underlying source for realizing this breakdown. For the trade branch the net turnover by product group is used for this purpose.

Revaluation of inventory stock in balance sheets requires special attention. Revaluation entries can be introduced at different stages in the balance sheet set up. This also relates to how the opening balance sheet of year T is valued by respondents: in prices of year T or in prices of year T-1. Analyses show that

statistical discrepancy tend to be smaller in most cases when it is assumed that the opening balance sheet is valued in previous year's prices. Micro data confirm for many cases that closing balance sheets of single companies of the previous year correspond to the opening balance sheets of the current year. As a logical consequence, it is assumed that respondents generally value their opening stocks in previous year's prices.

A breakdown by commodity groups can be established on the basis of product shares calculated for either the year T or the year T-1. To analyse the total outcomes of both options, the absolute statistical discrepancies and changes in inventories are used since the total values would be the same for both options. For all years and industries the same pattern emerges: absolute statistical discrepancies are smaller and absolute inventory changes are larger when previous year's shares are used compared to those derived from current year's shares. Since the commodity breakdown is particularly relevant for the inventory change entries in the supply and use tables, it was decided to determine inventories by commodity groups on the basis of product shares derived from the year T.

Finally it is was decided to show statistical discrepancies explicitly in the balance sheets for inventories. However, it appears that these discrepancies between closing (T-1) stocks and opening (T) stocks do not seem to cumulate over time. In other words, the discrepancies largely follow an erratic pattern.

The results seem to prove that the sources and methods applied for the Netherlands as presented in this paper are sufficiently robust to make reliable estimates for inventories. Since survey questions about inventories at the product level would substantially increase administrative burdens, the proposed method in this paper to allocate inventories to product groups seems from a statistical viewpoint the second best method solution.