Integration of international trade and transport flow statistics for the Netherlands

08

Gert-Jan Linders, Chris de Blois, Harm Jan Boonstra, Henri de Groot, Jeanet Exel

Statistics Netherlands

Voorburg/Heerlen, April 2008

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
2005 2006	=	2005 to 2006 inclusive
2005/2006	=	average of 2005 up to and including 2006
2005/'06	=	crop year, financial year, school year etc. beginning in 2005 and ending in 2006
2003/'04 2005/'06	=	crop year, financial year, etc. 2003/'04 to 2005/'06 inclusive

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

Publisher
Statistics Netherlands
Prinses Beatrixlaan 428
2273 XZ Voorburg

second half of 2008:
Henry Faasdreef 312
2492 JP The Hague

Prepress
Statistics Netherlands – Facility Services

Cover
TelDesign, Rotterdam

Information
Telephone .. +31 88 570 70 70
Telefax .. +31 70 337 59 94
Via contact form: www.cbs.nl/information

Where to order
E-mail: verkoop@cbs.nl
Telefax .. +31 45 570 62 68

Internet
http://www.cbs.nl

Summary

In the context of ongoing economic globalisation, international trade and transport are increasingly important for a trading nation like the Netherlands. Data on the volume and composition of international flows at Statistics Netherlands are included in both statistics on international transport and the trade statistics. Because they are not directly comparable, conventional statistics do not provide complete information on international goods flows, for example by type of flow and mode of transport. Furthermore, conventional trade and transport statistics do not contain explicit information on transport transit flows.

This report describes research which focused on integrating transport and trade statistics to construct a complete and consistent database on the volume of trade and transport flows. To realise this, methods were developed to make trade and transport statistics comparable. Furthermore, a statistical model was developed and used to consistently integrate trade and transport statistics. The result is an integrated database for 2004 with information on weight, type of flow, mode of transport and continent of loading/unloading or provenance, for a 10-sector classification of products. Moreover, the integrated statistics contains explicit estimations of the volume of transit flows through the Netherlands.

Keywords: international trade and transport, transit, integrated statistics, Bayesian model, uncertainty.

Title and Summary in Dutch

Integratie van de statistiek van de internationale handel in goederen en de statistiek van het internationaal goederenvervoer: een analyse voor Nederland

Samenvatting

Tegen de achtergrond van voortgaande economische mondialisering zijn internationale handels- en vervoerstromen van toenemend belang voor een open economie als Nederland, dat historisch gezien ook bekend staat als handelsland. De statistieken van internationale handel en van internationaal goederenvervoer van het Centraal Bureau van de Statistiek bevatten gegevens over de omvang en samenstelling van de internationale goederenstromen voor Nederland. Deze conventionele statistieken zijn echter niet direct vergelijkbaar en bieden op afzonderlijke basis geen compleet overzicht van de goederenstromen van en naar het buitenland, bijvoorbeeld per type stroom en per vervoerwijze. Bovendien bevatten de conventionele handels- en goederenvervoerstatistieken geen apart onderscheiden informatie over de transport-doorvoer door Nederland.

Dit rapport beschrijft onderzoek uitgevoerd bij het Centraal Bureau van de Statistiek gericht op het integreren van de transport- en handelsstatistieken, met als doel om een complete en consistente database over internationale handels- en transportstromen op te bouwen. Aan bod komen de methoden die zijn ontwikkeld om de informatie uit handels- en transportstatistieken te kunnen samenvoegen. Bovendien is er een statistisch model ontwikkeld en in gebruik genomen om de handels- en transportstatistieken op een consistente wijze te integreren. Het resultaat van het onderzoek is een geïntegreerde database voor het jaar 2004, met informatie over gewicht, type stroom, herkomst of bestemming, en vervoerwijze gecombineerd met werelddeel van lading of lossing. Deze informatie is beschikbaar voor een goederenclassificatie naar tien sectoren. Daarnaast bevat deze geïntegreerde database expliciete schattingen van het volume van de doorvoer met overlading door Nederland.

Kernwoorden: internationale handel in goederen, internationaal goederenvervoer, transport-doorvoer, geïntegreerde statistieken, Bayesiaans statistisch model, onzekerheidsmarges.

Contents

1. Introduction

International flows of goods are an important source of income, value added and prosperity. Alongside imports and exports, other forms of international flows have recently caught the attention of trend watchers and policymakers, most notably re-export and transit flows. For a trading and distribution nation like the Netherlands, it is therefore relevant to have reliable information on the value and quantity of goods transported to and from and traded with foreign countries, and the transport modes used for the various flows.

At the moment, information on international flows is presented in two separate sets of statistics at Statistics Netherlands: statistics on international trade and the statistics on transport flows. Both datasets contain substantial amounts of information. However, there is no complete and integrated overview of international goods flows, in terms of both value and weight, according to the type of flow (e.g. trade, re-export, transit), and according to the mode of transport at the border. Given the relevance of this information for analysing trends in internationalisation and for policy assessment, we need to develop integrated statistics on trade and transport flows. In order to match trade flows with transport statistics, complete and plausible information on gross weight is needed.

This report illustrates the method used at Statistics Netherlands to generate integrated data on international goods flows for the Netherlands, and presents empirical results of the integration. The results presented are preliminary and should be interpreted as such. By creating an integrated database on trade and transport flows of goods, the report intends to contribute to future research to improve the understanding of the impact of trade and transit flows on the economy, in terms of both domestic value added and potential social costs related to congestion and the emission of pollutants. Among other things, integrating trade and transport statistics allows us to derive estimates of the transport transit flows through the Netherlands. Furthermore, the integrated database enables us to enhance the coverage of the individual statistics. For example, we use transport statistics to assess the most plausible mode of transport of trade flows.

After discussing the scope and coverage of trade statistics and transport statistics for the Netherlands, we introduce the conversion methods used to link the two sets of statistics in Section 2. The results from the conversion model serve as input for a statistical model that allows us to combine prior information and consistency identities in a Bayesian framework, in order to improve the resulting estimation of integrated data on trade and transit flows. We discuss the statistical model in Section 3. Subsequently, Section 4 presents the resulting integrated trade and transport data. Section 5 explains how the uncertainty margins around the results should be interpreted. Lastly, Section 6 concludes.

2. Trade and transport statistics

2.1 Scope and coverage of trade and transport statistics

At Statistics Netherlands, data on international goods flows are collected in two separate statistics: statistics on international trade and transport statistics. International trade in and transport of merchandise are directly related. Goods are imported to or exported from or pass through the Netherlands, which implies cargo flows that are loaded or unloaded in ports and transit centres, stored in warehouses, and transported by road, rail or water, for example. In order to analyse the impact of international goods and transport flows on the economy, an integrated view of the relevant aspects of trade and transit is required. The required information would ideally include the value and gross weight of international goods flows in the Netherlands, broken down according to:

– type of goods flow (e.g. exports, imports, re-exports, transit);
– countries of origin and destination of the goods;
– mode of transport in combination with the country of loading or unloading of the goods;
– sector classification.

However, these variables are not consistently available for all types of international goods flows in the two separate statistical databases. If we can integrate the separate parts of information, a complete and integrated overview of international merchandise flows through the Netherlands can be established.

Chart 1
International flows of merchandise through the Netherlands

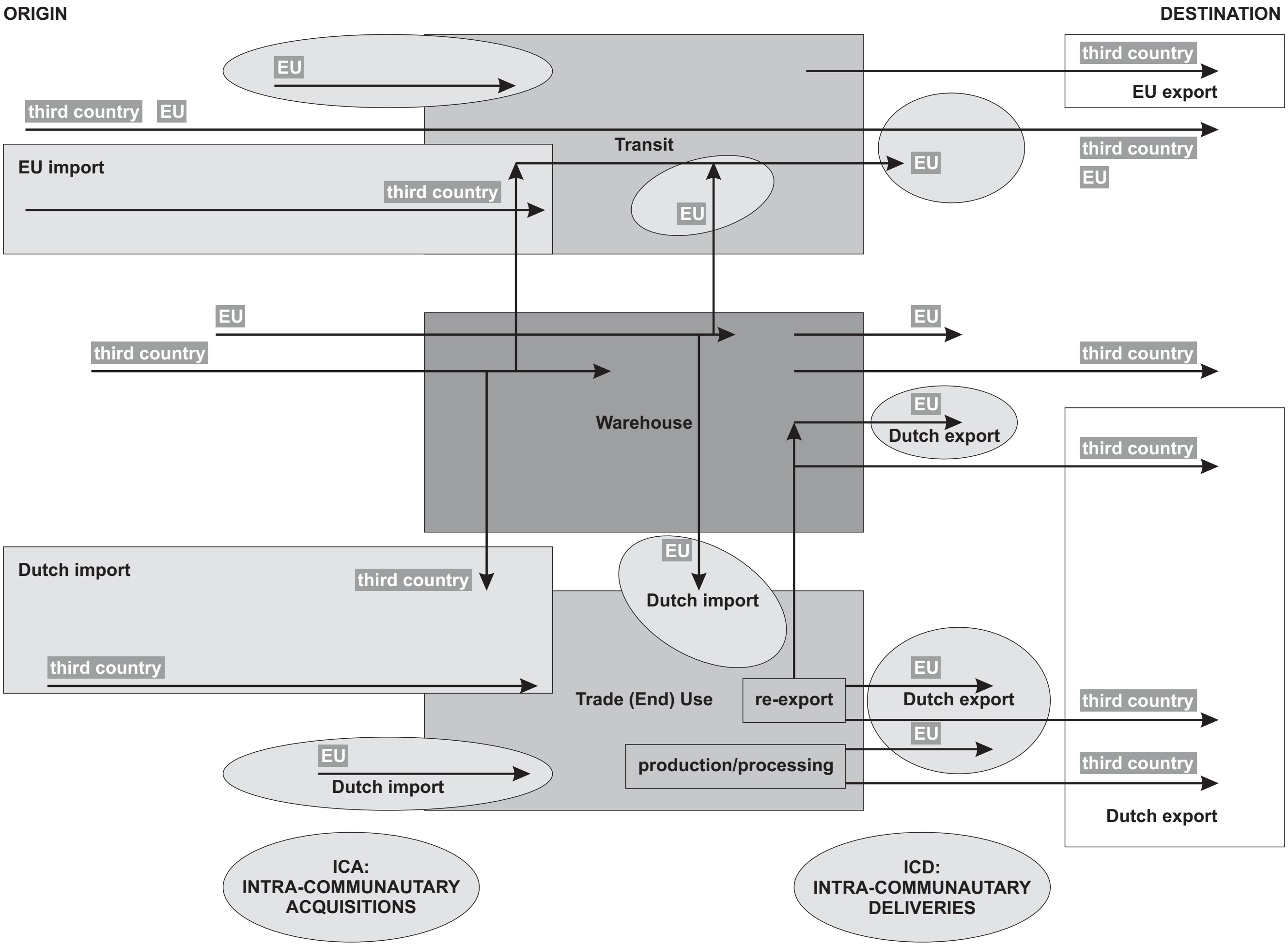


Chart 1 identifies both trade and transit flows. It distinguishes between flows originating from or destined for European Union (EU) countries, and flows involving so-called third countries (i.e. non-EU countries). The reason for this distinction is that we use bilateral trade reported according to the 'community concept'. Whereas Statistics Netherlands also publishes international trade data according to the national concept, Eurostat uses the community concept. This EU concept of trade includes both the flows that comprise exports or imports for the Netherlands and transit flows that enter or leave the European Union and are cleared for or from the common market via the Netherlands (labelled 'quasi-transit flows', see Rutten and Van Brummelen, 2001). Trade statistics also include re-export flows. Re-exports are trade flows in which the traded products remain virtually unchanged from when they enter the country to when they leave the country. Thus, goods are imported by the Netherlands purely for the purpose of re-exporting them. These goods may be subject to storage, (re-)packaging and other value added logistics before being re-exported to their final users. In the integration model and results presented in this paper, we shall combine all flows in trade statistics into what we - for the sake of simplicity - shall denote as 'trade'. This includes trade according to the 'community concept' and all other (i.e. intra-EU) quasi-transit flows. In Chart 1, note that flows coming from or going to other EU countries are denoted as intra-community acquisitions and intra-community deliveries.

The trade statistics used in this report only make use of observed and reported trade flows. Statistics Netherlands also provides estimates of trade flows that are missing because they are below the reporting threshold or because of non-response. However, we do not include the supplementary estimates of trade flows. The reason for this is that these estimates are not as detailed as the observed flows: they are collected at the product-group level, rather than product level; they do not include mode of transport and do not consistently include weights. We should stress that omission of these trade flows tends to cause an overestimation of transport transit flows in the final integrated database. The total combined value of supplementary estimates and imputations typically equals, in order of magnitude, some 10 percent of the total value of trade [1)].

Transport transit flows are not registered in trade statistics. In Chart 1, the transport transit flows are represented by the uninterrupted arrow in the box "transit" and the flows coming in and out of warehouses without clearance to the EU market or import into the Dutch market. For the remainder of this report, when we use the term transit, we mean transport transit unless indicated otherwise. Moreover, we can only include transit flows that are re-loaded in the Netherlands. These flows enter transport statistics totals of incoming and outgoing international transport. Transit flows through the Netherlands that are not re-loaded (e.g. goods transported on trucks coming from Belgium and going to Germany) do not enter the data in our analysis.

Goods flows, both of trade and transit, may involve temporary storage in customs warehouses (see the middle box in Chart 1). Depending on what happens when the goods leave the warehouse, the flows may be registered in trade statistics or consist of transport transit through a customs warehouse.

Transport statistics report transported weights for all incoming and outgoing international goods flows of the Netherlands, transported by both Dutch and foreign transport firms; the latter data are based on figures provided by Eurostat. However, the transport statistics do not distinguish between transit flows and trade flows. Table 1 gives an overview of the information available in the two statistics.

Integration of the two separate statistics on international goods flows yields several benefits. In particular, the primary data collected in aid of trade statistics are incomplete and of problematic quality for mode of transport. Using specific data on transport modes from the transport statistics helps to overcome problems in the quality and coverage of mode of transport data in trade statistics. Moreover, weight data in trade statistics are incomplete with respect to alternative quantity measures. The method developed for

1) Roos (2006) gives a more detailed description of the scope of trade statistics. A quantitative illustration of Dutch trade statistics for 2004 is presented in Linders, Odekerken-Smeets and De Groot (2006).

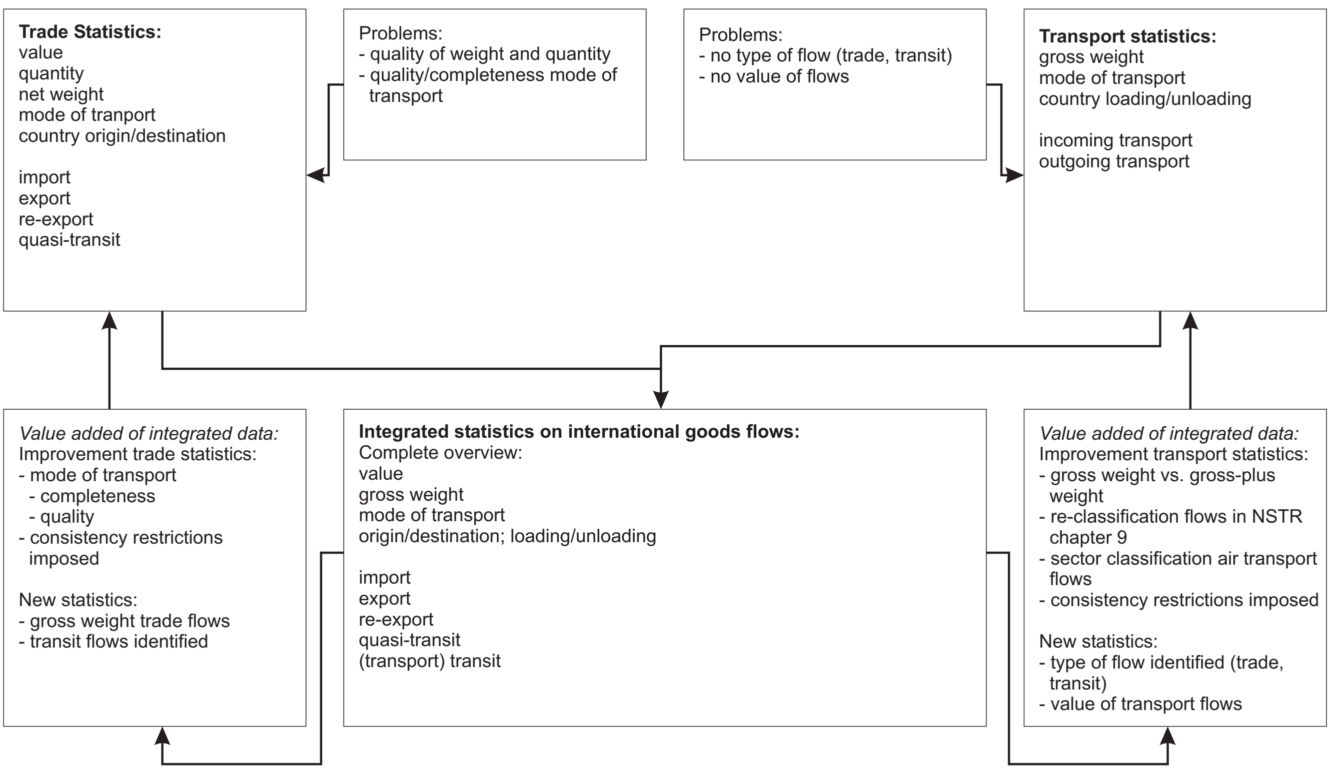
integrating trade and transport statistics enables supplementation of missing weight data, yielding consistent data on weight for trade statistics. For transport statistics, integration with trade statistics allows us to calculate estimates for the sector composition of air transport flows. Moreover, the methods for integration also involve a correction of the sector classification of transport flows, correcting for a significant overrepresentation of a particular sector in transport data, as discussed later on. Furthermore, transport transit can be quantified by comparing the two statistics. The separate trade and transport statistics currently do not explicitly present figures on the volume of transport transit flows.

Table 1
Variables described and international goods flows in reported statistics

	Transport statistics	Trade statistics
Variables described	Transported weights by mode of transport and lcation of loading or unloading and location of origin or destination	Value and weight or quantity by mode of transport and location of origin or destination
Type of goods flow		
Import for end use or processing	No	Yes
Export from domestic production	No	Yes
Re-export	No	Yes
Quasi Transit flows (EU trade for community concept)	No	Yes
Transport Transit (including via customs warehouse)	No	No
Total incoming transport	Yes	No
Total outgoing transport	Yes	No

The scheme in Chart 2 illustrates the issues surrounding the two separate statistics and motivating the construction of the integrated database. The scheme depicts the composition of the integrated database which is our ultimate aim. In the current integration outcomes presented in this report, we have not yet integrated trade and transport statistics in value terms (euro). Up to now, we have focused on integrating both statistics in gross weight terms. Moreover, re-export and quasi-transit flows have not yet been explicitly separated in trade statistics used here. They are included in import or export figures in the integrated data presented in this report.

Chart 2
Added value of integrated statistics on international goods flows



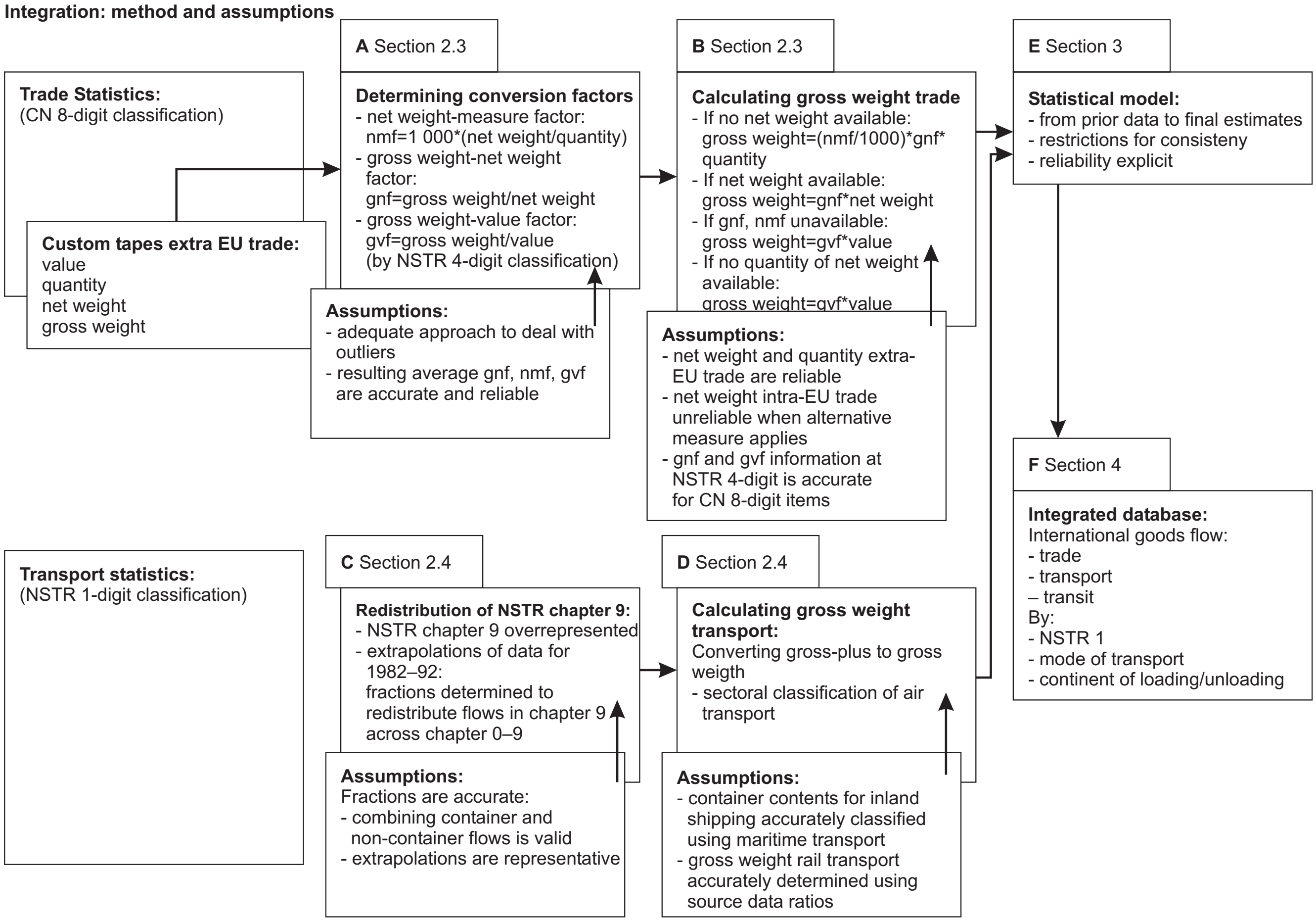
2.2 The method of integrating trade and transport statistics

As shown in Table 1, both trade and transport statistics include information on transported weight. Hence, they can be integrated by expressing them both in comparable weight units. The main difficulty in applying a common weight denominator to both datasets lies in the fact that weight data in the trade statistics are incomplete and use a different unit (net weight) than that used in transport statistics (gross weight). Moreover, transport statistics sometimes report gross-plus weight, which also includes the weight of containers used in transport. Therefore, in order to make trade and transport statistics comparable and suitable for integration into a single database, several conversion steps have to be taken.

Chart 3 illustrates the necessary conversion steps for trade and transport statistics. In the process of integrating trade and transport statistics, we need to make assumptions at various stages. For example, the integrated dataset uses the shares of transport modes in transport statistics to assign transport modes to trade statistics; the underlying assumption being that trade and transit flows are comparable in terms of the shares across transport modes. For continent of origin/destination, the shares from trade statistics are used instead, under a similar assumption of comparability. These and other assumptions and restrictions in the integration process are presented in Chart 3, and further discussed where relevant in Sections 3 and 4. Our statistical model, which uses some of the restrictions to derive consistent estimates of trade and transport flows for the final integrated database, is included in Chart 3 and discussed in Section 3. This model can account explicitly for uncertainty margins in the converted prior trade and transport flows that it uses as input for the estimations. These uncertainty margins are related to both measurement errors in the underlying data and the accuracy of the assumptions underlying the conversion steps.

The boxes in Chart 3 are labelled and show the consecutive steps in the construction of the integrated dataset on international goods flows that are discussed in the following (sub)sections.

Chart 3
Integration: method and assumptions



2.3 Trade statistics: computation of gross weights

Trade statistics classify international merchandise transactions according to the Combined Nomenclature (CN), an 8-digit extension of the Harmonised System (HS) classification. This classification distinguishes some 10,000 items, of which roughly one quarter report alternative measures of quantity, other than net weight. The most common are numbers of goods and volumes. For trade with other EU countries, weights are not always registered for items with alternative measures [2]. For international goods flows to and from non-EU countries, transported weights have to be reported to customs instead. In order to supplement the missing weights for intra-EU flows, a conversion between quantity and net weight has been constructed for each alternative measure.

To integrate the trade and transport statistics, we need to express both statistics in comparable weight units. Trade statistics are based on net weight of goods, while transport statistics report gross weight. For packed goods, gross weight includes the weight of the packaging material. Trade statistics sometimes report alternative measures of quantity (supplementary units) instead of net weight. We have chosen to convert quantity and weight data of trade statistics to a common unit, equivalent to the unit prevalent in transport statistics: gross weight. This is mainly motivated by the fact that gross weight is the most common unit of weight in transport statistics, which, moreover, focus on weight as the core variable. Hence, gross weight in transport statistics is more reliable. For the conversion of trade statistics to gross weight, two separate, subsequent transformations are required:

– International transactions that report alternative measures of quantity instead of weight have to be expressed in terms of net weight;
– Net weights reported for international goods flows in trade statistics have to be transformed into gross weights.

We have additional information at our disposal from the customs authorities that includes quantity, gross weight and net weight for a subset of trade transactions (i.e. extra-EU trade). To convert quantities and net weight to gross weight, we have to rely on averages, which are only accurate if certain assumptions are valid (see Chart 3). We used customs data for goods flows involving non-EU countries to calculate the conversion factors from measure to net weight in terms of gram per unit. Customs data report both weights and supplementary units traded. On the basis of customs data for 2004, for both incoming and outgoing international goods flows, we computed conversion factors for each registered transaction. Subsequently, the results were filtered by comparing them to averages per CN item on a monthly basis. All outcomes that differ by more than one standard deviation from their corresponding monthly average were excluded. Lastly, we combined the files of selected incoming and outgoing transactions and aggregated to total weights and supplementary units by CN item. For each item, the final conversion factor from supplementary unit to net weight was calculated from these totals as the average ratio between weight and supplementary quantity measure [3]:

$$NMF = 1\,000 * {}^{Netweight}/_{Quantity} \qquad (1)$$

where NMF is the conversion factor from supplementary unit of quantity to net weight in gram/unit, Net weight is measured in kg and Quantity in terms of the relevant supplementary unit.
After conversion of quantities expressed in supplementary units to net weight, the weight in trade statistics has to be converted to gross weight, to match transport statistics. A

[2] For extra-EU trade, both weight and (where relevant) alternative quantity measures are required at customs. For intra-EU trade (Common Market trade), weight information is no longer required from reporters if an alternative measure applies, as from 2006. In practice, weight information provided in intra-EU trade statistics is far from complete and appears to be of relatively poorer quality in 2004. For this reason, integrated data estimates of gross weight for intra-EU trade were based largely on quantity and value conversions.

[3] In fact, a second selection was applied to filter potential outlier observations for CN items that occurred only once in a particular month. This selection compared individual conversion factors to the yearly average factor. After applying the selection criterion once again, the final yearly average conversion factor was computed by CN item.

procedure similar to the one explained above yields conversion factors from net to gross weight. Customs data for outgoing trade flows report both gross and net weight. These data provide information that we used to construct conversion factors by CN item. Again, we compared conversion factors for individual transactions with monthly averages by item. We decided to exclude any individual factor exceeding a ratio of three between gross weight and net weight from the calculations of the final conversion factor [4]. After excluding these observations, monthly averages were computed; observations that yielded conversion factors that were more than one standard deviation from the mean were excluded. The final step aggregates weights by CN item and computes the yearly average ratio between gross and net weight. This yields the final conversion factor from net weight to gross weight.

$$GNF = {}^{Grossweight}/_{Netweight} \qquad (2)$$

where GNF is the conversion factor measured as the ratio between net weight and gross weight.

Application of the yearly average conversion factors by CN item results in trade statistics in terms of gross weight, which can be matched to gross weight in transport statistics. To match the two, we aggregated computed gross weights for trade statistics at the CN 8-digit classification to the more aggregated classification used in transport statistics, the NSTR classification (*Nomenclature uniforme des marchandises pour les Statistiques de Transport, Revisée*). This classification has been used by the EU member states since 1967 to classify goods transport flows. Because of the hierarchy in coding, it is possible to classify goods consistently in 10 chapters (1-digit), and 52 sub-chapters (2-digits). See the list in Appendix 1 for a detailed description of the 10 chapters (numbered from 0 to 9) of the NSTR classification.

2.4 Transport statistics: redistributing NSTR chapter 9 and converting gross-plus weights to gross weights

The transport statistics give gross weights (road, maritime, air and pipeline transport) or gross-plus weights (inland shipping and rail transport). The difference between the gross-plus weight and the gross weight is the weight of the containers used for part of the freight transport. Another, related, problem in the transport statistics is that since 1997 most container goods are classified as mixed cargo in goods chapter 9 (NSTR level 1) [5]. This means that the gross or gross-plus weight in goods chapter 9 is overestimated for most transport modes. For the other goods chapters, underestimation of the gross or gross-plus weight may occur. This section describes how the above-mentioned problems in the transport statistics have been handled.

2.4.1 Redistribution of NSTR 9

Up to 1992, the international transport statistics were composed on the basis of detailed customs reports. In these statistics, total incoming transport was broken down into imports, incoming transit, and storage in customs warehouses. Similarly, total outgoing transport was subdivided into exports, outgoing transit, and removals from customs warehouses. After 1992 customs formalities between the EU countries were discontinued, and as a consequence intra-EU international transport information was no longer available, while information on transport to and from non-EU countries remained available for some years. Up to 1997, transport to and from the EU countries was

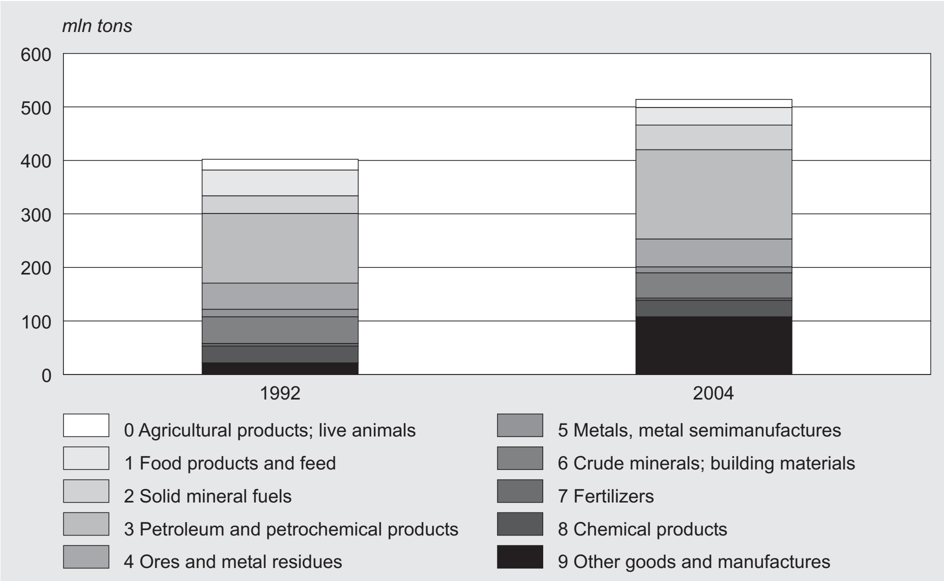
[4] For most CN items, packaging weighing twice as much as the product itself is deemed unlikely. Such observations have been regarded as measurement errors. However, one can imagine certain materials (for example, liquids or gases) for which these proportions in weight between packaging (barrels, bottles, etc.) and product are realistic. These items have to be checked separately. For example, if they are absent in the final conversion table, this may indicate that the mean conversion factor is higher than three.

[5] This is the case for all transport modes except for air transport, because transport statistics do not provide a sector classification for air transport, and for pipeline transport.

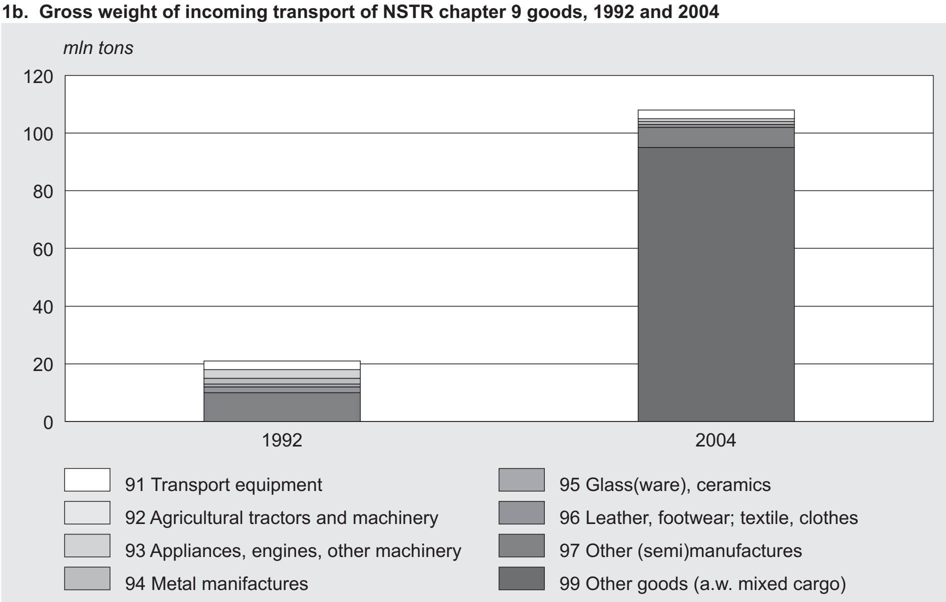
extrapolated on the basis of the old figures and the information on the non-EU transport. From 1997 onwards, international transport statistics were constructed on the basis of several sources: customs information (maritime transport), reports from all companies involved in inland shipping, rail transport, and pipeline transport, reports from airports, and a survey of road haulage companies.

The statistics based on transport documents are hampered by overestimation of the gross weight in goods chapter 9. This overestimation is caused by the reporting of goods from several goods chapters as mixed cargo in goods chapter 9. Most of these wrongly classified goods are container goods. The overestimation of the gross weight in goods chapter 9 is illustrated in Figure 1a. The figure shows how total gross weight of incoming transport is distributed over the goods chapters in 1992 and 2004. In Figure 1b, chapter 9 is further subdivided into goods groups (NSTR level 2). Assuming that the gross weights by goods chapters (and groups) were accurate in 1992, the distribution of the gross weights over the goods chapter (and groups) in 2004 seems illogical. First, Figure 1a shows a very strong increase of the gross weight in chapter 9 over 1992-2004. The increase in the other chapters is much smaller, and sometimes there is even a decrease, for example in chapter 1, which represents food products and feed. Taking into account

1a. Gross weight of incoming transport, by NSTR goods chapter, 1992 and 2004



1b. Gross weight of incoming transport of NSTR chapter 9 goods, 1992 and 2004



that the total population and the economy grew between 1992 and 2004, it seems unlikely that the total gross weight of incoming transport of goods in chapter 1 decreased at the same time. In Figure 1b, the increase of gross weight in group 99 is even larger. The strong decrease in group 93, including computers, is inconsistent with reality.

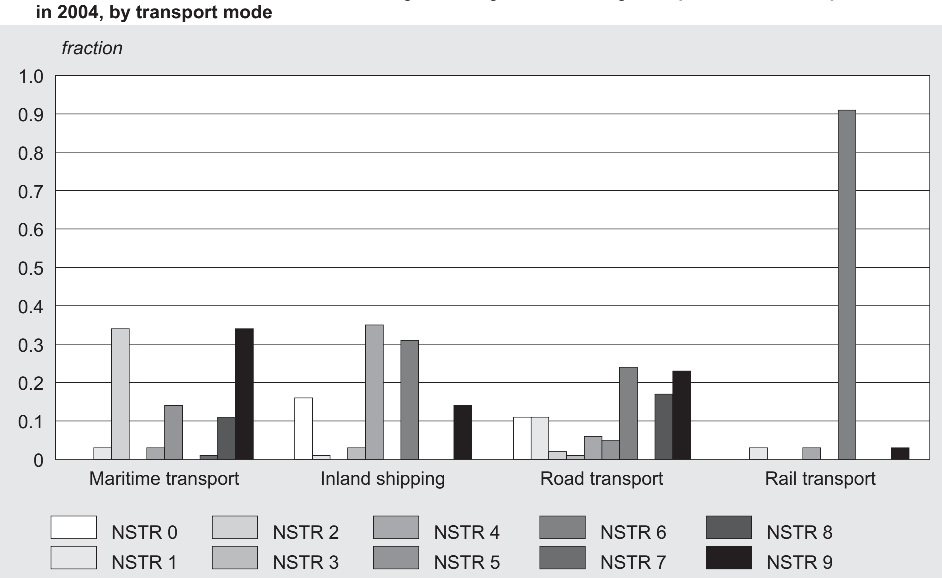
To solve the problem of overestimation in goods chapter 9, part of the gross weights in chapter 9 was redistributed across the other chapters: the gross weights of incoming and outgoing transport by goods type and transport mode for 1982–1992 were extrapolated to 2004. The extrapolation was carried out by linear regression of the logged values. The predicted 2004 values were delogged again and rescaled to sum up to the total by transport mode as observed in 2004. For all considered transport modes, this computation resulted in an expected gross weight in chapter 9 lower than the observed 2004 value. Most of the other goods chapters showed the opposite: expected flows were larger than the observed figures. Under the assumption that the observed gross weight is underestimated in goods chapters 0–8 (parts are in chapter 9) and overestimated in chapter 9 (parts belong in other chapters), the expected gross weights in chapters 0–8 which did not exceed the observed values were neglected. For the goods chapters with a positive difference between the expected and the observed 2004 value, the share in the total of the differences was computed. Then, the difference between the observed and expected value for chapter 9 was redistributed over the goods chapters according to these shares. Lastly, for each goods chapter a redistribution fraction, defined as the part of the observed gross weight in chapter 9 which is redistributed to the goods chapter, was computed. This is illustrated by the following formulas for transport flows:

$$T_{i,j,k,l} + f_{i,j,k} * T_{i,9,k,l} = T'_{i,j,k,l} \quad j = 0,...,8 \qquad (3)$$

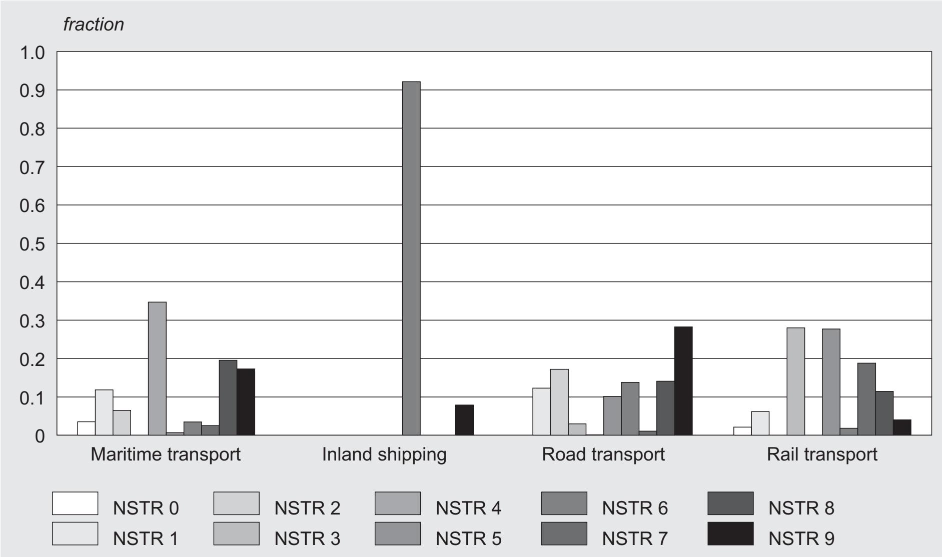
$$T_{i,9,k,l} * (1 - \sum_{j=0}^{8} f_{i,j,k}) = T'_{i,9,k,l} \qquad (4)$$

where:
T': estimated transport flow after the redistribution of NSTR chapter 9 gross weights;
T: observed transport flows;
f: fraction for redistribution from NSTR chapter 9 to chapter;
i: incoming, outgoing;
j: 0,…,9 (NSTR chapters);
k: maritime transport, inland shipping, road transport, rail transport, air transport, pipeline transport (mode of transport);
l: Europe, Africa, Asia, America, Oceania, Other (continents).

2a. Redistribution fractions for the observed gross weight of incoming transport in NSTR chapter 9 in 2004, by transport mode



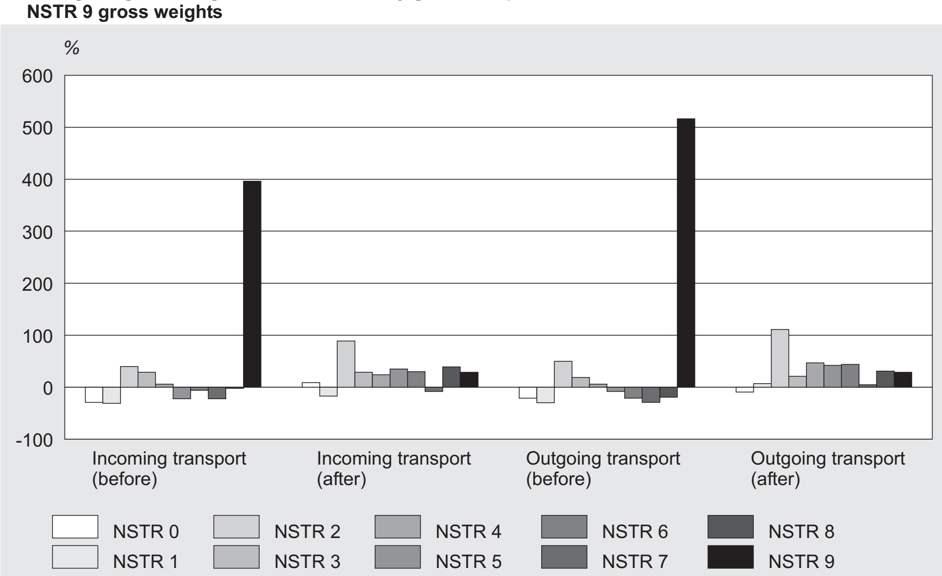
2b. Redistribution fractions for the observed gross weight of outgoing transport in NSTR chapter 9 in 2004, by transport mode



Figures 2a and 2b contain the results of the redistribution. The redistribution fractions for NSTR 9 represent the part of the NSTR 9 gross weight that remains in NSTR 9. The figures show that the redistribution can be quite drastic: for example, more than 90 percent of the observed incoming gross weight by rail transport in chapter 9 (mixed cargo) is assigned to chapter 6 (crude minerals and manufactures; building materials). However, for most of the goods flows the (re)distribution over the chapters is more even.

The redistribution of chapter 9 gross weights leads to a more realistic growth of the gross weights in the various chapters from 1992 to 2004. In the old situation, the incoming and outgoing gross weight in chapter 9 showed an extreme increase from 1992 to 2004, whereas gross weight decreased in twelve of the other cases. As Figure 3 shows, after redistribution of the chapter 9 gross weights, all growth percentages have the same order of magnitude and in only three cases does gross weight decrease in 1992–2004.

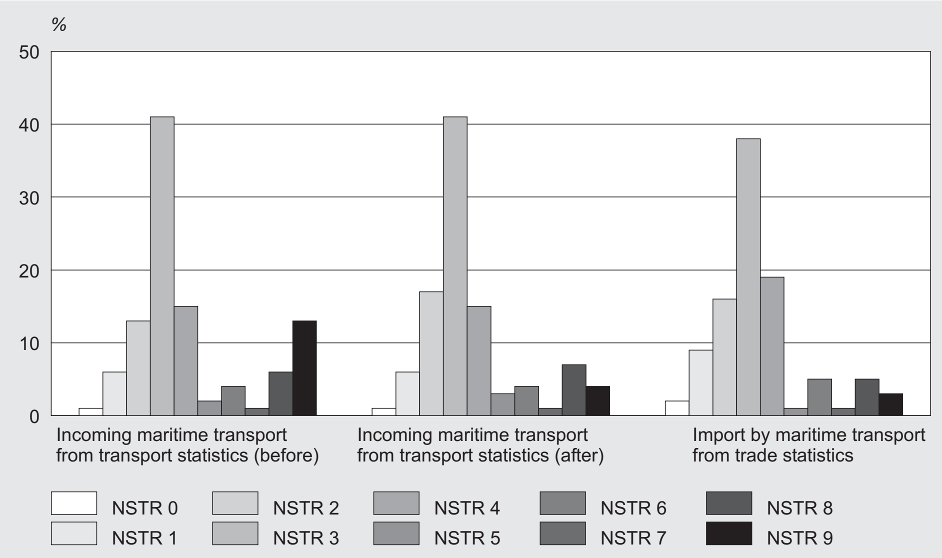
3. Change of gross weight over 1992–2004 by goods chapter, before and after the redistribution of NSTR 9 gross weights



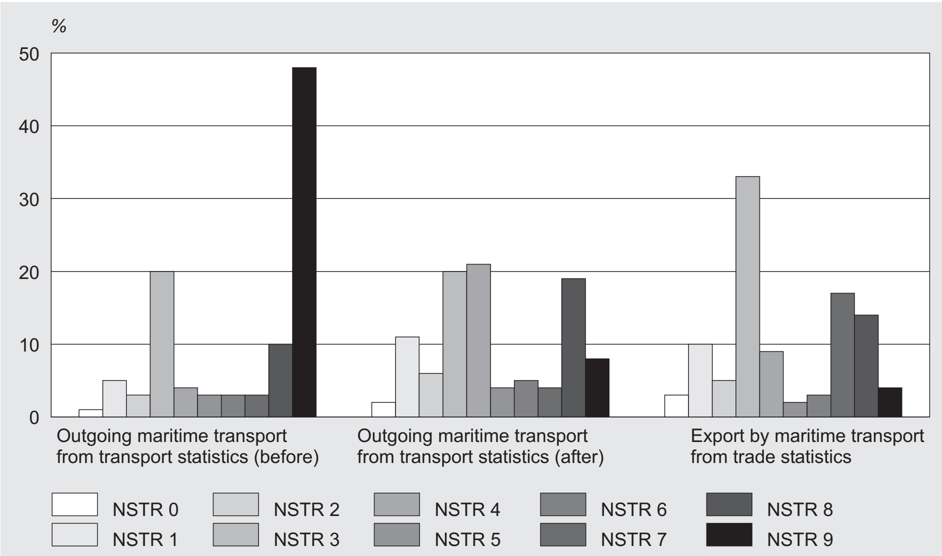
For the transport mode ‘maritime transport’, it was possible to compare the distribution of gross weights over the goods chapters between incoming transport from the transport statistics and extra-EU imports to the Netherlands from the trade statistics, and between outgoing transport and extra-EU exports from the Netherlands (see Figures 4a and 4b).

The redistribution of the chapter 9 gross weight of incoming and outgoing maritime transport over the other chapters in the transport statistics led to a distribution over the goods chapters which clearly resembles more the distribution of maritime imports and exports in the trade statistics. This is a good indication of the quality-improving effect of the redistribution of chapter 9 weights. It must be noted that the comparison is confused by four factors. First, there is uncertainty in the observed and redistributed figures. Secondly, the difference between incoming transport and imports and between outgoing transport and exports is transit transport, which may have a different distribution of gross weight over the goods chapters. Thirdly, the comparison is restricted to maritime transport because the trade statistics do not include sufficiently reliable information about the other transport modes. Fourthly, the trade figures only pertain to extra-EU trade, while transport statistics cover all international transport.

4a. Sector composition of the incoming maritime transport, before and after the redistribution of NSTR 9 gross weights, and the extra-EU import by maritime transport



4b. Sector composition of the outgoing maritime transport, before and after the redistribution of NSTR 9 gross weights, and the extra-EU export by maritime transport



2.4.2 Converting to gross weights: Inland shipping

For the inland shipping statistics, the gross-plus weight of incoming and outgoing transport by goods chapter and the number and size of containers was reported for

2004. The distribution of goods types over the containers cannot be derived from the reported information.

To determine the gross weights, the total container weight is estimated and distributed over the goods chapters according to the distribution as observed in maritime transport. In 2004, 99 percent of products arriving in containers on sea-going vessels was reported as NSTR 9 goods. For outgoing container transport by sea, 100 percent was reported as NSTR 9. By linking outgoing inland shipping transport to incoming maritime transport and vice versa, the estimated total outgoing container weight by inland shipping was assigned to the goods chapters according to the share of each chapter in the total of the incoming gross weights transported in containers over sea. Next, the gross weight per goods chapter in outgoing inland shipping was determined by subtracting the assigned container weight from the gross-plus weight. Because the outgoing maritime transport in containers is registered as including NSTR 9 goods only, the gross weights in incoming inland shipping are determined by simply subtracting the total container weight from the NSTR 9 gross-plus weight. So, for the other NSTR goods chapters, incoming gross weight by inland shipping is equal to the gross-plus weight. Table 2 shows the result of the calculation. The calculated gross weights are input for the redistribution as described above.

Table 2
Gross-plus weights and estimated gross weights of incoming and outgoing transport by inland shipping in 2004, by goods chapter

	Incoming transport			Outgoing transport		
	Gross-plus weight	Gross weight	Change	Gross-plus weight	Gross weight	Change
	1 000 ton		*%*	*1 000 ton*		*%*
NSTR chapter 9	13 830	12 243	–11	10 430	8 922	–14
Other NSTR chapters	46 253	46 253	0	115 019	114 997	0
Total	60 083	58 496	–3	125 449	123 919	–1

2.4.3 Converting to gross weights: rail transport

The transport statistics contain processed data, i.e. source data that have been corrected for all kinds of errors. In the case of rail transport, the source data stem from the main rail transport companies. Several small companies do not supply transport data. An expert guess puts the share of total gross-plus weight transported by these small companies at about 12 percent of total rail transport. No correction is made for this underreporting in the transport statistics. Furthermore, the statistics give the gross-plus weights instead of the gross weights.

To determine the gross weights transported by rail, the uncorrected source data are used. The source data contain the gross-plus weights and the number and size of containers for each transport, so the gross weights can be derived. Because the source data are not corrected for errors, only the ratio between gross-plus and gross weights by goods chapter is used. For each goods chapter, this ratio is applied to the processed gross-plus weights to obtain the gross weights. For goods chapters 0 to 8, this ratio equals 1; only for chapter 9 is there a difference between the gross-plus and the gross weights. This observation is linked to the problem of reporting container goods as mixed cargo in chapter 9 (see above).

Because only 88 percent of the transported weight is reported, the total gross weight is increased by the factor 100/88. Based on expert judgement, the increase in weight is assigned to goods chapter 9. Table 3 shows the results of the computation. The computed gross weights are input for the redistribution as described above.

Table 3
Gross-plus weights and estimated gross weights of incoming and outgoing transport by rail in 2004, by goods chapter

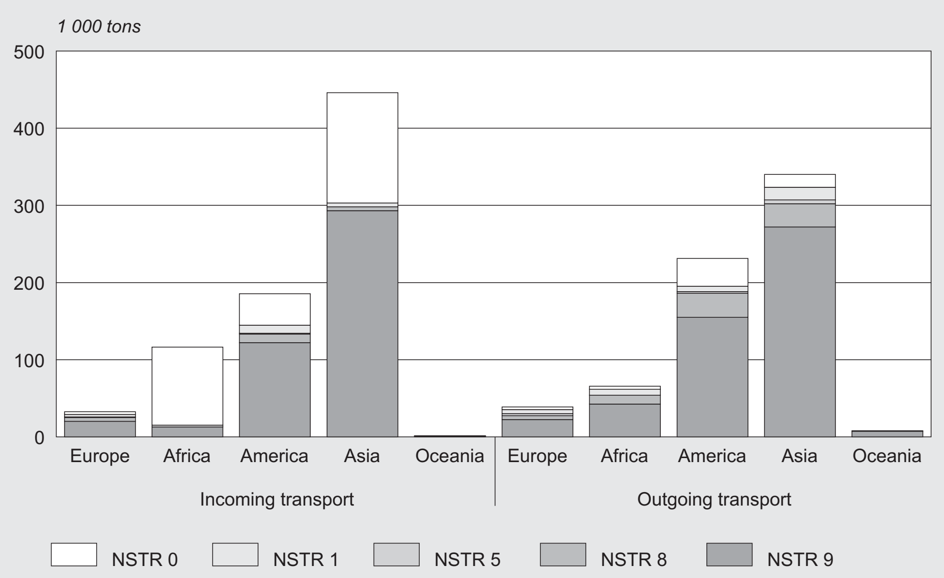
	Incoming transport			Outgoing transport		
	Gross-plus weight	Gross weight[1)]	Change	Gross-plus weight	Gross weight[1)]	Change
	1 000 ton		*%*	*1 000 ton*		*%*
NSTR chapter 9	2 921	3 163	8	3 515	5 501	57
Other NSTR chapters	3 085	3 085	0	15 408	15 408	0
Total	6 006	6 249	4	18 922	20 909	10

[1)] The gross weights have been raised by the factor 100/88 to take into account that part of the population is not observed.

2.4.4 Sector classification: air transport

The 2004 transport statistics include the total incoming and outgoing gross weight transported by aircraft, without specification by goods chapters. The total gross weight is distributed over the goods chapters by applying the distribution over chapters from the 1992 statistics on transport and transit. These old statistics contain a detailed goods classification of the air transport. Figure 8 gives the resulting distribution of the incoming and outgoing gross weights by air transport.

5. Gross weights of incoming and outgoing air transport by goods chapter



Underlying this computation is the assumption that for both incoming and outgoing air transport by continent the distribution over goods chapter stayed stable between 1992 and 2004. Or in other words: the growth of gross weights from or to each continent over 1992 – 2004 was assumed to be the same for all goods chapters.

3. A statistical model for integrating trade and transport statistics

So far, the integration method described has proceeded separately for the statistics on international trade and the transport statistics. On the basis of comparable weight units, trade and transport statistics can be linked, and information from the two statistics can be shared and integrated. Integrated information from both statistics allows us to derive estimates of the transport transit flows which are not separately quantified in either trade statistics or transport statistics. The integrated data should satisfy several consistency restrictions. In particular, transit flows should satisfy a set of restrictions presented in the definition equations below. These equations illustrate the approach at the aggregate level for total transport and trade flows (see Odekerken-Smeets, 2005).

Definition equation: Incoming goods flows
$\sum$ gross weight (incoming) = $\sum$ gross weight (imports) + $\sum$ gross weight (incoming transit) (5)

Definition equation: Outgoing goods flows
$\sum$ gross weight (outgoing) = $\sum$ gross weight (exports) + $\sum$ gross weight (outgoing transit) (6)

If the observations and estimates are consistent in both statistics, the following equality should hold:

Definition equation: Transit (7)
$\sum$ gross weight (incoming transit) = $\sum$ gross weight (outgoing transit)

If we combine these restrictions with the redistribution of transport figures described in equations (3) and (4), the model for the integrated database consists of the following set of equations:

$$T'_{i,j,k,l} = T_{i,j,k,l} + f_{i,j,k} * T_{i,9,k,l} = H_{i,j,k,l} + D_{i,j,k,l}\,;\; f_{i,j,k} \geq 0 \quad j = 0,\ldots,8 \qquad (8)$$

$$T'_{i,9,k,l} = T_{i,9,k,l} * \left(1 - \sum_{j=0}^{8} f_{i,j,k}\right) = H_{i,9,k,l} + D_{i,9,k,l} \qquad (9)$$

$$\sum_{k,l} D_{in,j,k,l} = \sum_{k,l} D_{out,j,k,l} \quad j = 0,\ldots,9 \qquad (10)$$

where:
T': corrected transport flows;
T: observed transport flows;
H: observed trade flows;
D: derived transit flows;
f: fraction for redistribution from NSTR chapter 9 to chapter;
i: incoming, outgoing;
j: 0,…,9 (NSTR chapters);
k: maritime transport, inland shipping, road transport, rail transport, air transport, pipeline transport (mode of transport);
l: Europe, Africa, Asia, America, Oceania, Other (continents).

The information on gross weight from both trade and transport statistics is subject to uncertainty. This uncertainty stems from both measurement error of the primary observations (on the variables weight, mode of transport, product group, origin/destination, etc.), and the recalculations needed to transform quantity information in the trade statistics into gross weight. The uncertainty in the data affects the reliability of the information in the integrated database on trade and transport flows. As a result, the outcomes for transit flows that follow from the confrontation of processed trade and transport statistics will generally not satisfy the definition equations. Therefore, we have developed a statistical model that allows us to explicitly incorporate the definition equations, taking into account the uncertainty margins of the primary information on gross weight. The model yields new estimates for the variables and flows in the integrated database that satisfy the imposed consistency relations.

The modelling framework used is described in Magnus et al. (2000) in the context of national accounts estimation. This Bayesian framework allows the combination of prior information, data, exact accounting restrictions, as well as indicator ratios describing (uncertain) relations between variables. In the present application, the 'accounting identities' are the definition equations (5), (6) and (7) previously specified. Furthermore, we can use ratios, for example, to impose the distribution according to mode of transport and country-group of (un)loading as given in the transport statistics on the trade flows. Thus, the model for integrated trade and transport data allows us to expand the information in either of the individual statistics on trade and transport with additional information drawn from the matched database. The ratios that define the distribution of weights across categories of other variables (e.g. mode of transport) are themselves subject to uncertainty margins, too. These uncertainty margins can be computed from the uncertainty in the underlying components of the ratios, using expressions for the standard deviation of functions of underlying variables. In applying these expressions, we assume independence of the underlying components. Where positive or negative correlations could be expected to be relevant, we performed a check on the direction in which such a correlation would affect the standard deviation of the ratio. In all cases, the standard deviation would be reduced by the correlations of components. The same check was performed for the expressions that compute the redistributed figures for trade and transport statistics using the ratios and the source data. Thus, by assuming independence, the resulting margins for ratios and redistributed statistics are conservative estimates. Within the framework constructed by the restrictions and uncertainty margins, the model estimates new outcomes for the international flows of goods, as well as new uncertainty margins.

The model as described does not yet impose the consistency restrictions that all ingoing and outgoing weight flows should be non-negative. Indeed, transit flow estimates are occasionally found to be negative, even after the correction for overreporting of NSTR 9 flows. To obtain a fully consistent integrated database, inequality restrictions should be included in the model. However, inequality restrictions are analytically more difficult to impose than equality restrictions such as equations (5), (6) and (7). Therefore, we adopted a simplified approach by which variables that exceed their definitional bounds are fixed on the boundary. This way the inequality restrictions are replaced by equality restrictions that can be imposed consistently, i.e. without disturbing the previously imposed equality restrictions, in the modelling framework as described. Newly imposed equality restrictions cannot disturb previously imposed equality restrictions, since the latter are permanently encoded as zero-variance combinations in the covariance matrix that goes with the model estimates. However, some other estimates may become negative when new restrictions are imposed. Thus it may be necessary to perform the procedure of eliminating negative estimates repeatedly. In most cases there was no need for repetitions, and when there was, two repetitions sufficed to obtain a fully consistent set of estimates. In Boonstra (2007) this method and some possible refinements are discussed in more detail.

4. Results

Based on the modelling approach described in Section 3, we developed two models to estimate and describe integrated trade and transport data. Both models serve to highlight specific aspects of the integrated statistics on international goods flows. The first model focuses on distinguishing goods flows divided across the ten sectors, classified as NSTR chapters, by continent of origin/destination. The second model describes international flows of goods through the Netherlands according to the mode of transport at the border, and the continent of loading/unloading.

4.1 Model 1: Flows by NSTR chapter, allocated by origin/destination

Inputs of this model are the gross weight of incoming and outgoing transport by NSTR chapter and the gross weight of imports and exports by NSTR chapter and continent of origin or destination. We use the distribution according to origin and destination for each NSTR chapter from trade statistics to allocate origin or destination to the flows in transport statistics. This implies that we redistribute the flows from the transport statistics to present the integrated transport statistics according to origin/destination instead of loading/unloading. Thus we can compare trade and transport flows in terms of origin/destination.

The assumptions underlying this data processing are:

- Accuracy of the distribution of gross weights by continent in the trade statistics. The model defines uncertainty margins for weight figures that, in general, reflect measurement errors, reporting errors and sampling errors. The uncertainty margins are used as a basis to calculate standard deviations. The margins for the source data are established by expert guess, because of a lack of direct information on the variation caused by measurement and reporting error. A hierarchy in reliability of the figures was selected, with fairly wide margins of uncertainty. For trade statistics, measurement and reporting errors in weights by origin/destination are assumed to be accurately represented by the uncertainty margins.
- Transferability of the origin/destination distribution. For each NSTR chapter we assume that the distribution according to origin/destination is the same for trade and transit flows. Hence, the distribution for trade flows also applies to the total of incoming or outgoing transport, which is the sum of trade and transit. This assumption has an interesting implication: not only the uncertainty in the ratios used is relevant, but also the uncertainty about whether these ratios accurately reflect the distribution for different types of flows. This latter type of uncertainty is not included explicitly in the model. Rather, we assume that it is discounted within the uncertainty margins computed for the ratios. An explicit assessment of this distinct source of uncertainty is to be preferred, and will be a topic for further research and sensitivity testing.
- Independence of disturbance-term variation in trade and transport statistics. In deriving the standard deviations for the redistributed transport flows, we assume that the underlying causes for uncertainty in the weight figures in the two statistics are unrelated. This seems to be a reasonable assumption. The disturbance term reflects reporting errors (e.g. classification errors) and other measurement errors. Given that trade and transport statistics have different observation and data collection procedures, there is no reason to expect systematic interdependence of these errors. Transport statistics also use sampling methods. The sampling errors are expected to be independent of measurement errors. Trade statistics use selective integral observation, as well as customs registration. This does not cover the entire population, because small traders are not required to report their intra-EU trade.
- Independence of disturbance-term variation between components (variables) within trade statistics and transport statistics. For the computation of ratios in trade or transport statistics, we assumed that the underlying variables are independent. As explained earlier, if we relieve this assumption, the resulting standard deviations would mostly decrease. However, dependence within trade and transport statistics may lead to structural over- or underestimation of flows (e.g. when measurement

errors are correlated). This may affect the reliability of the final model outcomes, and will be a topic for further research and sensitivity tests.

Table 4
Summary statistics for incoming and outgoing transit by sector and continent

	Unit	Observations	After redistribution of NSTR 9 gross weights	After redistribution over continents of origin / destination	After model application
Mean estimated value	*1 000 tons*	2 104	2 104	2 104	2 186
Mean standard deviation	*1 000 tons*	1 278	1 359	2 002	1 501
Ratio mean standard deviation / mean estimated value		0.61	0.65	0.95	0.69
Estimated value < 0	*number of cases*	71	39	17	0
Estimated value = 0	*number of cases*	4	4	4	12
Estimated value > 0	*number of cases*	45	77	99	108
Estimated value <–1 * standard deviation	*number of cases*	62	32	11	0
0 < ǀ Estimated value ǀ < standard deviation	*number of cases*	21	24	54	60
Estimated value < standard deviation	*number of cases*	83	56	65	60

Table 4 shows some summary statistics for incoming and outgoing transit by sector and continent. From the increase in the standard deviation after each redistribution step, we can conclude that both redistributions add to uncertainty. In particular, the redistribution of transport statistics according to the origin/destination distributions taken from trade figures raises the standard deviation of transit figures. This reflects the fact that the continent shares in the trade statistics are subject to uncertainty stemming from the uncertainty in the underlying data.

As shown in Table 4, the transit figures that result from directly comparing transport and trade totals are often inconsistent with the logical restriction of non-negative transit. The first column in the table shows that extracting the trade by NSTR chapter and by continent from transport results in 71 negative transit components, of which 62 are negative by more than one standard deviation. In the table, we can also see that for 21 components the absolute, estimated value is smaller than the standard deviation, which is an indication of a non-significant value.

The second column in Table 4 shows the results after redistribution of the flows in NSTR chapter 9 on the basis of extrapolated total transport figures (see Section 2.4.1). Because of the over-reporting of NSTR chapter 9 in the transport figures, transit in this sector appeared to be too large, while other sectors display small or negative transit. The redistribution of the gross weights of incoming and outgoing transport flows in NSTR 9 changes this picture. As shown in Table 4, the number of negative transit components decreases from 71 to 39 and the number of components that are negative by more than one standard deviation is almost halved. The cost of the redistribution is increased uncertainty in the figures, which is reflected by the mean value of the standard deviation and the number of times that the absolute value of the estimate is smaller than the standard deviation. The latter number (24) is larger than before the redistribution of NSTR 9 gross weights.

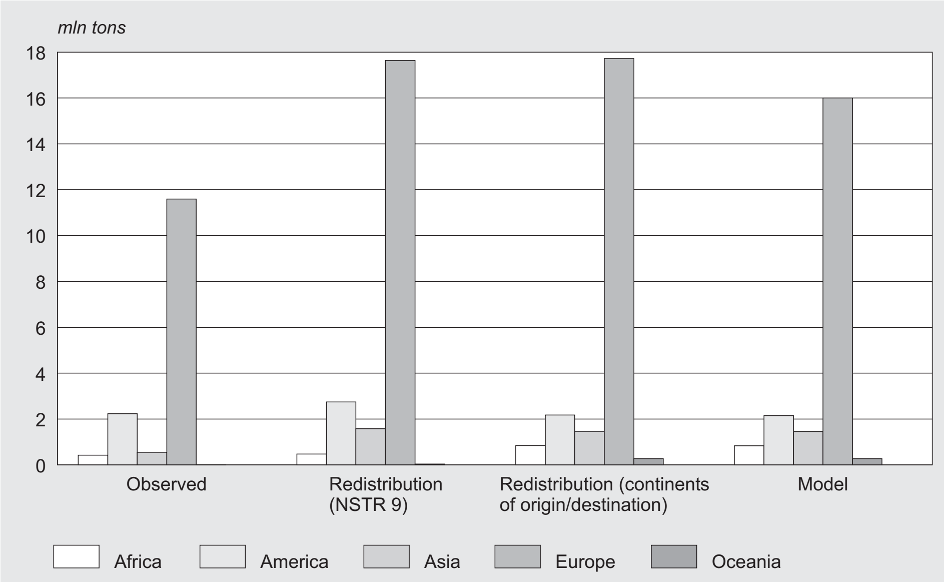
As shown in the third column of Table 4, the redistribution over continents of origin or destination has the same effects as the redistribution of the NSTR 9 weights. The number of negative transit components decreases to 17 and the number of negative components smaller than minus one standard deviation decreases to 11. The latter components are all in NSTR chapter 7, which includes fertilisers. The NSTR 7 negative transit components are relatively large in absolute value; they are of the same order of magnitude as the corresponding transport components. The cost of this redistribution is a further increase of the mean standard deviation and of the number of estimated components for which the absolute value is smaller than one standard deviation.

Lastly, the fourth column of Table 4 gives the results of the statistical model that enforces consistency restrictions on the integrated database. The model adjusts the initial estimates, taking into account their assigned standard errors, in such a way that they satisfy the restrictions. As we can see in the table, the model leaves no negative transit components. Because the equality restrictions operate at an aggregate (sector) level, the model estimations per NSTR chapter subdivided by continents are interdependent, whereas the input data are assumed to be independent. Moreover, incoming and outgoing transit estimates are also interdependent. This reduces the estimated standard deviations for the model outcomes, as can be seen in Table 4. Total transit estimated by the model exceeds the prior information on transit in the model, because the model eliminates all negative transit flows.

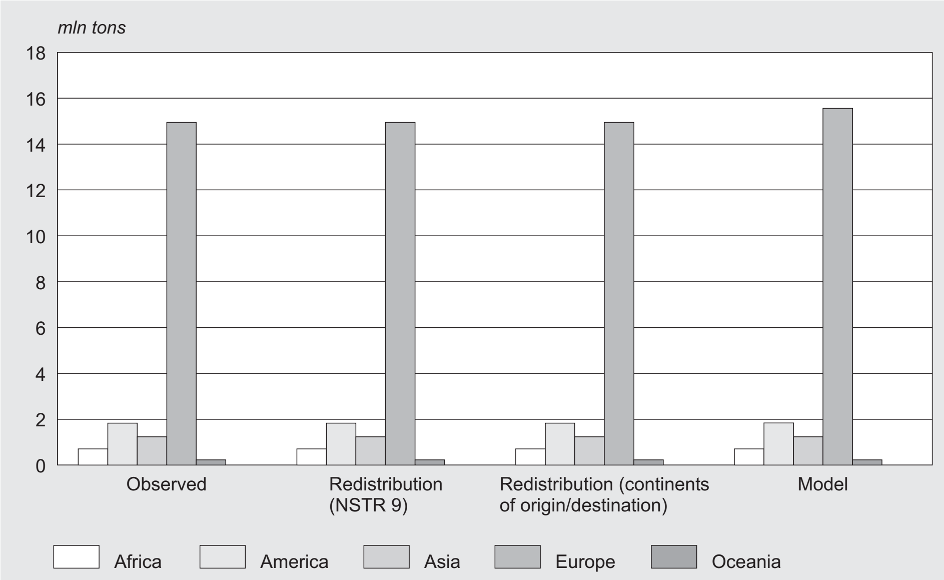
For all transport, trade and transit components, the standard deviation after model application is smaller than before the application of the model. The differences are greatest for the largest estimated values, which mainly concern the goods flows to or from Europe. These largest components are also the components which are most strongly adjusted by the model in order to comply with the restrictions.

Appendix 2 presents the estimated gross weights by NSTR chapter and continent after model application. Table 7a in the appendix shows the results for NSTR chapters 0–3. Table 7b contains the estimated gross weights for NSTR chapters 4–7. Lastly, Table 7c shows the results for NSTR 8–9 as well as the total gross weight over all chapters. The tables present both the estimated values and their standard deviations. The standard deviations give an idea of the uncertainty margins around the figures. Section 5 looks more closely at the interpretation of the results when taking into account uncertainty.

6. Gross weight of incoming transport of NSTR chapter 0 goods

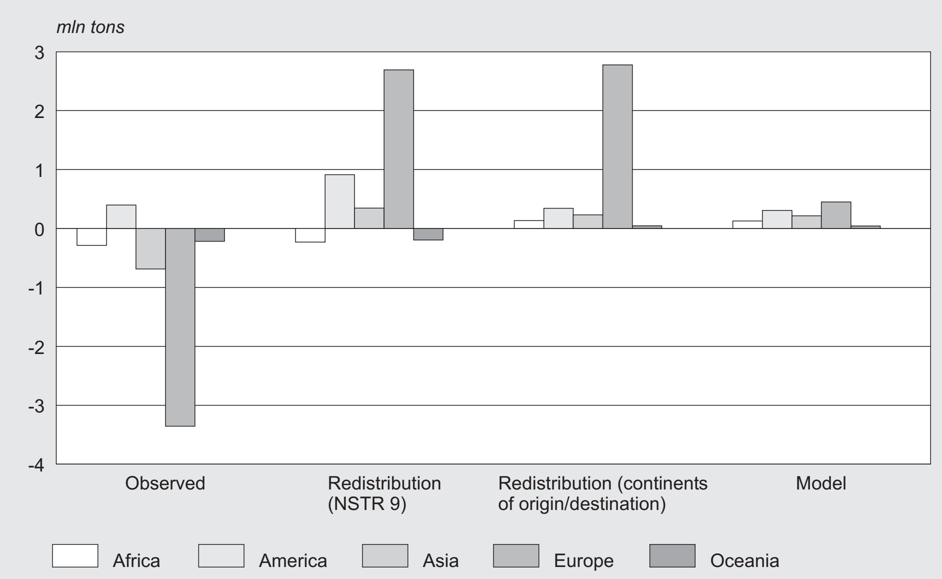


7. Gross weight of import of NSTR chapter 0 goods



In Figures 6 to 8, we illustrate the integration approach. The diagrams focus on goods flows by continent for NSTR chapter 0, as an example, and subsequently show the estimated gross weights after each step in the integration approach for the incoming transport, imports, and incoming transit flows. NSTR chapter 0 includes agricultural products and live animals.

8. Gross weight of incoming transit of NSTR chapter 0 goods



The first category ("observed") in Figures 6 and 7 shows the transport and trade figures that serve as prior information to the statistical model. These consistently contain gross weight figures; the transport statistics in Figure 6 have not yet been subjected to the reallocation of NSTR chapter 9 flows. Moreover, the observed flows in transport statistics are allocated to continent of loading/unloading, while the (observed) trade statistics are ordered according to continent of origin/destination. The two redistributions shown in the figures serve to make trade and transport statistics comparable. Both redistributions affect only transport statistics; trade statistics do not change in this stage of the integration model. We want the model to compare international flows ordered by origin or destination, rather than by last loading or first unloading.

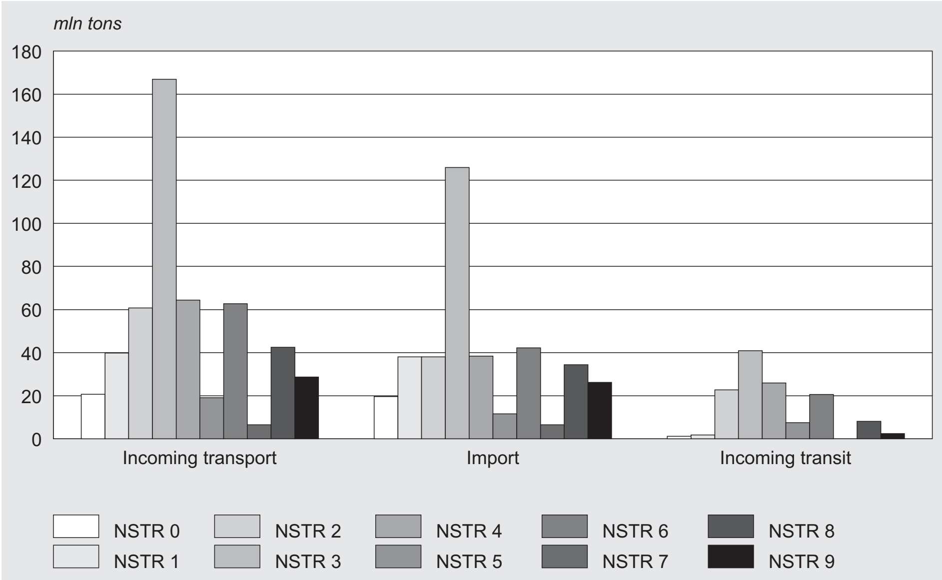
In the first redistribution, the flows in NSTR chapter 9 are partly reallocated to other NSTR chapters (including chapter 0), according to prior estimates of the sector composition of international transport, based on extrapolated figures. The most notable effect of this redistribution on integrated transport statistics is that negative transit figures become smaller and turn positive for Asia and Europe (see Figure 8).

The second redistribution recomputes transport statistics under the assumption that the origin/destination distribution in trade statistics holds for international goods flows in general. Hence, we applied the shares across continents in trade statistics for each NSTR chapter to transport statistics. As a result, the incoming transport of goods in NSTR chapter 0 shifts to the distribution across continents shown in the third category in Figure 6. Most incoming transport flows for NSTR chapter 0 originate in Europe and are last loaded in Europe as well. At the level of continents, the differences between origin/destination and loading/unloading are relatively small.

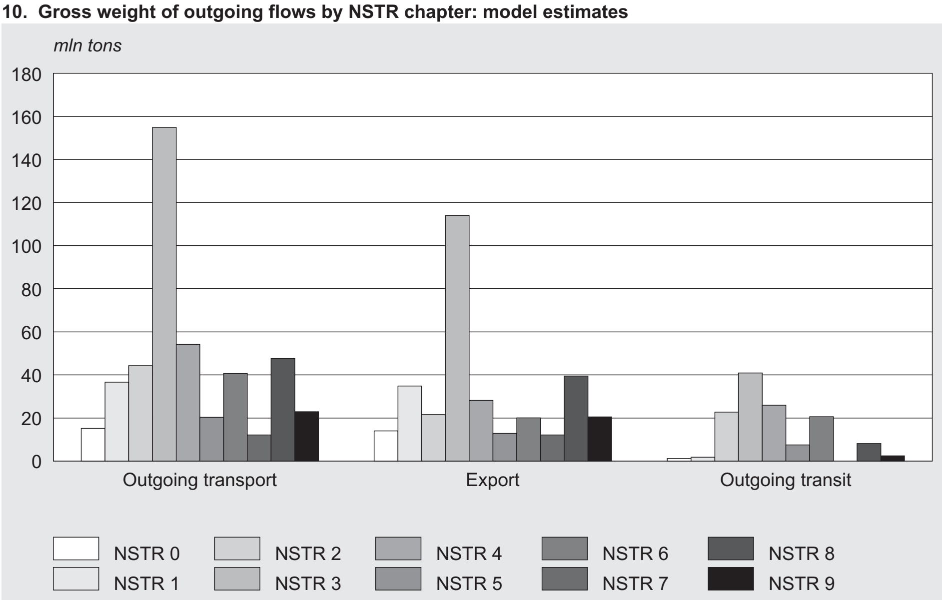
The statistical model, estimated to provide consistent integrated figures, is illustrated in the last category of Figures 6 to 8. The estimation procedure adjusts trade and transport figures in such a way that the consistency restrictions on transit results are satisfied. This means that the model makes use of the uncertainty margins in the (redistributed) prior data to determine optimal estimates for the goods flows that ensure non-negative transit, as well as equality between incoming and outgoing transit. As shown in Figure 8 for incoming transit, the model mostly changes estimates for Europe, the largest contributor to trade and transport in NSTR chapter 0 according to origin/destination, for which the uncertainty margins are largest in absolute terms as well. In Figures 6 and 7 we can see that these changes are still comparatively small. They suffice to ensure that transit by continent is non-negative, and that overall incoming transit in the sector equals outgoing transit.

Figures 9 and 10 show the model estimates for incoming and outgoing flows respectively, across the sectors, classified as NSTR chapters. This provides an overall picture of the international flows of goods through the Netherlands by NSTR chapter.

9. Gross weight of incoming flows by NSTR chapter: model estimates



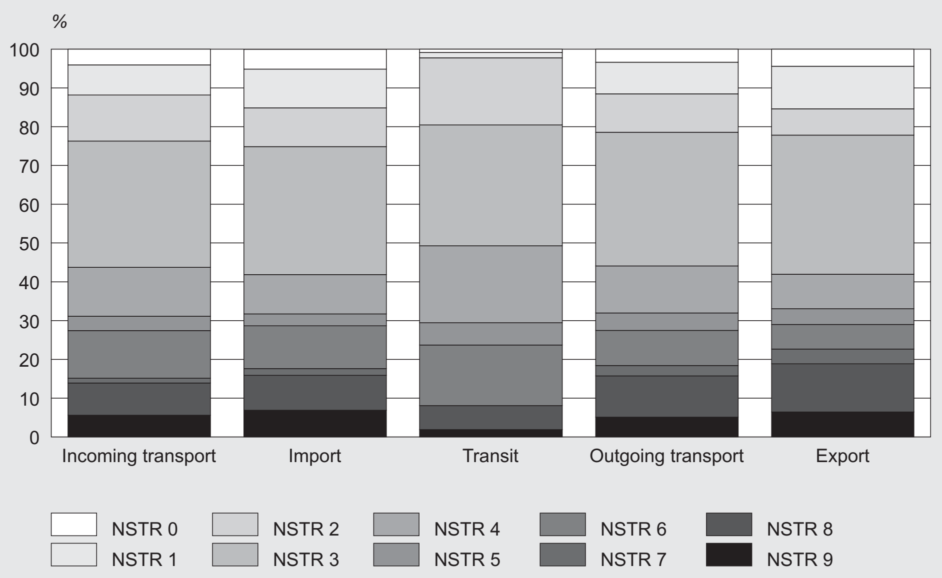
10. Gross weight of outgoing flows by NSTR chapter: model estimates



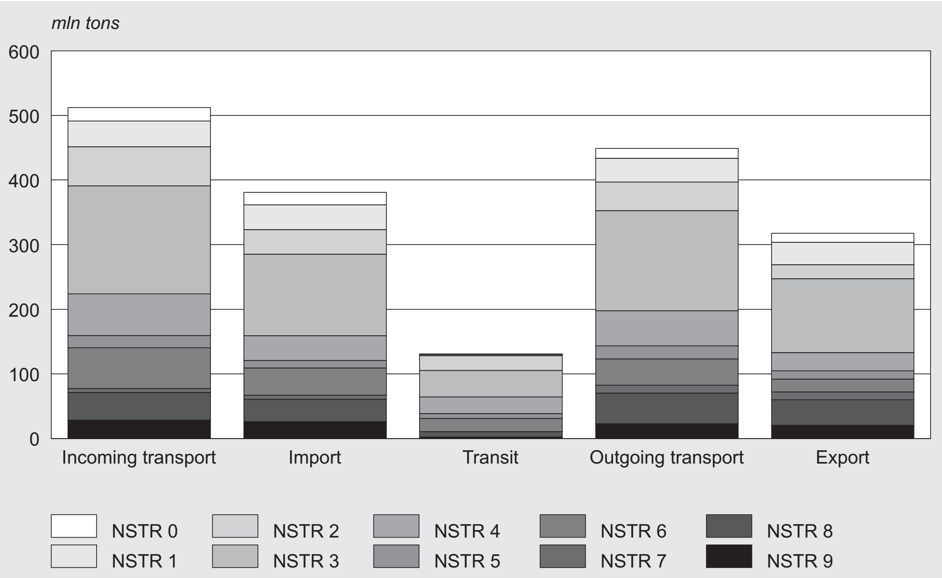
As an alternative presentation of these results, Figure 11 provides a combined view of the sector composition (in percentage shares) of the different types of incoming and outgoing goods flows. A similar picture, but in absolute weight terms, is presented in Figure 12.

As shown in Figure 12, total incoming transport exceeds total outgoing transport (516 vs. 446 million tonnes). Most of this difference in weight is located in NSTR chapters 2, 3, 4 and 6, which can roughly be summarised as material inputs, and to a lesser extent in chapter 9.

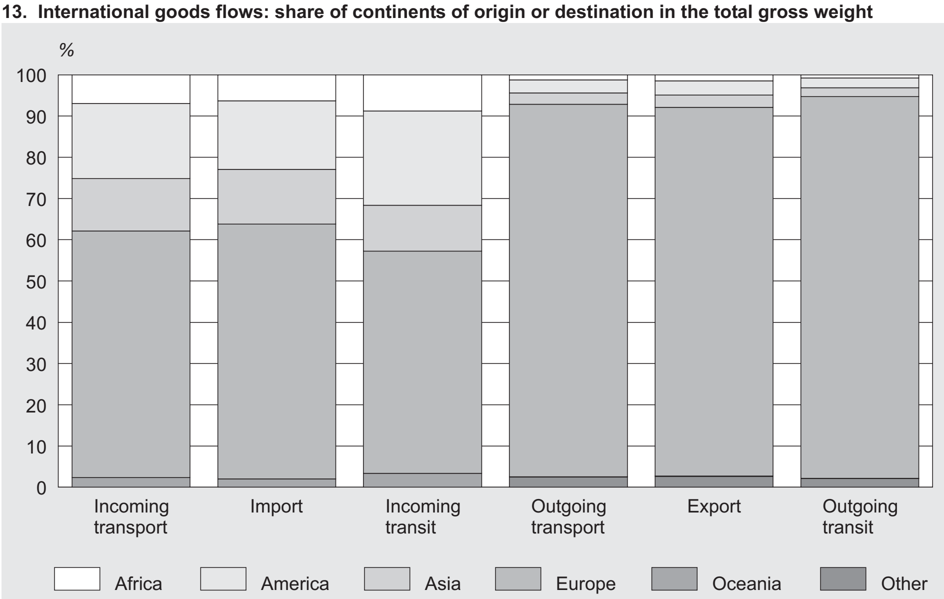
11. International goods flows: sector composition of gross weight



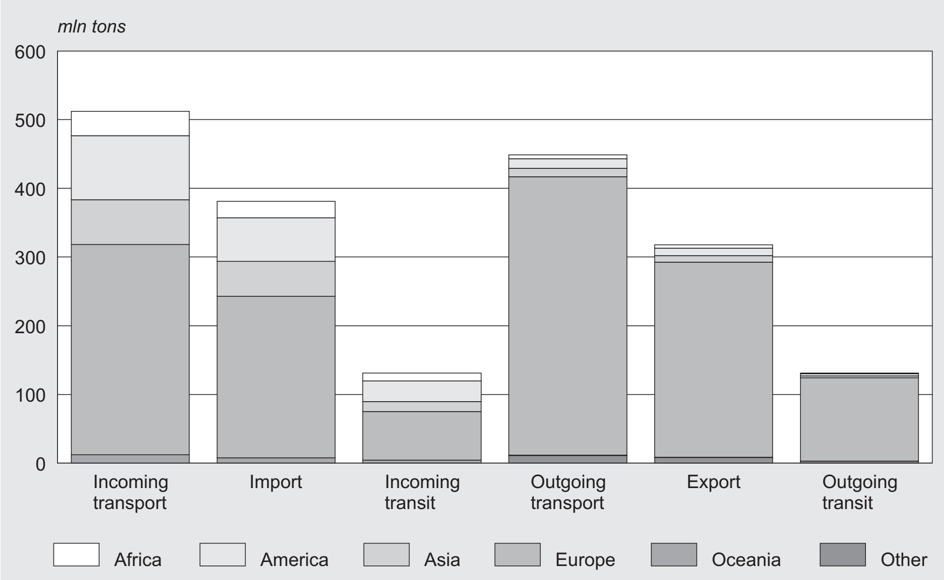
12. International goods flows: gross weight and sector composition



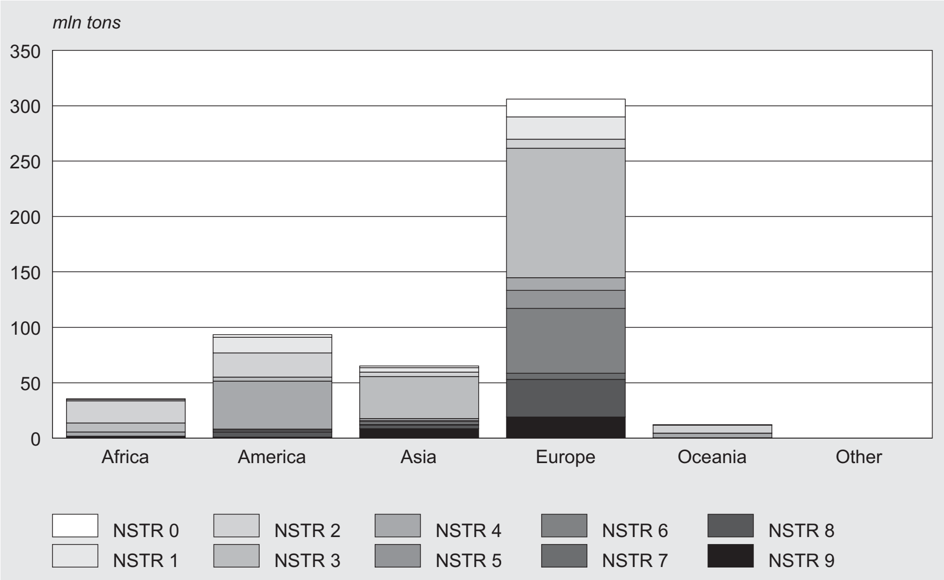
13. International goods flows: share of continents of origin or destination in the total gross weight



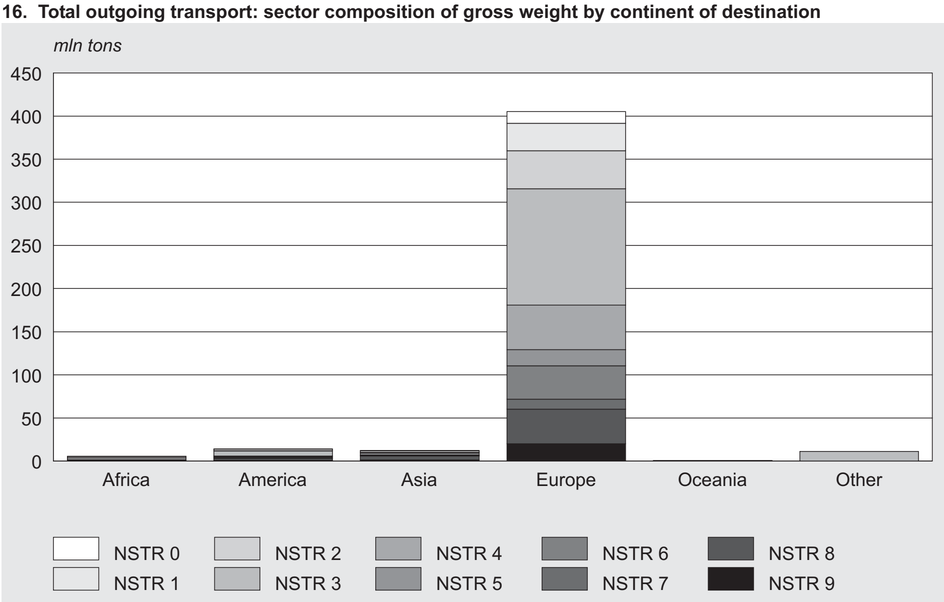
14. International goods flows: gross weight subdivided according to continents of origin or destination



15. Total incoming transport: sector composition of gross weight by continent of origin



16. Total outgoing transport: sector composition of gross weight by continent of destination



Figures 13 and 14 present the division across continents for each type of international goods flow, in percentages and absolute terms respectively.

Lastly, Figures 15 and 16 illustrate the sector composition of total incoming and outgoing transport by continent. A noticeable difference between incoming and outgoing transport is that Europe is very dominant as final destination for outgoing transport. In contrast, continents other than Europe feature more prominently as origin of incoming flows. For example, the incoming flows from America show notably large flows of ores and metals, which are classified in NSTR chapter 4; this may reflect the significance of imports of these goods from a number of South American countries.

4.2 Model 2: Flows by sector and transport mode, allocated by loading/unloading

We also estimated a second model that integrates trade and transport flows through the Netherlands according to the mode of transport at the border and the continent of loading or unloading of the products. This model simultaneously applies the distribution according to mode of transport and continent of loading or unloading from transport statistics to trade statistics, by NSTR chapter. This allows us to compare sector trade and transport flows by mode of transport and continent of loading/unloading.

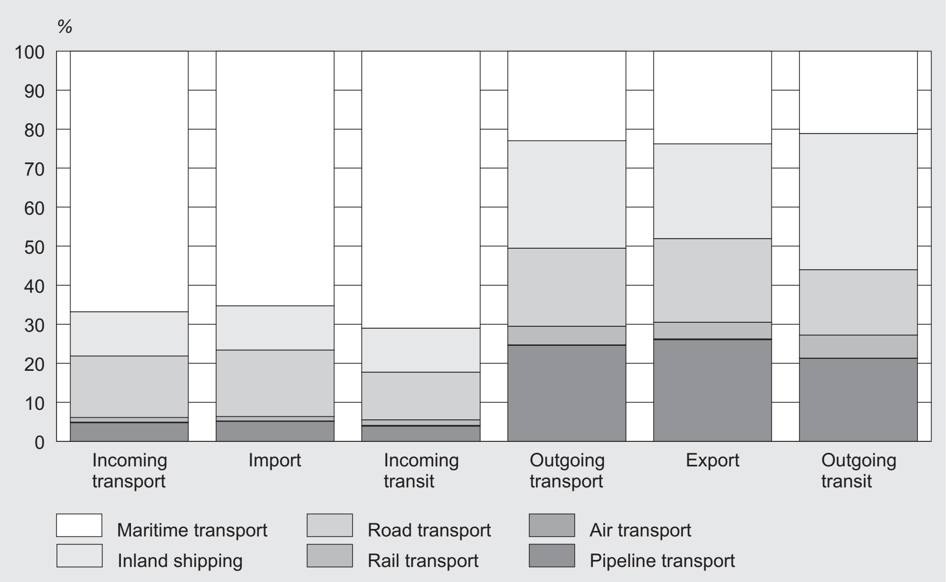
The assumptions underlying this data processing are:

- Accuracy of the distribution of sector weights across mode of transport in transport statistics. We assume that the uncertainty margins accurately represent measurement and reporting errors in weights by transport mode. Note that the redistribution of flows from NSTR chapter 9 in transport statistics was performed separately for each transport mode. Hence, differences in the significance of sector misreporting across mode of transport are accounted for.
- Accuracy of the distribution across continents of (un)loading by sector and mode of transport. Because we used transport statistics, the category “other” for continent (i.e. “unknown”, as used in the trade statistics) is not included. The transport statistics do report a category “other destinations”, which we reallocated proportionately across the five continents. The category “other destinations” includes unknown destinations, for example drilling rigs or dumping sites at sea. Only for maritime transport are the gross weights in this category significant, but still relatively small: in three NSTR chapters, they constitute at most 0.1 percent of the gross weights shipped.
- Transferability to trade statistics. For each NSTR chapter, we assume that the distribution across mode of transport and continent is the same for all types of flows. Hence, the distribution for transport flows also applies to trade and transit. This assumption has an interesting implication: not only the uncertainty in the ratios used is relevant, but also the uncertainty on whether these ratios accurately reflect the distribution for different types of flows. This latter type of uncertainty is not included explicitly in the model. Rather, we assume that it is discounted within the uncertainty margins computed for the ratios. An explicit assessment of this distinct source of uncertainty is to be preferred, and will be a topic for further research and sensitivity testing.
- Independence of disturbance-term variation in trade and transport statistics, as discussed previously.
- Independence of disturbance-term variation between components (variables) within trade statistics and transport statistics, as discussed previously.

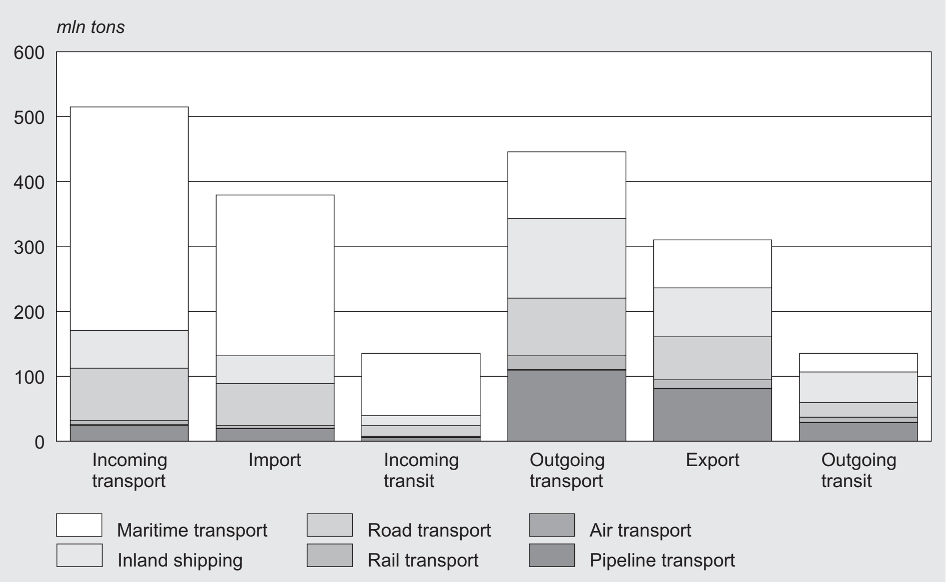
The selection of diagrams below illustrates some of the main results for the integrated database, modelled according to mode of transport and location of loading/unloading of the products.

Figures 17 and 18 compare the significance of various modes of transport across the different types of incoming and outgoing product flows. It immediately becomes clear that maritime transport is dominant as transport mode for incoming flows, while pipeline and inland shipping are considerably more prominent in outgoing flows than in incoming flows. Maritime transport is slightly more important for incoming transit than for imports, while inland shipping is of more importance for outgoing transit than for exports.

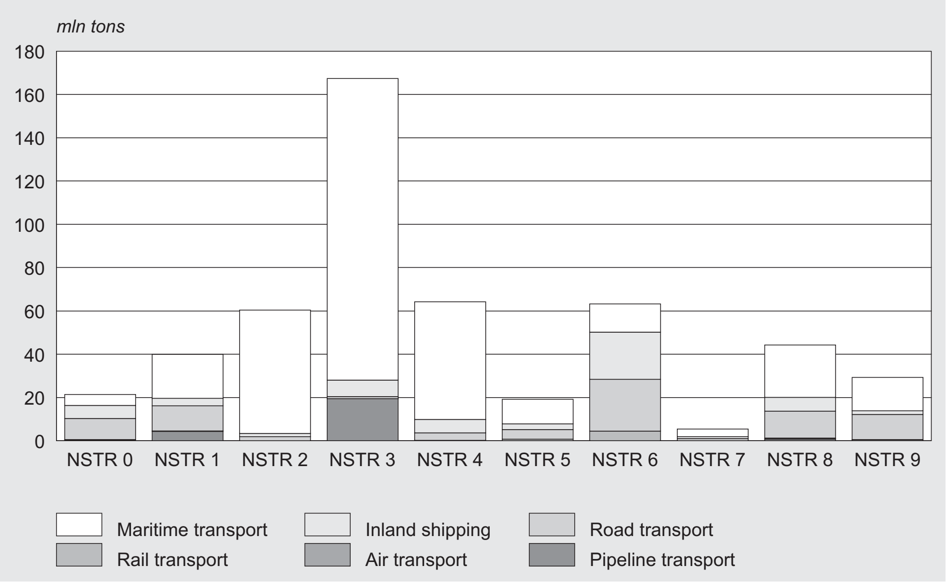
17. International goods flows: breakdown of total gross weight by mode



18. International goods flows: gross weight and breakdown by mode

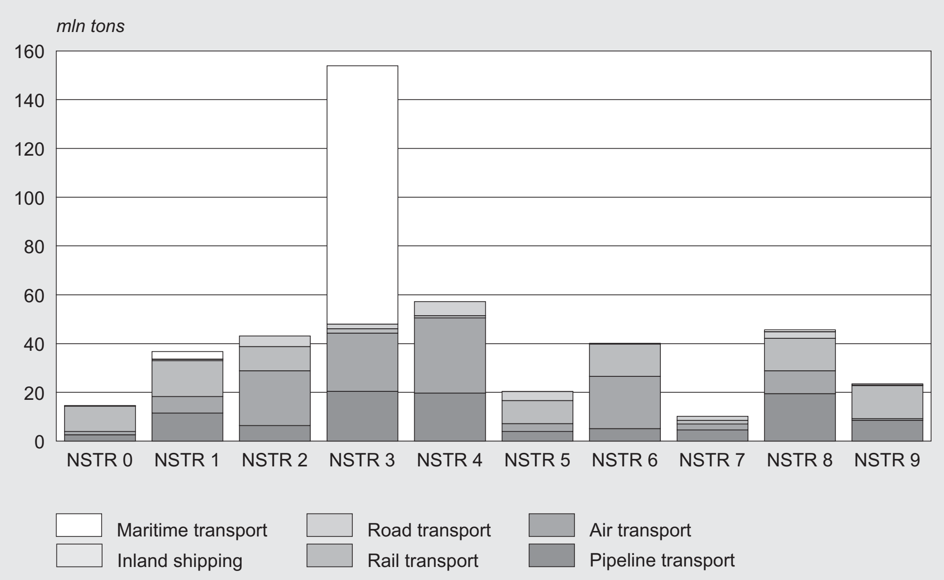


19. Total incoming transport: gross weight by sector and by mode



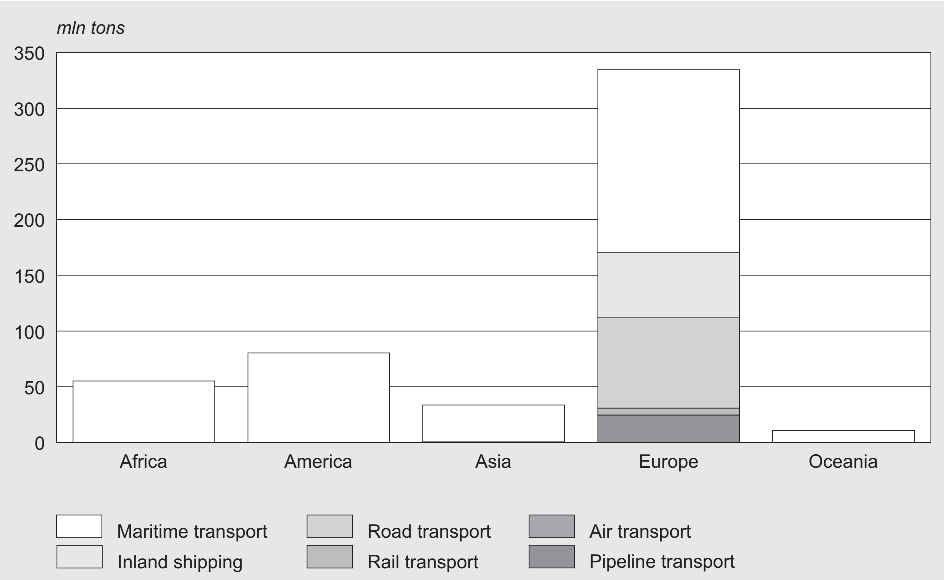
Figures 19 and 20 show that maritime transport is an important mode of transport for incoming flows in most NSTR chapters. For outgoing flows, inland shipping and road transport are relatively more significant in several NSTR chapters. Pipeline transport is the dominant mode of supply for oil and oil products transferred abroad. Pipeline transport is relevant for food products and feed (NSTR 1) as well. This mainly concerns the transport of drinking water. Like pipeline transport, rail transport is more important across sectors for outgoing transport, although its share remains small.

20. Total outgoing transport: gross weight by sector and by mode

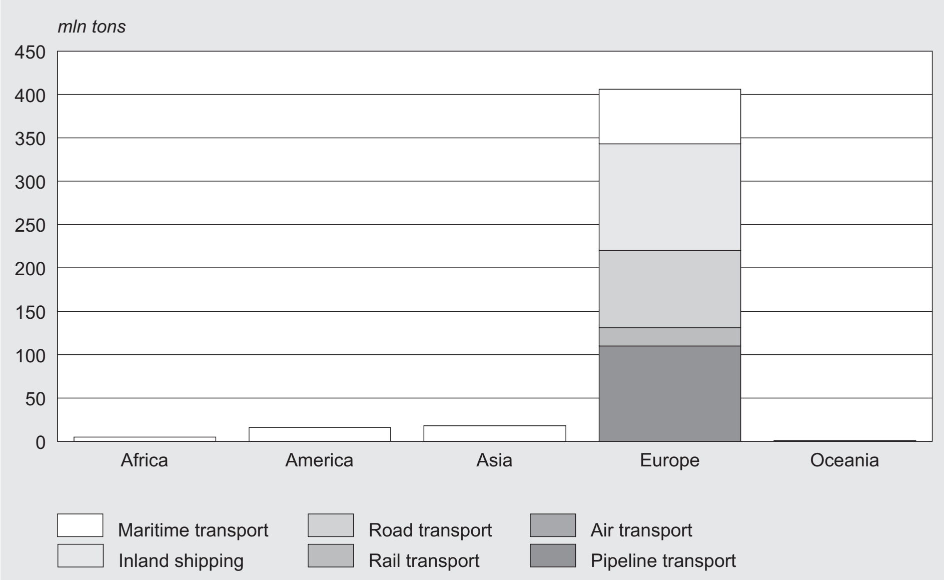


Figures 21, 22 and 23 show that air transport has a (small) share in the total outgoing transport in tonnes to all continents except Europe. Although some road transport to Asia and Africa exists, this is relatively negligible in terms of total weight. Because the continents are defined in terms of loading or unloading, no direct pipeline transport to continents other than Europe exists.

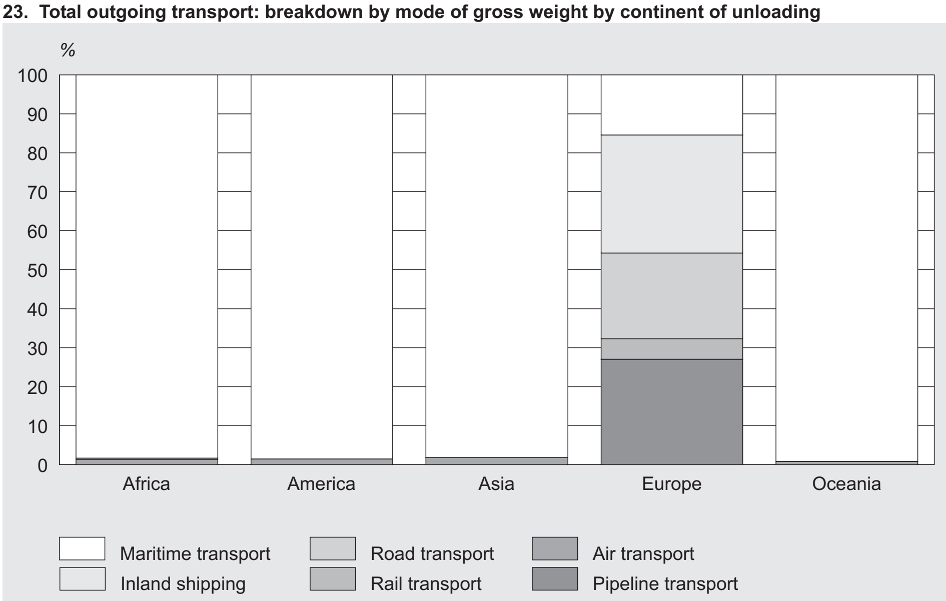
21. Total incoming transport: gross weight by continent of loading and by mode



22. Total outgoing transport: gross weight by continent of unloading and by mode



23. Total outgoing transport: breakdown by mode of gross weight by continent of unloading



5. Uncertainty

The gross weight values of incoming transport, outgoing transport, imports, and exports by continent and sector are the basis for estimating transit flows and creating the integrated view of international trade and transport flows. These gross weights are aggregates of processed observations of individual transport movements and individual trade transactions. Part of the processing was carried out exclusively for the integration of trade and transport statistics, for example the conversion of supplementary units or gross-plus weights to gross weights. However, a lot more computational effort preceded our conversions.

In general, the collection of data is error-ridden. For example, road transport statistics are based on a survey among companies involved in road transport. A stratified two-stage sample is taken from those companies and their vehicles. The results from the sample are raised to obtain estimates for the whole population of companies and vehicles. This procedure leads to sampling errors. Other sources of uncertainty are the misinterpretation of questions in the survey and simple typing errors. As far as possible, these errors are identified in the stage of data processing and corrected on the basis of expert knowledge and logical assumptions.

The results of the integration can be used to gain insight into the international goods flows to, from, and through the Netherlands. This insight may be useful for decision-makers, researchers, consultants, etc. To interpret the model results correctly, it is important to know how reliable – i.e. how certain – they are. Information about the extent of uncertainty may help policymakers to understand the gaps in current knowledge. Knowing about the uncertainties, policymakers may decide on spending resources to acquire additional information (see Morgan and Henrion, 1990). De Blois (2000) states that model makers should report uncertainty in the model results and that decision-makers should learn how to make decisions based on uncertain figures. As such they “will relevantly improve decision making based on the outcomes of mathematical modelling.”

Section 5.1 describes how uncertainty was estimated in this project. Section 5.2 presents the uncertainty in the model estimates of gross weights. Lastly, Section 5.3 discusses the results.

5.1 Determination of uncertainty

Because of the complexity of the whole procedure of data collection, processing, and aggregation, we used qualitative expert estimates of the uncertainty in the data on which our calculations were based, i.e. the gross weights of incoming transport, outgoing transport, imports, and exports by sector and by continent of origin or destination, or by continent of loading or unloading, in combination with transport mode. The data quality was expressed by a letter label standing for a numerical uncertainty margin (see Table 5). The uncertainty margin was assumed to represent a symmetrical 95 percent confidence interval around the estimated value. For example, data quality “B” for a goods

Table 5
Labels for data quality and corresponding uncertainty margin

Label	Margin (%)
N	0
A	5
B	10
C	20
D	30
E	40
F	50

flow of 100,000 tonnes stands for an uncertainty margin of 10 percent, i.e. a probability of 0.95 that the goods flow is between 90,000 and 110,000 tonnes. With this assumption, standard deviations for the transport and trade components were derived by multiplying each component by its margin and dividing the outcome by 1.96.

In both Models 1 and 2, the gross weights by sector and continent are redistributed twice: first to correct for the overestimation of transported gross weights in the NSTR 9 sector, and secondly to obtain the correct distribution over continents. In Model 2, the second redistribution also concerns the transport modes. In both redistribution steps, uncertainty is recomputed assuming that the uncertainty errors in the individual data are independent of each other. In fact, the uncertainty errors are somewhat negatively correlated because we have more confidence in the total gross weight transported or traded than in its components, i.e. gross weights by sector or by continent. This means that if, for example, the gross weight from Asia is overestimated (positive error), then the gross weight for one or more other continents would be underestimated (negative error), to sum up to the same total.

The assumption of independence of uncertainties in the case of negative correlation means that uncertainties of aggregates are estimated to be larger than they actually are. On the other hand, positive correlations of input figures within transport and trade statistics caused by common source of error have also been ignored.

The uncertainties as estimated after the second redistribution are input for the integration model. The uncertainty margins leave the sufficient elbow room to comply with the restriction that for each NSTR chapter incoming transit should equal outgoing transit. Because of this model restriction, uncertainties may change in the model.

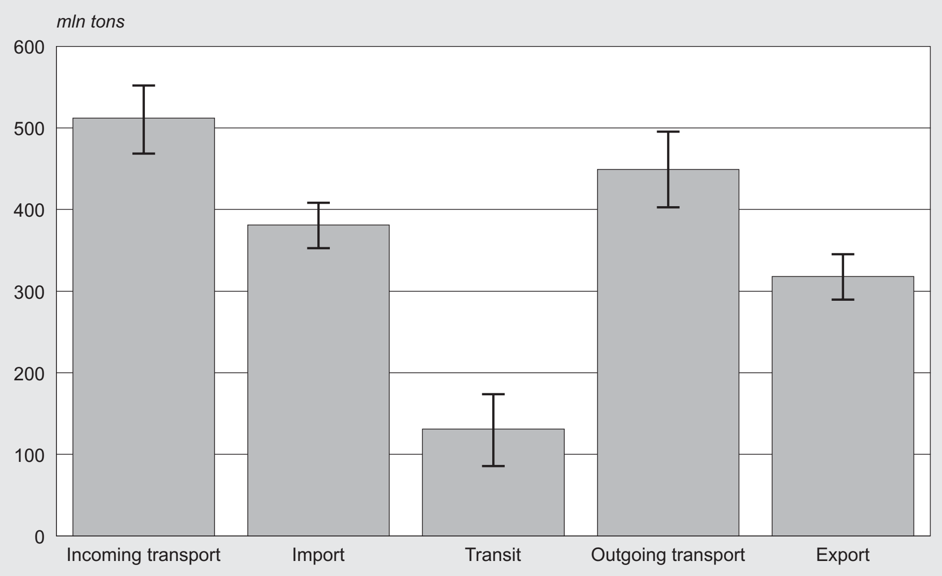
Components of transit may become negative after application of the model. The negative components are set to zero. The uncertainty computations in the model do not take into account the fact that transit should always be zero or positive.

5.2 Uncertainty in the results

This section presents the uncertainty margins of the results of Model 1 (see Section 4.1) for different levels of aggregation: total incoming and outgoing flows, flows by continent, flows by sector, and flows by continent and sector.

Figure 24 shows the uncertainty margins of the total incoming and outgoing flows. For incoming transport, imports, outgoing transport, and exports, the uncertainty is less than

24. Uncertainty (90% confidence) in the incoming and outgoing goods flows



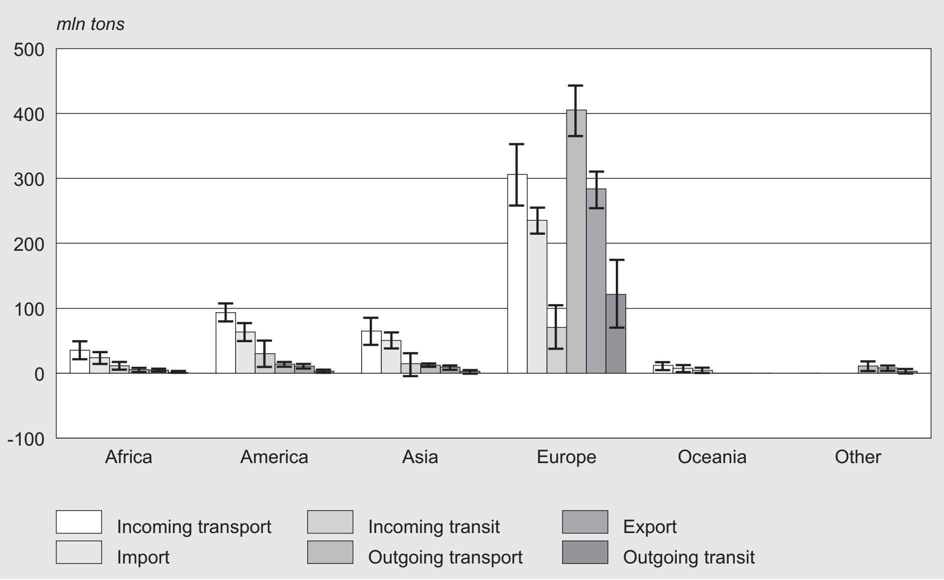
10 percent of the estimated value. For the transit flow, uncertainty is higher: about one third of the estimated value.

The uncertainty in the flows by continent is clearly higher than in the total flows, as Figure 25 shows. The uncertainty in incoming transport, imports, outgoing transport, and exports by continent ranges from 10 percent to 25 percent of the estimated value. The transport figures are more uncertain than the trade figures. The uncertainty of incoming or outgoing transit may even be larger than the estimated value itself. If so, in statistical terms the estimated transit is not significantly different from zero.

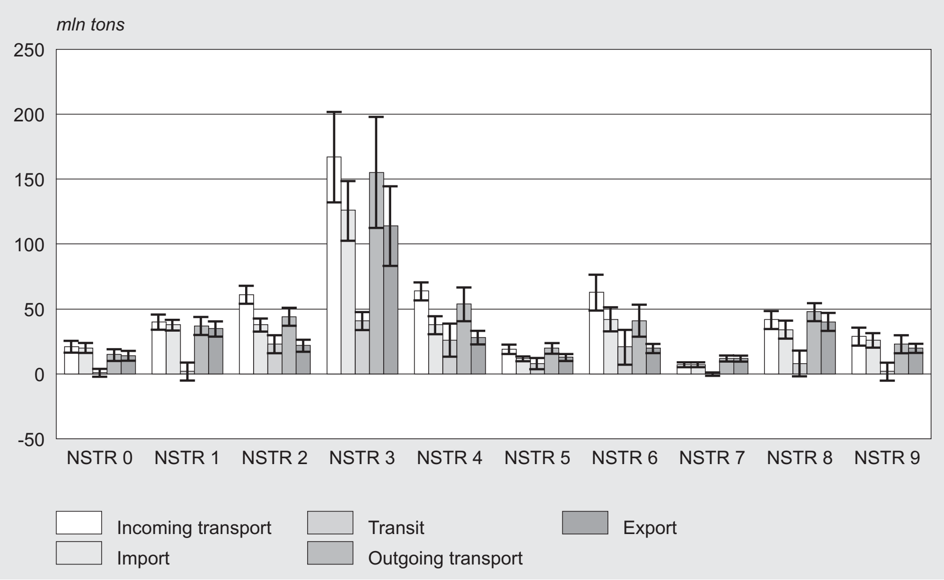
Figure 25 shows that the destination of transit is mainly Europe, while it comes from Europe, America, Africa, and Asia. The uncertainty in the estimated gross weight of incoming transit from Asia is large.

The uncertainty in the incoming transport, imports, outgoing transport, and exports by NSTR chapter ranges from 13 to 34 percent of the estimated value; see Figure 26. The estimated transit is significantly different from zero for half of the sectors: NSTR chapters 2 to 6. For the other five sectors, the uncertainty margin exceeds the estimated value.

25. Uncertainty (90% confidence) in the incoming and outgoing goods flows by continent of origin or destination

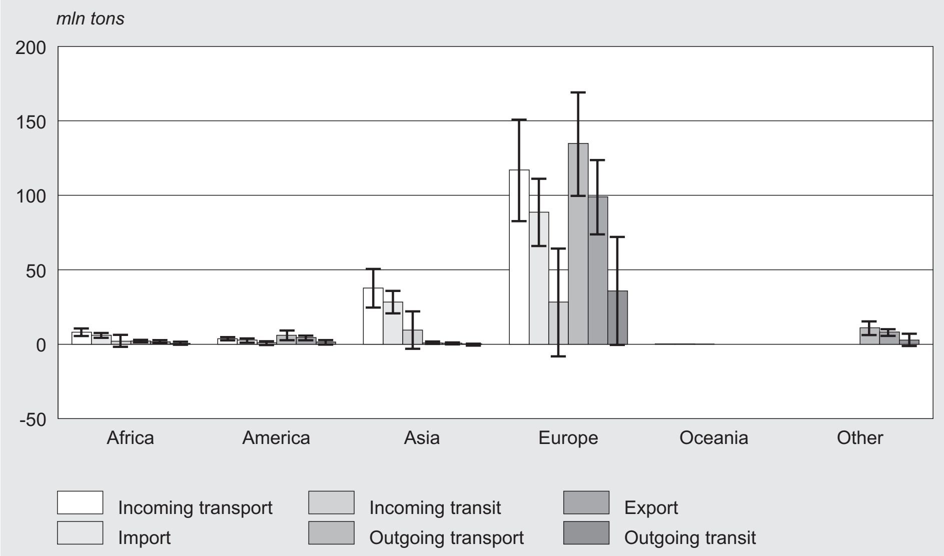


26. Uncertainty (90% confidence) in the incoming and outgoing goods flows by NSTR chapter



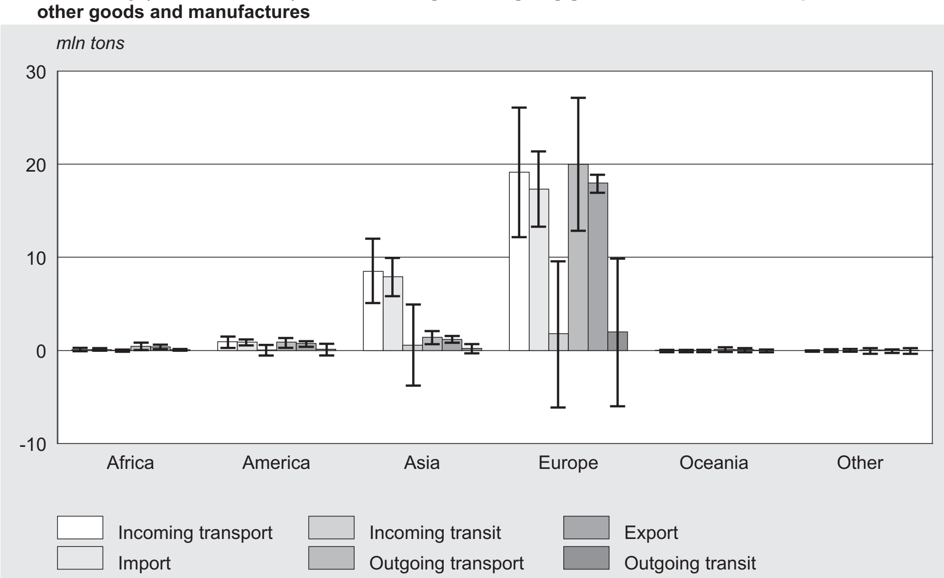
Figures 27 and 28 show the uncertainty in the gross weight flows by continent for NSTR chapters 3 and 9. For chapter 3, the uncertainty in incoming and outgoing transport is around 34 percent, while imports and exports have margins of about 25 percent. For chapter 9, these figures are 47 percent and 25 percent respectively. None of the transit estimates exceed their uncertainty margin.

27. Uncertainty (90% confidence) in the incoming and outgoing goods flows for NSTR chapter 3, petroleum and petrochemical products



The relatively low estimated value of transit in NSTR chapter 9 is noticeable. China's industry is booming, and the country exports large amounts of clothes, toys, etc. to Europe through mainport Rotterdam. As these products are classified in NSTR chapter 9, one would expect that transit through the Netherlands from Asia to Europe is higher than presented in Figure 28. We can give three arguments to explain this result. First, part of the goods flow from China is cleared through customs for the European market. This is the quasi-transit flow, trade in the community concept, which we have chosen to start from. Secondly, products like clothes, toys, etc. are relatively light in weight while their value is relatively high. The third argument is given by Figure 28 itself: the uncertainty in the estimated transit flow of NSTR 9 is high. This is partly because of the redistribution of NSTR 9 weights over the sectors. Further research on this redistribution will lead to better estimates of the gross weight of transit in NSTR chapter 9.

28. Uncertainty (90% confidence) in the incoming and outgoing goods flows for NSTR chapter 9, other goods and manufactures



5.3 Discussion

Knowledge of the uncertainty of modelling results is important to interpret these results correctly. It gives insight into the quality of the model results, which is relevant for users like decision-makers and researchers.

In this section, we have presented the uncertainty in the results of Model 1, which computes the gross weights by NSTR chapter allocated by continent of origin or destination. The uncertainty in the estimated transport is clearly higher than in the estimated trade. This is caused by the redistribution of NSTR 9 weights over the sectors and the redistribution of weights over continents of origin or destination. In Model 1, both redistributions are applied to the transport figures only.

Expressed as a fraction of the estimated value, the uncertainty is highest for the transit flows. This outcome is connected with the computing of transit as the difference between transport and trade. Consequently, the uncertainty in transit is of the same order of magnitude as the uncertainty in transport and trade, while the estimated value of transit is distinctly smaller.

The uncertainty grows with the level of detail. The estimates of the total transit flows have a margin of about 30 percent. The estimated transit by continent or by NSTR chapter is statistically not significantly different from zero for some continents and sectors. Small numbers are involved in these cases. The estimated gross weights of transit flows by continent and NSTR chapter are the least reliable: most of these transit flows have an uncertainty margin that exceeds the estimated value. So statements about these figures must be made with care.

The results of the uncertainty analysis clearly show that there is still quite a way to go yet. The quality of the results should be improved by further research, for example on the redistribution of NSTR 9 weights. The following section presents many more possibilities for improvement. Furthermore, it would be valuable to improve the estimation of the uncertainty itself.

6. Conclusions and recommendations

This report on integrating statistics on trade and transport goods flows intends to contribute to an improved understanding of the impact of merchandise trade and transit flows on the economy, and to facilitate research on both the value added and the potential social costs of international goods flows, for example costs related to congestion and the emission of pollutants. The integration of trade and transport statistics enables the explicit determination of transit statistics, for which no explicit direct observations exist in the trade and transport statistics individually.

Integrated trade and transport statistics have several advantages over individual trade and transport statistics:

- a complete and comparable overview of international trade and transport flows in terms of weight;
- combined trade, transport and transit flows according to origin/destination, loading/unloading and mode of transport;
- a statistical model using logical restrictions on derived transit flows improves integrated trade and transport figures and yields consistent statistics at the aggregated NSTR 1-digit level.

Moreover, the integration of trade and transport statistics allows us to identify and address specific problems in the separate statistics. The measurement problems concerning transport flows in NSTR chapter 9, for example, were identified and addressed by extrapolating historical transport statistics and checking the plausibility of the resulting estimated shares by NSTR chapter for maritime transport with trade statistics for maritime transport. Trade statistics were used to determine the sector composition of goods transported by air; this breakdown is not available in the transport statistics. The integration effort resulted in completion of the weights data in the integrated trade statistics. Weight data in trade statistics are incomplete because of the use of alternative quantity measures. Using source data from customs, and checking for the influence of measurement errors and outliers in reported weights, we completed the coverage of quantity in the integrated trade statistics in terms of gross weight.

The coverage of transport mode in trade statistics is problematic and incomplete; some of the data report that mode of transport is unknown. Using transport statistics, we can assign mode of transport to trade statistics at the 1-digit NSTR sector classification.

The integrated database offers a consistent overview of international trade and transport flows through the Netherlands in 2004 in terms of gross weight of the flows. The variables included in the database are: gross weight at the 1-digit NSTR sector level according to continent of origin/destination, loading/unloading, and mode of transport. This constitutes a valuable extension to the currently available separate statistics on trade and transport. However, several extensions of the integrated database and the statistical estimation model would further improve the scope and value added of the integrated data. Plans for further research in this area are the following:

- Estimation of the gross weight of the non-observed trade flows by NSTR chapter. If a reliable estimation can be made, these non-observed trade flows could be included in the integration analysis, thus improving the estimation of transit flows.
- Extending the list of variables included in the integrated database with reliable information on the value of transport flows. This would allow us to compare trade and transit flows in value terms. To do this, value-to-weight ratios will have to be determined at the 1-digit level of the NSTR sector classification.
- Extending the list of variables on type of flows with an explicit inclusion of re-exports, and investigating the usefulness and possibility to also include quasi-transit and warehouse transit flows explicitly.
- Extending the coverage of the integrated database to a time series of several years. Before 1992, the transport statistics contained information on type of flow (trade, transit) as well as total incoming and outgoing transport. The trade statistics are available from 1996 onwards. A time series of integrated data starting in 1996 could be aimed for. One problem with respect to the period before 2002 is that the customs

data tapes are not available for trade statistics, which implies that a complete set of conversion factors from quantity to (gross) weight may not be possible.

- Further sophistication of the statistical model used in the estimation of integrated trade and transport statistics. Some steps in the adjustment of trade and transport statistics to the integrated framework were implemented by calculating redistribution ratios based on figures prior to integration (for example, to redistribute transport flows classified in NSTR chapter 9; implement the distribution according to mode of transport from the transport statistics to trade statistics; transfer the distribution across continent of origin/destination from trade statistics to transport statistics). Alternatively, these ratios could be included in the statistical model, as variables to be estimated. As a result, the ratios calculated will depend on the final estimation results for integrated trade and transport data. This may enhance the precision of the redistribution parameters. Furthermore, additional research could be done to investigate whether observed and estimated weights in either trade or transport statistics show a systematic tendency to under- or overestimate true figures. This would imply a positive correlation in errors within either given set of statistics, raising the uncertainty margins for the final outcomes for the integrated database.
- Further disaggregation of the integrated database. A further decomposition of several NSTR 1-digit chapters to the 2-digit level of classification may be accomplished. Special attention should be paid to NSTR chapter 9. Moreover, a more detailed classification according to country group than the currently attained level of continents can be implemented.
- Improvement of the weight conversions for trade statistics. Alternative methods to compute conversion factors to express trade in terms of weight and to compute value-to-weight ratios will be implemented. Further analysis of outliers will be part of this extension. The results could be compared to current findings, as an application of sensitivity analysis. Furthermore, complementary methods to compute weight estimates for supplementary estimations and imputations of trade flows can be developed. These trade data can be integrated into the current framework to improve total gross weight statistics for trade flows. Within Eurostat, attention has recently increased for the net mass in trade statistics. If this information is not collected directly in (intra-EU) trade statistics, it is proposed that net mass be estimated. This further subscribes to the importance of improving estimates of net and gross weight in trade statistics.
- Special attention should be given to NSTR chapter 7, fertilisers; the estimated transit to and from Europe of this product has a large negative value, even after two consecutive redistributions of transport figures.
- Better use of container information in trade statistics. For maritime transport, information on container goods can be used to improve the estimation of the sector composition of the container gross weights in incoming and outgoing transport in the transport statistics. This information could be included as additional, prior knowledge in the integration model.
- Improvement of the redistributions and conversions to transport statistics. The extrapolations of 1982-1992 transport figures by transport mode and sector (for the sake of estimating a corrected distribution across NSTR chapters) could be separated for container and non-container flows. Container flows have increased their share in total transport flows. Hence, current extrapolations, based on total transport, may underestimate the actual growth of total transport. Moreover, differences in growth and composition of container flows, compared to non-container flows, may be better covered by treating them separately. Still, current extrapolations to 2004 based on total transport flows have already shown consistent overestimation of transport flows, compared to primary observations for 2004. Further research could be directed at assessing the extrapolations of transport figures and investigating whether shares across NSTR chapters are likely to be sensitive to these aggregate overestimations. More sophisticated techniques for extrapolating data series, such as state-space analysis, and explicit determination of reliability margins in these extrapolated figures could be considered. Furthermore, some of the sector redistribution fractions for transport statistics estimated on the basis of these extrapolations may provide cause for further specific investigation. The fractions for incoming transport in NSTR chapter 6 for rail transport, and the fraction for outgoing transport in this sector for inland shipping in particular are quite large.

Apart from further research stemming directly from the integration project, some other future developments at Statistics Netherlands may be fruitful for the integration and improvement of trade and transport statistics. In the coming years, Statistics Netherlands plans to implement a number of developments related to this research which may improve insight into international trade and transport flows. One of these developments concerns the use of the detailed information in the bills of loading from freighters. These bills include codes describing the container goods which could be used to classify these goods. The option of computerising most of this information extraction process would seem feasible. In addition, ideas are being discussed about tracking container flows in intermodal transport by using the container identification number. Lastly, a PhD research project in cooperation with Erasmus University Rotterdam is to investigate the use of modern monitoring techniques for improving the trade and transport statistics. These modern techniques include RFID, GPS navigation, and mobile telephony.

Acknowledgement

The views expressed in this report are those of the authors and do not necessarily reflect the views of Statistics Netherlands.
The authors would like to thank Margreet van Brummelen, Marly Odekerken, and Bas Vos for their contribution to the research project. We would like to acknowledge the comments and suggestions offered by our colleagues at Statistics Netherlands: Maarten Pouwels, Jasper Roos, Rub Rutten, Peter Smeets, Piet Smeijsters and Rob Willems, and the members of an external group of experts: Tom Dekker, Jan Francke, Robert van Leewen, Harry Oldersma and Albert Veenstra. All remaining errors are the responsibility of the authors.

References

Boonstra, H.J. (2007). Macro-integratie: het opleggen van ongelijkheidsrestricties [Macro-integration: imposing inequality restrictions]. Research paper DMH-2007-01-03-HBTA, CBS: Heerlen/Voorburg.

CBS / Statistics Netherlands (2006). De Nederlandse Conjunctuur 2006: aflevering 2 [The Dutch Economy 2006: volume 2]. Internet: www.cbs.nl, CBS: Heerlen/Voorburg.

CBS / Statistics Netherlands (1982–1992). Statistics of transport and transit. Data, CBS: Heerlen/Voorburg.

De Blois, C.J. (2000). Uncertainty in large-scale models for decision support in water management: an approach to effective and consistent modeling. PhD thesis, University of Twente: Enschede.

Eurostat (2002). Material use in the European Union 1980–2000: Indicators and analysis. Working papers and studies, Theme 2: Economy and finance, European Communities: Luxembourg.

Eurostat (2006). “Extra EU-25 trade in goods by mode of transport” in: Statistics in focus: External trade, 2/2006, by E. Pongas, European Communities: Luxembourg.

HIDC (2005). The Netherlands: The leading Gateway for Europe. Holland International Distribution Council: Zoetermeer.

Linders, G.J.M., Odekerken-Smeets, M.E.P. and De Groot, H.L.F. (2006). Linking Trade and Transport Statistics: The Dutch Case. Paper presented at the ERSA congress, August 30 – September 3, Volos, Greece.

Magnus, J.R., Van Tongeren, J.W. and De Vos, A.F. (2000). “National Accounts Estimation Using Indicator Ratios” in: The Review of Income and Wealth, 46, no. 3, p. 329-350. Blackwell Publishing.

Morgan, M.G. and Henrion, M. (1990). Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis. Cambridge University Press: New York.

Odekerken-Smeets, M.E.P. (2005). Statistieken handel en transport [Statistics of trade and transport]. Internal Memo, CBS: Heerlen/Voorburg.

OECD (2001). Stan Indicators 1980–2001. OECD, Directorate for Science, Technology and Industry: Paris.

Roos, J. (2006). Internationale handelsstromen en de statistiek [International trade flows and the statistics]. Internet: www.cbs.nl, CBS Heerlen/Voorburg.

Roos, J. and Exel, J. (2006). Wederuitvoer: vaststellen van de definitie [Re-export: definition]. Internet: www.cbs.nl, CBS: Heerlen/Voorburg.

Rutten, R. (2000). Description of the good flows of international trade. Internal Memo, CBS: Heerlen/Voorburg.

Rutten, R. and Van Brummelen, M. (2001). Statistieken van de internationale handel in goederen [Statistics of the international goods trade]. Internal Memo, CBS: Heerlen/Voorburg.

United Nations (2005). UNSD Report on Standard Unit Values. Statistical Issues of UNSD-OECD Data Processing Project, United Nations Department of Economic and Social Affairs and Statistics Division International Trade Statistics Branch.

Wetenschappelijke Raad voor het Regeringsbeleid [Dutch Scientific Council for Government Policy] (2003). Nederland Handelsland: het perspectief van de transactiekosten [The Netherlands as a Trading Nation from the perspective of transaction costs]. Rapporten aan de Regering, no. 66, SDU Publishers: The Hague.

Appendix 1: NSTR classification

Table 6
NSTR classification at the 1–digit level, with subdivision of NSTR chapter 9

No.	Sector
0	Agricultural products; live animals
1	Food products and feed
2	Solid mineral fuels
3	Petroleum and petrochemical products
4	Ores and metal residues
5	Metals, metal semimanufactures
6	Crude minerals; building materials
7	Fertilizers
8	Chemical products
9	Other goods and manufactures,
of which:	
91	Transport equipment
92	Agricultural tractors and machinery
93	Appliances, engines, other machinery
94	Metal manifactures
95	Glass(ware), ceramics
96	Leather, footwear; textile, clothes
97	Other (semi)manufactures
99	Other goods (a.w. mixed cargo)

Appendix 2: Tables of integrated data on transport, trade and transit

Table 7a
Gross weight of incoming and outgoing international goods flows through the Netherlands by sector and continent of origin/destination in 2004: results after model application, NSTR chapters 0–3

	NSTR 0		NSTR 1		NSTR 2		NSTR 3	
	value	st.dev.	value	st.dev.	value	st.dev.	value	st.dev.
	1 000 tons							
Africa								
incoming transport	835	182	1 165	223	19 780	3 559	8 129	1 674
import	709	108	1 114	170	12 442	1 867	6 065	928
incoming transit	126	211	51	281	7 338	3 937	2 063	1 913
outgoing transport	569	126	1 345	304	14	3	2 203	492
export	569	88	1 276	195	8	1	1 650	253
outgoing transit	0	154	69	361	7	4	553	553
America								
incoming transport	2 148	469	14 294	2 645	21 769	3 882	3 719	766
import	1 843	280	13 651	2 048	13 731	2 054	2 773	424
incoming transit	306	546	643	3 255	8 038	4 280	946	876
outgoing transport	342	76	1 849	418	75	18	5 955	1 328
export	342	53	1 753	268	40	6	4 457	682
outgoing transit	0	92	95	496	36	19	1 498	1 493
Asia								
incoming transport	1 454	317	4 034	771	4 057	753	37 804	7 692
import	1 240	189	3 855	589	2 498	382	28 324	4 308
incoming transit	214	369	178	969	1 559	843	9 481	8 750
outgoing transport	519	115	1 717	388	60	14	893	199
export	519	80	1 629	249	31	5	669	102
outgoing transit	0	140	88	461	28	15	224	224
Europe								
incoming transport	16 002	2 845	20 180	3 595	8 079	1 496	117 027	20 398
import	15 555	2 096	19 263	2 831	5 001	762	88 658	12 870
incoming transit	448	2 789	917	4 309	3 078	1 674	28 370	21 733
outgoing transport	13 700	2 481	31 674	5 233	44 141	5 945	134 797	22 118
export	12 564	1 869	30 132	4 139	21 518	3 216	98 944	14 308
outgoing transit	1 136	2 766	1 542	4 960	22 623	5 615	35 854	22 097
Oceania								
incoming transport	271	59	194	37	7 053	1 307	185	38
import	229	35	186	28	4 360	664	138	21
incoming transit	42	68	9	47	2 693	1 463	47	43
outgoing transport	12	3	73	16	27	6	5	1
export	12	2	69	11	14	2	4	1
outgoing transit	0	3	4	20	13	7	1	1
Other								
incoming transport	0	0	0	0	0	0	6	1
import	0	0	0	0	0	0	4	1
incoming transit	0	0	0	0	0	0	1	1
outgoing transport	1	0	8	2	0	0	11 020	2 454
export	1	0	8	1	0	0	8 242	1 262
outgoing transit	0	0	0	2	0	0	2 778	2 758
Total								
incoming transport	20 712	2 851	39 867	4 273	60 738	5 217	166 869	20 971
import	19 576	2 117	38 068	3 436	38 031	2 923	125 962	13 475
incoming transit	1 136	2 768	1 799	4 940	22 707	5 615	40 908	22 068
outgoing transport	15 142	2 484	36 666	5 236	44 317	5 945	154 873	22 138
export	14 006	1 872	34 867	4 152	21 611	3 216	113 965	14 365
outgoing transit	1 136	2 768	1 799	4 940	22 707	5 615	40 908	22 068

Table 7b
Gross weight of incoming and outgoing international goods flows through the Netherlands by sector and continent of origin/destination in 2004: results after model application, NSTR chapters 4–7

	NSTR 4		NSTR 5		NSTR 6		NSTR 7	
	value	st.dev.	value	st.dev.	value	st.dev.	value	st.dev.
	1 000 tons							
Africa								
incoming transport	3 809	749	567	130	380	87	30	5
import	2 407	369	339	52	244	37	30	7
incoming transit	1 402	835	228	140	137	95	0	8
outgoing transport	2	1	207	48	323	78	45	8
export	1	0	133	20	165	25	45	11
outgoing transit	1	1	75	52	158	82	0	14
America								
incoming transport	43 345	7 128	1 032	236	1 414	324	5	1
import	25 236	3 859	618	95	907	139	5	1
incoming transit	18 109	7 676	414	254	507	352	0	1
outgoing transport	262	61	937	216	1 077	259	481	80
export	116	18	600	92	548	84	481	119
outgoing transit	146	64	338	235	528	272	0	144
Asia								
incoming transport	2 044	403	980	224	2 312	530	877	144
import	1 297	199	586	90	1 484	227	877	191
incoming transit	747	450	393	241	828	576	0	239
outgoing transport	2 109	494	537	124	416	100	54	9
export	935	143	344	53	212	32	54	13
outgoing transit	1 174	514	193	135	204	105	0	16
Europe								
incoming transport	11 256	2 172	16 353	2 992	58 440	8 771	5 592	891
import	6 998	1 076	9 930	1 469	39 443	5 628	5 592	1 152
incoming transit	4 258	2 417	6 422	3 063	18 997	8 099	0	1 394
outgoing transport	51 811	8 260	18 619	3 084	38 782	7 834	11 530	1 655
export	27 156	3 939	11 720	1 722	19 134	2 905	11 530	1 868
outgoing transit	24 656	7 898	6 899	3 067	19 648	8 084	0	1 413
Oceania								
incoming transport	3 969	780	135	31	218	50	0	0
import	2 508	385	81	12	140	21	0	0
incoming transit	1 462	870	54	33	78	54	0	0
outgoing transport	1	0	18	4	18	4	15	2
export	0	0	12	2	9	1	15	4
outgoing transit	0	0	7	5	9	4	0	4
Other								
incoming transport	1	0	0	0	0	0	0	0
import	1	0	0	0	0	0	0	0
incoming transit	0	0	0	0	0	0	0	0
outgoing transport	0	0	1	0	0	0	0	0
export	0	0	1	0	0	0	0	0
outgoing transit	0	0	0	0	0	0	0	0
Total								
incoming transport	64 423	7 360	19 066	2 997	62 764	8 766	6 504	901
import	38 446	4 027	11 555	1 475	42 217	5 633	6 504	1 164
incoming transit	25 977	7 891	7 512	3 066	20 547	8 087	0	1 408
outgoing transport	54 185	8 256	20 320	3 084	40 616	7 836	12 125	1 656
export	28 208	3 941	12 809	1 725	20 068	2 907	12 125	1 867
outgoing transit	25 977	7 891	7 512	3 066	20 547	8 087	0	1 408

Table 7c
Gross weight of incoming and outgoing international goods flows through the Netherlands by sector and continent of origin/destination in 2004: results after model application, NSTR chapter 8–9 and total

	NSTR 8		NSTR 9		Total	
	value	st.dev.	value	st.dev.	value	st.dev.
	1 000 tons					
Africa						
incoming transport	753	162	96	28	35 543	4 020
import	595	91	91	14	24 037	2 130
incoming transit	157	186	4	31	11 507	4 477
outgoing transport	461	104	452	138	5 622	623
export	393	60	381	58	4 620	343
outgoing transit	68	120	71	149	1 002	711
America						
incoming transport	4 688	1 009	953	276	93 367	8 656
import	3 721	568	907	139	63 391	4 892
incoming transit	967	1 156	46	309	29 976	9 514
outgoing transport	2 255	507	896	273	14 128	1 549
export	1 921	294	756	116	11 015	819
outgoing transit	334	586	139	296	3 114	1 752
Asia						
incoming transport	3 066	660	8 488	2 340	65 116	8 176
import	2 431	372	7 905	1 206	50 497	4 563
incoming transit	636	757	582	2 597	14 619	9 291
outgoing transport	4 604	1 031	1 415	431	12 323	1 312
export	3 915	599	1 196	183	9 504	704
outgoing transit	689	1 190	218	468	2 819	1 487
Europe						
incoming transport	33 924	6 204	19 132	4 430	305 985	24 266
import	27 575	3 980	17 313	2 573	235 326	15 408
incoming transit	6 349	6 603	1 820	4 670	70 659	25 488
outgoing transport	40 224	6 667	19 976	4 767	405 254	27 697
export	33 204	4 744	17 981	2 609	283 881	17 188
outgoing transit	7 021	6 652	1 995	4 786	121 372	27 538
Oceania						
incoming transport	62	13	7	2	12 094	1 526
import	49	7	7	1	7 696	770
incoming transit	13	15	0	2	4 398	1 706
outgoing transport	79	18	118	36	366	44
export	68	10	99	15	302	22
outgoing transit	12	21	19	39	64	49
Other						
incoming transport	1	0	1	0	10	1
import	1	0	1	0	8	1
incoming transit	0	0	0	0	2	1
outgoing transport	3	1	66	20	11 099	2 454
export	3	0	55	8	8 309	1 262
outgoing transit	0	1	10	22	2 790	2 758
Total						
incoming transport	42 494	6 250	28 677	4 638	512 115	26 358
import	34 372	4 027	26 225	2 804	380 955	16 792
incoming transit	8 123	6 630	2 453	4 784	131 160	27 504
outgoing transport	47 627	6 680	22 922	4 770	448 793	27 717
export	39 504	4 778	20 469	2 617	317 632	17 250
outgoing transit	8 123	6 630	2 453	4 784	131 160	27 504