Linking Trade and Transport Statistics: The Dutch case

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Abstract

International trade flows are are an important source of income, value added, and welfare for a small open economy as The Netherlands. Trade flows are strongly related to transport flows of goods to and from a country. However, not all international transport flows through a country are registered as merchandize trade flows. For example, transit flows of goods are not recorded in international merchandize trade statistics. Such flows can just as well serve as a basis for value added, though. For example, goods transferred in Rotterdam harbour and transported and distributed by Dutch logistics firms create a basis for value added in services trade. Moreover, transport flows of goods entail costs as well, such as the costs of traffic congestion and environmental pollution. Therefore, it is of interest to have adequate information on the value and quantities of goods transported through countries, and the modes of transport used for various types of flows. For this purpose, we need integrated statistics on trade flows and transport flows in goods. In order to match trade and transit flows with transport statistics, complete and plausible information on mode of transport and gross weight is needed. This paper describes the scope and coverage of trade statistics in comparison to transport statistics for the Netherlands. We use transport statistics to allocate the plausible mode of transport to trade and transit flows. By creating an integrated view on trade and transport flows in goods, the paper intends to contribute to an improved understanding of the impact of merchandize trade and transit flows on the economy, both in terms of domestic value added and in terms of potential social costs related to congestion and the emission of pollutants.

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1. Introduction

The Netherlands can best be characterized as a small open economy. Because of its small size, compared to the global economy, foreign markets are an important outlet of products and provide a valuable supply of goods and services for consumption and intermediate use. The importance of foreign markets for the Netherlands at least goes back to the Golden Age. The economic successes achieved in those days were largely related to the international orientation of the Dutch economy and its succes and achieving a central position in increasingly complex trade networks, acting as a staple market and distribution centre for goods flows on the international market. A proper understanding of international flows of goods is hence of paramount importance for a country such as the Netherlands. These flows include both international trade in goods (exports from and imports into the Netherlands), as well as transit trade (goods transported to other countries via the Netherlands).

International merchandize trade and transit trade are directly related to international transportation of goods. To analyze the importance of international good flows for the Netherlands, we therefore need an integrated view on trade and transport flows of goods. This paper is the first result of an ongoing research effort to integrate statistics on trade and transport flows of goods. The structure of the paper is as follows. Section 2 provides a motivation for the need to integrate both statistics and describes the approach to be followed. Section 3 describes the international goods flows of the Netherlands for 2004, on the basis of available information from the statistics on external trade. Finally, Section 4 concludes the paper and sets out a path for further research on the integration of trade and transport statistics.

2. Motivation and background

International goods trade and transport are directly related. Goods are imported or exported, or are on transit 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 on waterways, for example. Moreover, both trade flows and transit flows have an impact on the Dutch economy. Both provide a source of income: trade directly, in the form of merchandize exports from domestic production and trader services, while transit flows enable value added creation in the form of transport and logistic services (see Roos, 2006). Moreover, as far as goods trade and transit imply transportation to, from and through the Netherlands,

international goods flows entail external costs associated with congestion and pollution. Both the potential for economic gains and the potential costs of being a trading and distribution nation are likely to increase with further international economic integration. The ongoing process of globalization and the rise of new markets in Asia (China, India) can be expected to increase the goods flows to and through the Netherlands.

In order to analyse international flows of merchandize, and to increase our understanding of the impact of these flows on the economy, an integrated view of the relevant aspects of trade and transit is required. The relevant required information ideally includes:

- value and weight of international goods flows of the Netherlands;
- country of origin and destination of the goods;
- mode of transport of the goods flows;
- type of goods flow (e.g., export, import, re-export, transit, transito trade);
- level of detail of the industrial classification (sectoral aggregation).

These characteristics of goods flows are not consistently available in a single statistics for all types of international goods flows. However, the information contained separately in the transport statistics and the trade statistics offers the opportunity to acquire a complete picture of international flows of merchandize for the Netherlands. Trade statistics record all international goods flows that comprise export or import for the Netherlands. Moreover, transit flows that enter the European Union via the Netherlands, and are cleared for the common market, are also registered in accordance to the community concept of trade (see Rutten and Van Brummelen, 2001). However, goods flows that do not involve ownership for Dutch residents, and that are not cleared for the common market, are generally not recorded in trade statistics. This implies that these transport transit flows are not registered in trade statistics. Transport statistics report transported weights for all incoming and outgoing international goods flows of the Netherlands. However, these statistics do not distinguish between transit flows and trade flows. Table 1 below gives a more detailed overview of the information that is in principle available in the two separate statistics.

Table 1. International goods flows in reported statistics.

Transport statistics	Type of goods flow	Trade statistics
Transported weights by mode of transport and location of loading or unloading	Import for end use or processing Export from domestic production	Value and weight or quantity by mode of transport
	Re-export	Value and weight or quantity by mode of transport
	Quasi Transit flows (EU trade for community concept)	Value and weight or quantity by mode of transport
	Transport Transit (including via customs warehouse)	Not registered

As both statistics include information on transported weight, the statistics can be integrated by matching on weights. Integration of these separate statistics on international goods flows yields several benefits. First, 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. The primary data collected for the sake of compiling trade statistics are incomplete and of problematic quality for the mode of transport, especially regarding road transport. Second, by comparing both statistics, transport transit can be quantified in terms of total weight, as the subtraction of the combined weight of all international goods flows recorded by transport statistics minus the combined weight of the international goods flows identified in trade statistics.

In order to match both statistics, several additional difficulties have to be overcome, though. First, part of the transactions in trade statistics does not report weights, but alternative units of measurement (such as pieces, litres, etc.). Therefore, incomplete weights data have to be supplemented. Second, weights in trade statistics are net of packaging whereas the transport statistics report gross weights including packaging and furthermore include container weight for containerised flows. To be comparable, all weights first need to be expressed in equal units. When this has been accomplished, trade and transport flows can be compared in terms of gross weights. Matching both flows, we can address the issues of

estimating transit flows, assigning plausible information on the mode of transport to trade flows when that information is missing or implausible in reported trade statistics.

A further difficulty for progressing into a more detailed integration is posed by the fact that country of origin and destination (versus loading and unloading) information from both statistics is not strictly comparable. Moreover, a significant part of the information in transport statistics is in terms of containerized goods, for which no further information on sectoral composition is available. This leads to problems when we want to proceed with a more detailed integration of the statistics on international goods flows of the Netherlands at the industry and country level.

Before describing the method followed in more detail, we first discuss the different types of international merchandize flows for the Netherlands, and present a quantitative overview based on the trade statistics for 2004.
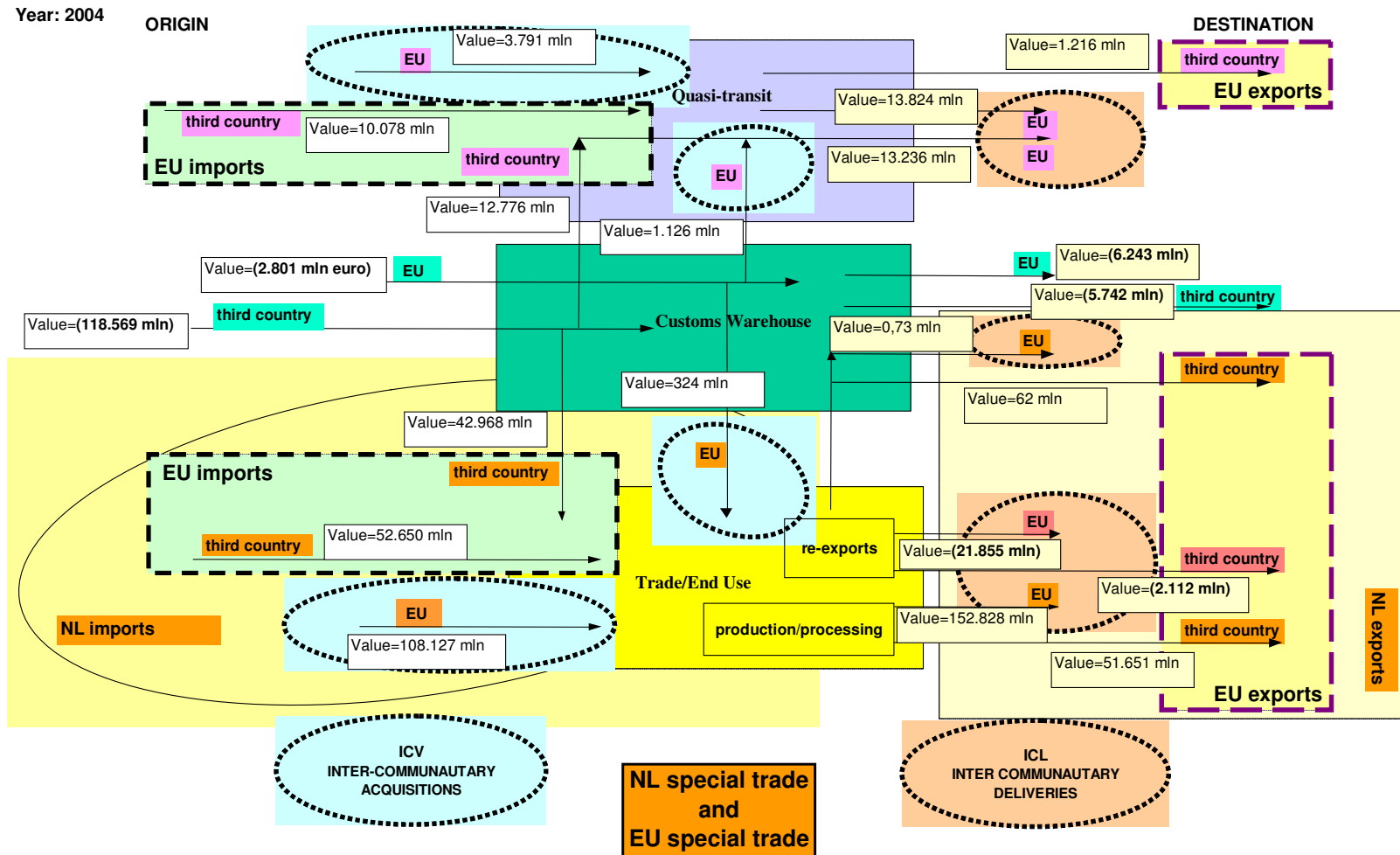
3. International goods flows of the Netherlands: an overview of trade statistics

Trade statistics contain all international goods flows administered by customs or in which Dutch residents have an ownership relation. As indicated in Table 1, this entails various types of goods flows. They include both trade and transit flows; some count as Dutch trade, others as trade of the European Union, and others are registered only as entering or leaving customs warehouses. Figure 1 below presents an overview of the different types of flows, with accompanying values for the most important representative flows for 2004 (based on Rutten, 2000).[1]

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[1]   Hence, the included values do not give a complete picture of incoming and outgoing flows for the Netherlands. Therefore, there are some discrepancies between total incoming quasi-transit and total outgoing quasi-transit. Furthermore, these values do not include estimated supplementations to trade flows, nor imputed supplementations to trade and quasi-transit.

Figure 1. International goods flow schedule.

Year: 2004 **ORIGIN**

DESTINATION

Value=3.791 mln

EU

third country Value=10.078 mln

EU imports

third country

Value=12.776 mln

Value=1.126 mln

Quasi-transit

Value=13.824 mln

Value=13.236 mln

EU

EU

EU

Value=1.216 mln

third country

EU exports

Value=(2.801 mln euro) **EU**

Value=(118.569 mln) **third country**

Customs Warehouse

Value=324 mln

Value=0,73 mln

EU

Value=(6.243 mln)

Value=(5.742 mln) **third country**

Value=62 mln

third country

Value=42.968 mln

EU imports

third country

third country Value=52.650 mln

Trade/End Use

EU

EU

re-exports Value=(21.855 mln)

EU

Value=(2.112 mln)

production/processing Value=152.828 mln

third country

NL imports

EU

Value=108.127 mln

Value=51.651 mln

EU exports

NL exports

**ICV
INTER-COMMUNAUTARY
ACQUISITIONS**

**NL special trade
and
EU special trade**

**ICL
INTER COMMUNAUTARY
DELIVERIES**

Notes: The flows included are representative and include the major international merchandize flows, but the schedule is not exhaustive. Imputed flows and supplementary estimations are not included. All values are in Euro. The values in brackets, for incoming and outgoing customs warehouse transit and re-exports, are unreliable. The reported figures for re-exports in trade statistics substantially underestimate the relative importance of these flows; estimations reported elsewhere by CBS indicate that re-exports may on average account for 40% of aggregate exports.

From the flow schedule in Figure 1, we can identify three types of flows: quasi-transit flows, customs warehouse flows and trade flows (see Roos, 2006). Only import and export flows located in the box at the bottom of the figure count as Dutch trade according to the so-called *national concept*. Flows that enter the Netherlands (either directly or via customs warehouses) for end use or significant processing qualify as imports into the Netherlands. These flows either involve incoming goods from abroad that become property of Dutch residents, or goods that are used for substantial processing in the Netherlands (whether or not involving Dutch ownership). Flows that leave the Netherlands and have been either property of Dutch residents, or have been processed extensively classify as exports according to the national concept of trade. Goods that have been produced domestically are labelled as exports from domestic production, whereas goods that have been imported as property of Dutch traders only to be exported again without any significant processing are denoted as re-exports.

The box at the top of Figure 1 includes international goods flows without relation to Dutch trade, but for which the Netherlands acts as the entry or exit point for the European Union's (EU) Common Market. These flows are essentially transit flows, which pass through the Netherlands with no or only marginal processing. However, because the Netherlands acts as customs for the EU, the goods are registered for clearance on the EU market (incoming quasi-transit), or export documents are compiled for leaving the EU market to a so-called third country (outgoing quasi-transit). Because of the administrative procedures involved, these transit flows are registered in Dutch trade statistics as EU-trade through the Netherlands, according to the *community concept*. Therefore, this part of transit flows is denoted as quasi-transit. A large part of transit flows is not registered in trade statistics, however. This includes for example flows between two EU countries which cross through the Netherlands, and flows from third countries that pass through Dutch ports on their way to other third countries, without any customs clearance involved. These transport transit flows are only transported through the Netherlands, with or without re-loading for further transport to the final destination, and are not stored in commercial warehouses or cleared for the EU market.

Both trade and quasi-transit can flow through customs warehouses, as shown in Figure 1. Goods enter customs warehouses if they are not cleared for import into the EU market, for temporary storage under customs control. Upon leaving the warehouse, the goods may be cleared for the common market, and the flows enter trade or quasi-transit statistics. However, part of the flows released from customs warehouses leave for a destination in third countries

without being further stored or processed in the Netherlands. Hence, these flows are part of transit flows. Because the value of goods flows is only well registered for the purpose of the national and community concepts of trade, Figure 1 does not report any values for the incoming storage flows in customs warehouses, and the outgoing transit flows from customs warehouses.

The remainder of this section further illustrates the size and distribution of international goods flows for 2004, in a variety of charts and graphs. Usually, the trade statistics are mainly used to present developments in terms of value for exports and imports. We follow this line, but also include data on quasi-transit flows, viz. purely transport related goods flows that are registered by Dutch customs. This provides a first illustration of the transit flow dimension of international goods flows. Explicitly distinguishing the type of flow is also relevant for assessing the meaning and importance of these flows within the context of the Dutch economy. As argued in the context of the flow diagram in Figure 1, we exclude customs warehouse storage and customs warehouse export flows. A substantial part of the incoming customs warehouse flows will be released from the warehouse for purposes of import or quasi-transit, and are registered as such within these flows. The remaining customs transit flows (part of the transport transit flows) are not registered adequately in trade statistics. Furthermore, we apply the presented statistics for an additional purpose: we use data from trade statistics to assess exports and imports of manufacturing industries, classified according to the degree of technological sophistication. This classification, based on an OECD typology (OECD, 2001), distinguishes four categories of manufactures (in ascending order of technological sophistication): low-technology, medium-low technology, medium-high technology and high-technology industries.

Figure 2. International goods flows of the Netherlands (2004): incoming vs. outgoing flows.

Incoming and Outgoing International Goods Flows
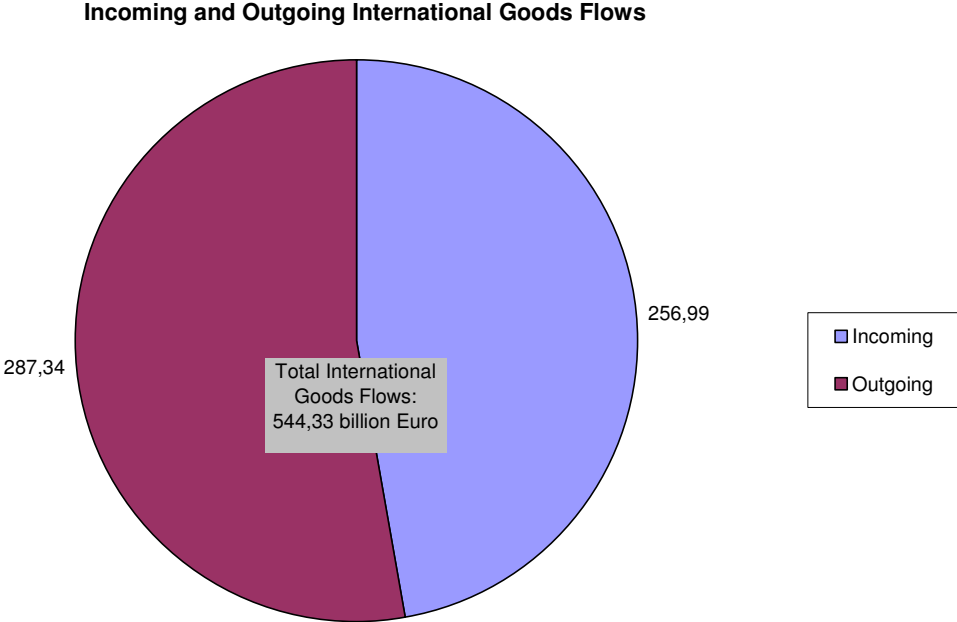
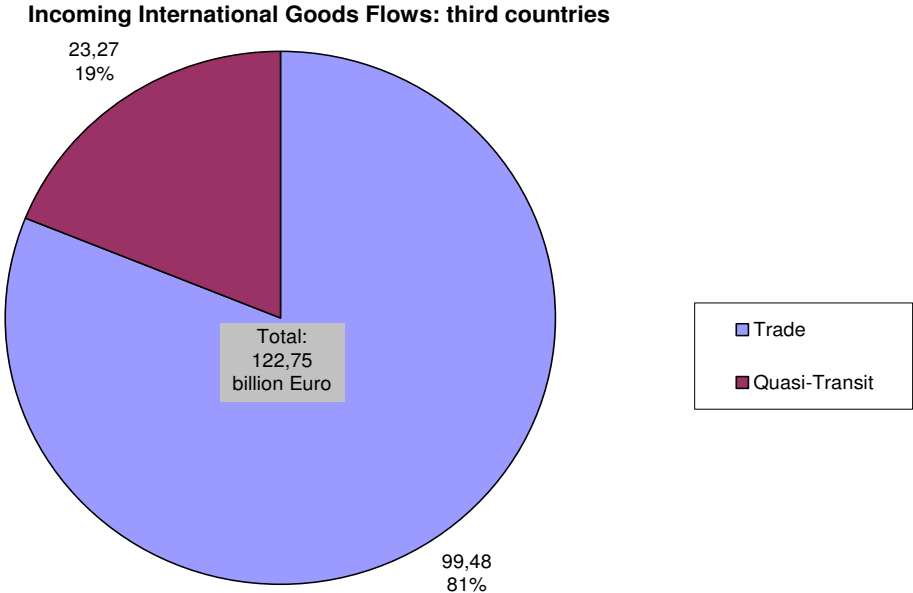*Notes:* International goods flows include trade and quasi-transit; customs warehouse storage flows are excluded. Trade is defined as Dutch imports and exports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

Figure 3. Incoming goods flows of the Netherlands (2004): intra-EU vs. third country flows.

Incoming International Goods Flows: intra-EU vs. third countries
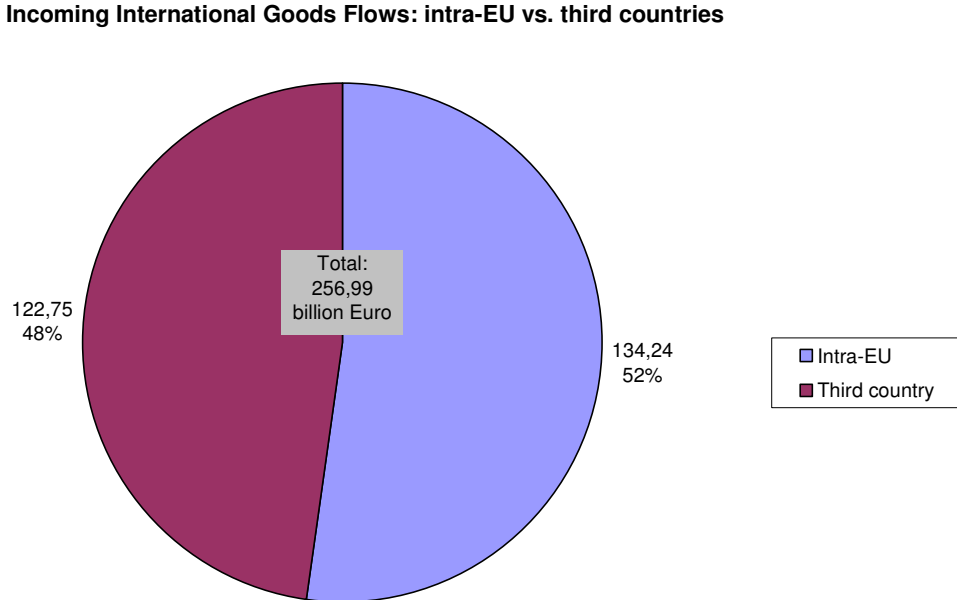
Notes: Incoming goods flows include trade and quasi-transit; customs warehouse storage flows are excluded. Trade is defined as Dutch imports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

Figure 4. Incoming goods flows according to type of flow: intra-EU flows for 2004.
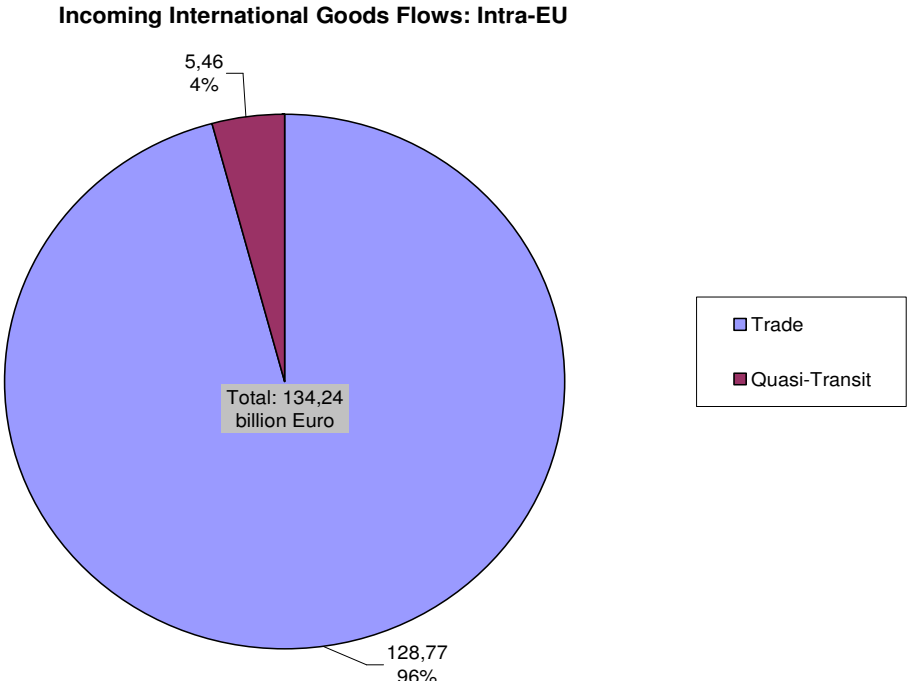
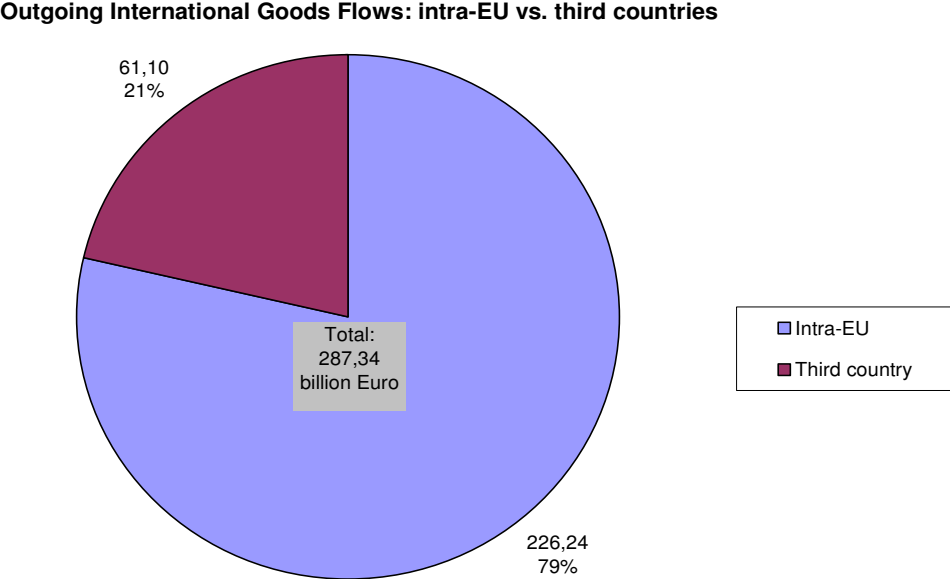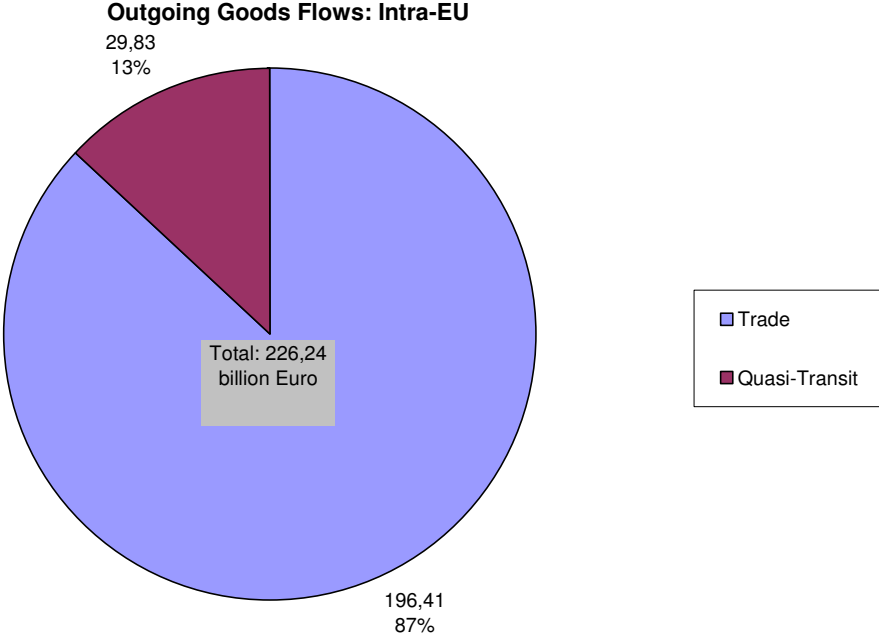**Incoming International Goods Flows: Intra-EU**

Notes: Flows include incoming trade and quasi-transit. Incoming trade is defined as Dutch imports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

Figure 5. Incoming goods flows according to type of flow: third-country flows for 2004.

Incoming International Goods Flows: third countries

Notes: Flows include incoming trade and quasi-transit. Incoming trade is defined as Dutch imports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

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Figure 6. Outgoing goods flows of the Netherlands (2004): intra-EU vs. third country flows.

**Outgoing International Goods Flows: intra-EU vs. third countries**

Notes: Outgoing goods flows include trade and quasi-transit; customs warehouse storage flows are excluded. Trade is defined as Dutch exports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

Figure 7. Outgoing goods flows according to type of flow: intra-EU flows for 2004.

**Outgoing Goods Flows: Intra-EU**

Notes: Flows include outgoing trade and quasi-transit. Outgoing trade is defined as Dutch exports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

Figure 8. Outgoing goods flows according to type of flow: extra-EU flows for 2004.
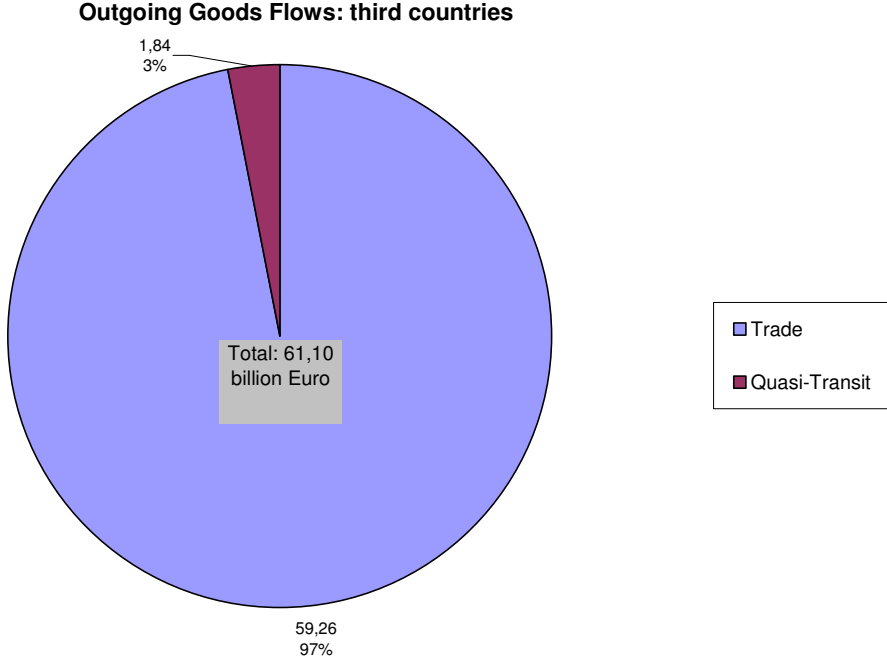
Outgoing Goods Flows: third countries

Notes: Flows include outgoing trade and quasi-transit. Outgoing trade is defined as Dutch exports according to the national concept. Trade includes estimated supplementations and imputed supplementations. Quasi-transit includes imputed supplementations.

Figure 9. Distribution by continent: incoming goods flows (2004).
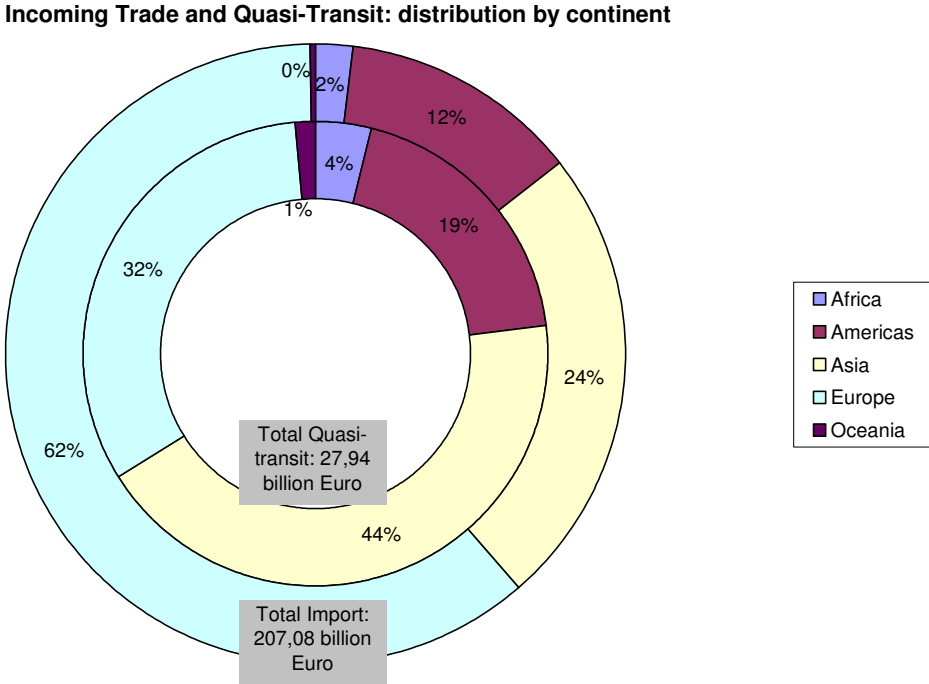
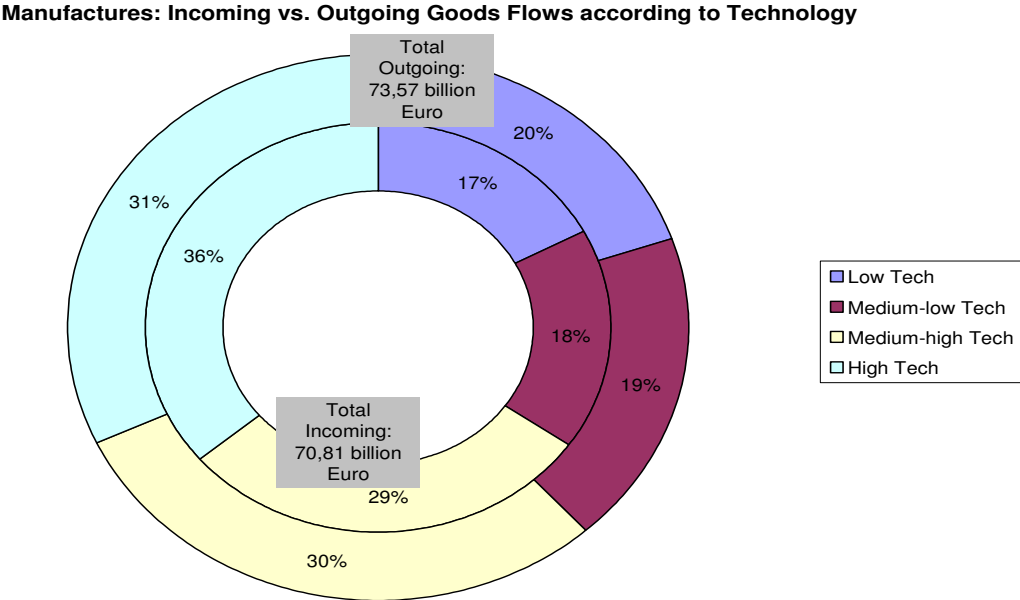**Incoming Trade and Quasi-Transit: distribution by continent**

Notes: Flows include incoming trade and quasi-transit, as defined before. Estimated supplementations and imputed supplementations are not included. Flows with unknown origin or destination are small, but positive. These flows have been excluded from the figure. The outer ring depicts trade, the inner ring depicts quasi-transit.

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Figure 10. Distribution by continent: outgoing goods flows (2004).
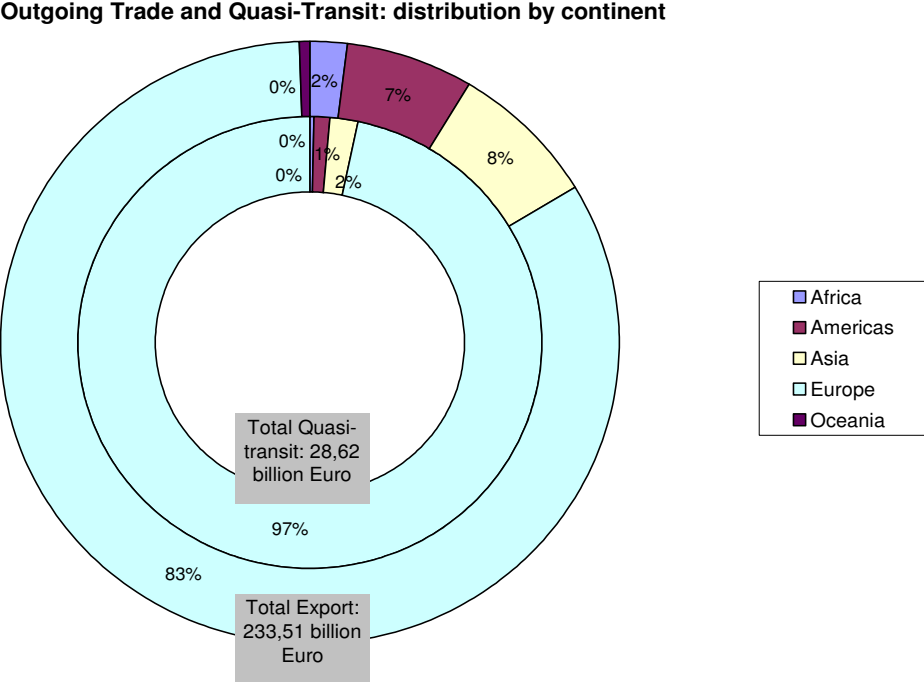
Outgoing Trade and Quasi-Transit: distribution by continent

Notes: Flows include outgoing trade and quasi-transit, as defined before. Estimated supplementations and imputed supplementations are not included. Flows with unknown origin or destination are small, but positive. These flows have been excluded from the figure. The outer ring depicts trade, the inner ring depicts quasi-transit.

Figure 11. Manufacturing goods flows according to technological sophistication (2004).

Manufactures: Incoming vs. Outgoing Goods Flows according to Technology

Notes: Flows include trade and quasi-transit, as defined before, for manufacturing industries classified according to technological sophistication in OECD (2001). The typology distinguishes 4 types: low-technology, medium-low technology, medium-high technology, high technology; for more information, see OECD (2001). Estimated supplementations and imputed supplementations are not included. The outer ring depicts outgoing flows; the inner ring depicts incoming flows.

Figure 12. Manufacturing imports and incoming quasi-transit of Low-technology goods (2004).
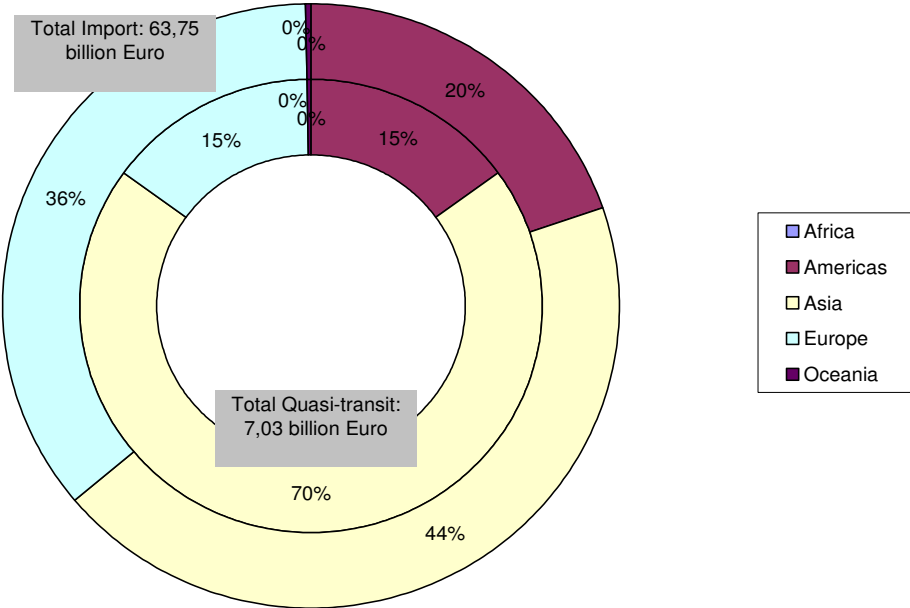
Manufactures: Incoming Low Technology According to Continent and Type of Flow
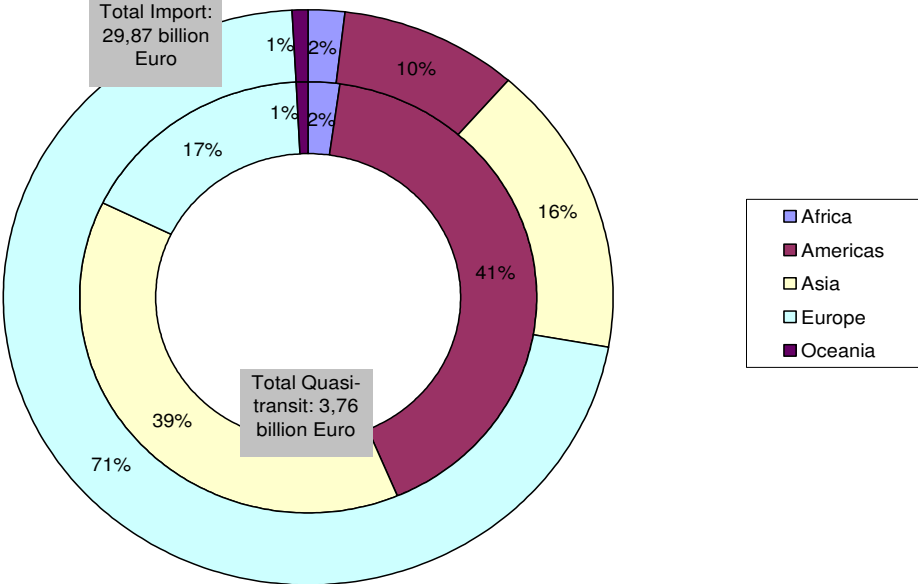
Notes: Flows defined as in previous figure. Flows with unknown origin or destination are small, but positive. These flows have been excluded from the figure. The outer ring depicts imports; the inner ring depicts incoming quasi-transit.

Figure 13. Manufacturing imports and incoming quasi-transit of High-technology goods (2004).
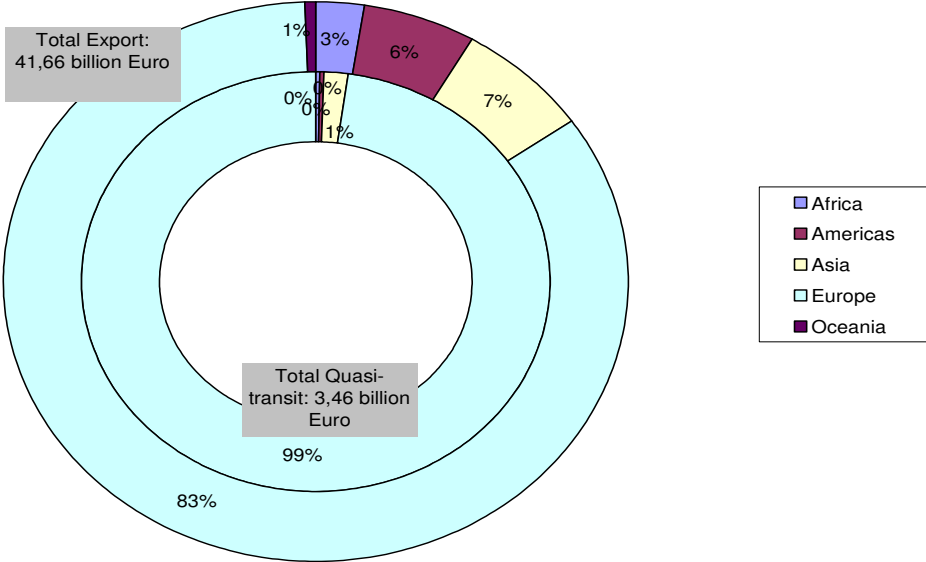
Manufactures: Incoming High Technology According to Continent and Type of Flow

Notes: Flows defined as in previous figure. Flows with unknown origin or destination are small, but positive. These flows have been excluded from the figure. The outer ring depicts imports; the inner ring depicts incoming quasi-transit.

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Figure 14. Manufacturing exports and outgoing quasi-transit of Low-technology goods (2004).
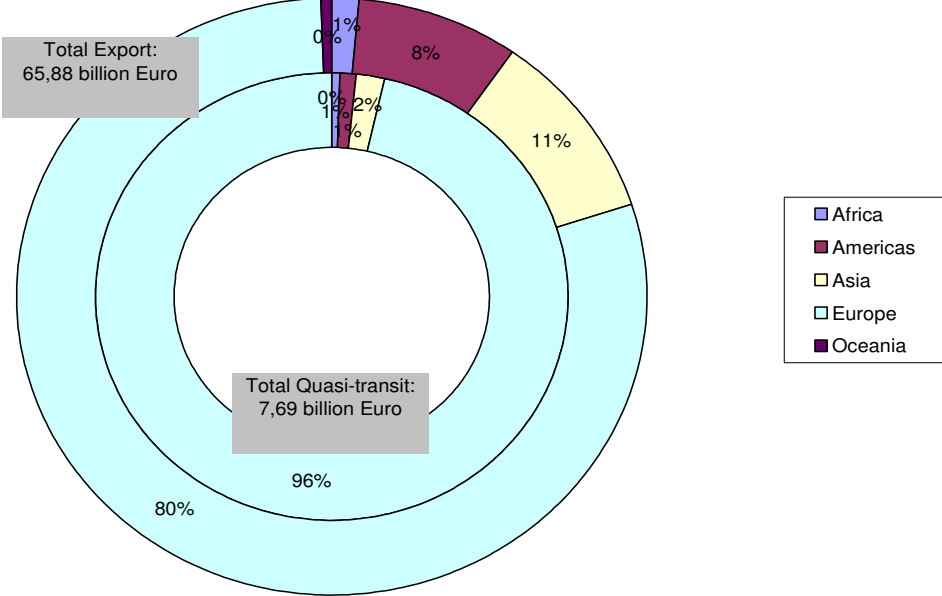
Manufactures: Outgoing Low Tech According to Continent and Type of Flow

Notes: Flows defined as in previous figure. Flows with unknown origin or destination are small, but positive. These flows have been excluded from the figure. The outer ring depicts exports; the inner ring depicts outgoing quasi-transit.

Figure 15. Manufacturing exports and outgoing quasi-transit of High-technology goods (2004).

Manufactures: Outgoing High Tech According to Continent and Type of Flow

Notes: Flows defined as in previous figure. Flows with unknown origin or destination are small, but positive. These flows have been excluded from the figure. The outer ring depicts exports, the inner ring depicts outgoing quasi-transit.

Approximately 40% of exports from the Netherlands concerns re-export (see CBS, 2006). Especially, in some high tech sectors the share of re-export is very high. This could influence the Dutch position in high tech trade with other countries.

4. Integration of trade and transport statistics: method

At present, the methodology for integration at the aggregate level for different types of goods flows has been developed. Application of the necessary conversions is about to begin. In this section, we discuss the method developed for integration of trade and transport statistics.

4.1 Integration of trade and transport statistics: fundamental equations

As indicated in Table 1, both trade and transport statistics report the weight of international goods flows. We have noted in Section 2 that this provides the starting point for the aggregation efforts. On the basis of comparable weight units, trade and transport statistics can be linked, and information from both statistics can be shared and integrated. The first application of integrated information from both statistics is to allow us to derive estimates for the transport transit flows which are not separately quantified in either trade statistics or transport statistics. The equations below illustrate the essentials of this approach at the aggregate level for total transport transit flows (see Odekerken-Smeets, 2005).

Fundamental definition equation 1: Total international transport[2]

$\sum$ gross weight (transport statistics) - $\sum$ gross weight (trade statistics) = $\sum$ gross weight (transport transit)

Fundamental definition equation 2: Incoming goods flows

$\sum$ gross weight (incoming) = $\sum$ gross weight (import) + $\sum$ gross weight (incoming transit)

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[2]   In the expositions in this sub-section, we use a broad definition of trade, import, and export, which include all (incoming and/or outgoing) goods flows in trade statistics. Hence, we use the community concept as definition for trade (including quasi-transit). On the other hand, the flows not registered (adequately) in trade statistics, pure transport transit and customs warehouse transit, are separately combined into the category 'transit'.

Fundamental definition equation 3: Outgoing goods flows

$\sum$ gross weight (outgoing) = $\sum$ gross weight (export) + $\sum$ gross weight (outgoing transit)

If these observations are complete and adequate in both statistics, we subsequently arrive at:

Fundamental definition equation 4: Transit

$\sum$ gross weight (incoming transit) = $\sum$ gross weight (outgoing transit)

In order to enable the integration of trade and transport statistics, we need to express both statistics in comparable weight variables. Trade statistics are based on net weights of goods, while transport statistics report gross weights. For goods that are packed, gross weights include the weight of the packaging material. Moreover, trade statistics sometimes report alternative measures of quantity (supplementary units) instead of net weight. We have chosen to transform quantity and weight data of trade statistics to a common unit, equivalent to the unit prevalent in transport statistics. 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.

The following sub-section discusses these two transformations.

4.2 Supplementary units and net weight: transformation to gross weight

Trade statistics classify international merchandize transactions according to the Combined Nomenclature (CN), which is an 8-digit extension of the Harmonized System (HS) classification. This classification distinguishes more than 10,000 items, of which almost 3000 items report alternative measures of quantity, other than net weight. Of in total 30 alternative measures, the most common are numbers of goods or volumes. For trade with other EU member countries, weights are not always registered for items with alternative measures. For international goods flows to and from third countries, instead, transported weights have to be reported to customs. 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. We have used customs data for goods flows involving third countries to calculate the conversion factors from measure to net weight in terms of gram per unit of quantity.

Customs data report both weights and supplementary units traded. On the basis of customs files for 2004, for both incoming and outgoing international goods flows, we have computed conversion factors for each registered transaction. Subsequently, we have filtered the results by comparing them to averages per CN-item on a monthly basis. All outcomes that deviate more than one standard deviation from their corresponding monthly average have been excluded. Finally, we have 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 has been calculated from these totals as the average ratio between weight and supplementary unit:[3]

$$NMF = {Netweight}/{Quantity} *1000 \ ,$$

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, the weight indicator in trade statistics has to be transformed to match transport statistics. A procedure similar to the one explained above yields conversion factors from net to gross weights. Customs data for outgoing goods flows report both gross and net weight. These data provide information that we have used to construct conversion factors by CN-item. Again, we have compared conversion factors for individual transactions with monthly averages by item. We have decided that any individual factor exceeding a ratio of three between gross weight and net weight is excluded from the calculations of the final conversion factor. After excluding these observations, monthly averages have been computed; those observations that yielded

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[3] In fact, a second selection was applied in order to filter potential outlier observations for CN-items that only occurred 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 has been computed by CN-item.

conversion factors more than one standard deviation from the mean were excluded.[4] 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.

$$GNF = {Grossweight}/{Netweight} \text{,}$$

where *GNF* is the conversion factor measured as the ratio between net weight and gross weight, *Net weight* is measured in kg as before, and Gross weight is measured in kg as well.

Application of the yearly average conversion factors by CN-item results in trade statistics in terms of gross weights. These can be matched to gross weights in transport statistics according to the fundamental equations introduced in Section 4.1. The next section will discuss the further steps to be taken in applying and extending the methodology for integration of trade and transport statistics.

5. By means of conclusion: forthcoming integration objectives and approach

One of the objectives of integrating trade and transport statistics is to offer a better picture of the size and importance of various types of international goods flows, most importantly transit flows versus trade flows. As we argued before, not only merchandize trade flows but also purely transport related goods flows have an important position for the Netherlands as a logistical hub and trading nation (see HIDC, 2005 and WRR, 2003). Matching trade and transport flows using the converted information in terms of gross weights enables an assessment of the importance of these flows at the aggregate level, including the transport transit flows that could not be explicitly identified before.

As described in Section 4, several steps have already been taken to enable integration at the aggregate level. We have assessed the data availability and comparability of trade and transport statistics, and developed a method for integration. Conversion factors have been determined by CN-item. The next phase in the integration project will be to finalize the aggregate integration. Two steps need to be taken to complete this phase. First, transport

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[4] For most CN-items, packaging weighing twice as much as the product itself is deemed improbable. 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 and the like) 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.

statistics for containerized flows have to be expressed in terms of gross weights. These flows are currently denominated in weights including both packaging and container weight. If this information has become available, both trade and transport statistics can be expressed in terms of gross weights. This allows a comparison at the level of the fundamental equations described in Section 4.

However, the objectives of the integration project reach further. Ultimately, the project not only aims at a comparison of international goods flows at the aggregate level, but intends to use the information available from both statistics to provide a consistent and more complete integrated view of the mode of transport, origin and destination, and sectoral distribution of the different types of trade and transit flows in terms of value and weight. For these purposes, the integration will be extended to assign plausible modes of transport to international goods flows at the NSTR 2-digit level, according to the country of origin or destination.

In Section 2 we have noted several difficulties for refining the integrated trade and transport statistics in these dimensions. With respect to the information on transport mode:

- mode of transport data has only limited availability for intra-European trade statistics, due to changes in requirement for reporting by respondents;
- the reported figures on road transport in trade statistics probably overstate the true importance of road transport as the mode of transport for international goods flows at the border.

Furthermore, we have noticed difficulties with origin and destination figures and sectoral disaggregation:

- the designated origin or destination of international goods flows in trade statistics is determined differently from the country of loading or unloading in transport statistics. Transport statistics register the last country involved, which may be influenced by transhipment of goods between origin and destination;
- for containerized flows, which form a substantial part of the flows in transport statistics, no precise sectoral decomposition is available.

To deal with these problems, we have to make assumptions from which to move onwards. With regard to the mode of transport, we depart from the realistic premise that transport statistics provide reliable information on the mode of transport for international goods flows.

Therefore, we will supplement missing transport mode data in trade statistics by imposing the distribution of weights across transport modes from transport statistics for the corresponding country. A similar approach will be followed to check implausible observations of road transport in combination with country of origin or destination in trade statistics.

Because the origin/destination designations from trade and transport statistics have different definitions, we have decided to first limit the scope of the integrated data by identifying only country aggregates: groups of countries at a (sub)-continental level. We have already used a division in continents in our presentation of trade statistics in Section 3.

The decomposition of containerized flows into their sectoral components remains an issue for further attention. A possible route would be to identify those divisions in the NSTR classification that are bulk (non-containerized), such as minerals, raw materials and fossil fuels. Moreover, the contents of containers are at least partly known from transport statistics. This differs between modes of transport and depends on the availability of information from the side of the data-supplier. Mostly, the data supplier is not exactly aware of the contents of the transported container. Of course, in case of dangerous goods this is no issue. So, only a part of the transported goods in containers can be directly linked to trade statistics. For the remaining part (in transport statistics often called "consolidated goods" or "general cargo") the precise distribution of weights can be gauged on the basis of corresponding value and weight distributions in trade statistics across the NSTR divisions involved.

The approach described above to determine transport transit and supplement missing data in trade statistics regarding mode of transport makes use of the corresponding distributions of weights in transport statistics. However, trade statistics also include values of goods flows, which is their main focus. Thus, we also need a way to supplement the corresponding values for corrected or supplemented mode of transport entries in the integrated statistics. Furthermore, we may also take interest in the values corresponding to the transport transit flows. Therefore, we also intend to assign values to these flows. In order to derive values from the assigned weights, unit value indices have to be determined (in euro per kg gross weight). Using observed values goods flows in trade statistics, supplemented with gross weights computed using the conversion factors determined in the first stage of the integration project, unit values can be computed using a selection methodology described by the UN statistical division to filter outliers from the observations used (see UNSD, 2005). For determining unit values of transport transit, we could apply the ratio between value and

weight that applies to total international goods flows in trade statistics to the weight of transport transit as determined in the previous stage of the integration of both statistics. Alternatively, we may use unit values determined specifically for quasi-transit flows in trade statistics as the benchmark. The underlying assumption of using these unit values to determine the total value of transport transit is that the composition of transport transit is on average comparable with that of the flows used to compute average unit values. Quasi-transit flows may provide a better approximation of the average composition of transport transit.

As we discussed before, missing mode of transport figures for intra-EU trade and quasi-transit flows in trade statistics have to be determined on the basis of transport statistics. However, transport statistics can only provide plausible information for transported weights per mode of transport on the basis of the country of loading or unloading. In order to determine the corresponding distribution for the registered values for the relevant flows in trade statistics across transport mode, unit values have to be used. These can be determined by transport mode and by country of origin or destination on the basis of those observations in trade statistics that are complete on these dimensions. The same procedure to determine and apply unit values will be used to construct the distribution of values and weights across transport modes in trade statistics for those observations for which reported road transport is unlikely to be the correct mode of transport.

An important paradox emerges when we consider the approaches to refine the integrated statistics of international trade and transport. On the one hand, we have to make considerable assumptions on the underlying data structure in order to refine the matching between trade and transport statistics. This implies that the accuracy of matched statistics may be expected to decline when moving to a greater detail in terms of the combinations of characteristics of the flows. Total transport transit needs less assumptions to be made, and will be less sensitive to the accuracy of the approach, while assigning mode of transport data on a sectoral level for transport transit flows is more sensitive to discretionary assumptions. On the other hand, supplementing mode of transport data and value-weight distributions will be more accurate when performed at a more disaggregate sectoral level. Unit values, for example, will be more accurate at a sectoral level or by transport mode, when we need to apply them to specific goods flows and transport modes. Because of the trade offs between accuracy and detail of the integration, we will make use of both direct assessment of integration outcomes at a detailed level, for specific combinations of the characteristics of goods flows (mode of

transport, country(-group) of origin and destination, by NSTR division), and develop a model to estimate these combination cells in the database on the basis of more robust integration outcomes at a more aggregate level (for example, by transport mode, or by country-group: 'row totals' in the database). Both approaches are complementary, because we can use specific combination cells that we have determined directly by integrating statistics under specific assumptions in the iterative procedures of estimating the combination cells in the model. For example, we can use the integration outcomes in terms of values and weights of assigning mode of transport by country of origin or destination, or the outcomes of assigning a sectoral distribution of value and weight to containerized flows. Table 2 illustrates the procedure, by a stylized presentation of a typical extract of the integrated database.

Table 2. International goods flows: Export by country of destination and transport mode per NSTR division.

Export: NSTR division x →Country Mode of transport↓	$\sum$Country $_i$	$\sum$Country $_j$	$\sum$Country $_k$
$\sum$ Road transport	Flow $_{i\ road}$	..	
$\sum$ Air transport	..	..	
$\sum$ Inland waterways navigation			
..			

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