Statistics Netherlands

Division of Macro-Economic Statistics and Dissemination
Development and Support Department

Attributing Quarterly GDP Growth Rates of the Euro Area to Final Demand Components[1]

Prepared for the XVII International Input-Output Conference, 13-17 July 2009, São Paulo, Brazil

By

Ruben van der Helm and Rutger Hoekstra[2]

Statistics Netherlands
Henri Faasdreef 312
2492 HA The Hague
The Netherlands

E-mail: rp.vanderhelm@cbs.nl
E-mail: r.hoekstra@cbs.nl

[1] This study was originally performed for the European Central Bank (May, 2008). This paper is an unedited copy of the final report.

[2] The authors would like to thank Jasper Roos and Oscar Lemmers for their work on the trade data. Furthermore, we thank Piet Verbiest and Reinier Bikker for comments and suggestions. We are grateful to Tjeerd Jellema, Nuno Silva and Ilja Kristian Kavonius (ECB) for their constructive and pleasant cooperation on this project.

Summary

For economists to analyse economic developments it is important to understand the driving forces of economic growth. One of the analyses which is used is the attribution of GDP growth rates to final demand components such as household consumption, gross fixed capital formation and exports. Two methods are available: Firstly, there is the "net-exports method" which is used in the *Monthly Bulletin* of the ECB (ECB, 2008, p53). In this method, the growth rate is decomposed using a net measure for exports i.e. imports are subtracted from exports. Secondly, there is the "attribution method" which adopts input-output modelling techniques to decompose the effects of changes in final demand components.

In a previous study for the ECB, Hoekstra *et al*. (2006) showed that that the attribution method leads to more fruitful economic analysis but that the data requirements are larger because the method requires an input-output table (IOT) for the euro area (EA). In the report an IOT for 2001 for the EA was constructed and was used for the attribution method for annual (2002-2005) and quarterly growth rates (2005Q1-2006Q1).

The current report builds on the work done in Hoekstra *et al*. (2006). EA-IOT for 2003, 2004 and 2005 are produced and used to attribute annual (2003-2006) and quarterly (2006Q1-2007Q3) growth rates to final demand components. Many improvements have been introduced along the way, but four stand out. Firstly, the data situation in the Eurostat transmission program has improved. Secondly, the IOT which have been produced are consistent with the latest macro-economic aggregates series produced by the ECB. Thirdly, IOT for multiple years have been produced (2003, 2004 and 2005). Finally, one of the problems identified in the previous report, re-exports and transit trade (for the Netherlands), has been tackled using new data from the department of trade statistics of Statistics Netherlands.

In the report we also discuss which steps would be necessary to produce the SUT/IOT and attribution calculations on a regular basis. Potential improvements and further research are also discussed. Detailed appendices, in which the data work is described and sensitivity analyses presented are also included.

Keywords: GDP growth rate, attribution method, attribution to final demand components, input-output modelling, asymmetries, European input-output tables

Table of Contents

Abbreviations

BEC	Broad Economic Categories
CBS	Statistics Netherlands
CPS	Cumulated Production Structure
COMEXT	Database containing EU trade data
CPA	Classification of Products by Activities
CPB	Netherlands Bureau for Economic Policy Analysis
CN	Combined Nomenclature
DNB	Dutch National Bank
EA	Euro Area
ECB	European Central Bank
BP	Basic Prices
HS	Harmonized System
IOT	Input-output table
ITS	International trade in services data
MED	Macro-economic aggregates
NPISH	Non-profit organisations serving households
PP	Purchaser prices
TLS	Taxes less subsidies on products
SUT	Supply and use tables
TTM	Trade and transport margins
WINADJUST	CBS Lagrangian balancing program (van Dalen and Sluis, 2002)

Country labels

AT	Austria
BE	Belgium
DE	Germany
ES	Spain
FI	Finland
FR	France
GR	Greece
IE	Ireland
IT	Italy
LU	Luxemburg
NL	The Netherlands
PT	Portugal
SI	Slovenia

1. Introduction

For economists to analyse economic developments it is important to understand the driving forces of economic growth. One of the analyses which is used is the attribution of GDP growth rates to final demand components such as household consumption, gross fixed capital formation and exports. Two methods are available: Firstly, there is the "net-exports method" which is used in the *Monthly Bulletin* of the ECB (ECB, 2008, p53). In this method, the growth rate is decomposed using a net measure for exports i.e. imports are subtracted from exports. Secondly, there is the "attribution method" which adopts input-output modelling techniques to decompose the effects of changes in final demand components.

In a previous study for the ECB, Hoekstra *et al*. (2006) showed that that the attribution method leads to more fruitful economic analysis but that the data requirements are larger because the method requires an input-output table (IOT) for the euro area (EA). In the report an IOT for 2001 for the EA was constructed and was used for the attribution method for annual (2002-2005) and quarterly growth rates (2005Q1-2006Q1).

The current report builds on the work done in Hoekstra *et al*. (2006). EA-IOT for 2003, 2004 and 2005 are produced and used to attribute annual (2003-2006) and quarterly (2006Q1-2007Q3) growth rates to final demand components. Many improvements have been introduced along the way but four stand out. Firstly, the data situation in the Eurostat transmission program has improved. Secondly, the IOT which have been produced are consistent with the latest macro-economic aggregates series produced by the ECB. Thirdly, IOT for multiple years have been produced (2003, 2004 and 2005). Finally, one of the problems identified in the previous report, re-exports and transit trade (for the Netherlands), has been tackled using new data from the department of trade statistics of Statistics Netherlands.

Theory

The two alternative methods to attribute GDP growth to final demand components are called the *net-exports method*[3] and *attribution method.*

The ECB currently uses the net-exports method. To apply this method, imports are subtracted from the exports when the growth rates of the final demand components are analysed. The results of this type of analysis are published in the ECB's *Monthly bulletin* (see for example ECB, 2008, p53). In these calculations the euro area (EA) quarterly GDP growth rates are attributed to domestic demand, change in inventories, and net-exports.

[3] The term "net trade" is sometimes also used. "Net-exports" is used in this report because this is used in the charts and texts of the *Monthly Bulletin* of the ECB.

An alternative approach is the attribution method which uses input-output modelling techniques to attribute GDP and imports to final demand components. This method was, to our knowledge, first introduced by the Dutch National Bank (DNB) (Alders, 1988). Subsequently it has been adopted by the Netherlands Bureau for Economic Policy Analysis (CPB) (see for example Kranendonk and Verbruggen, 2005, 2008) and Statistics Netherlands (CBS) (de Boer, 2004). It's popularity in the Netherlands explains why it is sometimes referred to as the 'Dutch method' (Kranendonk and Verbruggen, 2005).[4] However more recently, the method has caught on in other countries as well: Canada (Cameron and Cross, 1999) and Cross (2002); Denmark (Ministry of Finance, 2006); and France (Heitz and Rini, 2006).

A full derivation of the formulas is presented in Appendix A. However, a short summary is provided below.

Equations 1 and 2 provide simple formula for the net-exports and attribution method. Two final demand components, domestic final demand (c) and exports (e) are distinguished. Equation 1 shows that the growth of GDP (y) can be decomposed into the contribution of domestic consumption (D_c) and net-exports (D_e). The equations show that in the net-exports method the change in imports (m) is incorporated in the contribution of exports, which is why it is referred to as the net-exports method. In equation set 2, the growth of imports has an indirect effect which affects both domestic final demand and exports. The imports are attributed to the final demand categories through the GDP attribution shares (α) which are calculated using input-output techniques.

Net-exports method

$$\dot{y} = D_c^{net} + D_e^{net} \tag{1a}$$

$$D_c^{net} = \left(\frac{c^1 - c^0}{y^0} \right) \tag{1b}$$

$$D_e^{net} = \left(\frac{e^1 - e^0}{y^0} \right) - \left(\frac{m^1 - m^0}{y^0} \right) \tag{1c}$$

Attribution method

$$\dot{y} = D_c^{att} + D_e^{att} \tag{2a}$$

[4] Kranendonk and Verbruggen (2005) refer to the net-exports method as the "international method". In a recent publication they refer to the attribution method as the "import adjusted method" (Kranendonk and Verbruggen, 2008).

$$D_c^{att} = \frac{\left(\alpha_c^1 \cdot c^1\right) - \left(\alpha_c^0 \cdot c^0\right)}{y^0} \tag{2b}$$

$$D_e^{att} = \frac{\left(\alpha_e^1 \cdot e^1\right) - \left(\alpha_e^0 \cdot e^0\right)}{y^0} \tag{2c}$$

Where

y^t	GDP
$\dot{y}$	GDP growth rate
m^t	Imports
c^t	Domestic final consumption
e^t	Exports
α_c^t	Attributed GDP share of domestic final demand (scalar)
α_e^t	Attributed GDP share of exports (scalar)
D_c^{net}	Contribution of domestic final demand using the net-exports method
D_e^{net}	Contribution of exports using the net-exports method
D_c^{att1}	Contribution of domestic final demand using the attribution method
D_e^{att1}	Contribution of exports using the attribution method

As the equations show, the economic interpretation of these methods is different. In the net-exports method the contribution of domestic final demand does not distinguish between the source of the products (domestic or imported). For example, assume that total consumption increases from period 0 to 1. Assume also that the increase is entirely supplied by an increase in imports while all other variables remain the same. This means that the increase in consumption does not lead to an increase in GDP. However, the net-exports method would show a positive contribution of consumption with a corresponding negative contribution of net-exports. The attribution method would show no contribution to GDP growth from domestic consumption (or exports).

Many authors have stressed that, despite the greater data effort, the attribution method is preferable because of the economic interpretation (ECB, 2004; Kranendonk and Verbruggen, 2005, 2008; Hoekstra *et al*, 2006). Most authors point to the fact that the net-export method leads to underestimation of the external sector. For example, the Monthly Bulletin of June 2005 (Box 7, p 54-56) concludes that "Overall, while net trade and exports are useful measures of activity, it should be borne in mind that the former may in some circumstances give an understated picture of the impulse of the external sector. In Appendix A the mathematical conditions under which the underestimation occurs are discussed.

Data construction

To perform the attribution method calculations, three IOT (for 2003, 2004 and 2005) for the euro area were produced. Before we discuss the data construction methodology, it is important to understand the conceptual challenges related to EA-aggregates.

There are a number of conceptual reasons why the EA aggregates are not simply the summation of national accounts data supplied by the member states. First of all European institutions have to be added because these are not considered “residents” of any of the member states. Secondly, the aggregation of ROW accounts of the member states includes intra-EA trade, which should be excluded if one wants to correctly depict the external trade of the EA. To correct for intra-EA trade, the problem of asymmetries (the fact that intra-EA imports and exports are not equal) has to be resolved. In the process of reconciling these asymmetries it unavoidable that aggregates for the industry and goods levels as well as the total economy will differ from the summation of all countries.

Recently, the ECB has produced a time series of EA aggregates in which the above conceptual issues are tackled (for further details see (TFQSA, 2007)). However, this data set only provides macro-economic aggregates such as GDP and the totals for the final demand categories. In this project SUT/IOT for 2003, 2004 and 2005 have been produced which are consistent to these aggregates. This means that, for these years, there is a complete set of consistent production accounts (in current prices) available for the EA.

Now we are ready to discuss briefly the method by which this time series of IOT was produced (a full description is provided in Appendix B). There are five types of data which have been used in this project: Supply and use tables (SUT), Input-output tables (IOT), Macro-economic data (MED), International trade in goods (COMEXT) and International trade in services (ITS). The advantage of the approach used in this report is that it is almost entirely based on data available from the ESA95 transmission program and the EA series produced by the ECB. Only in a couple of instances was the data supplemented with information from individual countries.

The IOT required is an “IOT excluding imports in basic prices” as shown in the table below. In this type of IOT the imports and taxes less subsidies on products (TLS) are presented in the rows of the table. The final column is equal to domestic production of goods and services.

The production of the data can be split into six steps. In the first five steps an EA-IOT for 2003 is produced using country level data. The most recent SUT and IOT data is used as well as MED/COMEXT/ITS data for 2003. After the EA-IOT for 2003 is completed it is extrapolated to 2004 and 2005 using data at the EA level.

Input-output table excluding imports in basic prices

	Commodity 1	…	Commodity *n*	Domestic final demand	Export	Total
Commodity 1						
…						
Commodity *n*						
Value added						
TLS						
Imports						
Total						

In step 1, the SUT are constructed for the 13 countries of the EA for the year 2003. For this project, the Eurostat transmission program provided harmonized SUT for 10 of the 13 countries for 2003. The other SUT had to be produced by extrapolating older SUT with MED, COMEXT and ITS data. (ES:2001; GR:1999; IE:2000).

Step 2 involved the conversion of the use table in purchaser prices to basic prices. The trade and transport margins (TTM) and taxes less subsidies related to products (TLS) are calculated for the 13 use tables. IOT or special use tables from the transmission program are used as well as country specific information.

In step 3, the 13 use tables in basic prices are split into the domestic and imported components. This is done using the IOT or special use tables from the Eurostat transmission program or specific information for individual countries.

Step 4 leads to the production of the SUT for 2003 for the EA. This is done by aggregating the SUT (supply tables from step 1 and use tables in basic prices from step 3) for the 13 euro countries and subtracting the intra-EA trade from the imports and exports. The intra-EA trade asymmetries are resolved in this step. The import matrix of the EA is based on the results of the asymmetry calculations as well as the Broad Economic Categories (BEC) classification scheme. A novel aspect of this project was the inclusion of the re-exports data which was produced by the trade statistics department of the CBS. These data for the Netherlands were combined with the other available data of the EA countries to produce an EA re-export series.

In step 5 the IOT for the EA for the year 2003 is calculated by applying the industry technology assumption to the supply and use tables from step 4. The resulting IOT distinguishes 30 commodities as well as 6 final demand components (household consumption, consumption by NPISH, government consumption, gross capital formation and exports).

In step 6 the IOT for 2003 is extrapolated to 2004 and 2005 using MED, COMEXT and ITS data at the EA-level. Note that the MED that are referred to here are the macro-economic series produced by the ECB.

2. Results

The IOT for 2003, 2004 an 2005, which were described in the previous section, were used to apply the attribution method to annual and quarterly GDP growth rates. The GDP growth rate is attributed to the final consumption expenditures by households and NPISH[5], the final consumption by government, gross capital formation and exports. Details of these calculations are provided in appendix A. For this purpose of the calculations, attribution method 3 has been adopted. Appendix E provides the results for the net-exports method and attribution method 3.

The results of these calculations are provided in Tables 1-3 and Figures 1-3. The annual results are provided for the years 2001 to 2006 (Table 1 and Figure 1). Table 2 and Figure 2 provide the quarterly results (seasonally adjusted, compared to previous quarter) for quarters 2006Q1 to 2007Q3. Table 3 and Figure 3 shows the results for the growth rates compared to the same quarter in the previous.

The annual results shows that the contribution of government expenditures is remains fairly stable at around 0.2 to 0.4%. The most volatile determinant of growth is the changes in gross capital formation which contributed negatively in 2001 and 2002 while it was the second-most important factor for positive growth in 2005. The slow-down of 2002 and 2003 were caused primarily by a decrease in the gross capital formation (2002) and a slow down in consumption (2002 and 2003) and exports (2003). After 2003 the economy recovers to a high of nearly 3% growth in 2006. The recovery is caused mainly by the growth in exports and gross capital formation, but consumption growth does not show as strong a recovery.

The quarterly growth rates are provided on a quarter-by-quarter basis (Table/Figure 2) and on a year-on-year basis (Table/Figure 3). The quarter-on-quarter growth rates, which when added together should approximate but not exactly equal the annual growth rate, shows that the influence of the final demand categories is very variable over the quarters. Particularly exports and GCF show large variations per quarter. The conclusions from the year-on-year quarterly growth analysis are similar to those of the annual results: growth is primarily caused by exports and GCF, with rather stable contribution from household consumption and GCF.

[5] The IOT distinguish between consumption by households and NPISH but the EA data series do not. The attribution calculations are therefore done for the aggregate of both categories.

Table 1. Annual growth rate decomposition results

Year	GDP growth rate	Domestic demand				Exports
		Consumption by Households and NPISH	Consumption by Government	Gross capital formation	Total	
2001	2,23	1,14	0,37	-0,16	1,36	0,87
2002	0,82	0,27	0,45	-0,54	0,18	0,64
2003	0,91	0,20	0,34	0,29	0,83	0,08
2004	1,74	0,58	0,23	0,28	1,10	0,64
2005	1,68	0,50	0,19	0,54	1,23	0,45
2006	2,91	0,59	0,34	0,92	1,85	1,07

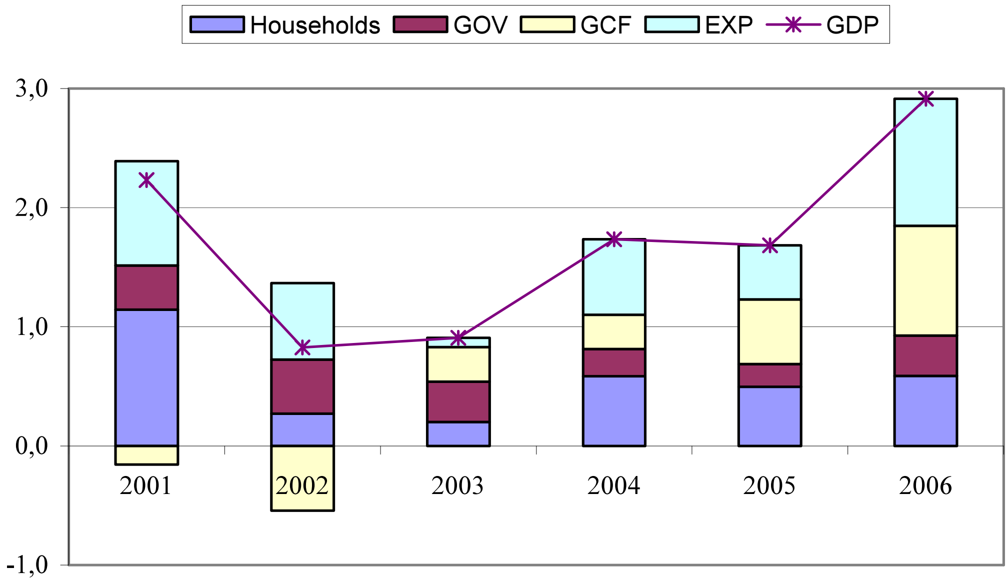

Figure 1. Annual growth rate decomposition results

Table 2. Quarter-on-quarter quarterly growth rate decomposition results

Quarter	GDP growth rate	Domestic demand				Exports
		Consumption by Households and NPISH	Consumption by Government	Gross capital formation	Total	
2005Q1	0,27	0,32	0,04	-0,10	0,26	0,01
2005Q2	0,65	-0,07	0,17	0,29	0,38	0,26
2005Q3	0,57	0,18	-0,04	0,00	0,13	0,43
2005Q4	0,58	-0,13	0,04	0,69	0,60	-0,02
2006Q1	0,76	0,39	0,10	-0,10	0,39	0,37
2006Q2	1,04	0,25	0,11	0,45	0,81	0,23
2006Q3	0,53	0,05	0,09	0,21	0,34	0,19
2006Q4	0,80	0,04	0,21	-0,06	0,20	0,60
2007Q1	0,64	0,07	0,02	0,48	0,57	0,05
2007Q2	0,39	0,24	0,03	-0,06	0,22	0,17
2007Q3	0,61	-0,02	0,12	0,09	0,19	0,43

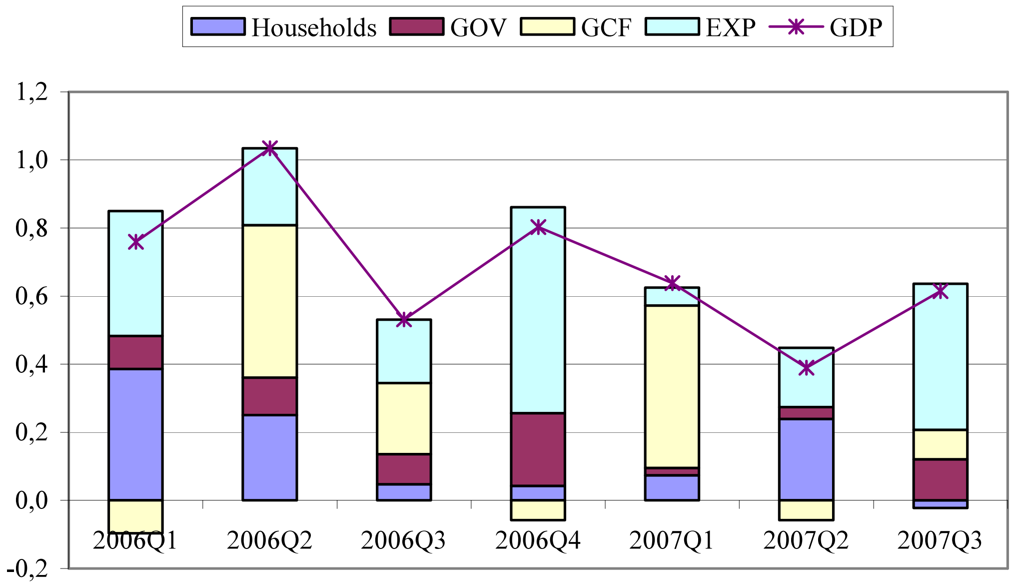

Figure 2. Quarter-on-quarter quarterly growth rate decomposition results

Table 3. Year-on-year quarterly growth rate decomposition results

Quarter	GDP growth rate	Domestic demand				Exports
		Consumption by Households and NPISH	Consumption by Government	Gross capital formation	Total	
2005Q1	0,77	0,56	0,11	0,08	0,75	0,03
2005Q2	2,01	0,56	0,27	0,86	1,69	0,32
2005Q3	1,68	0,67	0,16	0,16	0,98	0,70
2005Q4	1,73	0,21	0,22	0,73	1,16	0,57
2006Q1	3,29	0,36	0,28	1,33	1,97	1,34
2006Q2	2,27	0,73	0,21	0,57	1,51	0,76
2006Q3	2,63	0,59	0,34	1,05	1,97	0,66
2006Q4	2,96	0,67	0,53	0,41	1,61	1,33
2007Q1	2,89	0,39	0,44	1,03	1,86	1,05
2007Q2	2,42	0,45	0,36	0,56	1,37	1,05
2007Q3	2,53	0,37	0,39	0,47	1,22	1,32

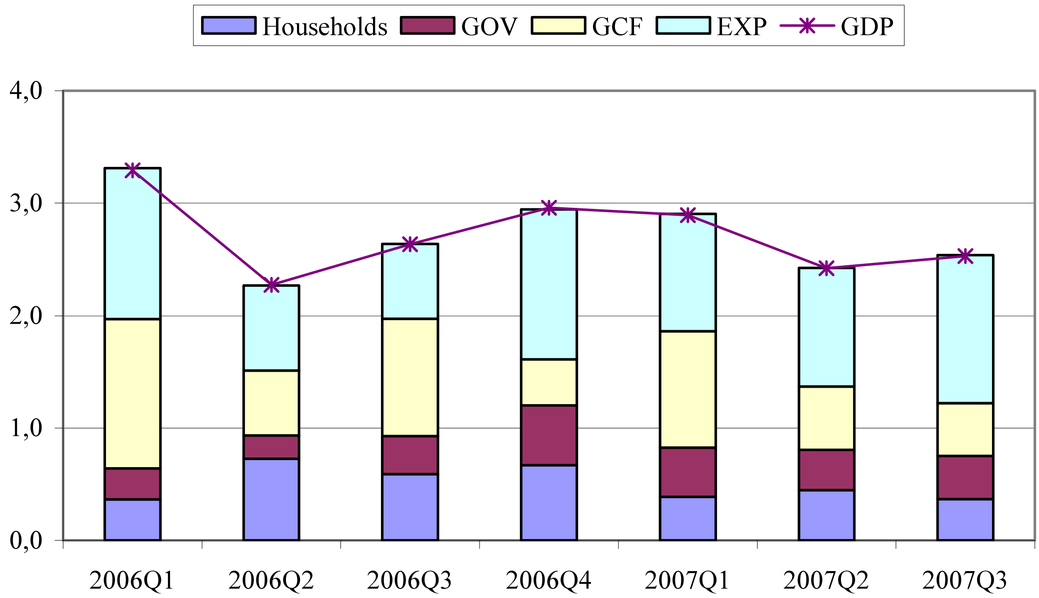

Figure 3. Year-on-year quarterly growth rate decomposition results

Summary statistics of the IOT

Table 4 shows the "Cumulated Production Structure" (CPS) of the IOT for 2005. The CPS breaks down the total final demand into attributed GDP and attributed imports. The attributed GDP and imports are composed of a direct portion ("final") and an intermediary portion, of which the latter is calculated using the input-output model (see Appendix A for a further explanation of the CPS).

The table shows total GDP of the EA is 8073 thousand million in 2005. Total imports of the EA from the rest of the world are 1557 thousand million euros while the exports are 1624 thousand million. Note that all these totals are consistent to the EA series published by the ECB.

Note that the IOT which are produced for 2003, 2004 and 2005 can be used in the attribution of growth rates, but may also be used for the other modelling applications.

Table 4. Cumulated Production Structure (CPS) matrix for the EA, 2005 (thousand million euro and ratio's)

	Households	NPISH	Government	Gross capital formation	Exports	Total
Attributed GDP	3792	91	1549	1398	1242	8073
-Final GDP	509	0	7	127	1	644
-Intermedairy GDP	3283	91	1543	1271	1241	7430
Attributed imports	764	6	106	300	382	1557
-Final imports	302	0	11	103	93	509
-Intermediary imports	461	6	94	197	289	1048
Total demand	4556	98	1655	1699	1624	9630
-Attributed GDP share	0,83	0,93	0,94	0,82	0,76	0,84
-Attributed imports share	0,17	0,07	0,06	0,18	0,24	0,16
-GDP contribution	0,47	0,01	0,19	0,17	0,15	1,00

Attributed GDP shares

For the attribution method, the attributed GDP shares of the annual IOT for 2003 and 2004 and 2005 are used as a first estimate for the quarterly data. However, the balancing routine adopted in attribution method 3 leads to an estimate of the implicit attribution shares per quarter. Figure 4 shows how these attribution shares of the different final demand categories develop from 2001Q1 to 2007Q3. The shaded area shows the period for which an IOT was produced. Generally, the shares remain within a fairly narrow range. All the shares, except the government shares, appear to increase slightly at first and then decrease. Particularly exports show a significant decrease in the attributed GDP share which is caused by both the increase in re-exports and an increase of imports used intermediately.

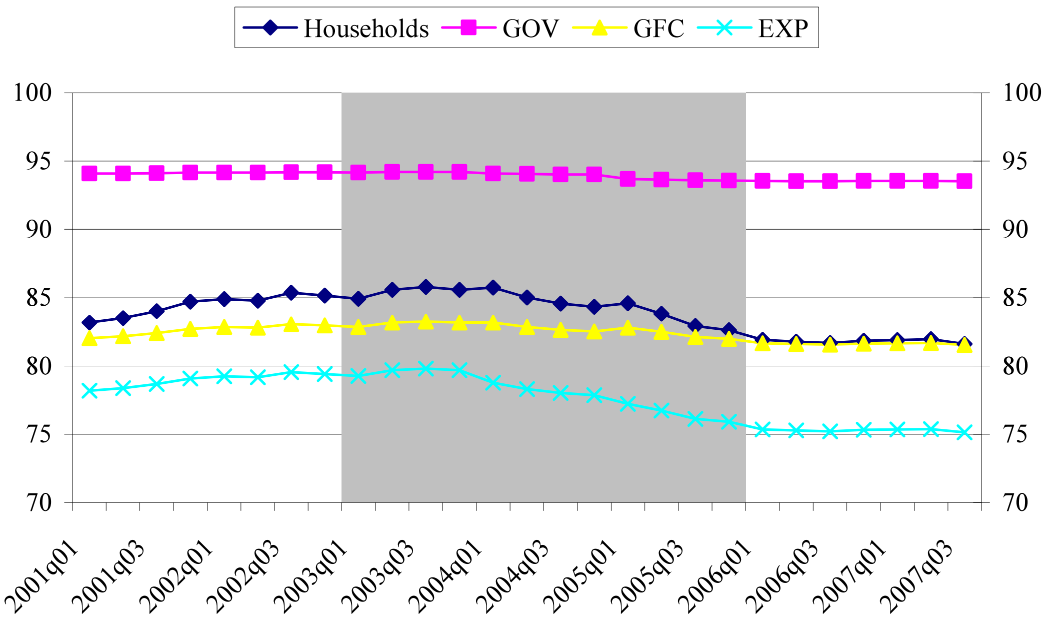

Figure 4. Quarterly attribution GDP shares of final demand categories

Note that the values in Figure 4 are not observations, but rather modelling outcomes of the attribution method 3. The results therefore also provide some hints about possible improvements to the attribution method. It is for example interesting to note that the change in the attributed GDP share is often quite large from the fourth to the first quarter (see for example the changes for 2003Q4-2004Q1). There is no way of checking whether this is a real phenomenon or a modelling artefact although the latter does seem fairly plausible. There are two ways of resolving this issue. Firstly one might smooth the developments in the attributed shares using procedures such as the Denton method (Bikker and Buijtenhek, 2006; TF-QSA, March 2004). Secondly, one could try to add more specific quarterly data to the calculations. For example, if quarterly estimates of re-exports were available or a breakdown of the products which are consumed by households per quarter, it would help to produce more accurate estimates of the quarterly GDP shares.

Re-exports of the EA

A major improvement in the data of this project has been the construction of time series of re-exports for the EA. The data is based on aggregate data which we were able to find for re-exports for individual countries, in particular the 4 major re-exporters Germany, the Netherlands, Belgium and France[6] (which constitute about 95% of the re-exports from a national perspective).

However, not all these national data are re-exports from the EA-community perspective. The trade statistics department of the Statistics Netherlands were therefore asked to distinguish the source and destination of the re-exports so that the re-exports can be recalculated using the community concept. Their method is discussed in detail in appendix D.

Table 5 shows the percentages of the re-exports per source-destination combination (EA-Euro area, NEA-Non-euro area) for the Netherlands. The results show that 25% of the re-exports of the Netherlands in 2006 are re-exports from the EA-community perspective. It is interesting to note that the importance of EA re-exports is increasing for this period.

Table 5. Source and destination of re-exports for the Netherlands, 2003-2006 (%)

	Source-destination			
	EA-EA	NEA-EA	EA-NEA	NEA-NEA
2003	26%	39%	14%	21%
2004	25%	39%	14%	23%
2005	24%	37%	14%	25%
2006	24%	37%	14%	25%

Table 6 shows the resulting estimates of the re-exports of the EA in thousand million euros. The figures show that the Dutch figures constitute about a third of the total estimate. Furthermore, the data shows that although re-exports are fairly modest as a percentage of the total exports, they are growing faster than total exports.

Table 6. Re-exports estimates for the EA, 2003-2006 (1000 million euro and %)

	2003	**2004**	**2005**	**2006**
Re-exports NL (EA community principle)	20778	25867	30905	34688
Re-exports EA	63168	80033	92523	105885
Exports EA	1371931	1493098	1623543	1828136
Ratio re-exports/exports EA	4.6%	5.4%	5.7%	5.8%

[6] Note that France has revised its re-exports significantly in the latest transmission of its IOT. In previous versions, France showed re-exports of around 100.000 million while the values are now lower than 20.000 million.

3. Comparison to previous study

Methodological improvements

This report contains a number of important improvements compared to the previous study (Hoekstra *et al*, 2006).

1. Better data situation. The timeliness and consistency of the Eurostat transmission program has improved. Firstly, more SUT were available for the year for which the benchmark was created. Secondly, the macro-economic aggregates of countries were generally more consistent to the SUT, particularly because FISIM registration was now consistently adopted in the MED and SUT series.

2. Macro-aggregates consistent to ECB aggregates. In the previous study, the growth rates in the report and the ECB growth rates were not the same. In this project, we have harmonized the SUT and IOT for 2003, 2004 and 2005 to the latest macro-economic data series which have been published by the ECB. This means that there is a consistent set of production accounts for these years.

3. IOT for multiple years. In Hoekstra *et al.* (2006) a single IOT was produced for 2001. In this study a time series (2004, 2005 and 2006) was produced, which also means that the time period between the last IOT and the quarter being analysed is smaller (in the old study 2006Q1 was analysed using the IOT for 2001 while now 2007Q2 is based on the IOT for 2005). Note however that the quality of the IOT does differ: 2003 is based on the data of the individual countries, while 2004 and 2005 are extrapolations based on EA data. Because of the availability of IOT for 3 years we are able to do sensitivity analysis on our attribution calculations (see appendix F).

4. Improvements in re-exports estimates. A major improvement of this exercise has been the introduction of specific re-exports data for the Netherlands. By identifying the source and destination of these trade flows, the re-exports from an EA-community principle can be established. The Dutch data was combined with other data of the major re-exports (Germany, France, and Belgium) to produce an EA re-exports series.

5. Minor improvements.

    - Inclusion of year-on-year quarterly growth rates. In the previous study only quarter-on-quarter quarterly growth rates were analysed. This report also includes results for the year-on-year growth rates.

    - The disaggregation of the IOT has increased from 29 to 30 commodities.

Empirical differences

It is not easy to compare the two studies empirically. The most important problem is that the macro-economic data (MED as well as SUT) at the country and EA level have been revised significantly (because of new deliveries to the Eurostat database as well as new work on EA macro-economic aggregates at the ECB). It is therefore not very fruitful to compare the outcome of the attribution calculations or the macro-economic aggregates. Nevertheless in this section we make an attempt to assess the importance of the methodological improvements described above.

The attributed GDP shares per final demand category are important outcomes of the calculations. Figure 5 shows these ratios for the previous project (year 2001) and current project (years 2003-2005). The figure indicates that the attributed shares are fairly similar for NPISH and Government consumption. Modest changes for household consumption, GCF (higher) and exports (lower) are observed.

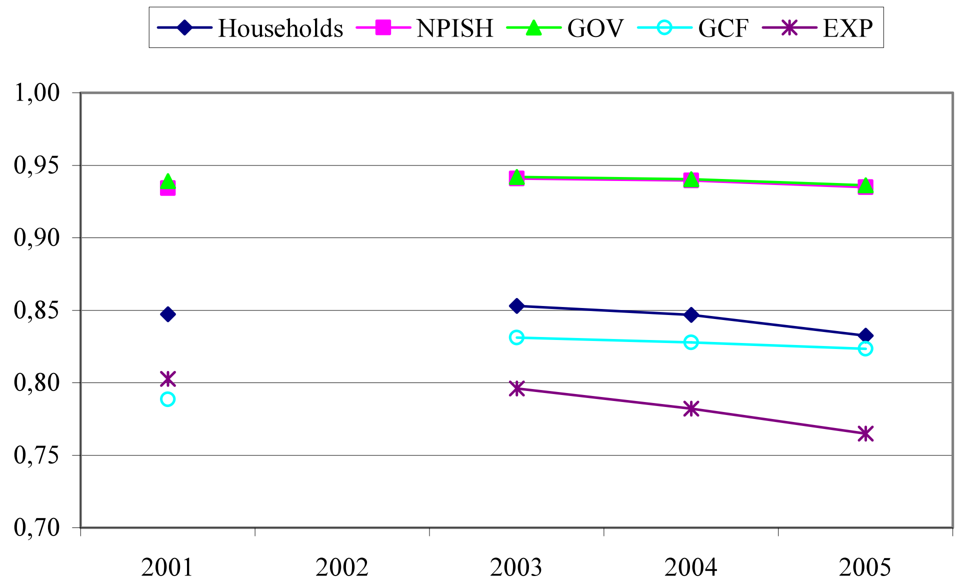

Figure 5. Annual attribution GDP shares of final demand categories

The changes in the attributed GDP shares are probably mostly the result of the improvements in the re-export figures, which are compared in figure 6. While the previous study estimated that these flows were just over a percentage point of total exports, the current study arrives at about 4.5 to 5.5 percent. This will naturally lead to the lower attributed GDP share for exports and an increase in other final demand categories.

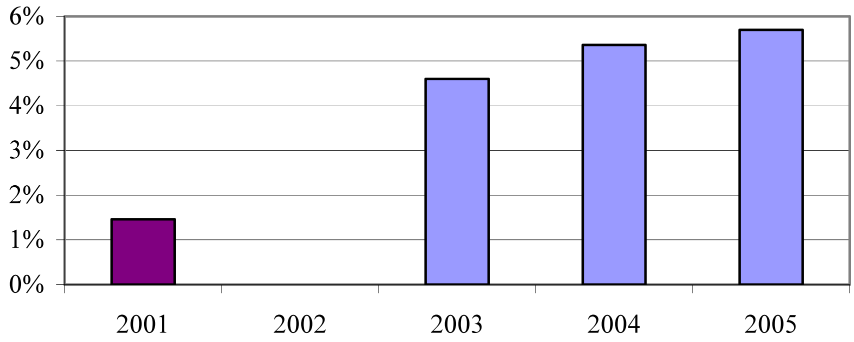

Figure 6. Re-exports of the EA (% of total EA exports)

4. Implementation strategies

The ECB has expressed its desire to produce an EA-SUT and EA-IOT and the derived attribution calculations on a regular basis. This not only provides a full statistical representation of the production account for the EA, but can also form a basis for input-output analysis or other economic modelling exercises. In this section we discuss how the EA-IOT may be produced on a regular basis and which improvements in the data availability could lead to improvements in its quality.

The production process is currently split into 6 steps which have been made in linked Excel workbooks. These can be quickly updated as new SUT and other macro-economic data become available.[7] If one would want to further automate the statistical process (using MATLAB for example) it would be wise to work backwards through the steps.

The quality of the IOT would benefit from the following improvements in the underlying data:

1. Further harmonization of data. More consistent data would benefit the automation and quality of the data.
    - SUT/IOT. The availability and consistency of SUT and IOT differs for each country. The data process would be easier to automate if all data (including all IOT sub tables) became available at a specified time.
    - MED/SUT. Although the consistency between the MED and SUT has improved there are still differences.

[7] In this project, the SUT for 2003 for France became available when we had nearly finished the project. Updating our calculations using the new data took about 2 days.

- COMEXT/ITS. Further improvement in the resolution of trade asymmetries for goods as well as services would be very useful for the EA-IOT calculations. Also further research into the differences in the COMEXT and SUT totals would be useful.

2. Improved timeliness.

   - SUT/IOT. This project was carried out at the end of 2007 but 2003 was the most recent year for which a SUT/IOT for the EA was feasible. In fact, even at that stage, three of the countries did not have tables for 2003 although the ESA transmission programme requires the annual transmission of SUT tables at t+36 months.

   - MED. The extrapolation of the IOT was feasible up to 2005. If the MED for value added per NACE, consumption etc became available more quickly then the IOT could have been extrapolated to 2006.

3. More detailed availability of data.

   - Value added and output per NACE. The IOT is currently 30 by 30 commodities. The supported detail would improve, perhaps even to 60 by 60, if the data on value added and output were provided in more than NACE30. These figures are required in steps 1 and 6.

   - Availability of data by commodity group. It would be helpful of the final demand aggregates were assigned to commodity groups (CPA classification). Although breakdowns are available for final consumption of households (COICOP) and final consumption of government (COFOG), these are functional classifications that do not necessarily translate well into CPA02. Breakdowns of imports and exports are obtained using COMEXT and ITS data; and GFCF data is broken down using a highly aggregate classification.

   - Specifically a commodity breakdown of changes in stocks would be welcomed. The transmission program only provides for MED country-level totals of stock changes. As a consequence the extrapolation per commodity is very poor. Information of the changes in stocks per CPA02 would improve this situation.

4. New data

   - Re-exports. This project has shown that re-exports are a significant, and growing, share of total EA exports. The current estimates are only based on Dutch data but would benefit if new data becomes available for Germany, France and Belgium.

   - Quarterly data. Figure 4 shows the attributed shares per quarter. These were calculated by using the annual shares from the IOT and quarterly aggregates. The calculations would benefit from more detailed quarterly data such as re-exports or household per quarter. For example, the consumption per COICOP per quarter would help to better estimate the attributed GDP share for consumption for a quarter.

- SUT. In step 2 the use tables is converted from purchaser prices to basis prices using the most recent IOT. This would be more accurate if use tables on TLS (Product related taxes less subsidies) and TTM (trade and transport margins) were available.
- SUT. In step 3 the use tables is split into an imported and domestic part using the most recent IOT. This would be more accurate if use tables separating imported and domestic use were available.
- It would be very useful if the national (use of) imports tables included direct geographical breakdowns, as this would reduce a large number of estimations from the compilation that rely on COMEXT data.

Each of these suggestions would constitute an improvement in the quality of the resulting EA IOT. However, the feasibility of introducing these data availability improvements is beyond the scope of this study.

References

Alders, J. A. J., 1988. De bijdrage van de bestedingscategorieën aan de groei, *Economisch Statistische Berichten*, 7 september 1988, p 816-821.

Beutel, J., 1999. *Input-output tables for the European Union 1995.* Report to the Statistical Office of the European Communities, June 1999.

Bikker, R., 2005. *Chained indices for quarterly national accounts*. Division of Macro-economic Statistics and Dissemination, Development and Support Department, 2005-47-MOO, 6 juli 2005.

Bikker R. en S. Buijtenhek, 2006. *Alignment of Quarterly Sector Accounts of annual data*. Projectnumber: MOO-204072-02: BPA number 2006-24-MOO.

Boer, S. de, 2004. *Contribution of final expenditure to real GDP growth*. Internal note, Statistics Netherlands, Voorburg, The Netherlands.

Cameron and Cross, 1999. The importance of exports to GDP and jobs. *Canadian Economic Observer*, November 1999, Statistics Canada, no. 11-010-XPB.

Cross, 2002. Cyclical implications of the rising import contents in exports. *Canadian Economic Observer*, November 1999, Statistics Canada, no. 11-010-XPB.

Dalen, J. van, and W. Sluis, 2002. *WINADJUST*, Statistics Netherlands, Voorburg, The Netherlands.

Ministry of Finance of Denmark, 2006. *Economic Survey*. December 2006. English Summary.

ECB (European Central Bank), 2005. *Monthly Bulletin*. June 2005.

ECB (European Central Bank), 2007. *Monthly Bulletin*. January 2007.

Eurostat, 1995. *European System of Accounts, ESA 1995.*

Eurostat, 2003. *Asymmetries of current account in the intra-UE balance of payments*. Working Papers and Studies.

Eurostat, 2004. *Differences between balance of payments and foreign trade statistics*. Working Papers and Studies. Theme 2: Economy and Finance.

Eurostat, 2005. *Changes to National Accounts in 2005*. 30.11.2005. http://europa.eu.int/estatref/info/sdds/en/na/na_changes2005.pdf

Fankhauser, S. and D. McCoy (1995), 'Modelling the economic consequences of environmental policies', in H. Folmer, H. Landis Gabel and H. Opschoor (eds), Principles of Environmental and Resource Economics, Edward Elgar, Aldershot UK and Brookfield US, pp. 253–275.

Heitz and Rini, 2006. Reinterpreting the contribution of foreign trade to growth. Trésor-Economics no. 6, December 2006.

Hoekstra, R. A. van den Berg en F. Hoekema, 2006. *Attributing the Euro Area GDP Growth Rate to Final Demand Components*, Macro-economic Statistics and Dissemination, Development and Support Department, 2006-67-MOO, Date 27th July 2006

Hoen, A. R., 1999. *An input-output analysis of European integration.* Phd thesis, University of Groningen, the Netherlands.

James, D.E., H.M.A. Jansen and J.B. Opschoor (1978), *Economic Approaches to Environmental Problems: Techniques and Results of Empirical Analysis*, Elsevier Scientific Publishing, Amsterdam/Oxford/ New York.

T. Jellema, S. Keuning, P. McAdam and R. Mink, 2004. *Developing a euro area accounting matrix: issues and applications*, Working paper 356, May 2004, European Central Bank.

Konijn, 1994. *The make and use of commodities by industries: on the compilation of input-output data from the National Accounts*, PhD thesis, Universiteit Twente, Enschede, The Netherlands.

Kranendonk, H. C., 1998. *Bijdrage van bestedingscategorieën aan de productiegroei,* CPB Internal paper nr. 98/II/1, Netherlands Bureau for Economic Policy Analysis.

Kranendonk, H. C. and J. P. Verbruggen, 2005. *How to determine the contributions of domestic demand and exports to economic growth?* CPB memorandum. Business cycle analysis unit, CPB Netherlands Bureau for Economic Policy Analysis.

Kranendonk, H. C. and J. P. Verbruggen, 2008. *Decomposition of GDP growth in European countries.* CPB document. CPB Netherlands Bureau for Economic Policy Analysis, January 2008, no. 158.

Rose, A. Z. and S. D. Casler, 1996. Input-output structural decomposition analysis: a critical appraisal. *Economic Systems Research* 8(1), p33-62.

TF-QSA (Task Force on Quarterly European Accounts by Institutional Sector), 2004. Compilation of European Quarterly Sector Accounts Annex: Reconciliation of Multiperiod Accounting Frameworks. TF-QSA-0403-06-Annex.

TF-QSA (Task Force on Quarterly European Accounts by Institutional Sector), 2005. *Balancing the European Accounts of goods and services*.

United Nations, 1993. *System of National Accounts,* 1993.

Appendix A. Mathematical derivation of decomposition methods[8]

The theoretical underpinnings of the net-exports and attribution methods are provided in this appendix. The derivations are based on the variables provided by the input-output table (IOT) shown in table A.1. This type of table is known as an IOT excluding imports in basic prices. Note that the data on the imports as well as taxes less subsidies on products (TLS) are provided in the row of the IOT.

Table A.1. Input-output table of year t excluding imports in basic prices

	Commodity 1	…	Commodity *n*	Domestic final demand	Export	Total
Commodity 1						
…		Z^t_{dom}		c^t_{dom}	e^t_{dom}	q^t
Commodity *n*						
Value added +TLS		w^t_Z		w^t_c	w^t_e	y^t
Imports		m^t_Z		m^t_c	m^t_e	m^t
Total		$q^{t\prime}$		c^t	e^t	

The superscript *t* indicates the time period for all variables. Matrices are shown in capital letters. Vectors and scalars are shown in lower case.

Z^t_{dom}	Intermediate demand satisfied by domestic products (*n* by *n* matrix)
c^t_{dom}	Domestic final demand satisfied by domestic products (*n* by 1 vector)
e^t_{dom}	Exports satisfied by domestic products (*n* by 1 vector)
q^t	Total output of domestic products (*n* by 1 vector)
w^t_Z	GDP (value added and TLS) per commodity (1 by *n* vector)
w^t_c	GDP (TLS) of domestic final demand (scalar)
w^t_e	GDP (TLS) of exports (scalar)
y^t	Total GDP (scalar)

[8] This section is taken almost entirely from Hoekstra *et al*, (2006)

m^t Imports per commodity (1 by *n* vector)

m_c^t Import requirements of domestic final demand (scalar)

m_e^t Import requirements for exports (scalar)

m^t Total imports (scalar)

c^t Total domestic final consumption (scalar)

e^t Total exports (scalar)

A.1. Net-exports method

GDP can be defined by the final demand components (domestic and exports) less imports:

$$y^t = c^t + e^t - m^t \tag{1}$$

The GDP growth from period 0 to period 1 can be attributed to these categories as shown in equation 2. Note that variables y^1, c^1, e^1 and m^1 are expressed in prices of year 0 so that the real growth in GDP is analysed.

$$\dot{y} = \left(\frac{c^1 - c^0}{y^0}\right) + \left(\frac{e^1 - e^0}{y^0}\right) - \left(\frac{m^1 - m^0}{y^0}\right) \tag{2}$$

Where $\dot{y} = \left(\frac{y^1 - y^0}{y^0}\right)$

The growth rate of variable *y* can therefore be related to the growth rate of variables *c*, *e*, and *m* weighted by the base year. The last two terms of equation 2 are defined as the contribution of net-exports as shown in equation 3.

$$\begin{aligned} \dot{y} &= D_c^{net} + D_e^{net} \\ D_c^{net} &= \left(\frac{c^1 - c^0}{y^0}\right) \\ D_e^{net} &= \left(\frac{e^1 - e^0}{y^0}\right) - \left(\frac{m^1 - m^0}{y^0}\right) \end{aligned} \tag{3}$$

D_c^{net} Contribution of domestic final demand using the net-exports method

D_e^{net} Contribution of exports using the net-exports method

A.2. Attribution method 1

In the net-exports method the imports are subtracted from exports. However, imports are used for domestic demand as well, through final and intermediate demand (Kranendonk and Verbruggen, 2005 p3; ECB, 2005 p54-56). In the attribution method the GDP and imported inputs per final demand component is calculated using an input-output modelling technique. Using the IOT in table A.1 it is possible to define GDP from the income perspective, as is shown in equation 4.

$$y^t = w_Z^t \cdot i + w_c^t + w_e^t \tag{4}$$

Where i is a summation vector (n by 1) of 1's. Using input-output analysis it is possible to impute GDP to final demand components. This imputation is represented by the following equations. A hat on a variable indicates that it is diagonalized. t is used throughout the report to identify the time period.

$$\begin{aligned} y^t &= \lambda^t \cdot L^t \cdot \left(c_{dom}^t + e_{dom}^t\right) + w_c^t + w_e^t \\ \lambda^t &= \left(w_Z^t \cdot \hat{q}^{t^{-1}}\right) \\ L^t &= \left(I - A^t\right)^{-1} \\ A^t &= \left(Z_{dom}^t \cdot \hat{q}^{t^{-1}}\right) \end{aligned} \tag{5}$$

λ^t GDP (Value added plus TLS) coefficients per commodity (n by 1 vector)
L^t Leontief inverse matrix (n by n matrix)
A^t Technical coefficients matrix (n by n matrix)

If the GDP growth rate is decomposed using this relationship for a year 0 and 1 then the following equation is obtained (the variables for year 1 are in prices of year 0).

$$\begin{aligned} \dot{y} = &\frac{\left(w_c^1 + \lambda^1 \cdot L^1 \cdot c_{dom}^1\right) - \left(w_c^0 + \lambda^0 \cdot L^0 \cdot c_{dom}^0\right)}{y^0} \\ &+ \frac{\left(w_e^1 + \lambda^1 \cdot L^1 \cdot e_{dom}^1\right) - \left(w_e^0 + \lambda^0 \cdot L^0 \cdot e_{dom}^0\right)}{y^0} \end{aligned} \tag{6}$$

Now define the attributed GDP share of domestic final demand and exports as follows (α_c^t and α_e^t respectively).[9]

$$\alpha_c^t = \frac{\left(w_c^t + \lambda^t \cdot L^t \cdot c_{dom}^t\right)}{c^t}$$
$$\alpha_e^t = \frac{\left(w_e^t + \lambda^t \cdot L^t \cdot e_{dom}^t\right)}{e^t} \qquad (7)$$

α_c^t Attributed GDP share of domestic final demand (scalar)

α_e^t Attributed GDP share of exports (scalar)

The equation for the GDP growth rate can be rewritten as shown in equation 8.

$$\dot{y} = \frac{\left(\alpha_c^1 \cdot c^1\right) - \left(\alpha_c^0 \cdot c^0\right)}{y^0} + \frac{\left(\alpha_e^1 \cdot e^1\right) - \left(\alpha_e^0 \cdot e^0\right)}{y^0} \qquad (8)$$

The contributions of domestic final demand and exports can therefore be defined by the following equations.

$$\dot{y} = D_c^{att1} + D_e^{att1}$$
$$D_c^{att1} = \frac{\left(\alpha_c^1 \cdot c^1\right) - \left(\alpha_c^0 \cdot c^0\right)}{y^0} \qquad (9)$$
$$D_e^{att1} = \frac{\left(\alpha_e^1 \cdot e^1\right) - \left(\alpha_e^0 \cdot e^0\right)}{y^0}$$

D_c^{att1} Contribution of domestic final demand using the attribution method 1

[9] This definition of the alpha's differ from Kranendonk and Verbruggen (2005). In that paper the domestically produced output are used as the denominator i.e.

$$\alpha_c^t = \frac{\left(w_c^t + \lambda^t \cdot L^t \cdot c_{dom}^t\right)}{\left(c^t - m_c^t\right)} \quad \alpha_e^t = \frac{\left(w_e^t + \lambda^t \cdot L^t \cdot e_{dom}^t\right)}{\left(e^t - m_e^t\right)}$$

This is done because the models of the CPB distinguish between the growth in imported and domestic shares of final demand components. Since there are only growth figures for total demand components for the EA, this report adopts coefficients which are related to the growth in total domestic final demand and total exports.

D_e^{att1} Contribution of exports using the attribution method 1

If an IOT is available for both years (in current prices for year 0 and in prices of the previous year for year 1) the contribution to GDP growth of the domestic final demand and exports can be calculated using this equation. This method is currently used at Statistics Netherlands.

In cases where there is only one IOT available, as is the case in this project, a number of alternatives exist which is described in subsequent sections.

A.3. Attribution method 2

Kranendonk and Verbruggen (2005, 2008) describe the method used by the CPB. In this approach the attributed GDP share that is derived from the IOT is assumed to remain constant for all years for which the analysis is done. Kranendonk and Verbruggen (2005, p 7) argue that "Earlier research suggested that in general these ratios are fairly stable over time. For most years, the error caused being committed by using fixed ratios is accordingly limited." They refer to Kranendonk (1998) for corroboration. It is important to stress that the CPB work is done at a very detailed level. It distinguishes over 10 different demand components and also has information about the final imports of each. At this level of detail the shares are more likely to remain constant than more aggregated data, such as this project. Replacing α^1 by α^0 in equation 9, the following equation is obtained:

$$\dot{y} = D_c^{att2} + D_e^{att2}$$

$$D_c^{att2} = \frac{\left(\alpha_c^0 \cdot c^1\right) - \left(\alpha_c^0 \cdot c^0\right) + r_c}{y^0} \tag{10}$$

$$D_e^{att2} = \frac{\left(\alpha_e^0 \cdot e^1\right) - \left(\alpha_e^0 \cdot e^0\right) + r_e}{y^0}$$

D_c^{att2} Contribution of domestic final demand using attribution method 2

D_e^{att2} Contribution of exports using attribution method 2

r_c Residual attributed to domestic final demand

r_e Residual attributed to exports

The contributions are therefore calculated using a pure effect and a residual. The residual emerges because of changes in attributed GDP shares. The following equation shows that if the attributed GDP shares remain constant, the residual equals zero.

$$r = \left(\alpha_c^1 - \alpha_c^0\right) \cdot c^1 + \left(\alpha_e^1 - \alpha_e^0\right) \cdot e^1$$
$$r = r_c + r_e \tag{11}$$

r Total residual

Kranendonk and Verbruggen (2005) split the residual according to the share of the final demand components in the attributed GDP. These weights can only be adopted for a year in which an IOT is present (year 0 in this case). Note that this approach has the drawback that the residual may actually exceed the pure effect and lead to a change in sign. Kranendonk and Verbruggen (2005, footnote 10, p8) however state that for the Netherlands, "in the period 1990-2004, the residual left to be divided has been approximately nil on average, and in absolute terms, except for one year, it had been 0.5 percentage point or less". Their procedure is shown in the following equation:

$$r_c = \beta_c \cdot r$$
$$r_e = \beta_e \cdot r$$
$$\beta_c = \frac{w_c^0 + \lambda^0 \cdot L^0 \cdot c_{dom}^0}{y^0} = \frac{\alpha_c^0 \cdot c^0}{y^0} \tag{12}$$
$$\beta_e = \frac{w_e^0 + \lambda^0 \cdot L^0 \cdot e_{dom}^0}{y^0} = \frac{\alpha_e^0 \cdot e^0}{y^0}$$

β_c Share of residual assigned to domestic final demand
β_e Share of residual assigned to exports

A.4. Attribution method 3

Statistics Netherlands currently adopts attribution method 1, but has also used an alternative approach in 1990's. Assume that table A.1 shows the results for the year for which the IOT exists (year 0). This table is a simple Cumulated Production Structure (CPS) discussed in Kranendonk and Verbruggen (2005)

If there is no IOT available for year 1, then only the macro-economic aggregates y^1, m^1, c^1 and e^1 (in prices of year 0) are known. The CBS estimates the attributed GDP and attributed imports for year 1 in two steps. First, the attributed GDP and imports are assumed to have the same shares as in year 0. Secondly, these initial estimates are fitted to the table totals using a WINADJUST, which is a Lagrangian balancing technique used by Statistics Netherlands (van Dalen and Sluis, 2002). The CPS estimates, denoted by the Π symbols, are shown in table A.3.

Table A.2. Cumulated Production Structure for year 0

	Domestic final demand	Exports	Total
Attributed GDP	$\alpha_c^0 \cdot c^0$	$\alpha_e^0 \cdot e^0$	y^0
Attributed imports	$\tau_c^0 \cdot c^0$	$\tau_e^0 \cdot e^0$	m^0
Total	c^0	e^0	

τ_c^t Import share of domestic final demand $\left(= \left(1-\alpha_c^t\right)\right)$

τ_e^t Import share of exports $\left(= \left(1-\alpha_e^t\right)\right)$

Table A.3. Cumulated Production Structure for year 1

	Domestic final demand	Exports	Total
Attributed GDP	Π_{yc}^1	Π_{ye}^1	y^1
Attributed imports	Π_{mc}^1	Π_{me}^1	m^1
Total	c^1	e^1	

Π_{yc}^t Estimated attributed GDP of domestic final demand (scalar)

Π_{ye}^t Estimated attributed GDP of exports (scalar)

Π_{mc}^t Estimated attributed imports of domestic final demand (scalar)

Π_{me}^t Estimated attributed imports of exports (scalar)

The equation for the share in the growth rate is therefore given by:

$$\dot{y} = D_c^{att3} + D_e^{att3}$$

$$D_c^{att3} = \frac{\Pi_{yc}^1 - \left(\alpha_c^0 \cdot c^0\right)}{y^0} \qquad (13)$$

$$D_e^{att3} = \frac{\Pi_{ye}^1 - \left(\alpha_e^0 \cdot e^0\right)}{y^0}$$

D_c^{att3} Contribution of domestic final demand using attribution method 3

D_e^{att3} Contribution of exports using attribution method 3

Note that this method provides an estimate of the attributed GDP shares in year 1. The shares are defined by the following equations.

$$\alpha_c^1 = \frac{\Pi_{yc}^1}{c^0}$$
$$\alpha_e^1 = \frac{\Pi_{ye}^1}{e^0} \qquad (14)$$

A.5. Summary

Table A.4 summarizes the formulas which are derived in the previous sections. The equations clearly illustrate the difference between the net-exports and attribution methods. In the net-exports method the imports are deducted fully from the exports to assess the contribution of (net) exports, while in the attribution method the imports are divided amongst the final demand components by multiplication of the attributed GDP share coefficients.

Table A.4. Summary of the methods

	Contribution of domestic final demand	Contribution of exports
Net-exports method	$\left(\frac{c^1 - c^0}{y^0}\right)$	$\left(\frac{e^1 - e^0}{y^0}\right) - \left(\frac{m^1 - m^0}{y^0}\right)$
Attribution method 1	$\frac{(\alpha_c^1 \cdot c^1) - (\alpha_c^0 \cdot c^0)}{y^0}$	$\frac{(\alpha_e^1 \cdot e^1) - (\alpha_e^0 \cdot e^0)}{y^0}$
Attribution method 2	$\frac{(\alpha_c^0 \cdot c^1) - (\alpha_c^0 \cdot c^0) + r_c}{y^0}$	$\frac{(\alpha_e^0 \cdot e^1) - (\alpha_e^0 \cdot e^0) + r_e}{y^0}$
Attribution method 3	$\frac{\Pi_{yc}^1 - \alpha_c^0 \cdot c^0}{y^0}$	$\frac{\Pi_{ye}^1 - \alpha_e^0 \cdot e^0}{y^0}$

Many authors have noted that the main problem with the net-exports is that it leads to an underestimation of the importance of exports for GDP growth and overestimates the importance of domestic expenditure categories (ECB, 2005; Kranendonk and Verbruggen 2005, 2008; Hoekstra *et al*. (2006)). It is easy to show that the impact of the domestic final demand component of the net-exports method is larger than the impact calculated through attribution method 1 if the following condition is met:

$$(1+\dot{c})\cdot(1+\dot{\imath}_c)>1 \quad (15)$$

$\dot{c}$ Growth rate of domestic final demand

$\dot{\imath}_c$ Growth rate of import share of domestic final demand

This condition in equation 15 will only be violated if the growth in the domestic consumption *c* is off-set by a decrease in the import share τ. Kranendonk and Verbruggen (2005) show, for the Netherlands, that this situation occurs regularly in practice. [10]. When applying these methods it is therefore likely that one will find that the net-exports method leads to a higher estimation of the contribution of domestic final demand to GDP growth.

As the previous section has argued, the attribution methods 2 and 3 are second-best alternatives that may be used if IOT data is not available for all time periods of the decomposition. Both are based on the attribution method and are therefore theoretically preferable to the net-exports method. Nevertheless, both methods have their drawbacks. Attribution method 2 leads to a residual which has to be split amongst the "pure" effects. Potentially, the sign of the pure effect and the total effect may be different because of these adjustments. Method 3 has the disadvantage that the updating method is based on the shares of the previous years. Although this has the advantage that information from recent time periods is being used, the estimates found are path-dependent and may vary from the actual attributed GDP and attributed imports. Note that if attributed shares remain constant over time, all three attribution methods are equal.

Table A.5. summarizes the theoretical and practical advantages and disadvantages of the 4 methods which have been introduced in this section.

Table A.5. Summary of advantages and disadvantages of the four methods

	Advantages	Disadvantages
Net-exports method	Ease of application due to readily available data.	Theoretically problematic because imports are attributed entirely to exports. Likely to overestimate contribution of domestic final demand.
Attribution	Theoretically preferable	Requires IOT for all time periods being

[10] Similarly the ECB's Monthly Bulletin of June 2005 (Box 7, p 54-56) concludes that "Overall, while net trade and exports are useful measures of activity, it should be borne in mind that the former may in some circumstances give an understated picture of the impulse of the external sector."

method 1	to the net-exports method	analysed
Attribution method 2	Theoretically preferable to net-exports method, but less so than attribution method 1.	The assumption of a constant attributed GDP share leads to a residual. The "pure effect" may therefore change sign after correction for the residual.
Attribution method 3	Theoretically preferable to net-exports method, but less so than attribution method 1. Uses information from recent year for updating.	Estimates of the attributed GDP and imports are path dependent and may therefore vary from the real values.

Appendix B. Data construction and attribution calculations

The data construction methodology and attribution calculations are undertaken in 7 steps. The aim of these steps is to produce IOT for 2003, 2004 and 2005 and to perform the attribution calculations. In steps 1-5 (sections B.1-B.5) the EA-IOT for 2003 is produced. In step 6 (section B.6) the IOT for 2004 and 2005 are produced while the attribution calculations are described in step 7 (section B.7). Finally, the differences with the previous project (Hoekstra *et al*, 2006) are discussed.

B.1. Construct SUT for 2003

These data construction steps can be found in the folder "St1" in 13 country files (AT.xls….. SI.xls), one summary file (Summary Step 1.xls) and one file to converse currencies for countries that do not supply SUT in euros (SI_conversion.xls).

The format of the supply and use tables in respectively basic and purchaser prices which are produced in this section are shown in Tables B.1. and B.2 respectively.

Table B.1. The supply table after step 1

Supply table (BP)	Industries (30)	Imports	TTM	TLS	Total
Commodities (30)					
Total					

Table B.2. The use table after step 1

Use table (PP)	Industries (30)	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (30)							
Gross value added							
Total							

B.1.a. Collect the most recent SUT

There are SUT available for 2003 for AT, BE, DE, FI, FR, IT, NL, LU, PT. For SI the SUT of 2003 is available in millions of Slovenian Tolars, which are converted to euro for the purposes of this project. In the future this exercise can be used to converse currencies of new euro member states. Three countries had older SUT: ES (2001), IE (2000) and GR (1999). All SUT have a 60 industry by 60 commodity structure.

B.1.b. Choose format SUT

For this project we have chosen to construct supply and use table with 30 industries by 30 commodities. Although the tables in the transmission program are 60 industries by 60 commodities, the need to extrapolate 3 countries (ES, IE and GR) using value added data and output for 30 industries makes the 30 by 30 dimensions the maximum level of detail possible.

Furthermore the supply table distinguishes columns for imports, taxes less subsidies (TLS) and for trade and transport margins (TTM). The use table contains additional columns for final consumption expenditures by households, by non-profit institutions serving households (NPISH) and by governments, Gross Capital Formation (GCF) and exports.

B.1.c. FISIM and classified information

Twelve out of 13 EA countries supplied a use table in which FISIM was distributed amongst the user (post-revision method). Only the data for GR registered the FISIM using the pre-revision method. The FISIM for GR are distributed according to the use of financial services.

The SUT of LU is incomplete because the data for some industries are classified. Only the column totals are provided. We have used the industry structure of Belgium to estimate the industry column. The remaining differences are eliminated using a Lagrangian method (WINADJUST).

B.1.d. Produce SUT for AT, BE, DE, FI, FR, IT, LU, NL, PT and SI

The tables for these countries are converted to the format chosen in step B.1.b. For the SUT of SI is converted from Slovenia Tolars to euros. Remaining differences in the table totals are eliminated by using a lagrangian method (WINADJUST)

B.1.e Produce SUT for GR, IE and ES.

The tables of GR, IE and ES are extrapolated using MED, ITS and COMEXT data. The extrapolation is done on a 30 industries (the maximum aggregation available for value added and output data) by 60 commodities matrix to be as precise as possible.

Total output for the 30 industries of the SUT for 2003 are derived directly from the MED. The supply per commodity is extrapolated using the output growth and the most recent supply table. No output per NACE was available for ES end IE. In these cases, value added was used as the extrapolator for output.

Total intermediate use per NACE is derived from the MED. The intermediate demand per commodity is estimated by multiplied the growth of intermediate use of the industry in question by data in the most recent use table. No intermediate use per NACE was available for ES end IE; growth of value added was used to multiply the old intermediate use values. The row of value added was filled with the actual value added numbers from the MED.

Consumption by households is extrapolated using COICOP data to extrapolate consumption data per commodity from the most recent SUT. Since COICOP (functions) and commodity classifications are not the same, the most closely related COICOP category was used for a commodity. The actual total of consumption by household from MED is used for the column total of consumption by households.

Consumption by NPISH is extrapolated by multiplying the data from the most recent SUT to the output growth of the industry where the production of NPISH is likely to be located. The actual total of consumption by NPISH from MED is used for the column total of consumption by NPISH.

Consumption by government is extrapolated by linking the growth of the COFOG that is most similar to the product group to the consumption vector of the most recent use table. No COFOG was available for ES; the growth number of the total governmental expenditure was used. The aggregate of consumption by government is taken directly from MED.

Gross Fixed Capital Formation is extrapolated by linking the growth of the category of the investment breakdown that is most similar to the product group which is invested. Changes in inventories and valuables are calculated separately, although the developments of these categories are very volatile over years and may even change in sign. The extrapolation of inventories and valuables using investment growth rates might cause them to grow continuously even when they have a negative sign. The absolute distance from zero is calculated for the sum of inventories and valuables for all commodities. Proportions that lead from this calculation are used to divide the difference of the aggregates of 2003 and the most recent SUT. Finally the proportion of the difference is added to the total of the most recent SUT.

The imports and exports are extrapolated by using the growth rates of the COMEXT and ITS goods and services data. The aggregates of import and export are taken directly from MED.

Trade and transport margins are extrapolated by linking the development of NACE i to the vectors in the most recent SUT. The product related taxes less subsidies are extrapolated by linking the growth of the output of the NACE in which production of the commodity is likely to be located to the vector of the most recent supply table. The aggregate is corrected by using the actual number of the MED. No output per NACE was available for IE and ES; gross value added was used instead.

The row totals where calculated in 4 steps: 1) the rows of both the supply and use tables were summed. 2) If there is just one intersection in the interior of the supply table, the row total of the supply table is used. 3) If there is more then just one intersection: the highest of both totals of the calculated row totals of supply and use table is used. 4) The difference of the total of the columns and the total of the rows is proportionally divided over the row totals, except those with just one intersection in the interior of the table. The remaining difference of the column totals between the supply and use table is divided equally over the import and export totals. Finally the supply is balanced by using WINADJUST. After placing the totals of the supply table on the use table, the use table is also balanced by using WINADJUST.

Evaluation of Step1

Ten out of thirteen countries supplied a SUT for 2003, which constitutes 86% of the EA GDP. In Hoekstra *et al* (2006) the country coverage was worse (6 out of the 12 countries) and GDP coverage was similar (84%). The countries which did not supply SUT for 2003 were ES (2001), IE (2000) and GR (1999), which account for 10%, 2% and 2% of the EA total respectively.

With respect to FISIM, the data situation had improved. In Hoekstra *et al* (2006) FISIM registration was still pre-revision for 11 of the 12 countries. For the current project only GR had not updated the FISIM registration in their SUT.

Weak point of this step remains the calculation of the changes in inventories and valuables, though we have improved the method compared to Hoekstra *et al* (2006). Fixed capital formation and the changes in inventories and valuables were now calculated separately, which makes the result more reliable. Still, there is no way to predict the changes in and the sign of both valuables and inventories by commodity.

The difference between the GDP from the 13 SUTs and the published EA-GDP is very small (about 0,2%).

B.2. Convert use tables to basic prices

These data construction steps can be found in the folder "St2+3" in 13 country files (AT(bp).xls…..SI(bp).xls) and one summary file (Summary Step2+3.xls)

In this step the 13 use tables in purchaser prices are converted to use tables in basic prices. The resulting use tables have the format shown in table B.3. The exercise is done using a 30 industries by 30 commodities classification.

Table B.3. The use table after step 2

Use table (BP)	Industries (30)	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (30)							
Value added							
TLS							
Total							

B.2.a. Insert data for ES, FI and NL

The use table in basic prices for 2003 was supplied through the transmission program (FI) and directly from the national accounts department (NL).

The use table in basic prices for ES is also provided in the transmission program (for 2001) but excludes FISIM. The ratio's between basic and purchaser prices were calculated for 2001 and used to calculate the use table in basic prices for 2003. The remaining differences were eliminated using WINADJUST.

B.2.b Convert use table of GE, FR, IE, IT and SI

These countries have not provided a use table in basic prices to the Eurostat transmission program so the most recent IOT in basic prices is used. Since all countries in this group have provided commodity-by-commodity IOT, the final demand value in basic prices for 2001 can be calculated by using the ratio's between the use table in purchaser prices and the IOT in basic prices. The intermediate consumption in basic prices is estimated by first converting the IOT to the use table in basic prices by assuming the industry technology assumption (Konijn, 1994). The ratios of this table and the use table in purchaser prices are then calculated. These ratios are then used on the 2003 use table in purchaser prices. The estimated tables in basic price are balanced using WINADJUST. FR supplied an IOT for 2003.

B.2.c. Convert use table of AT, BE, GR, LU and PT

For these countries, the IOT are also used, but first the pre-revision registration of FISIM has to be corrected. The FISIM is therefore split amongst the consuming categories based on the distribution of banking services. Subsequently the same procedure is used as in step B.2.b.

For GR there was a huge difference between the intersection (financial intermediation) in basic (5700 million euro) and purchaser prices (700 million euro). This caused troubles solving the Lagrangian equations. The column total was divided equally in accordance with the distribution in the use table.

There were no IOT available for LU, the shares of BE were used to produce a use table in basic prices for LU.

Evaluation of step 2

There is only specific data for 2 countries for 2003, NL (6% of EA-GDP), FI (2%). The data for ES (10%) is available for 2001. For the other countries the IOT had to be adopted. This is fine for the final demand components but may cause problems when calculating the ratio's for the intermediate inputs.

Despite the fact that this step might be problematic because of the lack of direct data, the adjustments which have to be made are, on aggregate, not that large. Generally, the adjustments are lower than 1% of the total use value. Only IE and GR require larger adjustments (+6% and -8% respectively).

B.3. Produce use tables in domestic and imported commodities

These data construction steps can be found in the folder "St2+3" in 13 country files (AT(bp).xls.....SI(bp).xls) and one summary file (Summary Step2+3.xls)

In this step the use table in basic prices is split into domestic and imported commodities. The format of the resulting tables is shown in tables B.4 and B.5.

B.3.a. Split the use table for ES

Only one country, ES, provides direct data to the transmission program about the imported and domestic portions of the use table. The tables are however for the year 2001. The shares of 2001 are used to produce the 2003 tables.

B.3.b. Split the use tables for AT, BE, FI, FR, GE, IE, IT, NL, PT and SI

For all these countries the most recent IOT is used to estimate the use tables for imported and domestically produced commodities. Since the IOT for most countries are commodity-by-commodity, they can be used directly for the final demand values. For the intermediate input the industry technology assumption is used as in step B.2.b. FR provided an IOT for 2003.

The IOT of FI and NL are industry-by-industry instead of commodity-by-commodity. However, we have assumed that the import/domestic industry shares are representative of the commodity shares of the main product of an industry.

Table B.4. The use table (domestic) after step 3

Use table (domestic) (BP)	Industries (30)	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (30)							
Value added							
TLS							
Total							

Table B.5. The use table (imported) after step 3

Use table (imported) (BP)	Industries (30)	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (30)							
Total							

B.3.c. Split the use table for GR and LU

For GR there are no IOT which distinguish imported and domestic products. The proportions of the totals of respectively imported and domestic produced commodities are used to calculate the individual use tables.

No IOT is available for LU. The shares of BE are therefore used to split the use table.

Evaluation of step 3

The data from the transmission program is not very good for the estimation of the imported shares. There is only specific data for one country: ES (10% of EA-GDP) as well as the final demand portion of the IOT for the countries which supply commodity-by-commodity IOT. In some cases fairly large adjustments are required after the first estimates are produced. Unlike step 2, this implies that the use of IOT data does not lead to very good results. As for step 2, the largest (percentage) adjustments were required for IE and LU.

B.4. Construct SUT for the EA

These data construction steps can be found in the folder "St4+5"in the files EAFINAL(2003).xls (section B.4.a&f.), asymmetry calculation.xls (section B.4.b-d), Reexports NL.xls, Reexports EA.xls(section B.4.a&f.)

Table B.6. The use table in basic prices after step 4

Use table (BP)	Industries (30)	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (30)							
Value added							
TLS							
Imports							
Total							

In this step, the SUT for the EA is produced by aggregating the data from the previous step. Furthermore, a number of important steps with respect to EA trade are encompassed in this step: the problem of asymmetries in the trade statistics are tackled and novel estimates of the EA-re-exports are presented based on data from the Netherlands trade statistics department.

B.4.a. Aggregate 13 SUT

The first estimate of the SUT of the EA is produced by aggregating the SUT of the 13 different member states. However, in this aggregation step the problem of the asymmetries arises. Theoretically the intra-EA imports and exports should be equal, in practice they are not. In the following three sections, the resolution of the asymmetries in goods, services and purchases aboard by residents are discussed respectively. In general the same procedure has been followed as in Hoekstra *et al*. (2006).

B.4.b. Solve asymmetries in goods

COMEXT data on imports and exports of individual countries can be used to produce intra-EA and extra-EA trade estimates. The intra/extra ratio's are multiplied by the exports and imports values from the SUT's (plus transit trade estimate for the Netherlands). In most cases, the export estimates are taken as intra-EA flows because these are viewed as more reliable. However, for three individual CPA codes (11, 24 and 34) imports have been used because it is suggested that there is under-reporting of exports in these cases (TF-QSA, 2005). Finally the total exports and imports are scaled up to the ECB aggregates for goods.

This procedure yields new supply and use totals for the EA-SUT which have to be distributed amongst the use categories. The differences are distributed among household consumption, gross capital formation and intermediate use according to the BEC classification of intra-EA imports. The resulting differences in the intermediate use are compensated in the value added.

The COMEXT shows negative asymmetries for some commodities such as petro-chemicals. This is due to the confidentiality treatment in some countries' COMEXT data. The quality of the COMEXT data would be enhanced should euro area data be available where such flows have been allocated to the appropriate commodity codes for the euro area aggregate.

B.4.c. Solve asymmetries in services

The calculations of the trade asymmetries in services are quite similar to those for goods. The SUT totals are split using ratio's from the ITS data. The ITS database does not use the CPA categorization, so the closest equivalent has to be used per commodity of the SUT. The asymmetries are distributed proportionally to the use table among household consumption and the intermediate use. Gross capital formation of services is very unlikely for most of the commodities, which is why this is not included in the distribution calculations.

B.4.d. Solve asymmetries for purchases abroad by residents

A special type of service is the purchase abroad by residents. The asymmetries are based on the "travel item" of the current account which are reported by all countries. The intra-EA imports are replaced by the intra-EA exports because in this case exports are viewed as more reliable.

B.4.e. Estimate re-exports

In Hoekstra *et al*. (2006) very crude assumptions about EA re-exports had to be made because of a lack of data for these flows. To improve this situation, the trade statistics department of Statistics Netherlands has produced a novel dataset for re-exports for the Netherlands. For each commodity the source and destination of the re-exports was distilled from the microdata. This enabled us to redefine the Dutch re-exports according to the EA-community principle. The Dutch data was subsequently used to produce estimates for other re-exporting countries. For a full discussion of this novel dataset, which also includes transit trade, see appendix D.

B.4.f. Produce the use tables in basic prices

The balancing of the trade asymmetry calculations is done using the use table in purchaser prices. This table subsequently has to be converted to basic prices. This is done by using the shares that are obtained by summing all 13 use tables in purchaser prices and basic prices. The remaining differences in the use table in basic prices are eliminated using WINADJUST.

To produce the domestic and imported commodity use tables, the BEC classifications are used. The BEC percentages differ significantly from those found in the EA SUT. Therefore SUT totals are use as a benchmark for the division of the BEC classifications. The resulting factors are used to determine the distribution of total imports (excluding re-exports) among gross capital formation, consumption and intermediate use. The distribution of consumption among consumption by household, government and NPISH as well as the distribution of intermediate use are calculated using the distribution of the total import matrix. The distribution of services is calculated using only the distribution derived from the total import matrix and the import totals for each commodity.

Evaluation of step 4

Clearly, this step is problematic because of the issue of asymmetries. It was beyond the scope of this project to resolve this issue conclusively and therefore we have adopted a strategy which is consistent to the work in the previous report and the ECB aggregates.

However this project has produced much improved re-exports estimates for the EA. Last time a very simple rule of thumb was introduced while now an estimate for the EA has been based on the Dutch data. Since the Netherlands contributes about this about a third of re-exports of the EA, this can be seen as major improvement.

B.5. Construct EA-IOT 2003

These data construction steps can be found in the folder "St4+5"in the file EAFINAL(2003).xls.

This step consists of a fairly straightforward application to the supply and use table of the EA of the industry technology assumption to produce a 30 commodity-by-30 commodity IOT. This has the format of table A.1.

Evaluation of step 5

The industry technology assumption is an accepted way of producing IOT despite the fact that the resulting table is inconsistent with the assumptions of the IO model. However, other methods of producing the IOT tables have their own problems or are very labour intensive (see (Konijn, 1994)).

B.6. Extrapolate EA-IOT 2003 to 2004 and 2005

These data construction steps can be found in the folder "St6"in the files Inventories and valuables.xls and Extrapolation SUT&IOT2004-2005.xls

The EA-IOT for 2004 and 2005 is produced by first extrapolating the EA-SUT using the same techniques as the country extrapolations in step 1. First the SUT for 2004 in purchaser prices is constructed using MED for extrapolating all cells of the 30 commodities-by-30 industry matrix and the final expenditure categories. Changes in inventories and valuables are extrapolated separately. The resulting SUT are then adjusted to the ECB aggregates using WINADJUST. Subsequently the use table in basic prices is calculated using the ratios between the purchaser and basic prices of 2003 and again adjusted. Finally the IOT for 2004 is produced using the industry technology assumption. Subsequently, the same process is used to produce the IOT for 2005.

Evaluation of step 6

In this step we have produced the production accounts for 3 years (2003, 2004 and 2005) which is consistent to the ECB aggregates which are currently available. Nevertheless, extrapolation has its limitations, particularly for categories such as the change in inventories and valuables.

B.7. Perform growth decomposition

These data construction steps can be found in files: CalculationsAttribution2.xls, CalculationsAttribution3.xls, CalculationsNE.xls and the summary file Results.xls

The attribution of growth rates to final demand categories on annual and quarterly data are performed using the IOT produced in B.6. Attribution method 1 is not feasible because this project has only produced IOT in current prices. Note that although the IOT distinguishes households and NPISH, these are aggregated in the calculation because the growth figures for these components are not published separately for the EA.

Evaluation of step 7

The growth decompositions have been calculated in according to the methods developed in Hoekstra *et al*. (2006).

Comparison to Hoekstra *et al*. (2006)

Compared to the previous study a number of differences can be distinguished.

Better data situation

The data situation is better in the current project than was the case for the Hoekstra *et al*. (2006) project. In the old project the SUT and the macro-economic aggregates very inconsistent. A major problem was the fact that the SUT data was mostly pre-revision 2001, while the macro-aggregates were post revision. This also meant that the treatment of FISIM was inconsistent. The consistency of the SUT and MED are now much better. The post-revision treatment of FISIM has also been adopted by nearly all countries.

Despite the fact that the data situation is better, a major problem is the fact that there was no recent SUT for FR. This meant that the GDP coverage was actually worse than in Hoekstra *et al*, (2006)

Consistent EA aggregates

In Hoekstra *et al*, (2006) the EA-IOT which was produced for 2001 was used to calibrate a new EA-GDP series. Since the EA series at the time had not resolved issues such as asymmetries the resulting figures were not consistent to the published EA series at the time.

At the time of this current project, it was now possible to harmonize the SUT/IOT with the macro-aggregates produced by the ECB. This implies that the SUT/IOT for 2003, 2004 and 2005 are now complete and consistent EA production accounts.

IOT for multiple years

In Hoekstra *et al.* (2006) a single IOT was produced for 2001. In this study a time series (2004, 2005 and 2006) is produced, which also means that the time period between the last IOT and the quarter being analysed is smaller (in the old study 2006Q1 was analysed using the IOT for 2001 while now 2007Q3 is based on the IOT for 2005). Note however that the quality of the IOT does differ: 2003 is based on the data of the individual countries, while 2004 and 2005 are extrapolations based on EA data.

Re-exports

The estimates for re-exports were simply produced by using a simple rule of thumb in Hoekstra *et al*. (2006). The situation has now improved because of the novel data produced by the trade statistics department of Statistics Netherlands.

Minor improvements

This report also includes a number of minor improvemenets such as:

- Hoekstra *et al* (2006) produced 29-by-29 commodity by SUT and IOT while in the current project this has been expanded to a 30-by-30 commodity classification.
- Our extrapolation of the changes in stock has also become somewhat better.
- The attribution calculations now include year-on-year quarterly growth rates.

Appendix C. Evaluation of the data

This section contains a discussion of the availability and quality of the data which has been used for this project. In each section we will compare the situation to that for the previous study (Hoekstra *et al*, 2007).

SUT/IOT

Table C.1. shows the availability of the SUT and IOT data available for this project. The table shows that 10 out of the 13 countries have provided data for 2003 (see countries indicted with an asterisk).

For Hoekstra *et al*, (2006) project only 6 out of the 12 countries had provided data for the most recent year (2001). The coverage, in terms of the share of countries, has therefore improved significantly. The coverage in terms of GDP has remained about the same (84% compared to 86%). ES is the largest omission (about 10% of EA-GDP).

Table C.1. Most recent SUT and IOT available for this project

		SUT	IOT	IOT domestic products	IOT imported products	IOT type
AT*	Austria	2003	2000	2000	2000	pp
BE*	Belgium	2003	2000	2000	2000	pp
DE*	Germany	2003	2002	2002	2002	pp
ES	Spain	2001	2000	2000	2000	pp
FI*	Finland	2003	2003	2003	2003	ii
FR*	France	2003	2003	2003	2003	pp
GR	Greece	1999	1998	-	-	pp
IE	Ireland	2000	2000	2000	2000	pp
IT*	Italy	2003	2000	2000	2000	pp
LU*	Luxembourg	2003	-	-	-	-
NL*	Netherlands	2003	2001	2001	2001	ii
PT*	Portugal	2003	1999	1999	1999	pp
SI*	Slovenia	2003	2001	2001	2001	pp

- = Not available for any year
pp = product-by-product IOT
ii = industry-by-industry IOT

MED

The availability of macro-economic data (value added output per NACE, investments, household consumption per COICOP) for the individual countries was good for the Hoekstra *et al*. (2006) and remained the same for this project.

A major problem in the previous study was the inconsistencies between the MED and SUT. Only 3 of the 12 countries (Italy, Austria and France) had consistent MED and SUT aggregates. This was mostly because the SUT were pre-revision 2001 while the MED were post-revision. For the current project most of these discrepancies have been eliminated. For example, one of the most important revisions was the registration of FISIM. For the previous study 11 of the 12 countries used the pre-revision FISIM registration in their SUT while this is now only down to 1 country (GR). Nevertheless it is still unfortunate that SUT and MED per industry often still include small discrepancies.

COMEXT

The COMEXT database was a valuable source of information for the previous and current project. The only problem is the issue of trade asymmetries which is discussed in section B.4.b.

A crucial input in the compilation was the availability of COMEXT data for the euro area cross classified by BEC and CPA to allow an improved geographical breakdown of the import matrix derived from the summation of Member States'. The use of the COMEXT data is not problem free, asymmetries exist in COMEXT data at this level of detail because of the treatment of confidentiality, notably with respect to petrochemical products.

It is also interesting to note that there are still large differences between COMEXT and SUT totals per CPA category, even when classification issues such as transit trade are resolved.

ITS

The services data was rather problematic for the Hoekstra *et al* (2006) project. The services data was not given in CPA classifications but broad comparisons to the SUT showed large differences in the levels of imports and exports in services. A final problem was that the trade in services to and from geographical units (such as the EA) is only disaggregated to 5 service categories.

The above problems remain for this project although the disaggegration of the ITS data has improved for some countries.

Appendix D. Re-exports for the EA (2003-2006)

In the previous study a very crude method was used to estimate the re-exports of the EA. In the final report it was recommended that this situation should be improved (Hoekstra *et al*., 2006).

To improve this situation a new method has been adopted. First all the available information about the development of re-exports (from a national perspective) in each country has been collected. Particularly the values for the four largest re-exporters of the EA (DE, FR, NL and BE) were important.

For the Netherlands the trade statisticians were asked to split the re-exports (and transit trade) into the source (intra- or extra-EA) and destinations (intra- or extra-EA) for the years 2003-2006. This enabled us to convert the Dutch re-exports from the national perspective to the EA-community perspective. Since these data do not exist for the other countries, assumptions based on the Dutch data per commodity were used for the other countries. The result is a time series of re-exports of the EA for 2003-2006. In the following sections the procedures are described in detail.

D.1. Re-exports for individual countries

The IOT data from the transmission program suggests that nine out of 13 countries have re-exports. For 2000 this was 341 thousand million euros. However, in absolute terms only the re-exports of DE (94 thousand million), FR (97), NL (82) and BE (53) are very significant. Together they account for 96% of the re-exports (from a national perspective).

To start the re-exports figures for the 9 re-exporting countries were obtained from the most recent IOT in the transmission prorgam: DE (2003), FI (2003) and NL (2003), SI (2001), AT (2000), BE(2000), FR (2000), IE (2000) and IT(2000). A time series for the German re-exports were obtained from the Statistische Bundesambt for the period 2003-2005. Furthermore, the detailed information from the Netherlands was obtained for the period 2003-2006 (see next section).

D.2. Re-exports for the NL

The Dutch trade figures are made up of "regular" imports and exports, re-exports and transit trade. For the COMEXT database, the total imports and exports are used including transit trade while for National accounting purposes transit trade are excluded because these trade flows are not attributable to Dutch residents.

Re-exports are goods, previously imported, which are exported in almost the same state as they were imported. Economically the re-exports have a different impact on the economy as the exports from domestic production. In the Netherlands the portion of the re-exports in the total exports is relatively large (44% of the COMEXT total in 2006 is re-exports and about 16% is transit trade). The re-exports figures are not measured directly but are produced using assumptions which are discussed in the following paragraphs.

The estimations for the re-exports start with the micro data of the international trade in goods. The main principle of the estimation is a comparison of the import flows with the export flows of a certain company. When a company exports the same goods as it imports, those exports are regarded as re-exports. When a company exports other goods as it imported it is assumed a production process took place and it considered an import for domestic production.

This principle is put into practice by comparing the imports and exports at the HS6 level. If the export value is less than twice the import value, the exports are considered to be re-exports, otherwise the exports are considered to be exports from domestic production. The plausibility of the estimation is improved by checking the largest exporting companies individually as well as other manual checks.

The corresponding value of the import is assumed to be 90% of the export value. This is based on a study by the CPB Netherlands Bureau for Economic Policy Analysis which found that the added value of one euro re-exports is about 10 cents.

The above procedure is followed in the estimation of the re-exports from the national perspective. However, for the purposes of this project the Dutch re-exports need to be redefined from the EA-community perspective. For the EA a re-export only counts as a re-export when the goods are imported from outside the EA and exported to a country outside the EA. It is therefore necessary to determine the origin and destination of the Dutch re-exports.

For the destination of the re-exports the calculation is rather simple. From the estimation of the re-exports we know the amount of re-exports at the level of company and commodity code. The requested figures are therefore obtained by combing the re-exports figures to the original data of the international trade in goods. The imports are a little bit more difficult. We have to make the assumption that there is no difference between the origin of imports for re-exports and imports for domestic use. In other words: if 20 percent of the imported goods come from outside the EA, it is assumed that 20 percent of the imported goods for re-export come from outside the EA. Note however that this assumption is applied to the microdata (at the good and company level).

After all the previous steps we got a file of all the imports and exports including a breakdown of the source and destination of the re-exports and transit trade.

D.3. Re-exports for the EA

Re-exports for the EA are calculated by combining the country data described in section D.1. and the specific Dutch data in section D.2. To do this a number of assumptions are required.

Nine countries report re-exports in the IOT which have been provided in the transmission program. The first step is to produce a time series (from the national perspective) for the years 2003-2006 by extrapolating the most recent IOT figures using the available time series for Germany and/or the Netherlands. Re-exports for the period before 2003 are extrapolated using German developments. For 2004 and 2005, the combined Dutch and German developments are used, while for 2006 the Dutch development was the only proxy available.

The resulting re-exports figures are the re-export figure from a national perspective. To convert these to EA-re-exports the percentages per commodity from the Dutch data are used. It is therefore assumed that the Dutch percentage per commodity is representative for the EA re-exports per commodity. The resulting estimates are provided in Table D.1.

Table D.1.Re-exports of the EA (million euro)

		2003	2004	2005	2006
a	Agriculture, hunting and forestry	826	869	1073	1366
b	Fishing	54	45	60	50
ca	Mining and quarrying of energy producing materials	219	109	108	112
cb	Mining and quarrying exept energy producing materials	567	607	752	833
da	Manufacture of food products; beverages and tobacco	1246	1452	1624	1721
db	Manufacture of textiles and textile products	1966	2320	2485	3036
dc	Manufacture of leather and leather products	466	638	680	680
dd	Manufacture of wood and wood products	92	133	160	202
de	Manufacture of pulp, paper and paper products; publishing and printing	517	574	644	603
df	Manufacture of coke, refined petroleum products and nuclear fuel	914	961	1801	2414
dg	Manufacture of chemicals, chemical products and man-made fibres	6644	11025	11908	14885
dh	Manufacture of rubber and plastic products	743	790	790	889
di	Manufacture of other non-metallic mineral products	149	184	202	226
dj	Manufacture of basic metals and fabricated metal products	1767	2137	2566	3695
dk	Manufacture of machinery and equipment n.e.c.	4228	4608	5715	6939
dl	Manufacture of electrical and optical equipment	27626	37472	43817	46691
dm	Manufacture of transport equipment	12382	12741	14459	17274
dn	Manufacturing n.e.c.	1536	1797	1828	2193
e	Electricity, gas and water supply	0	0	0	0
f	Construction	0	0	0	0
g	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	3	5	5	5
h	Hotels and restaurants	0	0	0	0
i	Transport, storage and communication	100	129	152	170
j	Financial intermediation	938	1206	1425	1599
k	Real estate, renting and business activities	31	41	48	54
l	Public administration and defence; compulsory social security	85	102	121	136
m	Education	0	0	0	0
n	Health and social work	0	0	0	0
o	Other community, social, personal service activities	69	88	100	112
p	Activities of households	0	0	0	0
	Total	63 168	80 033	92 523	105 885
	Percentage of total EA exports	4.6%	5.4%	5.7%	5.8%

Appendix E. Comparison of net-exports and attribution methods

Appendix A discusses the different ways in which the GDP growth rates may be decomposed. In this section the results for the net-exports and attribution methods 2 and 3 are provided for annual (Figure 1), quarter-on-quarter (Figure 2) and year-on-year (Figure 3) growth rates respectively. The results confirm what was already shown in the previous study (Hoekstra *et al*, 2006). Firstly, the net-exports method generally leads to an underestimation of the external sector. Secondly, attribution methods 2 and 3 lead to fairly similar results.

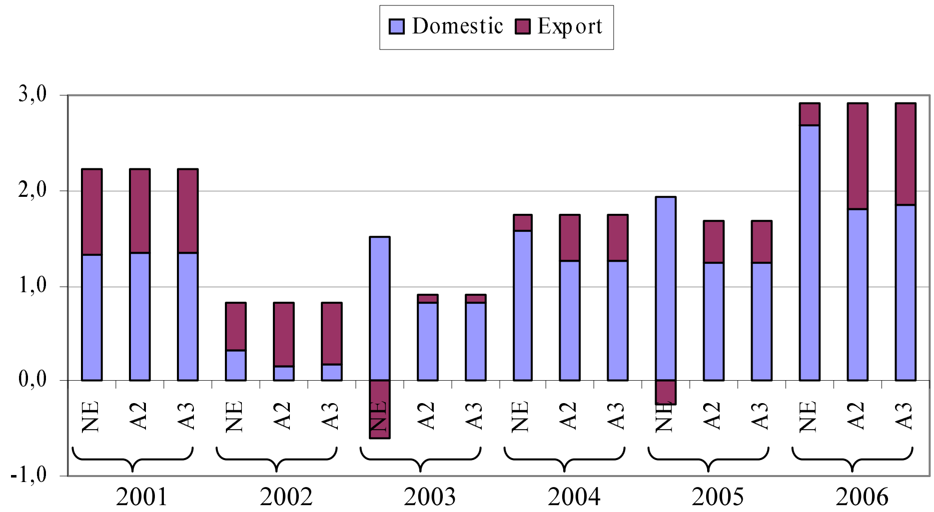

Figure E1. Attribution of annual growth rates

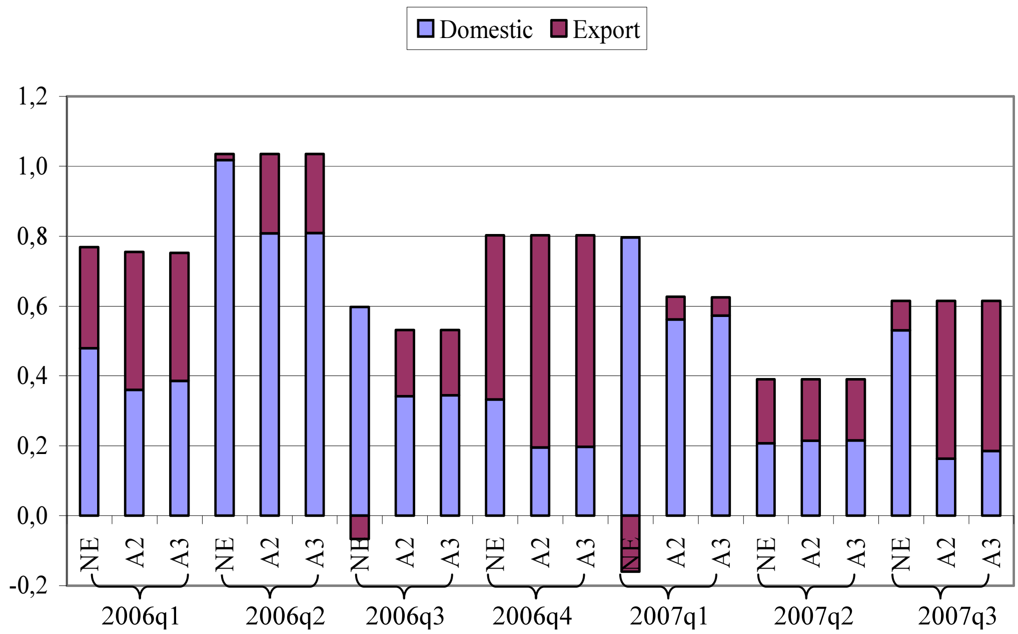

Figure E2. Attribution of quarter-on-quarter quarterly growth rates

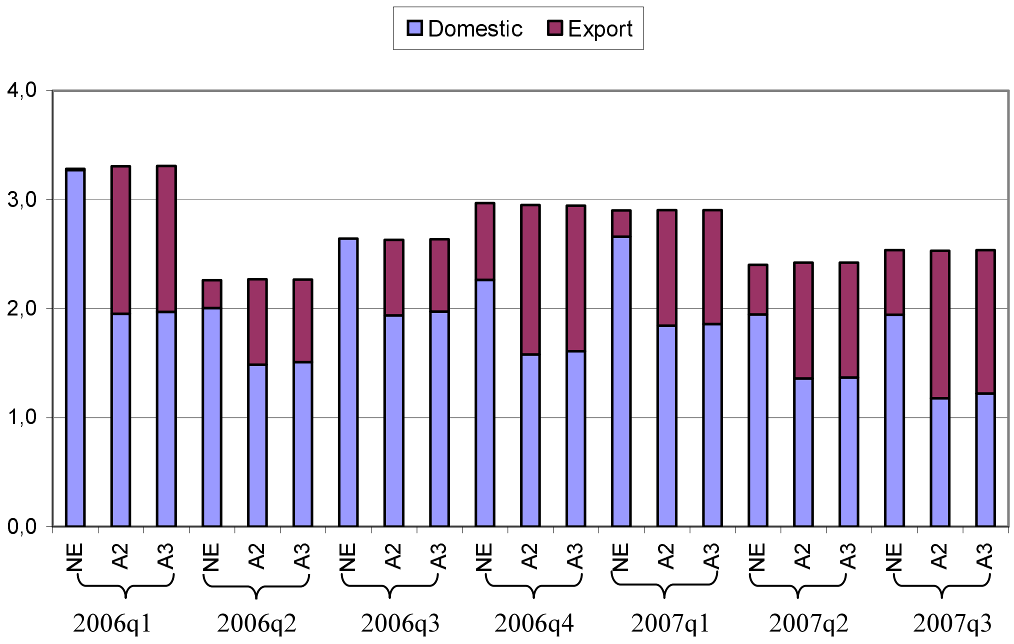

Figure E3. Attribution of year-on-year quarterly growth rates

Appendix F. Sensitivity analysis

The annual and quarterly results in this report were produced using the IOT for 2003, 2004 and 2005. This means that the quarterly results for 2006 and 2007 were based on the IOT for 2005, for example. But how important is it to use a recent IOT? What for example would be the result if we used the IOT for 2003 for the 2006-2007 quarters? Since we have IOT for multiple years we can do sensitivity analysis to test this issue. We distinguish method A (which used the IOT for 2003, 2004, 2005-like the rest of the report) and method B (which uses only the IOT for 2003).

The results for the attributed GDP shares are presented in figures F.1 (method A) and F.2 (method B). The figures for the quarterly attributed shares look very similar. The share for export however shows a sharper drop when the attribution calculations are based on IOT for 2003-2005. The difference can be explained partly by the increase of the re-exports for this period.

Figures F.3 and F.4 show the annual and quarterly attribution calcultaions respectively. The results are again very similar for both methods. The annual growth contributions differ only slightly for exports and domestic demand for 2004 and 2005. Again this can be explained by the fact that these are years that re-exports grew significantly. Growth contribution of export is therefore somewhat higher for method B. (see figure F.3)

The results support the idea that structural changes in an economy do not change very rapidly (James et al., 1978 and Fankhauser and McCoy, 1995). The results however do show that re-exports can influence the results quite significantly.

We must however remember how the IOT were produced: the IOT for 2004 and 2005 are extrapolations of the IOT-2003. This procedure may cause less structural change than exists in reality. When, in future, IOT for all years are based on the underlying SUT the sensitivity analysis should be repeated.

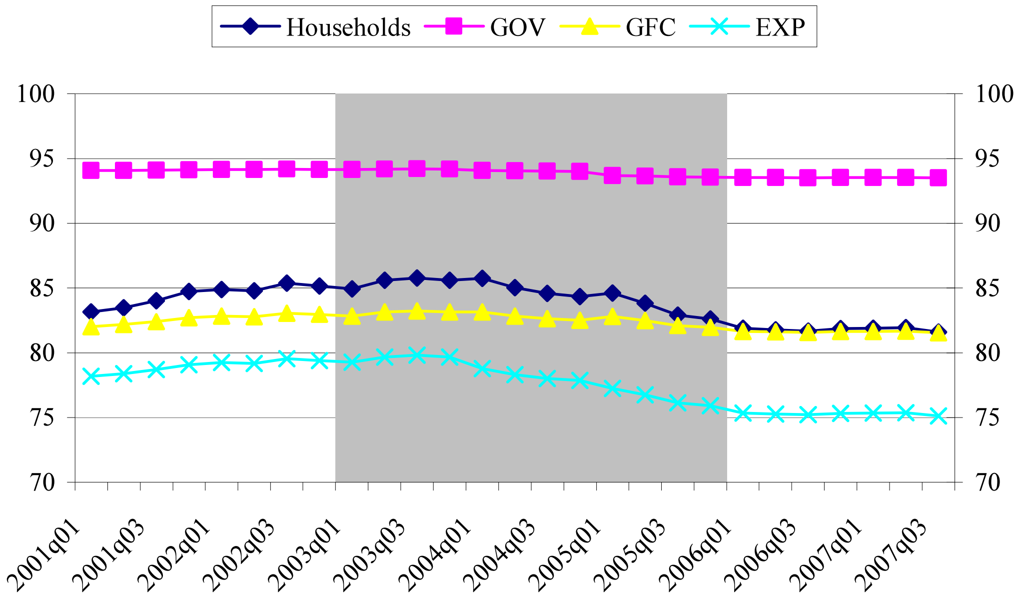

Figure F1. Quarterly attributed shares based on IOT 2003-2005

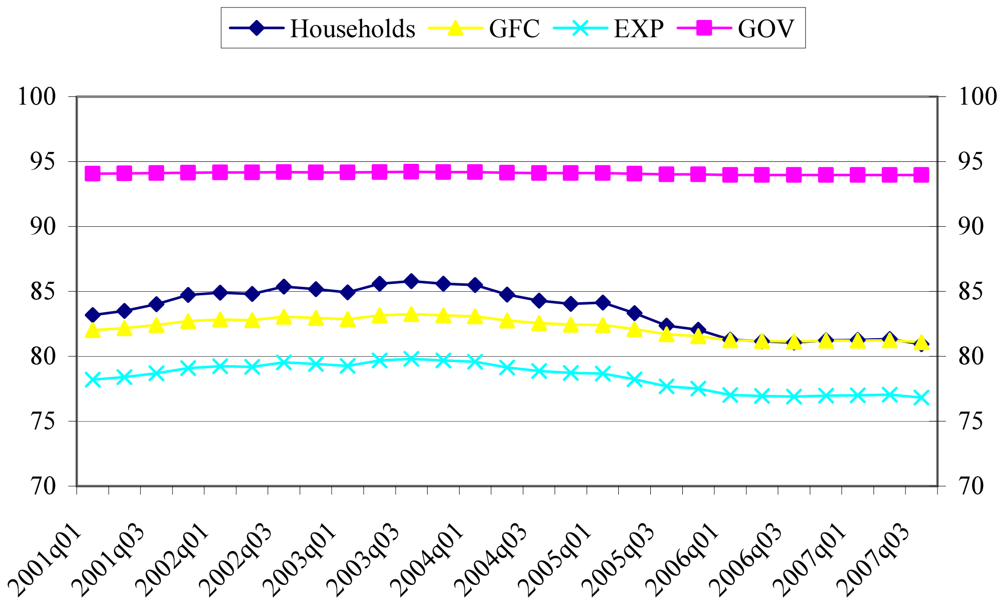

Figure F2. Quarterly attributed shares based on IOT 2003

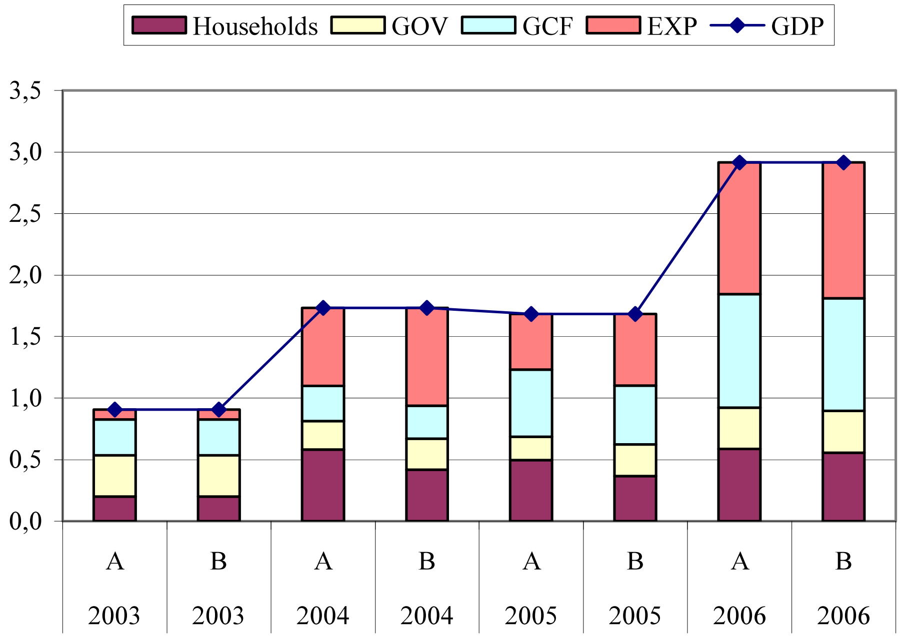

Figure F3. Annual GDP growth contribution based on A) IOT 2003-2005 and B) on IOT 2003

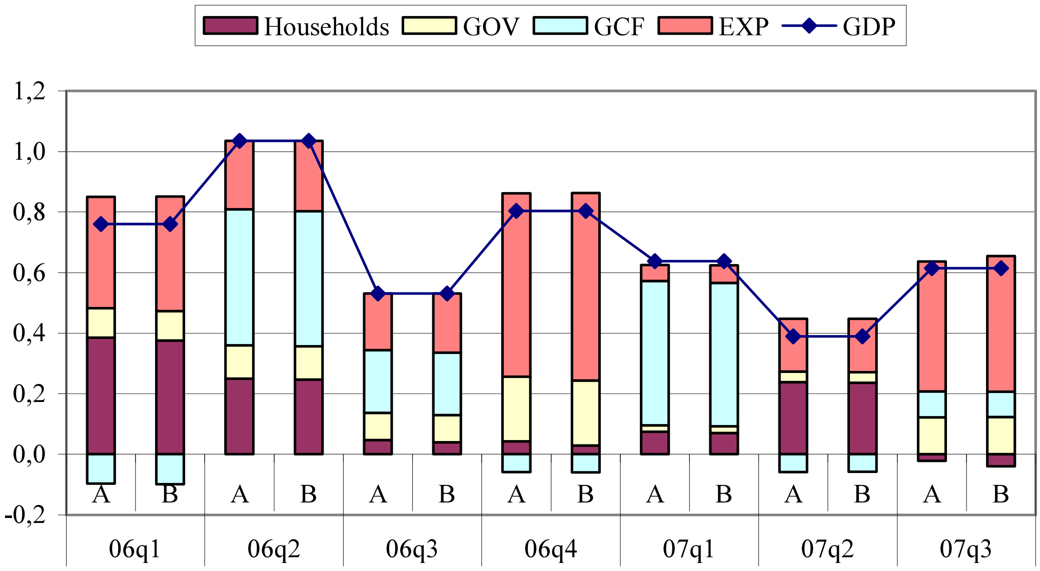

Figure F4. Quarterly GDP growth contribution based on A) IOT 2003-2005 and B) on IOT 2003