Statistics Netherlands

Division of Macro-Economic Statistics and Dissemination
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ATTRIBUTING THE EURO AREA GDP GROWTH RATE TO FINAL DEMAND COMPONENTS

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Summary

Currently the ECB attributes the GDP growth rate of euro area (EA) to final demand components using the "net-exports method". These calculations are published for quarterly growth rates in the *Monthly Bulletin*. In the net-exports method, the growth rate is decomposed using a net measure for exports i.e. imports are subtracted from exports. This method does not take into account that imports may also be used as intermediate inputs or domestic final demand.

This report discusses an alternative method of analysing GDP growth rates: the "attribution method". This method attributes GDP and imports to final demand components using input-output modelling techniques. This report shows that there are at least 3 ways of applying the attribution method.

This project shows that it is possible to apply the attribution method to the EA. To do this an input-output table (IOT) is constructed for 2001 using the most recent data on supply and use tables (SUTs) and other data of the Eurostat transmission program. The project describes the necessary steps required to produce the IOT as well as the many problems that are encountered in the process, in particular the asymmetries in trade statistics between countries.

The theoretical derivation and empirical application of the net-exports and attribution methods show that the former often underestimate the influence of growth in exports while overestimating the impact of changes in domestic final demand components. The interpretation of economic developments is therefore different in both approaches. The report argues that the attribution method is preferable but has the drawback that it requires more data. This document includes proposals for further research as well as implementation suggestions of the attribution method at the ECB.

This first portion of the report provides a summary of the project results and conclusions. The detailed description of this project is left to the appendices.

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

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Abbreviations

BEC	Broad Economic Categories
CBS	Statistics Netherlands
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

1. Introduction

This report discusses and two alternative methods to attribute GDP growth to final demand components: the *net-exports method*[2] and *attribution method*.

The European Central Bank (ECB) currently uses the net-exports method. To apply this method the imports are subtracted from the exports before the growth rates of the final demand components are analysed. The results of this analysis are published in the ECB's *Monthly bulletin* (see for example ECB, 2005). In these calculations the euro area (EA) quarterly GDP growth rates are attributed to domestic demand, change in inventories, and net-exports.

An alternative approach is the attribution method which uses input-output modelling to attribute GDP and imports to final demand components. This method has been applied at the Dutch National Bank (DNB) (Alders, 1988), Netherlands Bureau for Economic Policy Analysis (CPB) (Kranendonk and Verbruggen, 2005) and Statistics Netherlands (CBS) (de Boer, 2004). This is why it is also sometimes referred to as the 'Dutch method' (Kranendonk and Verbruggen, 2005).[3]

The ECB has commissioned the CBS to perform a pilot study which assesses the feasibility of the attribution method for the EA. The pilot study should be based on the data from the ESA95 transmission program and should lead to the decomposition of quarterly growth rates for the EA. This report is the culmination of this project.

Theory

In the net-exports method the contribution of each final demand component to the GDP growth rate is calculated by first subtracting imports from exports. In the attribution method the GDP components (value added and taxes less subsidies on products) as well as imports are attributed to final demand components using input-output modelling techniques. This leads to an attributed GDP share and attributed imports share for each final demand component. The mathematical derivation of both methods is provided in Appendix A.

Kranendonk and Verbruggen (2005) note that the net-exports method has the drawback that the imports are fully attributed to exports. The method therefore does not account for the fact that imports are also used for other final demand components and intermediate consumption. They therefore conclude that the

[2] 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.

[3] Kranendonk and Verbruggen (2005) refer to the net-exports method as the "international method".

attribution method is preferable. Kranendonk and Verbruggen (2005) show empirically for the Netherlands (1999-2004) that the net-exports method leads to an underestimation of influence of exports and an overestimation of the domestic demand categories. 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."

Appendix A shows that it cannot be proven mathematically that the net-exports method leads to overestimations of the domestic demand components. Nevertheless, it is argued that the conclusion are likely to hold in practice because the growth in domestic final demand is mostly greater than zero while the attributed import shares are not likely to change significantly.

Appendix A distinguishes three alternative approaches of the attribution method. The attribution method 1 is the best approach because it breaks down the growth rate using IOTs from both years of the period being analysed. This is current practice at Statistics Netherlands. If there is only one IOT available, as is the case in this project, attribution methods 2 and 3 may be adopted.

Attribution method 2 is used by the CPB (as described in Kranendonk and Verbruggen, 2005). In this approach the attributed GDP shares are calculated using the IOT. The attributed GDP and import shares are assumed constant. The method leads to a residual which is distributed amongst the final demand components.

Attribution method 3 was used previously at Statistics Netherlands (de Boer, 2004). It is an updating technique where the attributed GDP and attributed imports are estimated for years that do not have an IOT. Macro-economic data are combined with attributed GDP shares from the year which does have an IOT. The resulting estimate is balanced using a Lagrangian technique. The method exhibits path dependence because the estimates are based on attributed GDP shares from the past. Nevertheless, this path dependence may actually provide good estimates of the actual developments. This can only be verified if this approach is compared to attribution method 1 empirically.

In conclusion it may be said that from a practical point of view, the net-exports approach has the advantage that it is easy to apply because the data is readily available. The attribution methods require at least one IOT and are therefore more data-intensive. Nevertheless, the attribution method is preferable to the net-exports method because it attributes imports to all demand categories. Attribution methods 2 and 3 are second-best but it is not possible to asses the superiority of either method 2 or 3 from a theoretical point of view. Both methods have potential drawbacks (residuals and path dependence respectively) which need to be assessed empirically by comparing them to attribution method 1. Note that if attributed GDP shares are constant, all 3 attribution methods are equal.

Data construction and decomposition

To perform the attribution method at least one input-output table (IOT) is required. The IOT should be 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.

In this project this IOT for the EA is produced for the year 2001. This year was chosen because this was the most recent year for which supply and use tables (SUT) and IOT data was available from the transmission program (for most countries). 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).

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						

The advantage of the approach used in this report is that it is almost entirely based on data from the transmission program. Nevertheless, in some cases data from individual countries were obtained. The data construction process and the application of the decomposition can be split into 6 steps, which are discussed below. A complete discussion is provided in Appendix B.

In step 1, the SUTs are constructed for the 12 countries of the EA for the year 2001. The Eurostat transmission program provides harmonized SUTs, but only 6 countries provide data for 2001. The other SUTs are created by extrapolation of older SUTs using the MED or other methods.

Step 2 described 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 therefore calculated for the 12 use tables. IOTs from the transmission program are used as well as country specific information.

In step 3, the 12 use tables in basic prices are split into the domestic and imported components. This is done using the IOTs from the Eurostat transmission program or specific information for individual countries.

Step 4 leads to the production of the SUT for the EA. This is done by aggregating the SUTs (supply tables from step 1 and use tables in basic prices from step 3) for the 12 euro countries and subtracting the intra-EA trade from the imports and exports. The intra-EA trade asymmetries are resolved in this step (and described in detail in Appendix C). The intra-EA and extra-EA trade are calculated using the SUT levels, which are then combined with COMEXT and ITS data on the country shares. The export figures are then adopted as the intra-EA trade flows. Subsequently this intra-EA is subtracted from the export vectors as well as the import matrix from step 3 of the aggregated SUT.

The import matrix of the EA is based on the results of the asymmetry calculations as well as a method based on the Broad Economic Categories (BEC) classification scheme. Due to a lack of additional information, simple assumptions about the re-exports of the EA also had to be made.

In step 5 the IOT for the EA for the year 2001 is calculated by applying the industry technology assumption to the supply and use tables from step 4. The resulting IOT distinguishes 29 commodities as well as 6 final demand components (household consumption, consumption by NPISH, government consumption, gross capital formation and exports).

Finally, in step 6, the GDP growth decomposition is performed on the annual and quarterly growth rate data (seasonally adjusted and adjusted data by working days). Upon request by the ECB, a GDP series was constructed which are consistent with the IOT. The net-exports method and attribution methods 2 and 3 are calculated. Attribution method 1 was not possible because this would require multiple IOTs.

2. Results

Decomposition results

The results for the decomposition of the annual and quarterly growth rates are provided in tables and figures 1 and 2 and for the net-exports method, attribution method 2 and attribution method 3.[4]

[4] The results of the net-exports method are not the same as the *Monthly Bulletin* mainly because of adapted GDP series (Step 6). The conclusions drawn about the different methods are however not affected greatly by the GDP series which are used.

Table 1. Annual growth rate decomposition results

Method	Year	GDP growth rate	Domestic demand				(Net)Exports
			Consumption by Households and NPISH	Consumption by Government	Gross capital formation	Total	
Net-exports (NE)	2002	1.16	0.55	0.47	-0.57	0.45	0.70
	2003	0.58	0.70	0.34	0.35	1.39	-0.81
	2004	1.82	0.93	0.21	0.81	1.95	-0.13
	2005	1.11	0.80	0.25	0.49	1.53	-0.42
Attribution method 2 (A2)	2002	1.16	0.59	0.49	-0.41	0.67	0.49
	2003	0.58	0.16	0.16	0.14	0.45	0.13
	2004	1.82	0.19	-0.02	0.44	0.61	1.21
	2005	1.11	0.18	0.05	0.22	0.45	0.67
Attribution method 3 (A3)	2002	1.16	0.59	0.46	-0.40	0.66	0.50
	2003	0.58	0.15	0.25	0.08	0.48	0.09
	2004	1.82	0.17	0.10	0.37	0.64	1.18
	2005	1.11	0.17	0.16	0.16	0.49	0.62

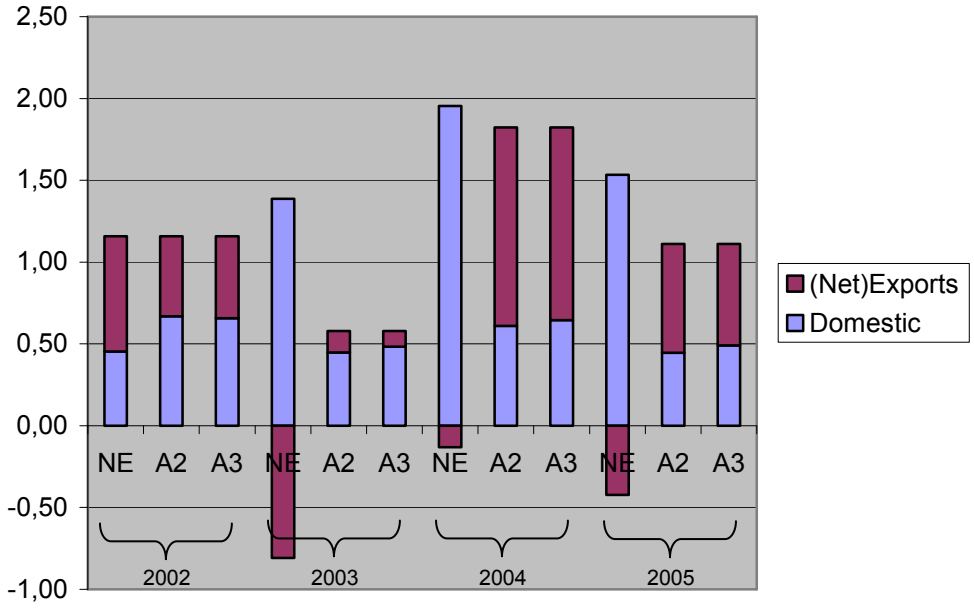

Figure 1. Annual GDP growth rate decomposition results

Table 2. Quarterly growth rate decomposition results

Method	Quarter	GDP growth rate	Domestic demand				(Net)Exports
			Consumption by Households and NPISH	Consumption by Government	Gross capital formation	Total	
Net-exports (NE)	2005q01	0.31	0.04	0.06	-0.03	0.06	0.25
	2005q02	0.47	0.21	0.13	0.25	0.59	-0.12
	2005q03	0.63	0.33	0.15	0.20	0.68	-0.05
	2005q04	0.38	0.07	0.00	0.47	0.54	-0.15
	2006q01	0.63	0.38	0.08	-0.17	0.29	0.34
Attribution method 2 (A2)	2005q01	0.31	0.12	0.09	0.00	0.20	0.10
	2005q02	0.47	0.03	0.07	0.15	0.25	0.21
	2005q03	0.63	0.07	0.06	0.09	0.22	0.41
	2005q04	0.38	-0.02	-0.03	0.34	0.29	0.10
	2006q01	0.63	0.29	0.07	-0.14	0.22	0.41
Attribution method 3 (A3)	2005q01	0.31	0.11	0.07	0.01	0.20	0.11
	2005q02	0.47	0.04	0.10	0.13	0.28	0.19
	2005q03	0.63	0.08	0.11	0.07	0.26	0.37
	2005q04	0.38	-0.01	-0.01	0.32	0.30	0.09
	2006q01	0.63	0.30	0.07	-0.13	0.24	0.39

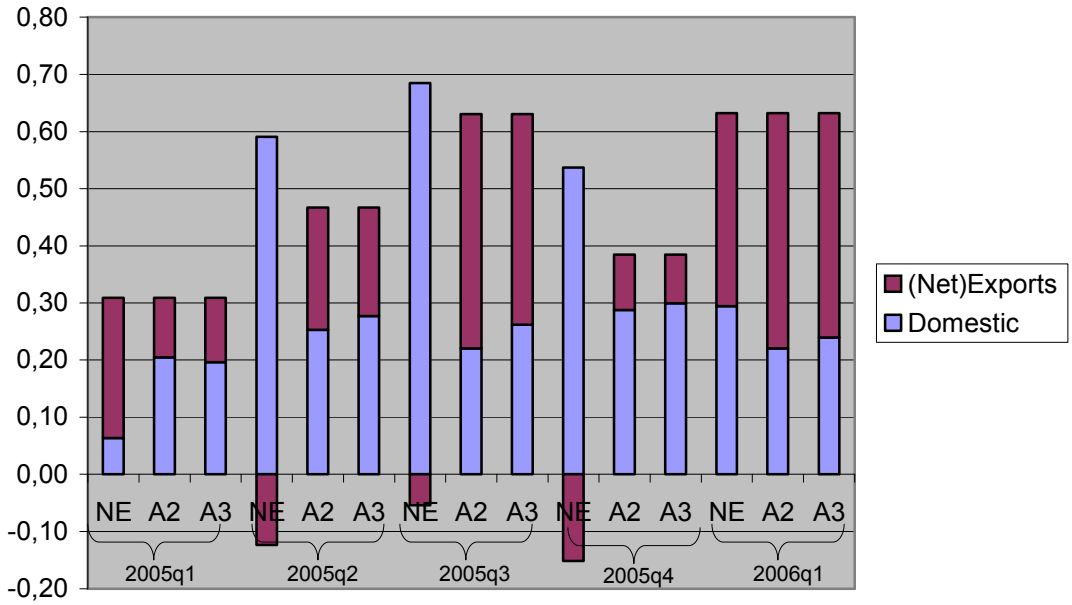

Figure 2. Quarterly GDP growth rate decomposition results

The results are provided for the years 2002 to 2005. The GDP growth rate is attributed to the final consumption expenditures by households and NPISH, the final consumption by government, gross capital formation and exports.

The annual results are depicted graphically in figure 1. The graph shows that the results for the net-exports method lead to higher results for the domestic final demand for the years 2003-2005. For 2002 results of the 3 methods are quite similar, but the impact of domestic demand is larger for the two attribution methods. Note that the results of attribution method 2 and 3 are very similar. Generally, the results for domestic demand are slightly higher for attribution method 3.

The results for the decomposition of quarterly growth rates of 2005 and 2006 are shown in table 2 and figure 2. The growth rates are based on GDP data which are seasonally adjusted and adjusted for working days. Again the results for domestic demand of the attribution methods are generally lower than the net-exports method, except for the growth rate of the first quarter of 2005. The results of the attribution method 2 and 3 are very similar, although the results for domestic demand are mostly higher than attribution method 3.

Figures 1 and 2 clearly show that the results lead to different interpretations of the economic developments. For example, in figure 2, the third quarter of 2005 exhibits growth which is fully attributed to domestic final demand by the net-exports method. The attribution methods, however shows about half of the growth rate is attributable to exports. Table 2 provides results for individual domestic final demand components (final consumption by households and NPISH, final consumption by government, gross capital formation). Figures 3, 4 and 5 show these detailed results for the net-exports, attribution methods 2 and 3 respectively (quarterly growth rates).

The results show again that both attribution methods provide very similar results and interpretations of economic developments. The net-exports method leads to a different perception of the sources of economic growth.

The reasons for these differences in interpretation have to do with the way in which the exports are attributed in both methods. The attribution method shows a positive influence of exports for all quarters, while the net-exports method shows sizeable negative impact for the second and fourth quarters of 2005. The difference between the two methods is particularly large in the second, third and fourth quarter of 2005.

Sometimes the sign of the effects are different for the net-exports and the two attribution methods. For the attribution methods the effect of government expenditures and consumption by households & NPISH are negative for the 4^{th} quarter of 2005. Since the net-exports results show small positive values, these must be caused by the correction for the residuals and updating approach used in attribution method 1 and 2 respectively. Note that the sign change only occurs for small values.

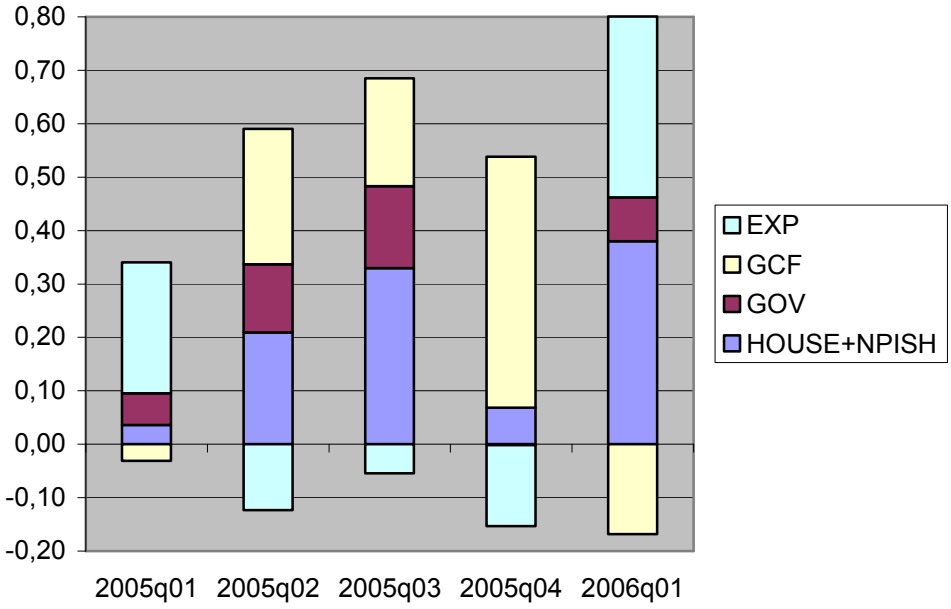

Figure 3. Detailed results of the quarterly growth rates (net-exports method)

Note: EXP – (Net)Exports, GCF – Gross Capital formation, GOV – Consumption by Government, HOUSE+NPISH – Consumption by Households and NPISH

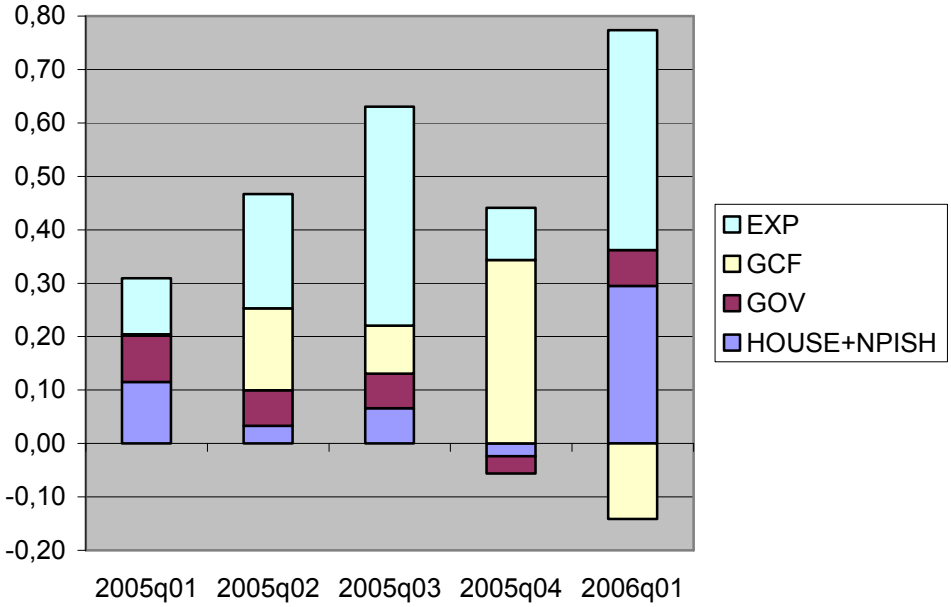

Figure 4. Detailed results of the quarterly growth rates (attribution method 2)

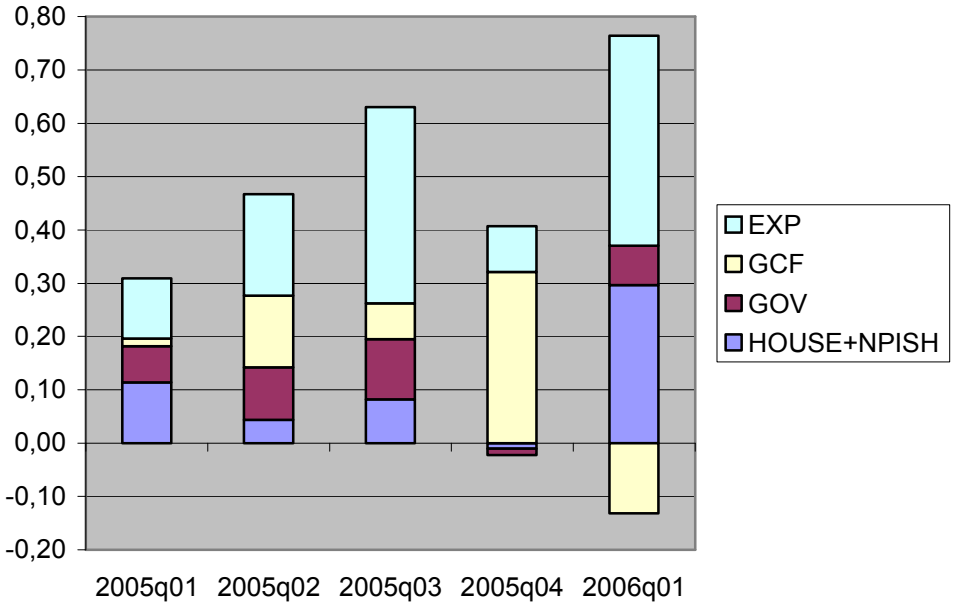

Figure 5. Detailed results of the quarterly growth rates (attribution method 3)

The IOT for 2001

To produce the decompositions discussed in this section an IOT was produced for 2001. This table may be used in decomposing the growth rates, but may also be used for the EAAM (Jellema et al., 2004) or modelling applications of the ECB. Table 3 shows a breakdown of the data in the "Cumulated Production Structure" matrix discussed in Kranendonk and Verbruggen (2005).

Table 3. Cumulated Production Structure (CPS) matrix for the EA, 2001 (thousand million euro and ratio's)[5]

	Households	**NPISH**	**Government**	**Gross Capital formation**	**Exports**	**Total**
Attributed GDP	3399	74	1288	1127	985	6874
Final GDP	388	0	5	97	1	491
Intermediary GDP	3011	74	1283	1030	985	6383
Attributed imports	613	5	83	302	242	1246
Final imports	263	0	9	145	18	435
Intermediary imports	350	5	74	157	224	811
Total demand	4012	79	1372	1430	1228	8120
Attributed GDP share (α)	0.85	0.93	0.94	0.79	0.80	0.85
Attributed imports share (τ)	0.15	0.07	0.06	0.21	0.20	0.15
Attributed GDP contribution (β)	0.49	0.01	0.19	0.16	0.14	1.00

[5] The Greek letters refer to the symbols which are used in the mathematical derivation in Appendix A.

The table shows the attributed GDP, attributed imports and total demand per final demand component. The attributed GDP and attributed imports are composed of a direct portion ("final") and an intermediary portion. The latter is calculated using the input-output model.

The table shows that the total imports of the EA from the rest of the world are 1246 thousand million euros while the exports are 1228 thousand million.[6] These figures exclude the intra-EA imports and exports.

3. Evaluation and conclusions

This report discusses the attribution of the GDP growth rate of the EA to the final demand components. The ECB uses the net-exports method for economic analysis. This report has successfully applied an alternative, the attribution method, to the EA. This section provides a critical appraisal of this project.

Decomposition methods

Appendix A derives the net-exports method as well as three types of attribution method. The theoretical comparison of the 4 methods is discussed in section 2. Summarizing, it may be concluded that:

- The attribution methods are theoretically preferable to the net-exports method because they take into account the fact that imports are used for all demand categories.
- The attribution methods are more data intensive.
- Attribution method 1 is the best approach, but requires IOTs for all years/quarters.
- Attribution method 2 and 3 are second-best approaches which suffer from residuals and path-dependence respectively. However, these methods are less data intensive than method 1 because only one IOT is required.
- From a theoretical point of view, the superiority of either the attribution method 2 or method 3 cannot be derived.
- If attributed GDP shares remain constant, all 3 attribution methods are identical.

[6] The import figures include direct purchases abroad by EA residents (68 thousand million euro). However, the export figures do not include purchases on the domestic territory by non-residents (83 thousand million euro) because they are included in the consumption column. See Appendix C.4. for further details.

The following conclusions may be drawn from the empirical results provided in section 3 and appendix B.6.:

- Analysis of economic developments can be very different for the net-exports and attribution methods.
- The conclusion of Kranendonk and Verbruggen (2005) and ECB (2005), that the influence of growth in domestic final demand components is overestimated by the net-exports method, is generally confirmed.
- Attribution methods 2 and 3 lead to similar results and interpretations of economic developments. The empirical results for the EA show that the effect of domestic final demand is slightly higher in attribution method 3.
- The residuals for the quarterly calculations increase in size as the quarter is further away from 2001. This suggests that the attributed GDP shares and import shares are not constant. [7] Specific research of the import shares of the different demand categories would be helpful in confirming this result. The influence of different methods of compiling the GDP series should also be investigated.

Data construction

This report has shown that it is feasible to produce an IOT for the EA for 2001 using the data from the ESA95 transmission program. This section provides a critical appraisal of the quality of the source data, the quality of the IOT and calculations as well as the solution to the asymmetries problem.

Source data

The data in the transmission program are sufficient to produce an IOT. Nevertheless, this project has identified many inconsistencies and other problems related to the data which were resolved. Potential improvements in future projects are described in section 4.

The data in the transmission program are sometimes mutually inconsistent. The major inconsistencies are discussed in Appendix D.5. The most important is the inconsistency of the SUT and MED: SUT were mostly pre-2005-revision, while the macro-economic data (MED) are mostly post-revision (Eurostat, 2006). This, as well as other reasons, has lead to a different GDP figure for the IOT than the published figure (IOT is 1.8% lower). As the SUTs are updated in the database of

[7] This contradicts the assertion by Kranendonk and Verbruggen (2005) that these shares remain fairly constant. It should be noted however that Kranendonk and Verbruggen (2005) distinguish more than 10 final demand components as well as the final imports per component. The data in this project is far more disaggregated and is therefore more likely to exhibit variation in the GDP and import shares.

the transmission program, the inconsistencies between the SUTs and MED will hopefully diminish.

The SUTs also showed evidence of errors and differences in classifications between countries. Furthermore, there were also inconsistencies in the trade data and SUT data. All these issues are discussed in detail in appendix D. Many errors and inconsistencies have been resolved but some remain and others may be undetected.

The quality of the IOT and calculations

Five steps are required to produce the IOT for the EA. Each of these steps is evaluated fully in appendix B but the main conclusions are repeated here.

For the production of SUTs for 2001 (step 1) the available data is good. Six countries, representing 83% of the GDP of the EA, provide SUTs for that year. The rest are extrapolated from older SUTs or other methods. The output of this data step is therefore deemed to be good.

In step 2, the use tables in purchaser prices are converted to basic prices. A few countries provided use table in basic prices but this step was mostly carried out using the most recent IOT in basic prices available for each country. Although this step could potentially be fairly problematic, the empirical results suggest that the quality of the estimates is reasonable.

Step 3 leads to the use tables of imports and domestic commodities. Similarly to step 2, this step is mostly based on the IOT data. However, the empirical results suggest that this step is less reliable. Adjustments to the actual import levels are quite high for some countries.

In step 4, the SUT for the EA is produced. This step includes the resolution of asymmetries which is discussed in the next section. It also includes problematic procedures related to the construction of the import matrix for the EA and the estimation of re-exports. This step is therefore probably the weakest of the data construction process.

Finally, step 5 lead to the production of the IOT for the EA. The industry technology assumption is a generally accepted method despite the fact that it does not adhere to the assumption of the input-output model.

In conclusion it may be said that the resulting IOT is as good as the underlying data will allow. As the above discussion shows, there are quite a large number of problems in the data, which lead to the conclusion that the quality of the IOT is modest. All the major problems are related to international trade (notably steps 3 and 4). Section 4 provides a number of suggestions with which to improve the quality of the IOT in future projects.

In step 6, the calculations of the 3 methods were performed. Upon request of the ECB, the GDP series (annual and quarterly) of the Eurostat transmission program were adapted in such a way that they are consistent with the IOT for 2001. This

means that the levels for 2001 are extrapolated using MED as well as trade statistics. The drawback of these figures is that they do not correspond to published data. Nevertheless, the use of this GDP data is not likely to affect the general conclusion about the differences in the methods.

A second problem in step 6 is the application of the annual IOT structure to the quarterly data. Ideally, IOT would be required per quarter, but this project uses simple assumption to use the annual IOT for 2001. Without producing quarterly IOTs it is not possible to asses how large the error is that this assumption creates.

Asymmetries in international trade

A major portion of the work in this project has gone into the analysis of the trade asymmetries. Despite the considerable efforts in this area, a solution of the bilateral trade asymmetries was not feasible. Several different novel approaches were attempted, but in the end it had to be concluded that detailed knowledge of bilateral trade relationships would be required to solve the asymmetries at this level.

An important conclusion of this project is that the solution of the asymmetries of the COMEXT database is not sufficient for the construction of the IOT. Since the SUT and COMEXT data on imports and exports exhibit large differences, the COMEXT data cannot be inserted directly into the SUT, even after correction for transit trade (see appendix D.3). This would lead to large changes in the structure of the SUT. This is why the method which was adopted combined the SUT levels with the country shares from the COMEXT database.

The availability of the statistics on international trade in services (ITS) is poor. In all important characteristics (disaggregation of services, countries and years) the data supplied by each country is very mixed. The trade asymmetries for services are therefore also based on the trade levels from the SUT combined with SUT and ITS information on country shares.

The asymmetries are consistent with the literature. The asymmetry for total trade is approximately 3.9% (exports-imports divided by imports). The asymmetry for goods is 3.8% and 4.1% for services in 2001. However, the asymmetry per commodity varies significantly.

4. Further research and implementation strategies

Further research

The methods described and applied in this report could be improved or refined. This report suggests that the following topics would be fruitful areas for further research. This is not an exhaustive list but merely a summary of important issues.

- The asymmetries in goods and services in the COMEXT and ITS databases. The solution presented in this report is a first step, but does not represent a complete resolution of the asymmetries.
- Comparison of the SUT export and import data to the COMEXT and ITS databases. The import and export data in the databases are different to the levels in the SUT even after correction for transit trade. This suggests that there are problems in the attribution to CPA codes or that national accountants adjust the trade data in the SUT setting.
- Investigation of the transit trade and re-exports flows of the EA, in particular for Germany, France, the Netherlands and Belgium.
- Further investigation of the use of the BEC classification scheme to produce the import matrix of the EA.
- Empirical comparison of attribution methods 1, 2 and 3 by a country which has IOTs for multiple periods.
- Empirical comparison of a method based on quarterly IOTs and the method used in this report.

Note that the most important problems in the data are all related to data on international trade.

Implementation suggestions

If the ECB wishes to adopt the attribution method, there are three potential implementation strategies.

The first strategy would be to replicate and improve upon this project. An IOT would be produced based on the most recent SUTs from the transmission program. These would be updated annually as new data becomes available. Attribution method 2 or 3 could then be applied.

The second strategy would be to update the IOT to a more recent year. Updating the IOT would lead to an improvement of the quality of the analysis compared to the first strategy. The extrapolation method, described in appendix B.1., could be used to update the data to the most recent year for which macro-economic data is available. Attribution method 2 or 3 could then be applied.

The third strategy would be to produce a series of IOTs so that attribution method 1 can be applied for the annual data. For the quarterly data a combination of attribution 1 and either method 2 or 3 could be used. Alternatively quarterly IOTs would have to be produced to apply attribution method 1. This strategy would require a concerted data effort because a series of IOTs would have to be produced in current and constant prices. The extrapolation method described in appendix B.1. could be used as a basis to construct a series of IOTs up to the most recent year for which macro-economic data is available. The investment in such a series of IOTs

could be further justified by other applications of the IOTs such as structural decomposition analysis[8] or other macro-economic modelling applications.

This project has also led to a number of other practical suggestions:

- The harmonization of the data is such that it is currently preferable to use Excel rather than programming languages such as MATLAB. Although the extrapolation of the SUT was done in MATLAB in this project, many exceptions had to be programmed because of the inconsistencies in the data. The remainder of the work was done in Excel because this has the advantage that the results of each step can be checked more easily. The disadvantage is that the formulas upon which the work is based is less clear.
- If it chooses to adopt the attribution method, the ECB needs to decide about how this work will be published in the future. The results in this report differ from the published GDP series, which poses problems for publication. In principle, it is possible to adapt the method or the IOT to adhere to the published growth rates.

[8] See for example Rose and Casler (1996), Dietzenbacher and Los (1998) and Hoekstra (2005).

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Appendix A. Mathematical derivation of decomposition methods

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)

m^t_Z Imports per commodity (1 by n vector)

m^t_c 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.

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

$$D_c^{net} = \left(\frac{c^1 - c^0}{y^0}\right) \tag{3}$$

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

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).[9]

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

[9] This relationship can be decomposed further using structural decomposition analysis (Rose and Casler, 1996; Dietzenbacher and Los, 1998; Hoekstra 2005.)

Now define the attributed GDP share of domestic final demand and exports as follows (α_c^t and α_e^t respectively).[10]

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

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.

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

[10] 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_c^{att1} Contribution of domestic final demand using the attribution method 1

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) 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:

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

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

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

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.

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

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:

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

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 in the past also used an alternative approach. Assume that table A.1 shows the results for the year for which the IOT exists (year 0).

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 resulting estimates, denoted by the Π symbols, are shown in table A.3.

Table A.2. Attributed GDP and imports in 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. Attributed GDP and imports in 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. Discussion

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 method. 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.

The attribution method is theoretically preferable because it allocates GDP and imports to all final demand components. However, the formulas of table A.4. do not confirm the conclusion drawn by Kranendonk and Verbruggen (2005) that "the international method [net-exports method - RH] …. underestimates the importance of exports for GDP growth and overestimates the importance of domestic expenditure categories…". The formulas in table A.4. show that it is mathematically possible that the contribution of domestic final demand resulting from the net-exports method is lower than the contribution found by the attribution method.

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	$\frac{\left(\alpha_c^1 \cdot c^1\right) - \left(\alpha_c^0 \cdot c^0\right)}{y^0}$	$\frac{\left(\alpha_e^1 \cdot e^1\right) - \left(\alpha_e^0 \cdot e^0\right)}{y^0}$
Attribution method 2	$\frac{\left(\alpha_c^0 \cdot c^1\right) - \left(\alpha_c^0 \cdot c^0\right) + r_c}{y^0}$	$\frac{\left(\alpha_e^0 \cdot e^1\right) - \left(\alpha_e^0 \cdot e^0\right) + r_e}{y^0}$
Attribution method 3	$\frac{\Pi_{yc}^1 - \alpha_c^0 \cdot c^0}{y^0}$	$\frac{\Pi_{ye}^1 - \alpha_e^0 \cdot e^0}{y^0}$

It is fairly easy to show the mathematical conditions under which the Kranendonk and Verbruggen (2005) conclusion holds. 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:

$$\left(1+\dot{c}\right)\cdot\left(1+\dot{\tau}_c\right)>1 \tag{15}$$

$\dot{c}$ Growth rate of domestic final demand
$\dot{\tau}_c$ 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. Given that $\dot{c}$ is likely to be greater than zero and $\dot{\tau}_c$ is likely to be close to zero, these conditions will not occur often in practice (as Kranendonk and Verbruggen show for the Netherlands in their paper). When applying these methods it is therefore likely that one will find that the net-exports method leads to an overestimation 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 method 1	Theoretically preferable to the net-exports method	Requires IOT for all time periods being 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 GDP decomposition

In this project an input-output table (IOT) for the EA was constructed for 2001.[11] The aim of the data construction steps is to produce a table for the EA which has the format shown in table A.1. This appendix discusses the data construction steps in detail in appendix B.1.to B.5. Furthermore, the application of the GDP decomposition calculations, using the IOT for 2001, is discussed in appendix B.6. The country codes, which are provided in the beginning of this report are used for the sake of brevity.

B.1. Construct SUTs for 2001

The format of the supply table in basic prices (BP) and use tables in purchaser prices (PP) are shown in table B.1 and table B.2 respectively.

Table B.1. The supply table after step 1

Supply table (BP)	Industries (29)	Imports	TTM	TLS	Total
Commodities (29)					
Total					

Table B.2. The use table after step 1

Use table (PP)	Industries (29)	FISIM	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (29)								
Gross value added								
Total								

[11] Other studies, such as Beutel (1999) and Hoen (1999) have previously attempted to produce IOTs for the EU. Jellema et al. (2004) present a "National Accounting Matrix" for the EA for 1999.

B.1.a. Collect most recent SUT

The transmission program is discussed in Appendix B. There are SUTs available for 2001 for AT, BE, DE, FR, IT and NL. FI has tables for 2000 and 2002. A number of countries have older SUTs: ES (2000), GR (1999), PT (1999) and IE (1998). LU has not provided a SUT for the transmission program.

B.1.b. Choose format SUT

The macro-economic data (MED) which are required to extrapolate the SUTs for ES, GR, PT, IE and LU distinguish 30 industries. However, due to the problem of secrecy the two mining categories are also aggregated in the format chosen (see appendix C.1.a). The resulting industry classification therefore distinguishes 29 industries. The commodity classification therefore also set at the equivalent 29 commodities because the later stages of the data construction process require square SUT and IOT. The use table distinguishes 6 final demand components: Final consumption expenditures by households, Final consumption expenditure by non-profit organisations serving households (NPISH), final consumption by government, gross capital formation and exports. The use table also includes a column to record FISIM because 11 out of the 12 EA countries had not yet applied the post-revision registration of the FISIM (Eurostat, 2006). AT was the exception (see appendix B.1.c). The supply table distinguishes imports, taxes less subsidies on products (TLS) and trade and transport margins (TTM).

B.1.c. Correct inconsistencies

Appendix D.1.c shows that the SUT for AT included the new registration of FISIM where these services are allocated to industries/sectors (Eurostat, 2006). Since the other countries had not yet applied the new method to their SUTs, the use table for AT was converted to the old method. This is done using data from AT which was provided by the ECB.

B.1.d. Produce SUTs for AT, BE, DE, FR, IT and NL

These are the countries for which SUT were available for 2001. The tables for AT, BE, DE, FR, IT and NL are converted to the SUT format chosen in step B.1.b. Sometimes there are small differences in the table totals of the transmission program. These are eliminated using a Lagrangian method (WINADJUST) (van Dalen and Sluis, 2002).

B.1.e. Produce SUTs for GR, ES, IE and PT

GR, ES, IE and PT have SUT for 1999, 2000, 1998 and 1999 respectively. These tables therefore have to be extrapolated using the other available data of the transmission program.

The column for output is extrapolated by multiplying the most recent supply table by the growth of the MED for output per NACE. No output per NACE was available for ES: Gross value added was used instead. No output per NACE was available for IE for the period 1998-1999. Gross value added was used instead for this period.

Value added is extrapolated by multiplying the most recent use table by the growth of the MED for gross value added per NACE.

The column for intermediate consumption is extrapolated by multiplying the most recent use table by the growth of the MED for intermediate consumption per NACE. No intermediate consumption per NACE was available for ES: Gross value added was used instead. No intermediate consumption per NACE was available for IE for the period 1998-1999. Gross value added was used instead for this period.

Consumption by households is extrapolated by linking the growth in the COICOP data to the consumption vector of the most recent use tables. The resulting vector is corrected for the aggregate change reported in the MED.

Consumption by NPISH is extrapolated by first coupling the commodities to the output of the industry in which it is assumed that the NPISH is likely to be located. The total is then corrected for the aggregate change reported in the MED.

Consumption by government is extrapolated by first coupling the commodities to the output of the industry in which it is assumed that the government production is located. The total is then corrected for the aggregate change reported in the MED.

Gross capital formation is extrapolated by the MED for investments. The total is then corrected for the aggregate change.

FISIM is extrapolated using the information of the MED. FISIM data for GR and PT. For ES and IE the value added of the NACE j is used.

The imports are extrapolated using the extrapolated values for intermediate consumption and final demand components excluding exports. The exports were extrapolated using the developments of the extrapolated domestic supply. For imports and exports, this approach was preferred above using the COMEXT and ITS data. The reasons are the inconsistencies between the SUTs and this data (described in Appendix D.5.b and D.5.c). Furthermore, some of the developments implied by the COMEXT data were deemed to be unrealistic.

The trade and transport margins are extrapolated using the development of the output of NACE i. No output for NACE i was available for ES: Gross value added was used instead. No output for NACE i was available for IE for the period 1998-1999. Gross value added was used instead for this period.

The product-related taxes less subsidies are extrapolated using the extrapolated output per commodity and imports.

Finally all the SUTs are balanced by using WINADJUST (discussed in step B.1.d). The totals of the supply table are placed on the use table and the differences are corrected using WINADJUST.

B.1.f. Produce SUT for FI

There are SUTs for 2000 and 2002 for FI. For this country the table for 2000 and 2002 are converted to values for 2001 according to the methods described in the B.1.e. The average of the two estimates for 2001 is then taken and then adjusted using WINADJUST.

B.1.g. Produce SUT for LU

There is no SUT for LU. The MED and COMEXT data are used. This is combined with the assumption that, if economic detail is missing, the economic structure of BE is adopted. The tables are then balanced using WINADJUST.

Evaluation of Step 1

Six countries provide SUTs for the year 2001, which constitutes 83% of the GDP of the EA. The extrapolation methods described in the B.1.e, B.1.f. and B.1.g constitute 15%, 2% and 0,3% of GDP respectively. Furthermore, the 15% of step B.1.e is dominated by ES which is only extrapolated for one year. The 2% of FI is also a fairly robust estimate because the estimate for 2001 is based on 2000 and 2002. Overall the results of this step are therefore fairly robust. Weak points are the extrapolation of changes in valuable and inventories which are part of the gross capital formation. The developments of these categories per commodity are difficult to estimate because they may vary greatly between years (and in sign).

B.2. Convert use tables to basic prices

In this step the 12 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.

Table B.3. The use table after step 2

Use table (BP)	Industries (29)	FISIM	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (29)								
Value added								
TLS								
Total								

B.2.a. Insert data for NL

The use table in basic prices was provided by the national accounts department of the CBS.

B.2.b. Convert use table of BE, ES and FI

BE and FI have provided special use tables with the valuation layers of TTM and TLS for 2000 and 2002 respectively. The shares of these valuations layers compared to the use table in purchaser prices are used to produce the use tables for 2001 in basic prices.

ES provides a use table in basic prices for 2000. The data is combined with the use table in purchaser prices for 2000 to create a use table in basic prices for 2001.

B.2.c. Convert use table of AT, DE, FR, GR, IE, IT and PT

These countries have not provided use table in basic prices to the Eurostat transmission program. Information is therefore used from the most recent IOT in basic prices. Since all countries in this group have provided commodity-by-commodity IOTs, the final demand value in basic prices for 2001 can be calculated by using the ratio's 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 commodity technology assumption. The ratio's of this table and the use table in purchaser prices are then calculated. These ratio's are then used on the 2001 use table in purchaser prices. The estimated tables in basic price are balanced using WINADJUST.

B.2.d. Convert use table of LU

The use table of LU is produced using shares of the BE use table. The result is then balanced using WINADJUST.

Evaluation of step 2

The data from the transmission program is not a very good basis for an estimate of the use table in basic prices. There is only specific data for small countries such as NL (6% of GDP), BE (4%) and FI (2%) and one larger country ES (10%). The rest have to be estimated using the most recent IOT (mostly for the year 2000).

Although this step could potentially be very problematic the total adjustments which have to be made by WINADJUST after the initial estimates are quite small. This suggests that using the IOT leads to fairly good results. The largest (relative) differences are found for Greece and Ireland, which is not surprising considering relatively old IOTs are used (1998 and 1999 respectively). Nevertheless, even for these economies the total adjustments are less than 1% of total demand in market prices.

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

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

Table B.4. The use table after step 3

Use table (domestic)	Industries (29)	FISIM	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (29)								
Value added								
TLS								
Total								

Table B.5. The use table after step 3

Use table (imported)	Industries (29)	FISIM	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (29)								
Total								

B.3.a. Insert data for NL

The split in the imported and domestic components of the use table is obtained from the national accounts department.

B.3.b. Produce use table for ES

The transmission program includes use tables of domestic and imported inputs for 2000 for ES. The shares of these tables are used for the use table for 2001.

B.3.c. Produce use table for AT, BE, DE, FI, FR, IE, IT and PT

These countries do not provide use tables which distinguish the imported and domestic inputs. Shares of imported goods are derived from the most recent IOT using a similar method as the one described in appendix B.2.c. Shares for final consumption are used directly for all countries except for FI because the latter does not have a commodity-by-commodity IOT. Intermediate consumption is split by first converting the IOT into a use table in basic prices using the commodity technology assumption. For FI, the IOT is converted to a use table in basic prices using the industry technology assumptions. The initial estimates for all countries are adapted to the import totals of the supply table in 2001.

B.3.d. Produce use table for LU

The tables for LU are based on those of BE.

B.3.e. Produce use table for GR

There is no IOT data for the imported and domestic components for GR. The imports are therefore assumed to be a fixed ratio for each user (except imports which are set to zero i.e. no re-exports are assumed).

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 NL (6% of GDP) and ES (10%). Most estimates are therefore based on the available IOT data and 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. The first estimate for IE is more than 10% lower than the actual import figures. Typically the adjustments are about 2-4% of total imports. The quality of the data from this step is therefore fair.

B.4. Construct SUT for the EA

In this step, the SUT for the EA is produced by aggregating the data from the previous step and solving the problem of asymmetries in international trade.

First, the 12 use tables (table B.3) and the 12 supply tables (table B.1) are aggregated to one table. Simultaneously, the intra-EA imports/exports are estimated because these have to be subtracted from the imports and exports of the aggregated SUT. This requires a solution for the asymmetries which occur in the data on international trade in goods and services. Because of the importance of the asymmetry calculations this is discussed separately in Appendix C.

Table B.6. The use table after step 4

Use table (BP)	Industries (29)	FISIM	Households	NPISH	Government	Gross capital formation	Exports	Total
Commodities (29)								
Value added								
TLS								
Imports								
Total								

The result of the asymmetry calculation leads to estimates for the extra-EA imports and exports per commodity group. The extra-EA exports are registered in the use table and the extra-EA imports are recorded in the supply table.

The extra-EA imports are also the basis for the EA import matrix. Initially the use table of domestic and imported components for all 12 countries are aggregated (tables B.4 and B.5).Unless other information is available, which is the case for services, it has to be assumed that the extra-EA imports have the same demand structure as the total imports.

The BEC (Broad Economic Categories) classification scheme is used to refine the assumption for goods. The BEC scheme classifies the products of the harmonized system (HS) according to its primary use (intermediate goods, consumer goods or capital goods). Correspondence tables provided by UNSD website (BEC-HS) and by Eurostat (HS-Combined Nomenclature (CN) and CN-CPA) were used to link the CPA 2-digit information from the COMEXT database to the BEC classification scheme. The correspondence is not perfect because some of the BEC codes are mixed and three correspondences were used which led to imperfect matches of all classifications (BEC to HS to CN to CPA).

Nevertheless a percentage split for intermediate goods/consumer goods/capital goods is found for intra-EA, extra-EA and total trade of the EA countries. The percentages for the total imports are compared to the SUT totals. These vary significantly, which is why the percentages from the SUT are taken as the benchmark. The SUT percentages are used to calculate an extra-EA component by using the ratio the extra-EA and total imports from the BEC data. The resulting factors are used to split the import matrix into intermediate, consumer and capital goods. Further subdivision (for example intermediates to industries) is done by using the percentages from the total import matrix of the EA.

Note that the exports column of the import matrix is not included in these calculations. This column of the import matrix identifies the re-exports of the EA i.e. goods and services which undergo a small transformation before subsequent export. Since this re-export is from outside the EA to another country outside the EA it is likely to constitute a small percentage of the re-exports of the EA countries. Unfortunately, no additional information was available for the major re-exporting countries (Germany, France, The Netherlands and Belgium) so a percentage of 5% of the total imports for re-exports for the 12 EA countries was assumed.

After the new import matrix has been calculated, the imports are registered in a row of the use table (see table B.6.)

Evaluation of step 4

This step includes a number of major problems. The most important is the issue of the trade asymmetries. Appendix C concludes that additional information on bilateral trade relationships is required for a full resolution of trade asymmetries.

The solution adopted in this project cannot be viewed is a definitive solution of the matter.

The second problem is the issue of the import matrix. Although the method used in the project is promising, it needs refinement. The BEC to CPA correspondence is imperfect and the resulting percentages differ from the percentages in the SUT.

Finally the issue of re-exports of the EA needs further investigation. A simple assumption has been used here, but data from the 4 major re-exporters (Germany, France, The Netherlands and Belgium) should be used to improve the IOT. Note also that the in appendix D.1.b it is suggested that different countries use different ways to register re-exports. Notably ES, IT and PT register hardly any re-exports, which raises the questions whether all countries adopt the same definitions of this phenomenon.

All these issues are important in determining the quality of the data which is used for the decomposition.[12] This step is the weakest of the data steps.

B.5. Construct EA-IOT

In this step the industry technology assumption is used to convert the supply and use table of the EA to a 29 commodity-by-29 commodity IOT. This has the format of table A.1. To obtain this format the column for FISIM has to be attributed to users. This is necessary because the input-output model requires these services to be attributed to users. This attribution is now standard practice after the national accounts revision of 2005 (Eurostat, 2006). In this case, the SUTs are pre-revision, and so the FISIM is attributed amongst the intermediate and final demand components based on the shares of CPA65. The value added is adjusted accordingly. The GDP of the EA increases by 1.1% (to 6874 thousand million euros) compared to the GDP of the IOT after step 5. This is about 1.8% lower than the published GDP of EA.

Evaluation of step 5

The industry technology assumption is an accepted way of producing IOTs despite the fact that the resulting table is inconsistent with the assumptions of the IO model (Konijn, 1994). However, the production of an IOT using the commodity or activity technology assumption can lead to negative values which have to be resolved.

[12] The problems related to the constructing the import matrix and re-exports are only important because the decomposition requires a split of the use table into domestic and imported commodities. For other applications, which require only the SUT, these problems are not relevant.

The GDP of the IOT is 1.8% lower than the GDP which is published in the MED for the EA. Considering the inconsistencies discussed in appendix D.5, and the solution of the asymmetries, this is not a very surprising difference.

B.6. Perform growth decomposition

The growth decomposition on annual and quarterly data can be performed using the IOT produced in B.5. Attribution method 1 is not feasible because this project has only produced an IOT for a single year. 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.

B.6.a. Produce consistent data series for GDP

The three methods have to be analysed using a consistent data series of GDP. As requested by the ECB, a GDP series is constructed which is consistent with the levels of the IOT for 2001, and which corrects for the asymmetries in trade over time.

For the annual data the data for 2001 are adjusted to the totals in the IOT. The series for final consumption by households, government and gross capital formation are then extrapolated using the MED.

The data on imports and exports are extrapolated using data provided by the ECB on the intra- and extra-EA trade. The asymmetries are resolved in these dataset by assuming that the intra-export figures are correct. The intra figures are deflated using the GDP deflator and the extra trade is deflated using the residual (where the MED contain the total trade).

For the quarterly GDP growth rates, the quarterly data in current prices is adapted to the 2001 levels in the IOT. Then the quarterly data is extrapolated and deflated using the MED series and the deflators for extra-EA trade. The series are expressed in prices of 2000. Small residuals which increase as the quarter is further away from 2000 are corrected on all components of GDP.

The GDP values which are produced by this method do not correspond to the published values because they are based on the IOT levels and are corrected for asymmetries.

B.6.b. Perform decomposition using net-exports method

For the calculations of the annual quarterly growth rates, the method which is currently used at the ECB is reproduced. Annual and quarterly (seasonally adjusted and adjusted by working days, quarter on quarter) growth rates are attributed to final demand components using the equations introduced in appendix A.

B.6.c. Perform decomposition using attribution method 2

The attributed GDP shares are applied to the GDP series produced in appendix B.6.a. For the quarterly growth rates the residual is very small for the quarters close to the year 2001 and increases as the data moves further into the future. The residual is about 4.0% of GDP in the first quarter of 2006.

B.6.d. Perform decomposition using attribution method 3

The GDP series produced in appendix B.6.a are used. For the annual series the values for the attributed GDP and imports per final demand category are updated by using the attributed GDP and import shares from 2001 and MED for 2002. For 2003 the updated values for 2002 are used and so on and so forth. A similar approach is used for quarterly growth. For 2001 the quarters are decomposed using the attributed shares for the annual data of 2001. Subsequently the attributed shares of GDP and imports of the quarter of the previous year are used. For example, the first quarter of 2002 uses the updated shares of the first quarter of 2001, the first quarter of 2003 uses the updated shares of the first quarter of 2002, and so on.

Evaluation of step 6

The calculation methods use consistent GDP series and the results are therefore comparable. Nevertheless, the construction of the series also requires a number of assumptions and leads to series that are not equal to published growth rates. In some cases the differences in the published growth rates are quite high. The year 2000 seems to particularly problematic because of the very large price deflators for the extra-EA component. Note that since we do not publish the results for older years, none of the results published in this report are influenced by this year. However, it does reflect the fact that this approach needs further investigation. An additional assumption is that the annual data of the IOT are used to breakdown the quarters.

The results of the attribution method 2 suggest that the attributed GDP shares are not constant because the residual increases in size as it diverges from 2001. This is particularly true for the quarterly data. The residuals are “solved” in attribution method 3 by updating the attributed GDP and import shares. However, it is not certain that the updating will occur in the way that developments actually occurred.

Appendix C. Asymmetries in international trade data

C.1. Introduction

Asymmetries in international trade data may be identified when the import and export data for different countries are compared. For example, if country A reports exports to country B this figure may be compared to the imports from country A reported by country B. The issue of asymmetries in the trade data therefore automatically arises once a multi-country IOT is being produced. Asymmetries can occur for trade in goods, services and the 'travel item' (purchases aboard by residents and purchases on the domestic territory by non-residents). These will be discussed in the following sections.

C.2. Asymmetries in goods

C.2.a. Introduction

The international trade in goods is registered in the COMEXT database. The database provides ample illustrations of asymmetries because all bilateral trade relationships of the EU25 are present in the database. According to Eurostat (2003) there are 4 reasons that asymmetries can occur in the bilateral trade relationships.

1. Geographic allocation error
2. Classification (or allocation) error.
3. Over or underestimation error of flows
4. Timelag errors

Eurostat (2003) concludes that the reasons 1, 2 and 4 are unlikely. The estimation error 3 is most likely to cause the most problems. Specifically they note that: "The main cause of the asymmetries is rather connected with the introduction of thresholds below which the companies are exempted from declaration, and to a non-response phenomenon from some companies above the thresholds." TF-QSA (2005) discusses individual CPA codes such as 11, 24, 34 for which they suggest that negative asymmetries are caused by under-reporting of exports. The positive asymmetries are ascribed to under-reporting of imports. TF-QSA (2005) estimates that the goods asymmetry is -52.2 billion for the EA (and -83,4 billion for the EU-15). Eurostat (2003) indicates an asymmetry of nearly -100 billion euro for the EU-15 in 2001.

C.2.b. Calculation of the intra-EA trade

The studies discussed above have focussed on asymmetries that have been calculated using the COMEXT database. The conversion to the CPA 2-digit classification requires a number of steps. The COMEXT database allows the user to generate output at CPA 4-digit. This is therefore aggregated quite easily to CPA 2-digit. However, significant quantities of the trade are not assigned to CA codes. By producing our own correspondence tables for the CN-CPA links, these are also assigned to CPA 2 digit.

Appendix D.4.b. shows that there are a number of differences between the COMEXT and SUT data. For some of the CPA categories this can lead to quite significant differences in import and export values. The differences are not only to do with transit trade but may also be caused by different correspondence tables for the detailed trade data for the COMEXT database and the SUTs. Furthermore, adjustments are made to the trade data by national accountants.

In this project an attempt was made to obtain the transit trade figures from EA countries but only data for the Netherlands for 2001 was obtained. Unfortunately this data is not very good, because a good estimation method has only recently been introduced. About 20% of the transit trade is not classified by CPA codes or countries. The total transit trade in this data set for the Netherlands is about 15 thousand million euro's. This is only about 0.75% of the imports of the EA. This difference, even if transit trade were known for all countries, is not likely to explain the differences observed in the SUTs and COMEXT data for each CPA group.

The differences in the COMEXT and SUT data are probably too large to justify replacing the COMEXT import and export values directly in the SUT, even after correction for the transit trade. A hybrid method, in which the levels of the SUTs are multiplied by the intra-EA shares of the COMEXT data is therefore used. This provides a first estimate of the intra-EA imports and extra-EA exports. The resulting asymmetries are shown in table C.1 The overall asymmetry of commodities is 3.9% using this method. The asymmetry in goods is equal to 3.8%. The calculation of the asymmetry in services is discussed appendix C.3. In this report, the intra-EA exports are taken as the intra-EA trade flow because the literature review has shown that these are generally viewed as more reliable.

C.2.c. Alternatives

This project has also attempted to analyse the bilateral trade relationships before adopting the method described above. The bilateral flows were estimated using the SUT-level COMEXT country ratio's described above. The resulting asymmetries were ranked according to their sizes and the potential sources of these differences were analysed. Unfortunately, it had to be concluded that this approach would require detailed knowledge of bilateral trade relationships which was beyond the scope of this project.

Another approach which was attempted was to use the idea that national accountants solve asymmetries during the production of the SUTs. For example, if imports are underestimated then one might expect that during the production of the SUTs these would be corrected upwards. In a novel approach, this principle can be used to assess whether a country thinks that its own trade data are more reliable (i.e. if they are closer to the SUTs totals) or the mirror statistics. Each bilateral trade flow therefore has two recommendations. If both are consistent then this can be seen as a sign on which trade flow is deemed to be more reliable. Problems however arise when the advice for a bilateral trade flow is different for both countries. Eventually this approach was abandoned because it was deemed too experimental to apply in the current work.

Table C.1. Intra-EA imports, intra-EA exports and asymmetries

Code	Label	Imports	Exports	Asymmetry
A	Agriculture, hunting and forestry products	30 306	28 032	-8%
B	Fishing products	1 945	1 925	-1%
C	Mining and quarrying products	19 144	11 227	-41%
Da	Food products; beverages and tobacco	80 897	85 864	6%
Db	Textiles and textile products	44 442	47 982	8%
Dc	Leather and leather products	11 971	13 575	13%
Dd	Wood and wood products	9 779	10 488	7%
De	Pulp, paper and paper products; publishing and printing	40 131	44 398	11%
Df	Coke, refined petroleum products and nuclear fuel	24 043	30 007	25%
Dg	Chemicals, chemical products and man-made fibres	148 427	146 027	-2%
Dh	Rubber and plastic products	34 268	36 224	6%
Di	Other non-metallic mineral products	17 571	19 189	9%
Dj	Basic metals and fabricated metal products	87 738	93 472	7%
Do	Machinery and equipment n.e.c.	89 359	97 143	9%
Dl	Electrical and optical equipment	153 119	162 872	6%
Dm	Transport equipment	183 040	183 330	0%
Dn	Manufacturing products n.e.c.	24 159	27 516	14%
E	Electricity, gas and water supply	4 456	3 964	-11%
F	Construction services	3 327	2 406	-28%
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	8 699	10 954	26%
H	Hotels and restaurants services	4 201	4 842	15%
I	Transport, storage and communication services	32 221	43 612	35%
J	Financial intermediation services	16 608	18 101	9%
K	Real estate, renting and business activities	54 350	46 221	-15%
L	Public administration and defence; compulsory social security services	388	1 200	209%
M	Education services	439	365	-17%
N	Health and social work services	398	433	9%
O	Other community, social, personal services	8 116	5 829	-28%
P	Activities of households	0	0	0%
	Total	1 133 541	1 177 200	3,9%
	Goods (a-e)	1 004 795	1 043 238	3,8%
	Services (f-p)	128 746	133 962	4,1%

Overall it had to be concluded that a bilateral solution for the trade asymmetries was beyond the scope of this project. Theoretically, two steps would be required before trade data can be adopted in the production of the IOT for the EA:

1. Harmonization of the bilateral trade data. The bilateral trade per category of goods would have to be solved. Eurostat working groups are currently looking at this issue.
2. Harmonization of trade and SUT data. The solution of trade asymmetries will not automatically lead to import and export figures that are exactly the same as the SUT values. Appendix D suggests that currently there are still large differences in these values for some commodities, even after correction of transit trade. Both sets of data would therefore have to be harmonized. Basically this would mean that once asymmetries are resolved, and corrected for transit trade, national accountants should adopt these trade figures without corrections.

C.3. Asymmetries for services

The quality of the international trade in goods is far greater than the quality of the trade in services (see appendix D.4). The COMEXT database includes data on thousands of goods, while the information on the trade in services is restricted to less than 100 categories and there is only a little bit of detail in the country breakdown, if at all. Furthermore, the services data does not look anything like the SUT values for imports and exports (see appendix D.5.c).

So far the focus in the literature has been on the asymmetries in goods. However, TF-QSA (2005) quote a services asymmetry for the EA of 11.4 billion euro (imports exceeding exports) for 2001.

Since the ITS values cannot be used directly in the SUTs because of the differences described in appendix D.5.c, the SUT values are again used as the basis for the calculations. First, the total imports and exports are split into an intra-EU15 and extra-EU15 portion. If there is data available in the SUTs themselves, then this is used. Otherwise the most appropriate ITS proportion is used. Second, the EU15 is split into an intra-EA and extra-EA portion. This is done by multiplying the EU15 values from the first step by the most appropriate ITS code which has an EA split. Table D.4. shows that this type of data is only available for very aggregated services categories.

The calculation above provides estimates for the exports and imports to the EA for all 12 EA countries. The overall sum of these imports and exports provides the services asymmetries which are shown in table C.1. The overall asymmetry is 4.1%, although it does vary significantly for different services.

C.4. Asymmetries for purchases abroad by residents

A special type of imported service are the purchases abroad by residents which are registered as a direct import by EA resident households. They are therefore also part of the GDP growth analysis. In this case a number of countries provide an intra-EU extra-EU split in the SUT that is supplied to the transmission program. This is split into an intra-EA and extra-EA component using ITS data of the "travel" component. If no information in provide in the SUT then the travel item is used directly. This procedure is used for the purchases abroad by residents and the purchases on the domestic territory by non-residents. As a result an asymmetry can be calculated for the consumption by EA residents in the EA (about 9 thousand million euro – which is about 11% when compared to the purchases abroad by residents (imports). The average of the 2 values is taken to resolve the asymmetry and the remainder is assumed to be the expenditures in the rest of the world. Using this procedure, the purchases abroad by residents amount to about 68 thousand million euro and the purchases on the domestic territory by non-residents amounts to about 83 thousand million.

C.5. Evaluation

The complete resolution of the asymmetries in trade remains illusive even after the considerable effort and approaches adopted in this project. A bilateral solution of the asymmetry in goods was abandoned because of a lack of knowledge on bilateral trade relationships. Furthermore, the calculation of the asymmetry in services is based on poor data.

An important result of this investigation is the fact that if the asymmetries in goods were resolved they could still be inconsistent with the SUT totals. This is why the SUT totals have formed the basis for the calculation methods.

Appendix D. Evaluation of the data

The data used in this project is based on the ESA95 transmission program. For the SUT/IOT data a CD-ROM, dated 1-4-2005, was used.[13] It included all the SUTs and IOTs of the transmission program at that moment. Most of the other data was downloaded from the Eurostat website in the period January/February 2006. The conclusions are therefore representative of the situation at the beginning of 2006.

D.1. SUTs/IOTs

The transmission program includes SUT and IOTs. They are provided by the countries in a consistent framework which distinguishes 59 commodities and industries. As table D.1 shows, 6 countries provide SUT for 2001. There is a SUT for 2000 and 2002 for FI, while the most recent SUT for ES were for the year 2000. The most recent SUT for GR and PT are for 1999 while IE only provide a SUT for 1998. LU does not provide a SUT or IOT.

With respect to the IOT in basic prices, only NL provide an IOT for 2001. FI provide an IOT for 2000 and 2002 while 5 countries provide data for 2000. GR and IE provide a relatively old IOT (1998) but ES has the oldest (1995). All countries, except GR split the IOT table into imported and domestic components. Nine countries provide product-by-product IOT while NL and FI have industry-by-industry tables.

Table D.1. Most recent SUT and IOT available

		SUT	IOT	IOT domestic products	IOT imported products	IOT type
AT	Austria	2001	2000	2000	2000	pp
BE	Belgium	2001	2000	2000	2000	pp
DE	Germany	2001	2000	2000	2000	pp
ES	Spain	2000	1995	1995	1995	pp
FI	Finland	2000/2	2000/2	2000/2	2000/2	ii
FR	France	2001	2000	2000	2000	pp
GR	Greece	1999	1998	-	-	pp
IE	Ireland	1998	1998	1998	1998	pp
IT	Italy	2001	2000	2000	2000	pp
LU	Luxembourg	-	-	-	-	-
NL	Netherlands	2001	2001	2001	2001	ii
PT	Portugal	1999	1999	1999	1999	pp

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

[13] The 2001 data for Germany was not on the CD-ROM but was downloaded from the Eurostat site.

The Eurostat transmission program provides a harmonized format in which countries have to provide data. The SUT and IOT distinguish 59 commodities and industries. The use table includes 4 value added components and 7 final demand components. The supply table distinguishes the trade and transport margins and taxes less subsidies on products. However, despite the identical formats a number of differences have been identified in this project.

D.1.a. Aggregation /secrecy

Some countries have chosen to aggregate certain commodities and industries, sometimes because of secrecy. This is particularly the case for mining in which uranium and thorium ores are involved (CPA12/NACE12). Some countries aggregate this data with CPA13/NACE13.

D.1.b. Differences in definitions

The SUTs provided to the Eurostat transmission program have a 59 commodity by 59 industry classification scheme. Underlying these tables are the detailed SUT for the national accounts departments of individual countries. It is of course not certain that each country aggregates the detailed SUTs to the same CPA or NACE codes. Furthermore, it is not certain that the source data such as production statistics or international trade data are all assigned to CPA and NACE codes consistently for all countries. The SUTs provide some hints that these differences may occur.

The first difference is in the treatment of the commodities that have to do with trade margins. The total output of CPA51 is equal to 0 in purchaser prices in FR, GR and NL while CPA52 is also equal to 0 for FR. This implies that for these countries these commodities consist exclusively of margins while in the other countries other services are also included. Secondly, environmental services do not always seem to be recorded. BE and FR do not record output for CPA 37 while IE does not record output for CPA90. Thirdly, IE also does not include data on CPA23/NACE23.

A strange negative number in the French supply table is also attributable to a difference in CPA classifications. The intra-EU imports column for FR includes a negative item for water transport services (CPA61). Upon consultation of the INSEE they confirmed that France subtracts cif/fob corrections from these imports so that the values are fob. The INSEE provided us with the appropriate data to adjust the data to the same definitions adopted by the other countries.

Another potential difference in definitions between countries concerns the issue of re-exports. These are goods which are imported and then exported after a small transformation. The SUT and IOTs suggest that different countries have different interpretation of this phenomenon. Countries such as Germany, France, The Netherlands and Belgium register large values in their IOT for imported commodities. However, some countries such as ES, IT and PT register zero or

negligible values for re-exports. These differences are most likely to stem from a different view of re-exports.

D.1.c. FISIM

The way in which FISIM has to be recorded was changed in 2005 (Eurostat, 2006). Before 2005 these services were recorded as a single column in the use table. Now they are attributed to the intermediate and final uses. All SUT's in the transmission program, except for AT, recorded FISIM using the pre-revision method.

D.1.d. Unreported values

The SUTs all have information on the output and value added per NACE category. The most recent use tables all provide estimates for consumption by households, NPISH and government as well as gross fixed capital formation.

All SUTs contain imports and exports, but BE, GR and IT do not split this international trade into an intra and extra-EU component.

Only 4 countries (AT, FR, IT and PT) provide data on the change in valuables while 7 countries provide data on change in inventories (AT, BE, FI, FR, GR, IE, IT, PT).

D.1.e. Surprising values

Germany recorded a negative value for extra-EU exports of insurance (CPA66). This value was checked with the German statistical office and it turns out that this is not an error. The ESA and SNA defines the output of insurance services as the premiums received reduced by the benefits to policy holders. In the 3rd quarter of 2001 this output was negative because of the payments that had to be made by German re-insurers as a result of the attacks of September 11th in the US (Eichmann, 2001).

D.2. Macro-economic data (MED)

A variety of different types of macro-economic data were downloaded from the Eurostat website. These include:

1) Macro-economic aggregates. Eurostat provides a table for each country in which a large number of macro-economic aggregates such as GDP, Final consumption expenditure of households and gross capital formation are recorded. Note that final consumption expenditure of households, final consumption expenditure of NPISH, changes in inventories as well as the acquisitions less disposals of valuables are not published for the EA.

2) Output, value added and intermediate consumption per NACE. The transmission program also provides information on output, value added and intermediate consumption at NACE30 industry branches. All countries provide value added information at this level but, no data was available for ES and IE for output and intermediate consumption per NACE.

3) Final consumption by households. All countries provide data on the consumption by households at the COICOP 3-digit level (41 categories).

4) Gross fixed capital formation. All countries, except BE provided the transmission program with information for 6 types of investment goods in 2001 (Products of agriculture, forestry, fisheries and aquaculture; Metal products and machinery; Transport equipment; Construction work: housing; Construction work: other constructions; and Other products).

D.3. COMEXT

The trade of goods is provided in the COMEXT database, which is produced by Eurostat. The discussion of the data reported in this report is based on the annual COMEXT data of the 2004 CD-ROM labelled "Intra- and Extra-EU trade-Supplement 2". The underlying data is extremely detailed, including thousands of goods.

D.4. ITS

The transmission program includes data on the international trade in services (ITS). Table D.3. shows the availability of data for each country to the EU-15. A dash (-) indicates that there is no data whatsoever. A tick (√) indicates the presence of data for 2001 and otherwise the most recent year for which data is available is provided (precedence is given to the most recent year i.e. if there is data for 2000 and 2002 then 2002 is quoted). The table shows that the level of detail for services is much lower than the thousands of goods distinguished in the COMEXT database. The level and scope of detail of the data varies greatly per country.

Table D.4. shows the information on the imports and exports to/from the EA. The tables show that although most countries provide this data, the level of aggregation is very high. The maximum disaggregating only distinguishes 4 services.

Table D.3. Services data availability of import/exports from/to EU-15

code	description	AT	BE	DE	ES	FI	FR	GR	IE	IT	LU	NL	PT	EA
200	Services	√	'02	√	√	√	√	√	√	√	'02	√	√	'00
205	Transportation	√	'02	√	√	√	√	√	√	√	'02	√	√	'00
206	Sea transport	√	'02	√	-	√	√	√	√	√	'02	√	√	'00
207	Sea transport - Passenger	-	'02	√	-	√	√	√	'00	√	'02	√	'03	'00
208	Sea transport - Freight	-	'02	√	-	√	√	√	'00	√	'02	√	√	'00
209	Sea transport - Supporting, auxiliary and other sea transport services	-	'02	√	-	√	√	√	'00	√	'02	√	√	'00
210	Air transport	√	'02	√	-	√	√	√	√	√	'02	√	√	'00
211	Air transport - Passenger	-	'02	√	-	√	√	√	'00	√	'02	√	√	'00
212	Air transport - Freight	-	'02	√	-	√	√	√	'00	√	'02	√	√	'00
213	Supporting, auxiliary and other air transport services	-	'02	√	-	√	√	√	'00	√	'02	√	√	'00
214	Other transport	√	'02	√	-	√	√	√	'99	√	'02	√	√	'00
215	Other transport - Passenger	-	'02	√	-	-	-	-	-	√	'02	√	√	-
216	Other transport - Freight	-	'02	√	-	√	-	-	-	√	'02	√	√	-
217	Other transport - Other	-	'02	√	-	-	-	-	-	√	'02	√	√	-
218	Space transport	-	'02	-	-	-	√	-	-	-	-	-	-	-
219	Rail transport	-	'02	√	-	'98	'02	√	'99	√	-	√	√	'00
220	Rail transport - Passenger	-	'02	√	-	-	'02	-	-	√	-	√	√	-
221	Rail transport - Freight	-	'02	'00	-	-	-	-	-	-	-	√	√	-
222	Rail transport - Supporting, auxiliary and other rail transport services	-	'02	√	-	-	-	-	-	-	-	-	√	-
223	Road transport	-	'02	√	-	√	'00	√	'99	√	-	√	√	'00
224	Road transport - Passenger	-	'02	-	-	-	-	-	-	√	-	-	√	-
225	Road transport - Freight	-	'02	'00	-	√	-	-	-	√	-	√	√	-
226	Road transport - Supporting, auxiliary and other road transport services	-	'02	-	-	-	-	-	-	√	-	√	√	-
227	Inland waterway transport	-	-	√	-	-	'00	-	'99	-	-	√	-	'00
228	Inland waterway transport - Passenger	-	-	√	-	-	-	-	-	-	-	-	-	-
229	Inland waterway transport - Freight	-	-	√	-	-	-	-	-	-	-	√	-	-
230	Inland waterway transport - Supporting, auxiliary and other inland waterway transport services	-	-	-	-	-	-	-	-	-	-	-	-	-
231	Pipeline transport	-	'02	√	-	-	-	√	'99	-	-	√	√	'00
232	Other supporting and auxiliary transport services	-	'02	√	-	-	-	√	-	-	-	-	-	-
236	Travel	√	'02	√	√	√	√	√	√	√	'02	√	√	'00
981	Other services	√	'02	√	√	√	√	√	√	√	'02	√	√	'00
237	Business travel	-	'02	-	-	'03	-	√	-	√	'02	√	-	-
238	Expenditure by seasonal and border workers	-	-	-	-	-	-	-	-	√	'02	-	-	-
239	Other business travel	-	-	-	-	-	-	-	-	√	'02	-	-	-
240	Personal travel	-	'02	-	-	'03	-	√	-	√	'02	√	-	-
241	Health-related expenditure	-	'02	-	-	-	-	√	-	√	'02	-	-	-
242	Personal travel - Education related expenditure	-	'02	-	-	-	-	√	-	√	-	-	-	-
243	Other personal travel	-	'02	-	-	-	-	√	-	√	'02	-	-	-
245	Communications services	√	'02	√	-	√	√	√	√	√	'02	√	√	'00
246	Postal and courier services	'02	'02	√	-	√	'03	√	'00	√	'02	√	√	'00
247	Telecommunication services	'02	'02	√	-	√	'03	√	'02	√	'02	√	√	'00
249	Construction services	√	'02	√	-	√	√	√	√	√	'02	√	√	'00
250	Construction abroad	√	-	√	-	√	'00	√	-	√	'02	√	√	'00
251	Construction in the compiling economy	√	-	√	-	'00	'00	√	-	√	'02	√	√	'00
253	Insurance services	√	'02	√	-	√	√	√	√	√	'02	√	√	'00
254	Life insurance and pension funding	-	'02	√	-	√	-	-	'02	√	'02	-	√	-
255	Freight insurance	-	'02	√	-	-	-	√	-	√	'02	√	√	-
256	Other direct insurance	-	'02	√	-	√	-	'02	'02	√	'02	-	√	-

257	Reinsurance	-	‘02	√	-	√	√	√	-	√	‘02	-	√	-
258	Auxiliary services	-	‘02	-	-	-	-	√	-	√	‘02	-	√	-
260	Financial services	√	‘02	√	-	‘03	√	√	√	√	‘02	√	√	‘00
262	Computer and information services	√	‘02	√	-	√	√	√	√	√	‘02	√	√	‘00
263	Computer services	‘02	‘02	√	-	√	‘03	√	‘02	√	‘02	√	√	‘00
264	Information services	‘02	‘02	-	-	√	‘03	√	‘99	√	‘02	‘00	√	‘00
266	Royalties and license fees	√	‘02	√	-	√	√	√	√	√	‘02	√	√	‘00
268	Other business services	√	‘02	√	-	√	√	√	√	√	‘02	√	√	‘00
269	Merchanting and other trade-related services	√	‘02	√	-	√	√	√	‘02	√	‘02	√	√	‘00
270	Merchanting	√	‘02	√	-	‘00	√	√	‘00	√	‘02	‘00	‘02	‘00
271	Other trade related services	√	‘02	√	-	‘00	√	√	‘02	√	‘02	‘00	√	‘00
272	Operational leasing services	√	‘02	√	-	√	√	√	‘02	√	‘02	√	√	‘00
273	Miscellaneous business, professionnal and technical services	√	‘02	√	-	√	√	√	‘02	√	‘02	√	√	‘00
274	Legal, accounting, management and public relations services	‘02	‘02	√	-	√	‘00	√	‘02	√	‘02	√	√	‘00
275	Legal services	‘02	-	-	-	-	-	-	-	√	-	-	√	-
276	Accounting, auditing, book-keeping and tax consulting services	‘02	-	-	-	-	-	-	-	√	-	-	√	-
277	Business and management consultancy, public relations services	‘02	-	√	-	-	-	-	‘02	√	-	-	√	-
278	Advertising, market research and public opinion polling	‘02	‘02	√	-	√	√	√	‘00	√	‘02	‘00	√	‘00
279	Research and development services	‘02	‘02	√	-	√	‘00	√	‘00	√	‘02	‘00	√	‘00
280	Architectural, engineering and other technical consultancy	‘02	‘02	√	-	√	‘00	√	‘00	√	‘02	√	√	‘00
281	Agricultural, mining , and on-site processing	‘02	‘02	√	-	‘02	‘00	√	‘00	√	‘02	‘00	√	‘00
282	Waste treatment and depolution	‘02	‘02	-	-	-	-	-	-	√	‘02	-	√	-
283	Other agricultural mining, and on-site processing	‘02	‘02	-	-	-	-	-	-	√	‘02	-	√	-
284	Other miscellaneous business, professionnal and technical services	‘02	‘02	√	-	√	‘00	√	‘02	√	‘02	‘00	√	‘00
285	Services between affiliated enterprises, n.i.e.	‘02	‘02	√	-	√	√	√	‘02	√	‘02	√	√	‘00
287	Personal, cultural and recreational services	√	‘02	√	-	√	√	√	√	√	‘02	√	√	‘00
288	Audio-visual and related services	‘02	‘02	√	-	√	√	√	‘00	√	‘02	√	√	‘00
289	Other personal,cultural and recreational services	‘02	‘02	-	-	√	√	√	‘99	√	‘02	√	√	‘00
291	Government services, n.i.e.	√	‘02	√	-	√	√	√	√	√	‘02	√	√	‘00
982	Services not allocated	√	‘02	√	-	√	‘00	-	√	‘98	-	√	-	‘00
292	Embassies and consulates	‘02	-	-	-	‘03	-	√	-	√	‘02	-	√	-
293	Military units and agencies	-	-	√	-	-	-	√	-	√	‘02	-	√	-
294	Other government services n.i.e.	-	-	√	-	‘03	-	-	-	√	‘02	-	√	-
889	News agency services	-	-	-	-	-	-	-	-	√	-	-	√	-
890	Other information provision services	-	-	-	-	-	-	-	-	√	-	-	‘02	-
891	Franchises and similar rights	-	-	√	-	-	-	-	-	√	-	-	-	-
892	Other royalties and license fees	-	-	√	-	-	-	-	-	√	-	√	√	-
895	Education services	-	-	-	-	-	-	-	-	√	-	-	√	-
896	Health services	-	-	-	-	-	-	-	-	√	-	-	√	-
897	Other	-	-	-	-	-	-	-	-	√	-	-	√	-
958	Postal services	-	-	‘00	-	-	-	‘02	-	√	-	-	√	-
959	Courrier services	-	-	-	-	-	-	‘02	-	√	-	-	-	-

Table D.4. Services data availability of import/exports from/to EA

code	description	AT	BE	DE	ES	FI	FR	GR	IE	IT	LU	NL	PT
200	Services	2002	2002	√	-	2003	2002	2003	2002	√	2002	√	√
205	Transportation	2002	2002	√	-	2003	2002	2003	-	√	2002	√	√
236	Travel	2002	2002	√	-	2003	2002	2003	-	√	2002	√	√
981	Other services	2002	2002	√	-	2003	2002	2003	2002	√	2002	√	√
982	Services not allocated	2002	-	√	-	2003	2003	-	-	-	-	√	-

D.5. Inconsistencies

The data described in this appendix are often mutually inconsistent. The mayor inconsistencies are discussed in the following sections.

D.5.a. SUT/MED

There are differences in the level of the macro-economic aggregates that are published by Eurostat and the macro-economic aggregates that can be derived from the SUTs. The SUTs for IT and AT are exceptions, although small differences remain. The differences also occur for the output, value added and intermediate consumption per NACE industry category (except Italy, Austria and France which show broad consistency).

The differences seem to occur because of the revision of the national accounts that has taken place in many countries. For the Netherlands this project has verified that this the case: the MED are post revision, while the SUT are pre-revision.

D.5.b. SUT/COMEXT

It is possible to compare the data on the trade in goods from the COMEXT database to the SUT levels for imports and exports. Table D.2. shows that for a number of commodities there are significant differences in the import and export values from the COMEXT and SUT tables.

Table D.2. Imports and exports of goods for 2001(millions of euro)

CPA	Label	Imports			Exports		
		COMEXT	SUT	difference	COMEXT	SUT	difference
01	Products of agriculture, hunting and related services	57160	56139	2%	66379	43431	53%
02	Products of forestry, logging and related services	3610	3808	-5%	1555	1672	-7%
05	Fish and other fishing products; services incidental of fishing	4331	4171	4%	2449	2383	3%
10-14	Mining products	154969	157447	-2%	21297	19479	9%
15	Food products and beverages	119481	117033	2%	135171	137064	-1%
16	Tobacco products	6449	6674	-3%	6453	7040	-8%
17	Textiles	48689	50325	-3%	57747	57953	0%
18	Wearing apparel; furs	55654	52809	5%	39966	36377	10%
19	Leather and leather products	26401	27773	-5%	28691	29276	-2%
20	Wood and products of wood and cork (except furniture); articles of straw and plaiting materials	19462	20737	-6%	17975	18369	-2%
21	Pulp, paper and paper products	47228	48466	-3%	51936	52417	-1%
22	Printed matter and recorded media	10787	16062	-33%	15234	27116	-44%
23	Coke, refined petroleum products and nuclear fuels	46957	50738	-7%	47800	53526	-11%
24	Chemicals, chemical products and man-made fibres	242873	246742	-2%	285742	290808	-2%
25	Rubber and plastic products	53448	53785	-1%	63400	63116	0%
26	Other non-metallic mineral products	26187	27687	-5%	36877	38249	-4%
27	Basic metals	109972	109870	0%	101020	101107	0%
28	Fabricated metal products, except machinery and equipment	44380	47589	-7%	57090	60200	-5%
29	Machinery and equipment n.e.c.	157850	162018	-3%	236008	234525	1%
30	Office machinery and computers	112887	116731	-3%	90629	90397	0%
31	Electrical machinery and apparatus n.e.c.	75177	74593	1%	85334	85610	0%
32	Radio, television and communication equipment and apparatus	132590	126466	5%	126904	118889	7%
33	Medical, precision and optical instruments, watches and clocks	61661	60184	2%	65032	63989	2%
34	Motor vehicles, trailers and semi-trailers	218822	215558	2%	282186	274882	3%
35	Other transport equipment	97945	72861	34%	111206	92704	20%
36	Furniture; other manufactured goods n.e.c.	91848	52168	76%	86308	54827	57%
40	Electrical energy, gas, steam and hot water	5017	8151	-38%	5460	6345	-14%

The difference observed in table D.2. could be explained by the following reasons:

1. Community vs. national principle. The COMEXT database uses the community principle whereby the imports are registered in the country where the goods enter the EU. In the SUT, imports are only recorded if a resident purchases the goods, exports are only registered if this involves the sale of goods to a non-resident. Transit trade is therefore recorded in the COMEXT database while it is not in the SUT. Re-exports, where ownership of the goods is transferred to a resident, are recorded in both the SUT and the COMEXT databases.
2. Aggregation. The COMEXT database and the SUTs are serviced by the trade statistics departments. The COMEXT database and SUTs can be aggregated to CPA. It is however possible that the aggregation from trade statistics to COMEXT to CPA is inconsistent with the conversion of trade statistics to SUTs to CPA.
3. Adjustments. National accounts departments make adjustments to the import and export data in the process of producing their SUTs. One might expect that these adjustments could even lead to reductions in asymmetries in international trade data. For example, if imports are underreported, national accountants would identify this problem because supply is lower than use.

D.5.c. SUT/ITS

This project has also attempted to reconcile the data in the ITS database with the values in the SUT. An attempt was made to create a correspondence table for the ITS and CPA codes so that the data could be compared at the CPA 2- digit level. In the end the reconciliation was unsuccessful.

Appendix E. Description of electronic files

ECB.xls

This file contains the data for all EA countries which is used to do the extrapolation described in appendix A.1.

Matlab files

These files were used to extrapolate the SUTs for the countries described in appendix B.1.e. and B.1.f. and AT.

at.xls, be.xls, de.xls, es.xls, fi.xls, fr.xls, gr.xls, ie.xls, it.xls, lu.xls, nl.xls, pt.xls

These files contain the steps 1-3 (except for the extrapolation) for each country.

asymmetry.xls

In this file the asymmetry calculations are done for goods, services and the purchases abroad by residents. The asymmetry calculations are also based on data from the *trade-services.xls*, *trade-goods non-cpa.mdb* and *trade-goods non-cpa.xls*.

EA.xls

This file combines the data of the previous files to create the IOT for the EA. The results of the 'BEC' worksheet are taken from *BECimports.mdb.*

GDP series.xls

This file produces the GDP series which are used for the empirical application in this report.

calculations.xls

This file contains the calculations and graphs for the final report.