Attribution of GDP and Imports to Final Demand Components for Germany

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1 Introduction

Up to now the contribution of final demand components to GDP growth has been measured only by the so-called net-export method in Germany. Quarterly and yearly data about the contribution of final demand categories as a whole and the contribution of the balance of exports and imports to GDP growth is published regularly by the German Federal Statistical Office. The German national accounts provide first quarterly data about 55 days after the end of the reporting quarter. This data is very important for the analysis of the economic performance. Timeliness and quality are crucial factors.

Due to globalisation German imports and exports have risen rapidly since mid 1990th. How did domestic and foreign producers profit from these changes of international interdependence? The net-export method cannot give an answer, but the so-called attribution method can. According to this method value added generated in domestic production, net taxes on products for intermediate consumption and imports are attributed to the domestic final demand categories and to exports using input-output tables.

At the Input-Output Conference in Sao Paulo last year Statistics Netherlands presented a paper which shows the calculation of GDP Growth rates of the Euro area using the attribution method.[1] The study here applies the attribution method to German national accounts data. It shows how domestic production on the one hand and foreign production on the other hand contribute to the value-added chain of final demand components in Germany 2000 to 2006. It examines the differences between the yearly contribution of the final demand components to GDP growth rates in Germany calculated with the established net-export method and calculated with the attribution method and deals with the question: to what extent can Germany supplement the established data about GDP growth according to the net-export method by estimates for GDP growth according to the attribution method based on input-output modelling? Data availability, quality of the results and timeliness are main issues in this connection.

[1] van der Helm, R., Hoekstra, R., Attributing Quarterly GDP Growth Rates of the Euro Area to Final Demand Components, paper presented by Statistics Netherlands at the XVII International Input-Output Conference, Sao Paulo 2009.

2 Databases

The GDP growth analysis is usually based on quarterly data and it is very timely. The challenge of the attribution method is that detailed information about final demand by product groups and data for the estimation of the input structures of the domestic production process subdivided by origin (domestic or imported) is needed.

So far the Federal Statistical Office of Germany has calculated combined input-output tables for domestic output and imports as well as input-output tables for domestic output and the import matrices only on a yearly basis. In April 2010 comparable German input-output tables are available for 1995 to 2006. They can be downloaded free of charge from the publication service of the Federal Statistical Office at www.destatis.de/shop, searching for the keyword "input-output". First results form German input-output accounts are usually published about 32 months after the end of the reporting year. They are going to be revised twice. For example the input-output tables 2005 were published in August 2008 for the first time. A revised version was provided in April 2009. The third and final results are available in April 2010.

Detailed data about final uses at purchasers' prices by category and about imports cif are calculated much earlier in Germany. Consumption expenditure of private households by product groups on a two-digit-level of the Statistical Classification of Products by Activity in the European Economic Community (CPA) is published nine months after the end of the reporting year. In addition quarterly data about consumption expenditure of private households by purposes is calculated according to the Classification of Individual Consumption by Purpose (COICOP) on a five-digit-level regularly. On a tree-digit level of the CIOCOP yearly results for consumption expenditure of private households by purposes are published for the first time three months after the end of the reporting year. The data for consumption expenditure of private households by purposes can be used to extrapolate yearly data and to estimate quarterly data for consumption expenditure of private households by product groups. For quarterly and yearly calculation of gross capital formation the so-called commodity flow approach is used in Germany. Therefore results subdivided by product groups are provided regularly at an early stage. Yearly data about capital formation by product group on a two-digit-level of the CPA is published nine months after the end of the reporting year for the first time. Exports and imports by product group are published on a two-digit level of the CPA nine months after the end of the reporting year for the first time as well. Up to now for exports and imports by product groups only yearly results are calculated. But monthly data is available from the main statistical sources for imports and exports: the foreign trade statistics provided by the Federal Statistical Office and the balance of payments statistics provided by the Deutsche Bundesbank. Therefore quarterly and earlier estimates seem to be possible.

The different yearly and quarterly data about final consumption expenditure, gross capital formation, imports and exports are useful sources for the estimation of GDP growth by the attribution method as long as no input-output tables are available. Nevertheless a lot of data is missing. If the attribution method is used very early, many structures will have to be taken from the last input-output tables available. For measuring quarterly GDP growth by the attribution method the input-output tables provide only yearly structures for Germany. That could cause problems between the fourth quarter of a year and the first quarter of the following year. As long as no quarterly input-output tables are available, technical splits of yearly input-output tables into quarterly input-output tables regarding the changes between adjoining years may be necessary. For first calculations three months after the end of the reporting quarter only few statistical data is available and the structures from the input-output tables can be more than three years old.

2 Foreign and domestic contribution to the value added chain

Based on information about goods flows and production-related interactions within a national economy and with the rest of the world shown in the input-output tables it is possible to divide final consumption expenditure, capital formation and exports into two parts: the content of domestic GDP and the content of imports. The results show how domestic producers on the one hand and foreign countries on the other hand participate in German consumer demand, in German investment demand and in foreign demand for goods and services produced in Germany.

Domestic GDP incorporated in final use components contains GDP (value added including net taxes on the products for intermediate consumption) directly generated in the domestic production of goods and services for the final use components or generated in the domestic production of goods for intermediate consumption on an earlier stage of the domestic production process indirectly attributed to the final use components as well as net taxes on the final use components themselves.

Imports incorporated in final use components contain imported goods and services used directly in the domestic production of the goods and services for final uses or used in the domestic production of goods and services for intermediate consumption on an earlier stage of the production process indirectly attributed to the final use components as well as exports of goods from foreign origin and exports after inward processing (without the value of the processing itself). It is assumed that imported goods and services are produced completely abroad.

Table 1 shows the whole nominal value and its composition by domestic and foreign origin for the different final use components in Germany 2000 to 2006. The import share was higher in the

Table 1 Import dependence of final use components in Germany 2000 to 2006

Year	Final uses	Content of		Share of imports 1)
		domestic GDP	imports	
	Billion Euros			%
	Final consumption expenditure			
2000	1606	1315	291	18,1
2001	1659	1357	302	18,2
2002	1675	1384	291	17,4
2003	1701	1402	300	17,6
2004	1719	1411	308	17,9
2005	1745	1418	327	18,7
2006	1783	1437	345	19,4
	Gross capital formation			
2000	449	323	126	28,1
2001	412	302	110	26,6
2002	370	280	90	24,4
2003	376	285	91	24,2
2004	379	281	98	25,7
2005	378	275	103	27,2
2006	410	285	125	30,6
	of which: machinery, equipment and other products			
2000	201	110	90	45,0
2001	192	107	86	44,5
2002	176	102	74	41,9
2003	174	100	73	42,2
2004	179	103	76	42,5
2005	187	105	82	43,8
2006	205	107	98	47,8
	Exports			
2000	688	424	264	38,4
2001	736	454	282	38,3
2002	766	479	286	37,4
2003	771	477	295	38,2
2004	850	518	332	39,0
2005	922	549	373	40,5
2006	1055	603	452	42,8
	Total final uses			
2000	2744	2063	681	24,8
2001	2806	2113	693	24,7
2002	2811	2143	668	23,8
2003	2849	2164	685	24,1
2004	2948	2211	737	25,0
2005	3045	2242	803	26,4
2006	3248	2325	922	28,4

1) Imports contained in the final use component as a percentage of the whole nominal value of the final use component.

All values are defined in accordance with the concepts of national accounting. The sums differ from the total aggregates due to rounding differences.

year 2006 than it was in the year 2000 for final consumption expenditure, for total gross capital formation, for capital formation in machinery, equipment and other products (i.e. software, entertainment, literary or artistic originals) and for exports. It differs strongly between the final use components. The import share of final consumption expenditure was less than 20% during the whole period under review. This is mainly due to the great importance of domestic consumer demand for domestic services. Against this the import share of exports rose above 40% in the year 2005. The import share of gross capital formation varies by kind of capital goods: In the year 2006 it was 48% for machinery, equipment and other products but only 13% for construction.

Table 2 Nominal growth rates of final uses and their content of domestic and foreign GDP 2001 to 2006

Year	Final uses	Content of	
		domestic GDP	imports
	Changes on the previous year in %		
Final consumption expenditure			
2001	3,3	3,2	3,9
2002	1,0	2,0	-3,5
2003	1,6	1,3	3,0
2004	1,0	0,7	2,6
2005	1,5	0,5	6,2
2006	2,2	1,3	5,7
Gross capital formation			
2001	-8,3	-6,4	-13,3
2002	-10,1	-7,4	-17,6
2003	1,7	2,0	0,7
2004	0,7	-1,4	7,2
2005	-0,2	-2,2	5,5
2006	8,4	3,4	21,8
Exports			
2001	6,9	7,0	6,6
2002	4,1	5,6	1,7
2003	0,7	-0,5	2,8
2004	10,2	8,7	12,6
2005	8,5	5,9	12,5
2006	14,4	10,0	21,0
Total final uses			
2001	2,3	2,5	1,8
2002	0,2	1,4	-3,6
2003	1,4	1,0	2,6
2004	3,5	2,2	7,5
2005	3,3	1,4	8,9
2006	6,6	3,7	14,9

Table 2 shows the annual nominal growth rates of final consumption expenditure, gross capital formation and exports. The nominal growth rates of domestic GDP incorporated in final uses partly differ considerably from the nominal growth rates of the whole final use for consumption, for gross capital formation and for exports from 2000 to 2006. One therefore gets valuable additional information for the analysis of the economic development by the application of the attribution method.

For example: In the year 2002 gross capital formation decreased 10.1%, but the domestic GDP derived from domestic production for domestic capital formation dropped only 7.4% while the content of imports went down 17.6%. Therefore foreign countries suffered much more form the weakness of German capital formation in the year 2002 than the domestic economy. On the other hand foreign countries benefited more from the increase of German exports 2004 to 2006 than the domestic economy. 2006 exports from Germany increased 14.4%. But the content of domestic GDP rose only 10% while the content of imports went up 21%. The export of goods from foreign origin increased higher-than-average.

3 Real growth of GDP: net-export method versus attribution method

In the analysis of the economic development the contributions of domestic demand and of foreign demand to real growth of GDP play an important role. Up to now they are calculated with the net-export method in German national accounts using a "comparative approach": The contribution to growth rates of a certain aggregate are determined as difference between the GDP growth rate and a hypothetical growth rate that would result if the aggregate did not show any change.

For the application of the net-export method specific deflators are used to convert the nominal values of the different final use components and the nominal values of the imports on previous year prices. For the application of the attribution method no appropriate deflators are available. Gross value added generated in many different branches is incorporated in every domestic product for final use. Therefore it would be best practice, if the value added incorporated in the final use components was converted on previous years prices with input-output tables in prices of the previous year. But these tables are not available for Germany. In this study the GDP deflator is generally used for all final use components to convert the content of domestic GDP on prices of the previous year. This method seems to be second best. Specific deflators for final consumption expenditure, gross capital formation and exports can only be used for the net-export method. They are unsuitable for the attribution method because they can strongly be influenced by the development import prices.

Table 3 Contribution of final demand to the growth of price-adjusted GDP 2001 to 2006

Year	Attribution method	Net-export method	Difference
	%-points		
Final consumption expenditure			
2001	1,2	1,2	0,0
2002	0,4	-0,2	0,6
2003	0,1	0,2	-0,1
2004	-0,2	-0,1	-0,1
2005	-0,1	0,3	-0,4
2006	0,5	0,9	-0,4
Gross capital formation			
2001	-1,2	-1,7	0,5
2002	-1,2	-1,8	0,6
2003	0,1	0,4	-0,3
2004	-0,3	-0,1	-0,2
2005	-0,4	-0,3	-0,1
2006	0,4	1,2	-0,8
Foreign demand 1)			
2001	1,2	1,7	-0,4
2002	0,9	2,0	-1,1
2003	-0,4	-0,8	0,4
2004	1,7	1,4	0,4
2005	1,2	0,8	0,5
2006	2,3	1,0	1,2
GDP			
2001	1,2	1,2	0,0
2002	0,0	0,0	0,0
2003	-0,2	-0,2	0,0
2004	1,2	1,2	0,0
2005	0,8	0,8	0,0
2006	3,2	3,2	0,0

1) Attribution method: domestic GDP included in exports; net-export method: exports minus imports.

All values are defined in accordance with the concepts of national accounting. The sums differ from the total aggregates due to rounding differences.

Table 3 shows differences between the contributions of final demand components to the growth of price-adjusted GDP calculated with the net-export method and the attribution method. For final consumption expenditure, for gross capital formation and for foreign demand these differences are between -1.1% and +1.2% for the years 2001 to 2006. Particularly strong differences occurred 2002 when the economic growth came for a standstill in Germany. Due to a real decrease of imports (-1.4%) the contribution of final consumption to GDP growth still remained positive (+0.4%) according to the attribution method in the year 2002. According to the net-

export method contribution of final consumption to GDP growth was slightly negative already (-0.2%) in the year 2002. For gross capital formation the negative contribution to the growth of GDP was lesser according to the attribution method than according to the net-export method in the year 2002. On the other hand, the contribution of the exports to GDP growth according to the attribution method (+0.9%) was much lower than the contribution of the balance of exports and imports according to the net-export method (+2.0%).

4 Input-output tables of previous years

It is too late to calculate contribution of final use categories to GDP growth for the first time, when input-output tables are available for the reporting year in Germany. More than two year after the reporting year the results would be outdated for current economic analyses. Therefore one has to answer the question: can the attribution method be based on input-output tables of previous years? The impact of the input-output tables for different years on GDP attributed to final use components has been analysed by the following model calculation: For the reporting years 2000 to 2005 data about final consumption expenditure, gross fixed capital formation and exports are taken from the input-output tables for domestic production of the reporting years. The Leontief coefficients and the import coefficients of domestic production by branches are taken from the input-output tables of the four years before the reporting year. Due to the temporal inconsistency of the data base a difference between the sum of imported intermediate consumption in the model calculations and the sum of imported intermediate consumption in the input-output tables of the reporting years occurs. This difference is attributed proportionally to the imported goods and services for intermediate consumption incorporated in the different final use components.

Table 4 shows how the results of the model calculation for GDP attributed to final use components differ from the results calculated with input-output tables of the reporting years. The differences are mostly 0.5 and less even if the input-output tables are four years old. That means that the input structures do not vary too strongly in Germany from year to year and GDP attributed to the final use components is influenced only little by the use of older input output tables.

Table 4 Changes in the results of attributed GDP to final demand 2001 to 2005 using different input-output tables of the past

Year t	GDP attributed to final use components based on input-output tables (IOTs) of the year			
	t-1	t-2	t-3	t-4
	Difference to results based on IOTs of the year t in %			
	Final consumption expenditure			
2001	0,1			
2002	-0,1	0,0		
2003	-0,1	-0,2	-0,1	
2004	-0,1	-0,2	-0,3	-0,2
2005	0,2	0,0	-0,1	-0,2
	Gross capital formation			
2001	0,0			
2002	-0,5	-0,6		
2003	0,3	-0,1	-0,2	
2004	0,1	0,4	0,0	0,0
2005	-0,2	0,0	0,4	-0,2
	Exports			
2001	-0,3			
2002	0,5	0,3		
2003	0,0	0,5	0,3	
2004	0,3	0,3	0,8	0,5
2005	-0,3	0,0	0,0	0,5

5 Conclusions

The attribution method provides valuable additional information about the economic development. The results for Germany show that the import shares of final consumption expenditure, gross capital formation and exports vary over time. For gross capital formation and for exports they were much higher in the year 2006 than in the year 2000. The contribution of final demand components to the growth of price-adjusted GDP depends on the method used. It differs more or less strongly between the net-export method and the attribution method. From 2001 to 2006 the yearly difference was between -1.1% and 1.3% in Germany.

The net-export method can not be replaced by the attribution method. The attribution method needs very detailed data about production and final uses by product groups and about import shares. Most of this information has to be taken from input-output tables. They can only be calculated with a long time-lag, because the complete detailed statistical data base is available with a time-lag as well and the calculation of input-output tables is very time-consuming.

Therefore current calculations with the attribution method have to be based on the assumption that many structures do not change over time. Current estimates with the attribution method have to be made very carefully. Further investigations are necessary for Germany to find out how early estimates are possible.

There is a good statistical database to calculate quarterly data for final uses at purchasers' prices by product groups. But there are no quarterly input-output tables available for Germany. Further investigation is necessary to decide whether quarterly calculations with the attribution method can be based on yearly input-output tables.

For the calculation of the contribution of final demand components to the growth of price-adjusted GDP with the attribution method input-output tables in prices of the previous year should be used, if they were available. Otherwise GDP deflators may be used generally.

For Germany it is not necessary to wait until input-output tables are available for the reporting year. The production structures are stable enough for the attribution of GDP and imports to final demand components with input-output tables of previous years. Model calculations for 2000 to 2005 show that the results do not differ significantly. As soon as reliable estimates for consumption expenditure, gross fixed capital formation and exports of domestic products at basic prices subdivided by product groups are possible the attribution method can be applied in Germany.