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## **Two aspects to the economic growth: symmetric input-output tables (SIOT) based attribution method and net export method**

*Abstract:*

The purpose of this paper is to compare the effects of the so-called attribution method versus the net export method in measuring Gross Domestic Product (GDP) growth. The paper analyses the economic growth in the euro area countries using the two methods. The net export method assigns the growth contribution of the whole domestic demand to GDP. The attribution method allocates imports to the corresponding domestic demand components by using SIOT tables. In the euro area the two different methods lead to different results, in particular, for exports and gross fixed capital formation.

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## 1. Introduction

The recent financial crisis has emphasised the importance of having structural analysis in order to understand the actual driving forces in the economy. The ECB publishes in its Monthly Bulletin GDP growth rate decomposition, based on the euro area national accounts as published by Eurostat.<sup>2</sup> The current analysis used by the ECB in its publications is based on the so called *net export method*. The method shows the growth contribution of whole domestic demand to the GDP. The imported goods, which are domestically consumed, are reflected in imports and thus, the demand of products can be seen as an increase of negative balance in the net export. From this point of view the net export method exaggerates the GDP growth contribution of domestic demand components.

Another way of measuring GDP growth is using the so called *attribution method*. This method allocates imports to the corresponding domestic demand components. From this point of view, the attribution method gives a correct picture of the GDP contributions. The attribution method is a considerably more data intensive estimation as symmetric input-output tables (SIOT) as well quarterly main aggregates are required for the analysis. For the net export method the quarterly main aggregates are sufficient.

The GDP growth attribution for the euro area was for the first time estimated in 2008 when the ECB estimated supply and use (SUT) and SIOT tables for the euro area aggregates. GDP growth attribution calculations were based on these tables.<sup>3</sup> The method used was not new and similar methods have been used in different contexts using slightly different terminology and labelling.<sup>4</sup> In the past year, the ECB has been further developing the IT-infrastructure in order to implement this method. Currently, an estimation procedure is currently being implemented using Matlab. This procedure is implemented for the euro area aggregate as well all euro area countries for which the data availability allows this.

This paper presents the results of the above mentioned estimation procedure. Additionally, the paper discusses the difference between the two methods and shows the different results

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<sup>2</sup> See for instance: ECB Monthly Bulletin November 2011, page 49.

<sup>3</sup> Helm van der and Hoekstra (2009).

<sup>4</sup> Kranendonk and Verbruggen (2005) call it the “Dutch method” and use the concept “import-adjusted method” in (2008), whereas Cameron and Cross (1999) and Cross (2002) refer to “value-added contribution” and the Ministry of Finance Denmark (2006) call it “IO-based contribution” and “contribution net of its contents”.

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obtained using the two approaches. Section 2 provides the methodological background describing the *net exports* as well as *attribution method*. In Section 3 the results are analysed and compared. Finally, in Section 4 conclusions are drawn.

## 2. Method

The two alternative methods to attribute GDP growth to final demand components are the so called *net export method* and *attribution method*. The ECB in its Monthly Bulletin uses the net export method. In these calculations the quarterly GDP growth rates are attributed to domestic demand, changes in inventories and net exports. The net export method can be presented as follows:

$$(1.) \quad \frac{\Delta y}{y_{t-1}} = \frac{y_t - y_{t-1}}{y_{t-1}} = D_c^{net} + D_e^{net}$$

$$(2.) \quad D_c^{net} = \frac{c^t - c^{t-1}}{y^{t-1}}$$

$$(3.) \quad D_e^{net} = \left\{ \frac{e^t - e^{t-1}}{y^{t-1}} \right\} - \left\{ \frac{m^t - m^{t-1}}{y^{t-1}} \right\},$$

where  $D_c$  is domestic expenditure (or demand) growth,  $D_e$  is net exports,  $y$  is GDP,  $c$  is domestic final expenditure,  $e$  is exports and  $m$  is imports. Equation (1.) shows that the growth of the GDP can be de-composed into the contribution of domestic consumption and net-exports. The equation shows that in the net-export method the change in imports is incorporated in the contribution of exports, which is why it is referred as the net export method.

The attribution method can be presented as follows<sup>5</sup>:

$$(4.) \quad \frac{\Delta y}{y_{t-1}} = \frac{y_t - y_{t-1}}{y_{t-1}} = D_c^{att} + D_e^{att}$$

$$(5.) \quad D_c^{att} = \frac{(\alpha_c^t * c^t) - (\alpha_c^{t-1} * c^{t-1})}{y^{t-1}}$$

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<sup>5</sup> The method is presented more in detail for instance in: Helm van der and Hoekstra (2009). Balabanova and Kavonius: Two aspects to the economic growth: a SIOOT based attribution method and net export method

$$(6.) \quad D_e^{att} = \frac{(\alpha_e^t * e^t) - (\alpha_e^{t-1} * e^{t-1})}{y^{t-1}},$$

where  $\alpha_c^t$  is attributed GDP share of domestic final demand at period  $t$  and  $\alpha_e^t$  is attributed share of exports for the same period. It should be emphasised that in this context the calculation refers to the shares of demand on the domestically produced products. This can be illustrated by showing the so-called Cumulated Production Structure (CPS) matrix, which is calculated on the basis of SIOT. For simplicity we will drop the reference to the period  $t$  in the notation below.

	Domestic final demand	Exports	Total
Attributed GDP	$\alpha_c * c$	$\alpha_e * e$	Y
Attributed imports	$\tau_c * c$	$\tau_e * e$	M
Total	C	E	

The table shows that the attributed expenditure and exports cover only the part produced domestically and not the imported part of the consumption and exports, i.e.  $\tau_c * c$  and  $\tau_e * e$ .

Table 1: Availability of symmetric input-output tables for domestic production (as of 15 June 2014)

Code	Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007 Rev 1	2007 Rev 2	2008 Rev 1	2008 Rev 2	2009	2010	2011
BE	Belgium	x					x					x							x	
DE	Germany	x					x	x	x	x	x	x	x	x			x	x	x	
EE	Estonia			x			x					x							x	
IE	Ireland				x		x					x							x	
GR	Greece						x					x					x	x	x	
ES	Spain	x					x					x								
FR	France	x		x		x	x	x	x	x	x	x	x	x			x	x	x	
IT	Italy	x					x					x							x	
CY	Cyprus						2009					2011								
LV	Latvia		x		x															
LT	Lithuania						x					x								x
LU	Luxembourg																			
NL	Netherlands	x	x	x	x	x	x	x	x		x	x	x	x			x	x	x	
AT	Austria	x					x					x					x	x	x	
PT	Portugal	x				x						x					x			
SI	Slovenia		x				x	x				x						x	x	
SK	Slovakia						x					x								x
FI	Finland	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x

available    
 Derogation    
 Derogation until year    
 Compulsory years

Source: Eurostat

Attributed GDP and export shares are calculated by using the corresponding SIOT. The availability of SIOT is presented in Table 1. In this paper, the calculations are done for the euro area and the euro area member states. In many countries SIOT are available only for some years and CPS matrices are therefore based on the available SIOT; for periods where SIOT are not available, CPS matrices are extrapolated. This tends to imply that for the

countries which have SIOT for every single year (DE, FR, NL and FI as indicated in Table 1), the quality of the growth contribution calculations is better than for the countries which do not publish SIOT so frequently.<sup>6</sup>

An additional limitation in this exercise is that all the countries do not transmit data which are required for this exercise. For three countries (LU, CY, MT) there are no SIOT tables available. For GR the seasonally adjusted QNA time series are discontinued after 2011Q1. Due to this reason, these countries are excluded from this analysis.

In order to attribute quarterly patterns, in a first step, quarterly final use is broken down using the proportions from the CPS matrix. In a second step in the calculation, these initial estimates are fitted to the quarterly totals for domestic demand components using a simple Lagrangian balancing technique.

When the estimations for the two contribution methods are compared side by side, the economic interpretation might be very different. For example, assume that there is an increase in final consumption, but that this increase is fully attributable to imports and thus, the increase in final consumption does not have impact on GDP. The net export method would show a positive contribution of consumption with a corresponding negative contribution of net-exports. On the other hand, the attribution method would show no contribution to GDP growth from domestic consumption (or exports).

### **3. Results**

This section focuses on the results of the two estimation methods. As mentioned in the previous section, the calculations are made for the euro area and all the euro area countries. These calculations are based on time series from 2005q1 to 2013q4. In this part, we present the euro area results. Annex 1 covers the results for the individual countries.

Table 2 presents the cumulated production structure for the euro area. The total refers to the total demand which is either imported (imports, total) or domestically produced (GDP, total). These are further divided to direct and indirect total demand, i.e. these are either directly used in the final consumption or used as intermediate consumption (thus, used to produce some

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<sup>6</sup> For instance Kranendonk and Verbruggen (2008) find that import intensities in selected euro area member states are unstable and results will change after IOTs and QNA aggregates become available or are revised.  
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goods or services). Euro area GDP represents 82 per cent and imports 18 per cent of the euro area final demand.

Table 2: Cumulated production structure euro area (2008), EUR billions

		HH+NPISH	GOV	GCF	EXP	Total
	Total	4069	1750	1586	1437	<b>8841</b>
GDP	Direct	557	4	134	6	<b>701</b>
	Indirect	3512	1746	1452	1431	<b>8141</b>
	Total	775	128	450	567	<b>1920</b>
Imports	Direct	294	24	218	187	<b>722</b>
	Indirect	480	104	233	380	<b>1197</b>
<b>Total</b>	<b>Total</b>	<b>4844</b>	<b>1878</b>	<b>2036</b>	<b>2004</b>	<b>10761</b>
GDP	%	84	93	78	72	<b>82</b>
Imports	%	16	7	22	28	<b>18</b>

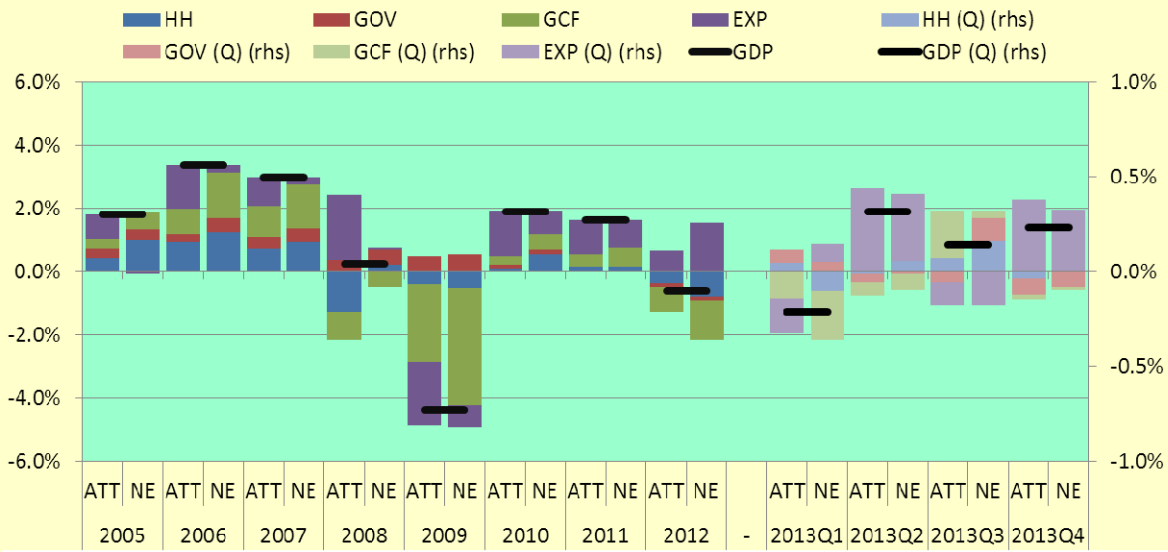
Source: ECB calculations based on Eurostat and national data.

Chart 1 compares the growth contribution of the attribution method and net exports method. The corresponding graphs for countries are presented in Annex 1. The largest difference between the two methods can be seen in the external trade. The exports are not measured in a comparable manner, as the net export method shows how much the exports increase or decrease vis-à-vis imports, while the attribution method shows the development of the gross value added export. Similarly, the net export method shows the contribution to the growth of total *output* demand to GDP (value added) and the attribution method shows the actual *value added* (i.e. *net of imported intermediate consumption*) contributions to GDP (value added). In this sense the concepts in the net export method are not commensurate.

As a result, the net export method indicates that the impact of foreign trade on GDP is often smaller than it is measured by the attribution method. In almost all years and quarters the attribution method shows a larger impact of exports than the net export method. Only in 2012 net export, i.e. the balance of trade increased more than value added export. Similarly, the net export method shows larger impact of the domestic demand components. The size of the adjustment is dependent on the share of the corresponding imported domestic demand component. As can be seen in Chart 1, the largest difference exists in gross fixed capital formation. The demand of investment goods is typically volatile and often has a large impact on growth rates. Additionally, as also confirmed by the cumulated production structure (Table 2), gross fixed capital formation has the largest share of the domestic demand components which is imported. The effect is small on the rest of the components.

**Chart 1: The growth decomposition for the euro area by using the attribution method and net exports method**

(annual growth on left hand-side and quarter to quarter growth rate on right hand-side)



Source: ECB calculations

#### 4. Conclusions

This paper discussed theoretical differences between the attribution and the net export method. Additionally, it compared results of the two methods in the euro area and in all euro area countries. In the euro area the two different methods have different effects on, in particular, exports and gross fixed capital formation. The reason for this is that the concept of exports applied by the two methods is different, i.e. the net export method uses net export of goods and services while the attribution method uses gross value added export. The large effect on the gross fixed capital formation is explained by the largest share of demand components which is imported.

## References:

Cameron, G. and P. Cross (1999), The importance of exports to GDP and jobs, Canadian Economic Observer, November 1999.

Cross, P. (2002), Cyclical implications of the rising import content in exports, Canadian Economic Observer, December 2002.

European Central Bank (2011), Monthly Bulletin, November 2011.

Helm, R.P. van der and R. Hoekstra (2009), Attributing quarterly GDP growth rates of the euro area to final demand components, paper prepared for the WVII International Input-Output Conference, 13-17 July 2009, Sao Paulo, Brazil, [http://www.iioa.org/conferences/17th/papers/661674801\\_090608\\_153134\\_IO\\_SAOPAULO\\_CBS.PDF](http://www.iioa.org/conferences/17th/papers/661674801_090608_153134_IO_SAOPAULO_CBS.PDF)

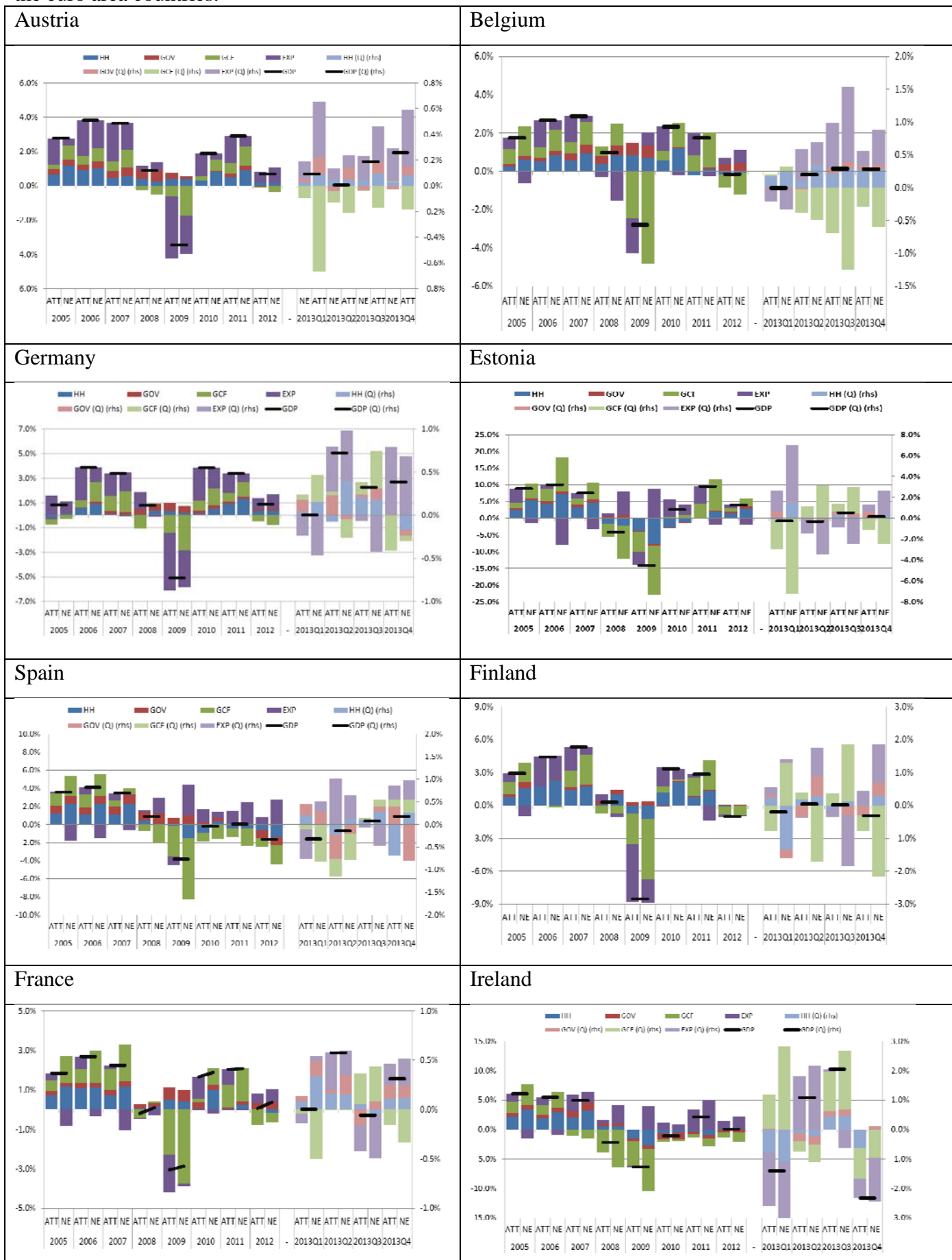
Kranendonk, H. C. and J. P. Verbruggen (2005), *How to determine the contributions of domestic demand and exports to economic growth?*, Centraal Planbureau memorandum. Business cycle analysis unit, CPB Netherlands Bureau for Economic Policy Analysis.

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

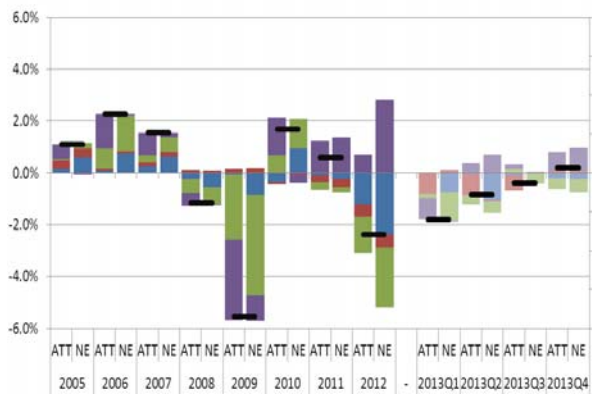
Ministry of Finance of Denmark, 2006, Economic survey, December 2006.



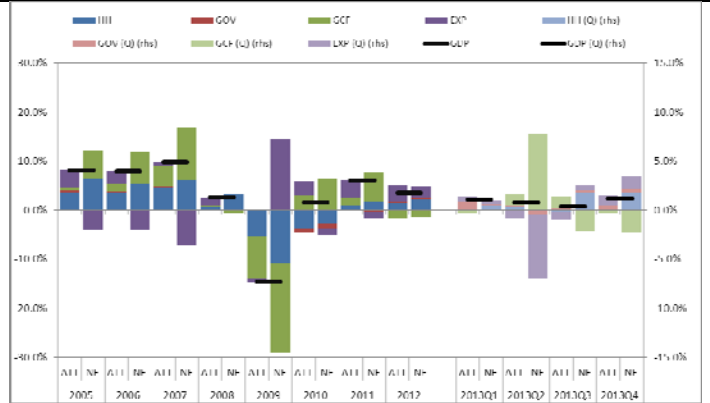
Annex 1: Growth contributions estimated by using the net export and attribution method in the euro area countries.



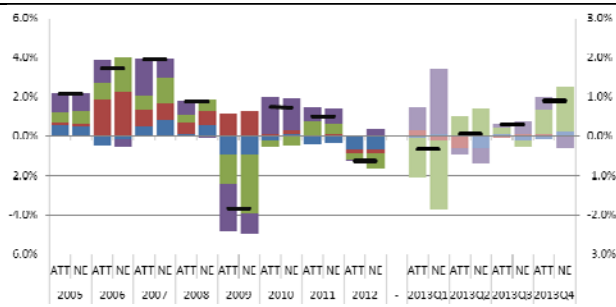
### Italy



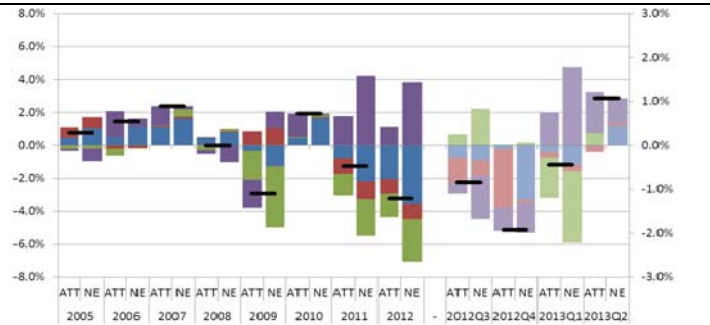
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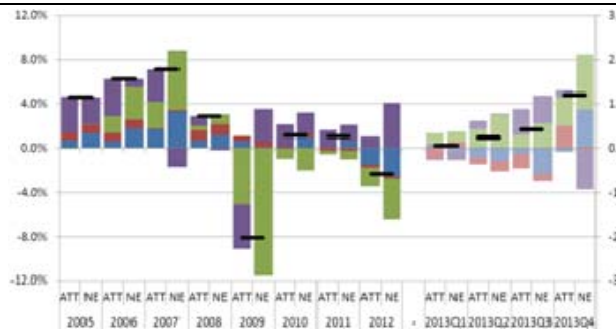
### Netherlands



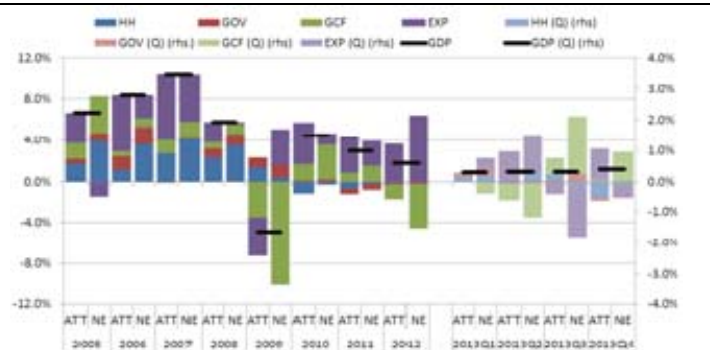
### Portugal



### Slovenia



### Slovakia



Source: ECB calculations using Eurostat and national data.