Long-run determinants and short-run dynamics of the trade balance in the EU-15 countries*

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Abstract

Several studies have analyzed the long-run determinants of current account balances using panel cointegration techniques. In this paper we will study both the long-run determinants and the short-run dynamics of the trade balances in the EU-15 countries. We will analyze each country separately and decompose the aggregate trade balance into the intra balance (trade balance vis-à-vis euro area) and the extra balance (trade balance vis-à-vis the rest of the world). Overall, our results suggest that there are significant differences in the long-run relations across the EU-15 countries which might be overlooked in the panel cointegration studies. In most of the countries there is a long-run cointegration relation between the variables, but in many cases the coefficient of the trade balance variable is statistically insignificant in the relation. When we analyze the intra balances and the extra balances, we find that they do not adjust to the disequilibrium error in an error-correction representation of the variables. Our results on the short-run dynamics indicate that in general the aggregate trade balance cannot be adjusted by expenditure-switching or expenditure-reducing policies.

Keywords: Trade balance, Competitiveness, European monetary union

JEL classification: F21, F32, F45

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1 Introduction

When the euro was introduced, widening current account imbalances were not seen as a problem, but rather as a natural consequence of the economic integration (see, e.g., Blanchard and Giavazzi 2002). After a decade, a much more cautious view has been adopted by the European Union. A legislative package and a surveillance procedure for the prevention and correction of macroeconomic imbalances were enforced in 2011.[1] The Macroeconomic Imbalance Procedure (MIP) stresses the importance of external balance and competitiveness.[2] Apparently the majority of the indicators in the MIP scoreboard have been derived from the standard Mundell-Fleming model, according to which external adjustment can occur through expenditure switching (a change in exchange rate) or expenditure shifting (a change in domestic demand). European Commission (2010a, 8) claims that differences in the domestic demand and price competitiveness have contributed to the divergence of current account balances, and intra-euro area imbalances have been a large part of this divergence (see, e.g., European Central Bank 2013, p. 69, or Darvas 2012).

We use Johansen and Juselius (1992) cointegration methodology to test if there is a long-run cointegration relation between the trade balance, the real effective exchange rate, the foreign output and the domestic output. The intertemporal approach to current account balance emphasizes other variables. However, in this study we focus on the variables listed above, because the key predictions of the intertemporal approach to the current account have been rejected several times by the data (see, e.g., Gourinchas and Rey 2014, p. 586) and the MIP stresses the importance of price competitiveness among other indicators. Our prime interest is to find out if the aggregate trade balance can be adjusted by expenditure-switching or expenditure-reducing

[1] Regulation (EU) No 1176/2011 of the European Parliament and of the Council of 16 No-vember 2011 on the prevention and correction of macroeconomic imbalances (OJ L 306, 23.11.2013, pp. 25-32) and Regulation (EU) No 1174/2011 of the European Parliament and of the Council of 16 November 2011 on enforcement measures to correct excessive mac-roeconomic imbalances in the euro area (OJ L 306, 23.11.2011, pp. 8-11).

[2] The scoreboard consists of current account balance, net international investment position, export market shares, nominal unit labor costs, real effective exchange rates, private sector debt, private sector credit flow, changes in the house price index, general government sector debt, and unemployment rate and there is a threshold value for each of these indicators. These indicators are claimed to focus on the most relevant dimensions of macroeconomic imbalances and competitiveness losses. (European Commission 2012a).

policies and if the intra-euro area balance differs from the aggregate trade balance or the extra balance in this respect. To our knowledge, this is the first study using quarterly data on the intra-euro area and extra-euro area trade balances separately in statistical analysis.[3]

We find that in most of the EU-15 countries there is a long-run cointegration relation between the aggregate trade balance, the real effective exchange rate, the foreign output, and the domestic output. However, the coefficient of the aggregate trade balance is often statistically insignificant in the cointegration vector. Only in Germany (1995Q4-2013Q3), Italy (1994Q1-2013Q3) and the UK (1994Q1-2013Q3) we obtain exactly one cointegration vector and a statistically significant trade balance coefficient. When we consider intra-euro area balances or extra balances, we encounter another problem: weak exogeneity. Neither the intra balances nor the extra balances adjust to the disequilibrium error. Thus, in most of the cases we cannot apply the error-correction representation. Consequently, we use VAR-models and first differenced series for short-run analysis. This analysis indicates that in general the trade balances cannot be adjusted by expenditure-switching or expenditure-reducing policies.

The remainder of this paper is organized as follows. In Section 2 we will briefly summarize the vast empirical literature in which the relation between the aggregate trade balance, the real exchange rate, and the foreign demand has been studied. Our emphasis is on the discussion about the factors that have contributed to the diverging current account imbalances in the euro area. In Section 3 we describe our data and explain our empirical methodologies. In Section 4 we will present the results on both the long-run relation and the short-run adjustment. Conclusions are drawn in Section 5

[3]Schmitz and von Hagen (2011) were the first to use annual data. Intra balance is the trade vis-à-vis the EMU-12 countries and extra balance is the trade balance vis-à-vis the rest of the world.

2 Literature

Our paper is related to a vast amount of literature on open-economy macroeconomics. This short literature review is organized as follows. In Section 2.1 we discuss the time series properties of current account balances. In Section 2.2 we summarize the studies in which cointegration methods have been applied to EMU countries. In Section 2.3 we will present some important studies on trade balance and price competitiveness.

2.1 Stationarity of current account balances and the long-run budget constraint

The time series properties of current account balances have been analyzed quite a lot.[4] The hypotheses in these analyses is that the long-run budget constraint, which is essentially the foundation of the intertemporal approach to current account balances, implies stationarity. If current account balance is nonstationary and non-mean reverting, a country may accumulate an infinite level of external debt (see, e.g., Coakley et al. 1996). Taylor (2002) collected annual data on current account balances for 15 countries over a hundred years. He found that savings (ratios to GDP) and investments (ratios to GDP) are nonstationary, whereas current account balances (ratios to GDP) are stationary. Consequently, savings and investments are cointegrated and the long-run budget constraint holds.[5] Taylor considers the long-run budget constraint as an explanation for the so-called Horioka-Feldstein puzzle (i.e. high correlation between savings and investments under free capital mobility).[6] (Taylor 2002.) Raybaudi et al. (2004) propose a different procedure. They use Markov-switching unit root test which allows for the possibility that a country enters a nonsustainable regime in several sub-periods even though the external debt might be sustainable in the long-run. (Raybaudi et al. 2004.)

Clower and Ito (2012) have a large sample of countries (72 countries over 205 quarterly observations) and they find that while ADF-GLS, KPSS and HEGY (Hylleberg, Engle, Granger

[4] Chen (2011) includes a survey on the existence of unit roots in current account series.
[5] By definition the current account balance equals savings minus investments.
[6] Coakley et al. (1996) propose this same argument.

and Yoo) unit root tests all imply rejection of unit root in less than 20% of countries, the rejection rate increases substantially if a structural break in trend and/or intercept is allowed. They also explore determinants that increase the probability of a country entering a non-stationary regime. For the developing and emerging countries both the fixed exchange rate regime and financial openness increase this probability. (Clower and Ito 2012.)

Net foreign asset positions can change both via trade channel and valuation channel (see, e.g. Gourinchas and Rey (2007). Hence, there is no deterministic relationship between the current account balances and the net foreign asset position. Theoretically a country could constantly run trade deficits and still satisfy the long-run budget constraint. Thus, we cannot rule out the possibility that trade balance series contains a unit root for an extended period of time.

2.2 Cointegration studies on current account balances with EMU countries

There are several studies in which the cointegration relationship between current accounts, price competitiveness, domestic demand and foreign demand have been analyzed in EMU countries (see Table 1 for a summary). Arghyrou and Chortareas (2008) use the Johansen-Juselius cointegration methodology and find that for most of the EMU-12 countries the real exchange rate has a statistically significant coefficient in a cointegration vector. Consequently, if real exchange rate depreciates, this has a positive effect on the current account balance in the long-run. However, in most cases the coefficient of the income variables are larger in absolute value than the coefficient of real exchange rate, which implies that a one percentage point change in these variables has a larger effect on current account balances than a one percentage point change in the price competitiveness. For none of the countries the lagged values of real effective exchange rates are jointly significant in the linear VECM of current account balance. Hence, the real exchange rate does not seem to be important for the short-run adjustment towards the equilibrium. For most of the countries, the real effective exchange rate is weakly exogenous which implies rigidity of the price variables. More importantly, tests reject the null hypothesis of linear current account adjustment for most of the countries. Usually the external adjustment is faster, if the current account balance is below a threshold. (Arghyrou and Chortareas 2008.)

Afonso and Rault (2009) were among the first to examine panel cointegration between the current account balances and its determinants in EMU countries. When they performed SUR estimation, they found that the government budget balance had a positive effect on the current account balance in Austria, Belgium and Ireland, and a negative effect in Italy, Luxembourg, Spain and the UK. The real effective exchange rate had a negative effect on the current account balance in all countries excluding Austria (positive), Denmark (positive), Ireland (positive), France (not significant at the 5% level), Luxembourg (not significant) and the UK (not significant). (Afonso and Rault 2009.)

Belke and Dreger (2013) analyze the importance of price competitiveness (unit labor cost-based real effective exchange rate) and catching up (measured by the GDP per capita relative to the euro area average) for the current account balances in a panel of 11 EMU countries. They find that both of these components are statistically significant, but a 1% increase in relative price competitiveness has had a larger positive effect on the current accounts than a 1% increase in the relative per capita income. However, when they divide the sample into deficit and surplus countries, the results change. The per capita incomes have had a statistically significant negative effect on the current account balances in Greece, Portugal and Spain during the post-1990 period. In the surplus countries the real effective exchange rate has been statistically insignificant. In addition, they find that government debt has had a negative effect on the current account balance whereas real interest rate has had no effect. (Belke and Dreger 2013.)

Gossé and Serranito (2014) elaborate on the analysis of Belke and Dreger (2013) in two ways. First, they include a larger set of variables. Secondly, they use a panel VECM to analyze the short-run adjustment. Budget balance seems to be important only in the long-run, whereas the real effective exchange rate is important both in the long-run and short-run. In the short-run the coefficient is even larger in absolute terms. External adjustment is rather slow as only 15% of the disequilibrium (the difference between actual current account balance and the structural long-run level of current account balance) of the previous year is corrected at the current year. Hansen's F-test indicates that there is one structural break in the short-run external adjustment. With exogenous zero threshold level they find that the half-life of deviations is much shorter if a country is below its structural long-run level than if it is above this level. With endogenous threshold level they find that if surplus is above 5.5% (of GDP), there is no significant adjustment of the current account balance. (Gossé and Serranito 2014.)

Comunale and Hessel (2014) differ from Belke and Dreger (2013) in three respects. First, they model exports, imports and trade balances separately. Secondly, they use the mean group estimator (coefficients are allowed to be heterogeneous both in the short-run and in the long-run). Thirdly, they use quarterly data. Foreign demand has a positive effect on exports in the short-run and in the long-run the effect is even stronger. Real effective exchange rate appreciation has a negative effect on the exports in the short-run, but no effect in the long-run. The domestic demand and the exports have positive effects on the imports both in the short-run and in the long-run. Price competitiveness seems to be insignificant for the imports. Neither GDP-based nor unit labor cost-based real effective exchange rate is significant for the trade balance. With respect to fiscal cycle, the results depend on which proxy is used. (Comunale and Hessel 2014.)

According to Lane and Milesi-Ferretti (2002) the real exchange rate depreciation is strongly associated with trade surplus. However, much larger depreciation is needed for a given improvement in trade balance in the G3 countries than in the non-G3 countries. Also the relative price of nontraded goods co-moves with the trade balances. (Lane and Milesi-Ferretti 2002.)

|Table 1 |

2.3 Trade balance and price competitiveness

Demirden and Pastine (1995) stress the importance of feedback effects between the trade balance, real exchange rate, domestic income and foreign income in a flexible exchange rate regime. Hence, they assert that VAR methodology in which all variables are allowed to be endogenous is well suited for this purpose. More recently some studies have utilized structural VAR models for exchange rates and current account balances that are based on the implications of the intertemporal approach to current account. Lee and Chinn (2006) estimate a VAR model including exchange rates and current account balances. They suggest that one reason for the difficulty to uncover the relationship between exchange rate and the current account has been the inability to control for permanent shocks which dominate movements of the real exchange rate. Their key assumption is that temporary effects (nominal shocks) have no long-run effects on the real exchange rate.[7] Fisher and Huh (2002) point out that in the more recent intertemporal models with sticky prices nominal shocks can have a long-run effect on the real exchange rate as well as on the trade balance. Gourinchas and Rey (2014, p. 586) remark that the key predictions of the intertemporal approach to the current account have been rejected several times by the data.[8]

European Central Bank (2012) is an extensive analysis on the factors that have contributed to the diverging current account balances in the euro area. Some EMU member countries have suffered competitiveness losses (measured by the unit labor cost-based real effective exchange rate). The appreciation of unit labor cost-based real effective exchange rate indicates that the development of labor costs was not driven by changes in productivity. A wage determination mechanism with wage spillovers from non-traded or public sector to the traded-sector might explain this disconnection. Given the high taxes on labor incomes, a country can improve its competitiveness by fiscal devaluation, i.e. a shift from direct taxes and social security

[7] Giuliodori (2004) expands this model by including a demand shock.

[8] Nason and Rogers (2006) is a good summary of the potential reasons for the shortcomings. See also Bergin (2006), Kano (2008), and Campa and Gavilan (2011).

contributions towards indirect taxes. On the other hand, productivity growth can increase competitiveness via price competitiveness (enhanced process efficiency, improved skills etc.) or non-price competitiveness (higher product quality etc.). The only problem is that it is difficult to measure the ability to innovate.[9] Based on disaggregated sectoral data, the price and non-price competitiveness factors have been equally important for the trade balance in most of the EMU countries. Model simulations on four different models ranging from a Dynamic Stochastic General Equilibrium (DSGE) model to an empirical Global Vector Autoregressive Model (GVAR) suggest that a 5% to 10% temporary reduction in relative wages is needed for the current account balance to improve by 1% of GDP in the medium term. However, the short-run impulse responses vary substantially across models. The peak of the current account response could be 3 quarters or 13 quarters after the shock depending on the model. (European Central Bank 2012.)

Zemanek et al. (2010) employ a dynamic panel model (system GMM estimator) to find out whether structural reforms or private sector adjustments affect bilateral trade balances. They find, for example, that the changes in unit labor costs are statistically insignificant in explaining the changes in bilateral trade balances. According to European Commission (2010b) foreign demand and real effective exchange rate accounted for only a half of the variation in exports of the EMU member countries during 1998-2008. Furthermore, the correlation between exports and real exchange rate has actually been positive. This has been interpreted as evidence for the fact that price competitiveness is only one of the factors determining the export performance. (European Commission 2010b, p. 29.) Import intensity of exports may weaken the relation between real effective exchange rate and exports (see European Commission 2012b, p. 31, Graph 3.1, or European Central Bank 2012, pp. 30-32).

Collignon and Esposito (2014) point out that wages do not measure the total cost structure

[9] See Nieminen (2015) in which he found that there is a strong positive link between Hofs-tede's Individualism index and intra-euro area trade balances. Based on Gorodnichenko and Roland (2010) the Individualism index is a very good proxy for the ability to innovate.

of economy. Hence, they develop a competitiveness index which also includes capital efficiency and profit rates. However, there is not a significant difference between the real effective exchange rate and their own index in the explanatory power for the trade balances. Wyplosz (2013) claims that the competitiveness narrative of the Eurozone crisis is misleading and based on the faulty use of data. He has three arguments for this interpretation. First, EMU member countries do not only compete with each other and therefore unit labor costs should be measured with respect to all countries, not just relative to the EMU countries. Secondly, changes in total economy unit labor costs might reflect the changes in nontraded goods sector. Thirdly, there is no reason to set indices to 100 at an arbitrary year as if real effective exchange rates were in equilibrium at this arbitrary year. It is more reasonable to assume that the real effective exchange rates are in equilibrium in the long-run. If these points were taken into consideration, the divergence in competitiveness would probably be much less dramatic. On the other hand, the competitiveness narrative does not explain why inflation has been higher in Southern European countries. It is very likely that changes in competitiveness have been endogenous and driven by domestic demand shocks. Countries that entered the EMU with above-average inflation rates had lower-than-average real interest rates and this resulted in credit booms and high domestic demand. (Wyplosz 2013.) Related to this view, Fratzscher et al. (2010) build a Bayesian structural VAR model and show that asset market reactions (equity market shocks and housing price shocks) were much more important than the behavior of exchange rate in explaining the US current account balance.

3 Data and methodology

3.1 Data

We use quarterly data on trade balances, real exchange rates, domestic GDP per capita and foreign GDP per capita. Our dataset includes the EU-15 countries except Belgium, Luxembourg, Austria, and Ireland.[10] The length of the sample period varies from 135 quarters (1980Q1-2013Q3, Greece, Italy and Sweden) to 171 quarters (1971Q1-2013Q3, France, Germany, Spain and the UK). There is strong seasonality not just in the output series but also in the trade balance series. Consequently, we apply linear X-11 filter and take logarithms of the series.[11] We use the CPI-based real exchange rates, because this is the indicator that was included in the Macroeconomic Imbalance Procedure scoreboard.[12]

Both in the long-run and in the short-run analyses we examine three systems of four variables. The three systems differ in respect to the set of partner countries. In the first system we have aggregate trade balance (as ratio to GDP), domestic GDP per capita, GDP per capita in the world economy, and the CPI-based real effective exchange rate.[13] Hence, the set of partner countries consists of the whole world. In the second set we have the intra balance (as ratio to GDP), domestic GDP per capita, GDP per capita in the rest of the EMU-12 countries, and the CPI-based real exchange rate against the EMU-12 countries. In these models the set of partner countries consists of the EMU-12 countries. In the third system we have extra balance (as ratio to GDP), domestic GDP per capita, GDP per capita in the non-EMU-12 countries, and the CPI-based real exchange rate against the non-EMU-12 countries. In this case the set of partner countries consists of the non-EMU-12 countries. In the short-run analysis we estimate the VAR models for two subsamples (the pre-EMU period and the EMU period).

3.2 Long-run analysis

Most of our time series contain a unit root (see Table 2). In some series there is a structural break. For all countries at least two of the four variables are I(1). Consequently, we use the Johansen-Juselius cointegration methodology to test if there is a long-run cointegration relation

[10] The problem with Belgium and Luxembourg is that prior to the year 1997 there is no data for these two countries separately in the IMS's Direction of Trade Statistics. For Ireland and Austria the pre-EMU sample length is too short (4 quarters for Ireland and 40 quarters for Austria). However, all these countries are included as partner countries, when intra balances or real exchange rates against the EMU-12 countries are calculated.

[11] We did not take logarithms of trade balance series, because these include negative values.

[12] Note that in order to calculate the real exchange rates against an arbitrary group of countries (EMU-12 countries or non-EMU-12 countries), one needs to re-scale the trade weighting matrix.

[13] See details in Table A2.

between the trade balance, the domestic output, the foreign output, and the real effective exchange rate. We use Johansen and Juselius (1992) cointegration methodology instead of Engle and Granger (1987) cointegration test as it allows for the possibility of several cointegration vectors. We apply backwards recursive estimation because in most of the countries the series contains a structural break.[14] When choosing the country-specific sample period, we face a constrained optimization problem. We maximize the sample length, but try to ensure that the following conditions hold: cointegration rank equals one (based on the trace test with small sample correction) and the sample does not contain structural breaks (according to the Zivot-Andrews endogenous structural break test). Sample period is country specific, but common to all three different systems for each country. In most cases this is feasible (see Table 3). However, for example in the Netherlands we cannot find a long-run relation. The same applies to the EMU-12 and the rest of the world systems in Portugal, Denmark and the UK as well as to the EMU-12 system in Sweden.[15] If the trace test confirms that the cointegration rank equals one, we estimate the cointegration vector and normalize it with respect to the trade balance variable (the aggregate trade balance, the intra balance, or the extra balance). However, before estimating the cointegration vectors we impose zero restrictions on the trade balance variables. Only if we can reject the zero restriction, we estimate the cointegration vector. We will present the results on long-run relations in Section 4.1.

Some studies run cross-section regressions in which changes in the trade balance or changes in current account balance are explained by changes in the real effective exchange rate and GDP per capita growth rate (see, e.g., Estrada et al. 2013, Table 1). However, these regressions have some problems. First, it is very difficult to claim that the real exchange rate could be considered exogenous with respect to the trade balances. Secondly, it is very likely that the countries differ in respect to the adjustment dynamics. When we ran such cross-section regressions with the EU-15 countries using 5-year rolling averages, we observed one additional problem: the results are

[14]For Greece we also estimated a sample excluding the euro crisis period.

[15]For Greece 1999Q1-2013Q3 we were unable to perform the trace test because the matrix was non-invertible.

very sensitive to the time interval (see Figure A1). For example, the estimated value of t-statistic of real effective exchange rate alternates from -3.87 (2002Q1-2007Q1) to 6.22 (2005Q4-2010Q4) in less than four years.

|Table 2 |

|Table 3 |

3.3 Short-run analysis

Our results on the long-run relations imply that in general there is no error-correction representations for the trade balance variables.[16] Thus, we perform the short-run analysis using VAR models and first differenced series which are stationary. In the short-run analysis we estimate the VAR models for two subsamples (pre-EMU period and EMU period). The lag structure is always four, because we have quarterly data.[17] Bayesian Information Criterion of Schwarz often suggests a much shorter lag structure. Consequently, in the short-run analysis we estimate the following VAR(4) model:

$$x_t = \nu + A_1 x_{t-1} + ... + A_p x_{t-p} + u_t, \tag{1}$$

where $x_t = (\Delta y*_t, \Delta reer_t, \Delta y_t, \Delta tradebalance_t)'$ is a column vector, the A_i are coefficient matrices, ν is a column vector of intercept terms, and u_t is an innovation process, and with four lags p equals four.

We use conventional VAR modelling, because it would be difficult to derive identifying restrictions for the effects of intra and extra balances. Lee and Chinn (2006) focused on current account balances and real effective exchange rates and they assumed that the temporary effects (nominal shocks) have no long-run effects on the real exchange rates. Fisher and Huh (2002)

[16]Lack of cointegration between the variables, and/or inability to reject the zero restrictions on the trade balance variable, and/or inability to reject the weak exogeneity of the trade balance variables.

[17]Actually this is the maximum number of lags that we can put into our model. In the EMU-period we have only 59 periods, 236 observations and with four lags the number of parameters is 17 (16 lags and a constant).

questioned such identification restrictions. Actually, it would be difficult to explore the effects of nominal shocks on trade balances using our sample, because all EMU countries face the same monetary policy. Lee and Chinn (2006) claimed that the ordering of variables in the VAR models for this type of analysis is arbitrary in the Choleski factorization. We use the following ordering: foreign GDP per capita, the real effective exchange rate, domestic GDP per capita, and the trade balance. This implies that the real exchange rate shock has a contemporaneous effect on the trade balance, but not vice versa. We also tested an alternative ordering: foreign GDP per capita, domestic GDP per capita, the trade balance, and the real effective exchange rates. Concerning the aggregate trade balances none of our results changed. This robustness is based on the fact that the correlations between the different shocks are typically very low. Taking into account previous empirical studies and our results, it might be questionable to use sign restriction approach.[18] We will present the result on short-run dynamics in Section 4.2.

4 Results

4.1 Long-run trade balance determination

Before estimating the cointegration vectors we impose zero restrictions on the trade balance variables (the aggregate trade balance, the intra balance, and the extra balance) (see Table 4). It turns out that in many cases we cannot reject the restricted model. Only if the zero restriction can be rejected at the 5% significance level, we estimate the cointegration vector.[19]

|Table 4 |

The estimated cointegration vector are presented in Table 5.[20] The long-run relations are normalized on the trade balance variable (the aggregate trade balance, the intra balance, or

[18] There is no consensus on exchange rate devaluation having a positive effect on exports or net exports (see Section 2.3). The correlation between exports and real exchange rate was actually positive in the EMU countries during the period of 1998-2008 (European Commission (2010b). See also Bahmani-Oskooee and Ratha (2004).

[19] In addition, the rank of cointegration has to be equal to one.

[20] Country-specific sample periods were derived from Table 3 (the trace test and the back-wards recursive estimation).

the extra balance).[21] We expect the following signs of coefficients in Table 5: the domestic GDP per capita positive, the foreign GDP per capita negative, and the real effective exchange rate positive. The coefficient of α captures the adjustment of the trade balance variable to the disequilibrium error. We expect that the aggregate trade balance adjusts to the disequilibrium error which implies that the coefficient of α is statistically significant and negative. Red font indicates that the sign of the coefficient is theoretically implausible and the coefficient is statistically significant.

In most of the cases the signs of coefficients are theoretically plausible. On the other hand, in the UK the coefficients of domestic output and foreign output have wrong signs.[22] In Greece both the intra-euro area relation before the euro crisis and the extra balance relation during the EMU period contain several coefficients with theoretically implausible signs. Overall, we observe that there are large differences in the long-run relations across the EU-15 countries.

For a meaningful error-correction model the trade balance variables (the aggregate trade balance, the intra balance, or the extra balance) should not be weakly exogenous (see Table 6). The intra-euro area balance and the extra balance are frequently weakly exogenous and consequently do not adjust to the disequilibrium error. Consequently, we could only apply error-correction representation to 6 out of 35 cases and there is no country where we could perform a comparison between the three systems.

Germany is the largest economy in the euro area and in 2011 its current account surplus surpassed China's surplus. According to our results domestic GDP per capita had no deteriorating effect on Germany's trade balance during the 1995Q4-2013Q3 period. In addition, weak exogeneity of trade balance is rejected only at the 10% significance level and the coefficient of α is much smaller in absolute value than for example in Italy or in UK. This implies that in Germany the trade imbalances are relatively persistent.

[21] In order to restore the normal interpretation of effects (trade balance on the left-hand side and the rest of the variables on the right-hand side) the coefficients of domestic output, foreign output and real effective exchange rate should be multiplied by -1.

[22] Also Lee and Chinn (2006) noticed that in the UK the current account dynamics differed from other G7 countries.

|Table 5 |

|Table 6 |

4.2 Short-run trade balance determination

We estimated VAR models using the first differenced series which are stationary. Our VAR analysis indicates that the trade balances respond neither to changes in foreign output, changes in the real effective exchange rate, nor to changes in domestic output (see Table 7). However, there are some exceptions such as Finland, France and Spain.

In Finland, the dynamics of the trade balance changed when they adopted the euro currency. Impulse responses for the aggregate trade balance are shown in Figure 1. The red dotted lines represent the 95% error bands (based on a Monte Carlo integration with 10000 draws). More specifically the dynamic response of aggregate trade balance to the real effective exchange rate changed. During the EMU period the real effective exchange rate has had a deteriorating effect on the trade balance and this change took place specifically in the extra balances (see Figure 2, rows 3 and 4). This implies that for Finland the exchange rate of euro against other currencies is an important determinant of its trade balance in the short-run.

|Table 7 |

The relative importance of intra and extra balances is naturally related to the share of the intra-euro area trade which varies considerably across the EU-15 countries (see Table A2). In Finland and in Greece the share of intra trade is low. This probably explains at least to some extent why for example in Finland the changes in Granger causality regarding the aggregate trade balances have resulted from the extra balance. However, this does not tell the reason why the dynamics changed in the first place.

|Figure 1 |

|Figure 2 |

In France the changes in real effective exchange rate Granger caused changes in the trade balances during the pre-EMU period but not during the EMU period (see Table 1 and Figure 3). The change took place in the extra balance. In Spain domestic GDP per capita growth has had a negative effect on the aggregate trade balance during the EMU period (see Table 1 and Figure 4).

|Figure 3 |

|Figure 4 |

5 Conclusions

In this paper we analyzed the long-run determinants and the short-run dynamics of trade balance in the EU-15 countries. Consistent with the Macroeconomic Imbalance Procedure scoreboard and the Mundell-Fleming model our set of variables included the trade balance, the real effective exchange rate, domestic GDP per capita, and foreign GDP per capita. In the analysis we decomposed the aggregate trade balance into the intra balance (trade balance vis-à-vis the euro area) and the extra balance (trade balance vis-à-vis the rest of the world). Overall, we found that there is lot of heterogeneity in the long-run relations across the EU-15 countries. In most of the countries there is a long-run cointegration relation between the variables, but in many cases the coefficient of the trade balance variable (the aggregate trade balance, the intra balance, or the extra balance) is statistically insignificant. The intra-euro area balance and the extra balance are frequently weakly exogenous and consequently do not adjust to the disequilibrium error. In Germany (1995Q4-2013Q3) domestic GDP per capita had no deteriorating effect on the aggregate trade balance and the aggregate trade balance was nearly weakly exogenous. This implies that the trade surplus of Germany, which is only comparable to China's surplus, is relatively persistent.

Our results on the long-run relations implied that in general there is no error-correction representation. Thus, we performed the short-run analysis using VAR models and the first differenced series. Contrary to standard undergraduate textbook presentations and the Mundell-Fleming model we cannot find robust evidence that the aggregate trade balance could be adjusted by expenditure-switching or expenditure-reducing policies. In some countries the short-run dynamics of aggregate trade balance changed when they adopted the euro. Our decomposition of the aggregate trade balance enabled to pin down this change into the intra balance or the extra balance. In Finland the real effective exchange rate has had a deteriorating effect on the trade balance during the EMU period and this results from the extra balance. This is plausible, because Finland has high foreign trade activity with non-EMU countries. In terms of international competitiveness, the exchange rate of euro against other currencies is significant for Finnish net exports in the short-run.

In the mass media internal devaluation and austerity policies are usually the only suggested remedies for the external adjustment. This same belief is reflected in the European Commission's Macroeconomic Imbalances Procedure which stresses the importance of price competitiveness. Our results call such a belief into question to a certain degree. We find no strong or clear relationship between the trade balance and price competitiveness in the EU-15 countries. Global supply chains may weaken the relation between real effective exchange rate and exports. Since we analyzed net exports, our findings are unlikely to be explained solely by the increased importance of global supply chains.

6 Appendix: Additional tables and figures

|Table A1 |

|Table A2 |

|Figure A1 |

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Table 1. Cointegration studies on current account balances with EMU countries

Study	Sample	Unit root test	Cointegration	Estimation
Arghyrou and Chortareas (2008)	Quarterly data (except GR), EMU12 (exc. IE and LU), 1980Q1-2005Q3. Variables: ca, reer, ys, ys7.	Not specified: all series are I(1).	Johansen-Juselius cointegration test (Johansen and Juselius 1990, 1992) and Engle-Granger (Engle and Granger 1987): one cointegration vector (two in [illegible]	VECM system estimated using the full information maximum likelihood (FIML) and after tests (Luukkonen et al. 1988; Granger and Teräsvirta 1993) indicate nonlinear adjustment logistic smooth threshold error-correction model (L-STECM) (e.g. van Dijk et al. 2002).
Afonso and Rault (2009)	Annual data, EU15, 1970-2007. (Also larger panels with smaller T.) Variables: ca, reer, budget.	Bootstrap tests (Smith et al. 2004): the null of a unit root cannot be rejected	Panel bootstrap cointegration test (Westerlund and Edgerton 2007): the null of cointegration cannot be rejected	Seemingly Unrelated Regression (SUR) method
Belke and Dreger (2013)	Annual data, 11 EMU countries, 1982-2011. Variables: ca, reer, y, r, debt (all are expressed relative to the euro area average).	Covariate-augmented Dickey-Fuller test (Pesaran 2007): all series are I(1).	Panel test of cointegration with cross-sectional dependence (Westerlund 2007): in most of the cases the null of no cointegration is rejected	Pooled mean group estimator (Pesaran et al. 1999)
Gossé and Serranito (2014)	Annual data, 21 OECD countries, 1974-2009. Variables: ca, reer, y, r, prod, fb, oil, credit, dep, tot (HP-filter to all except fb). Data is demeaned.	First generation tests (Levin et al. 2002; Im et al. 2003) and Covariate-augmented Dickey-Fuller test (Pesaran 2007): all series are I(1), except r is I(0).	Panel test of cointegration with cross-sectional dependence (Westerlund 2007): in most of the cases the null of no cointegration is rejected	1) Panel DOLS to estimate the long-run structural values of ca (after this a normalization to country-specific intercept (Elbadawi et al. 2011) and 2) both linear panel VECM (derived from ARDL (1, 1, 1) model (Pesaran and Shin 1999)) and nonlinear panel VECM (Hansen 1999)
Comunale and Hessel (2014)	Quarterly data, 17 EMU countries, 1994Q1-2012Q3. Three systems: [exp, reer, fd]; [imp, reer, dd, exp]; [tb, reer, fcycle]. Imports are demeaned.	Im et al. (2003) and Covariate-augmented Dickey-Fuller test (Pesaran 2007): all series are I(1), except tb is I(0).	Panel test of cointegration with cross-sectional dependence (Westerlund 2007): in most of the cases the null of no cointegration is rejected	Mean group estimator (Pesaran and Smith 1995)
Lane and Milesi-Ferretti (2002)	Annual data, 20 OECD countries, 1970-1998. Variables: tb, reer, y, yd, tot, rp, rprod.	Hadri (2000): the null of stationarity can be rejected in all series.	Pedroni (1999): the null of no cointegration can be rejected.	Dynamic Ordinary Least Squares (DOLS) estimator (Stock and Watson 1993)

Abbreviations: Greece (**GR**), Ireland (**IE**), Luxembourg (**LU**), ratio of the current account balance to GDP (**ca**), ratio of the exports to GDP (**exp**), ratio of the imports to GDP (**imp**), ratio of the trade balance to GDP (**tb**), real effective exchange rate (**reer**), seasonally-adjusted real GDP volume (**ys**), GDP per capita (**y**), GDP per capita relative to trading partners (**yd**), domestic demand (**dd**), seasonally-adjusted real GDP volume of the G-7 area (**ys7**), foreign demand (**fd**), proxies for the financial cycle (**fcycle**), real interest rate (**r**), general government budget balance (**budget**), ratio of the government fiscal balance to GDP (**fb**), ratio of the cyclically adjusted government debt to GDP (**debt**), labor productivity of the total economy (**prod**), labor productivity in the traded goods' sector relative to the nontraded goods' sector (**rprod**), ratio of the oil balance to GDP (**oil**), ratio of the private credit to GDP (**credit**), dependency ratio (**dep**), terms of trade (**tot**), price of nontraded goods relative to traded goods (**rp**).

Table 2. Results of the unit root tests

	Finland 1975Q1-2013Q3			France 1971Q1-2013Q3			Germany 1971Q1-2013Q3			Greece 1980Q1-2013Q3			Italy 1980Q1-2013Q3		
Unit root test:	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT
tradebalance	**I(1)**	**I(1)*****	1991Q3	**I(1)**	**I(1)*****	2004Q2	I(1)	I(0)	1990Q2	I(0)**	I(1)***	2008Q4	**I(1)**	**I(1)*****	1992Q3
$y_{domestic}$	**I(1)**	**I(1)****	1990Q3	**I(1)**	**I(1)*****	2007Q2	**I(1)**	**I(1)*****	1990Q1	**I(1)**	**I(1)*****	2008Q3	**I(1)**	**I(1)*****	2008Q2
y^*_{world}	I(1)	I(0)	1981Q2	I(0)**	I(0)	1980Q2	I(0)**	I(0)	1980Q2	I(1)	I(0)	1987Q2	I(1)	I(0)	1987Q2
$reer_{world}$	**I(1)**	**I(1)****	1991Q4	I(0)**	I(0)	1980Q4	**I(1)**	**I(1)****	1980Q1	**I(1)**	**I(1)****	1991Q3	**I(1)**	**I(1)****	**1992Q4****
Number of I(1) variables	3			2			2			2			3 or 2		
Δtradebalance	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta y_{domestic}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
Δy^*_{world}	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta reer_{world}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
intrabalance	**I(1)**	**I(1)*****	1990Q1	**I(1)**	**I(1)*****	1998Q4	**I(1)**	**I(1)*****	2007Q2	**I(1)**	**I(1)*****	2008Q3	**I(1)**	**I(1)*****	1990Q2
y^*_{EMU-12}	**I(1)**	**I(1)*****	2007Q4	**I(1)**	**I(1)*****	2007Q2	**I(1)**	**I(1)****	1997Q2	**I(1)**	**I(1)*****	2008Q3	**I(1)**	**I(1)*****	2008Q3
$reer_{EMU-12}$	I(0)**	I(1)***	**1991Q4*****	I(0)***	I(0)	**1993Q4*****	I(0)**	I(1)**	**1992Q4*****	**I(1)**	**I(1)*****	1985Q2	**I(1)**	**I(1)****	**1992Q4*****
Number of I(1) variables	3			3			3			4			4 or 3		
Δintrabalance	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
Δy^*_{EMU-12}	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta reer_{EMU-12}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
extrabalance	**I(1)**	**I(1)*****	1992Q3	I(0)**	I(1)**	2005Q3	**I(1)**	**I(1)*****	2001Q1	I(0)**	I(1)**	2000Q2	**I(1)**	**I(1)*****	1998Q4
y^*_{RoW}	**I(1)**	**I(1)*****	2003Q3	**I(1)**	**I(1)*****	2005Q2	**I(1)**	**I(1)*****	2005Q2	**I(1)**	**I(1)*****	1993Q3	**I(1)**	**I(1)*****	1993Q2
$reer_{RoW}$	**I(1)**	**I(1)****	1992Q4	I(1)	I(0)	1980Q4	I(1)	I(0)	1980Q2	I(1)	I(0)	1999Q1	**I(1)**	**I(1)****	1992Q4
Number of I(1) variables	4			2			3			2			4		
Δextrabalance	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
Δy^*_{RoW}	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta reer_{RoW}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		

Abbreviations: Augmented Dickey Fuller test (ADF), Kwiatkowski-Phillips-Schmidt-Shin test (KPSS), Zivot-Andrews endogenous structural break test (ZIVOT), for others see Table A1.
Notes: In Augmented Dickey Fuller test (with a constant and a trend, lag structure by Bayesian information criterion) the null hypothesis is that the series contains a unit root. In Kwiatkowski-Phillips-Schmidt-Shin test (with trend, four lags) the null hypothesis is that the series is trend stationary. Zivot-Andrews is endogenous structural break test. Bold font indicates that the series contains a unit root. Most of the time series contain a unit root, but all first differences are stationary. Δ denotes period-to-period changes. **, *** denote statistical significance at 5% and 1% levels.

Table 2. Results of the unit root tests (continues)

	Netherlands 77Q1-2013Q3			Portugal 1978Q1-2013Q3			Spain 1971Q1-2013Q3			Denmark 77Q1-2013Q3			Sweden 1980Q1-2013Q3			UK 1971Q1-2013Q3		
Unit root test:	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT	ADF	KPSS	ZIVOT
tradebalance	I(0)***	I(0)	**1997Q1*** **	**I(1)**	**I(1)*** **	1984Q2	**I(1)**	**I(1)*** **	1977Q3	**I(1)**	**I(1)*** **	1986Q4	**I(1)**	**I(1)*** **	2006Q2	**I(1)**	**I(1)*** **	1977Q2
$y_{domestic}$	**I(1)**	**I(1)*** **	2008Q1	**I(1)**	**I(1)*** **	1988Q1	**I(1)**	**I(1)*** **	1998Q3	**I(1)**	**I(1)*** **	2008Q1	**I(1)**	**I(1)*** **	1990Q2	**I(1)**	**I(1)*** **	1994Q1
y^*_{world}	I(1)	I(0)	1987Q2	I(1)	I(0)	1987Q2	I(0)**	I(0)	1980Q2	I(1)	I(0)	1987Q2	I(1)	I(0)	1987Q2	I(0)**	I(0)	1980Q2
$reer_{world}$	**I(1)**	**I(1)*** **	2001Q1	**I(1)**	**I(1)*** **	1990Q1	**I(1)**	**I(1)** **	1992Q4	I(1)	I(0)	1986Q2	**I(1)**	**I(1)** **	1998Q3	I(1)	I(0)	2007Q2
Number of I(1) variables	2			3			3			2			3			2		
Δtradebalance	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta y_{domestic}$	I(0)***			I(0)***			I(0)**			I(0)***			I(0)***			I(0)***		
Δy^*_{world}	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta reer_{world}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
intrabalance	**I(1)**	**I(1)*** **	**1986Q1** **	I(0)**	I(1)***	1996Q3	**I(1)**	**I(1)** **	1986Q1	**I(1)**	**I(1)*** **	1987Q1	**I(1)**	**I(1)*** **	**1990Q2** **	**I(1)**	**I(1)*** **	1990Q2
y^*_{EMU-12}	**I(1)**	**I(1)*** **	2008Q1	**I(1)**	**I(1)*** **	2008Q2	**I(1)**	**I(1)*** **	2007Q2	**I(1)**	**I(1)*** **	2008Q1	**I(1)**	**I(1)*** **	2008Q3	**I(1)**	**I(1)*** **	2007Q2
$reer_{EMU-12}$	**I(1)**	**I(1)*** **	1983Q1	**I(1)**	**I(1)*** **	**1990Q4*** **	**I(1)**	**I(1)*** **	1992Q4	I(1)	I(0)	1986Q2	I(0)**	I(0)	1992Q4	I(1)	I(0)	1979Q1
Number of I(1) variables	3			3 or 2			4			3			3 or 2			3		
Δintrabalance	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***	I(0)***		I(0)***		
Δy^*_{EMU-12}	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***	I(0)***		I(0)***		
$\Delta reer_{EMU-12}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***	I(0)***		I(0)***		
extrabalance	**I(1)**	**I(1)*** **	1985Q2	**I(1)**	**I(1)*** **	**1984Q3*** **	**I(1)**	**I(1)*** **	1983Q2	I(0)***	I(1)***	1983Q1	**I(1)**	**I(1)*** **	1993Q3	I(0)***	I(1)***	**1977Q3** **
y^*_{RoW}	**I(1)**	**I(1)*** **	2003Q3	**I(1)**	**I(1)*** **	2003Q3	**I(1)**	**I(1)*** **	2005Q2	**I(1)**	**I(1)*** **	2003Q3	**I(1)**	**I(1)*** **	1993Q2	**I(1)**	**I(1)*** **	2005Q2
$reer_{RoW}$	**I(1)**	**I(1)** **	2002Q2	I(1)	I(0)	1989Q3	I(1)	I(0)	1992Q4	I(1)	I(0)	1985Q4	**I(1)**	**I(1)** **	1997Q1	I(0)**	I(0)	1996Q4
Number of I(1) variables	4			3 or 2			3			2			4			2		
Δextrabalance	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
Δy^*_{RoW}	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		
$\Delta reer_{RoW}$	I(0)***			I(0)***			I(0)***			I(0)***			I(0)***			I(0)***		

Abbreviations: Augmented Dickey Fuller test (ADF), Kwiatkowski-Phillips-Schmidt-Shin test (KPSS), Zivot-Andrews endogenous structural break test (ZIVOT), for others see Table A1.

Notes: In Augmented Dickey Fuller test (with a constant and a trend, lag structure by Bayesian information criterion) the null hypothesis is that the series contains a unit root. In Kwiatkowski-Phillips-Schmidt-Shin test (with trend, four lags) the null hypothesis is that the series is trend stationary. Zivot-Andrews is endogenous structural break test. Bold font indicates that the series contains a unit root. Most of the time series contain a unit root, but all first differences are stationary. Δ denotes period-to-period changes. **, *** denote statistical significance at 5% and 1% levels.

Table 3. Determination of cointegration rank (trace test with small sample correction)

	Null hypothesis:	Set of partner countries: The whole world	EMU-12 countries	The rest of the world
FI	H_0: r=0	0.047	0.014	0.008
	H_0: r≤1	0.186	0.869	0.038
	H_0: r≤2	0.902	0.979	0.844
	time period	1991Q4-2013Q3 based on st. break in $reer_{EMU-12}$ and backwards recursive estim.		
FR	H_0: r=0	0.004	0.007	0.001
	H_0: r≤1	0.126	0.900	0.197
	H_0: r≤2	0.177	0.856	0.135
	time period	1998Q1-2013Q3 based on st. break in $reer_{EMU-12}$ and backwards recursive estim.		
DE	H_0: r=0	0.033	0.001	0.006
	H_0: r≤1	0.157	0.280	0.065
	H_0: r≤2	0.283	1.000	0.399
	time period	1995Q4-2013Q3 based on st. break in $reer_{EMU-12}$ and backwards recursive estim.		
GR	H_0: r=0	0.006		0.000
	H_0: r≤1	0.611		0.106
	H_0: r≤2	0.707		0.241
	time period	1999Q1-2013Q3 based on backwards recursive estimation		
GR	H_0: r=0	0.001	0.000	0.000
	H_0: r≤1	0.748	0.119	0.388
	H_0: r≤2	0.850	0.272	0.839
	time period	1994Q1-2007Q4 based on backwards recursive estim. (starting from 2007Q4)		
IT	H_0: r=0	0.034	0.008	0.040
	H_0: r≤1	0.127	0.153	0.551
	H_0: r≤2	0.777	0.339	0.566
	time period	1994Q1-2013Q3 based on st. breaks both in $reer_{world}$ and $reer_{EMU-12}$ and backwards recursive estim.		
NL	H_0: r=0	0.130	0.268	0.093
	H_0: r≤1	0.374	0.705	0.547
	H_0: r≤2	0.592	0.772	0.740
	time period	1997Q1-2012Q3 based on st. break in trade bal. and backwards recursive estim.		
PT	H_0: r=0	0.043	0.178	0.124
	H_0: r≤1	0.216	0.674	0.288
	H_0: r≤2	0.550	0.574	0.489
	time period	1999Q3-2013Q3 based on st. breaks both in extra bal. and $reer_{EMU-12}$ and backwards recursive estim.		
ES	H_0: r=0	0.045	0.001	0.013
	H_0: r≤1	0.676	0.825	0.763
	H_0: r≤2	0.413	0.812	0.521
	time period	1998Q1-2013Q3 based on backwards recursive estimation		
DK	H_0: r=0	0.012	0.474	0.094
	H_0: r≤1	0.225	0.787	0.197
	H_0: r≤2	0.428	0.646	0.277
	time period	1998Q2-2013Q3 based on backwards recursive estimation		
SE	H_0: r=0	0.021	0.164	0.016
	H_0: r≤1	0.472	0.694	0.177
	H_0: r≤2	0.946	0.694	0.898
	time period	1991Q4-2013Q3 based on st. break in intra bal. and backwards recursive estim.		
UK	H_0: r=0	0.008	0.763	0.550
	H_0: r≤1	0.497	0.937	0.591
	H_0: r≤2	0.488	0.957	0.966
	time period	1994Q1-2013Q3 based on st. break in extra bal. and backwards recursive estim.		

Notes: We report the p-values of rejecting the null hypotheses using the Johansen-Juselius cointegration method with four lags (linear trends in the variables and in the cointegration relation). r indicates the number of cointegration vectors (i.e. cointegration rank).

Table 4. Testing the zero restrictions on the trade balance variables

	Set of partner countries:			
	The whole world	EMU-12 countries	The rest of the world	Time period
FI	0.096	0.002	0.052	1991Q4-2013Q3
FR	0.235	0.000	0.003	1998Q1-2013Q3
DE	0.007	0.450	0.095	1995Q4-2013Q3
GR	0.684		0.032	1999Q1-2013Q3
GR	0.764	0.000	0.705	1994Q1-2007Q4
IT	0.037	0.002	0.001	1994Q1-2013Q3
NL	0.535	0.587	0.232	1997Q1-2013Q3
PT	0.054	0.019[a]	0.365	1999Q3-2013Q3
ES	0.110	0.083	0.000	1998Q1-2013Q3
DK	0.361	0.522	0.080	1998Q2-2013Q3
SE	0.248	0.354	0.373	1991Q4-2013Q3
UK	0.000	0.005[a]	0.231	1994Q1-2013Q3

Notes: The null hypothesis is that the coefficient of the trade balance variable (the aggregate trade balance, the intra balance, or the extra balance) is zero in the cointegration vector. We report the p-value of rejecting the null hypothesis (the chi-square test with small sample correction) using the Johansen-Juselius cointegration method with four lags (linear trends in the variables and in the cointegration relation). [a] The trace test did not confirm any long-run cointegration relation.

Table 5. Cointegration vectors based on the Johansen-Juselius method

	Variables:	The whole world	EMU-12 countries	The rest of the world	Time period:
		Set of partner countries:			
FI	tradebalance		1.000		1991Q4-2013Q3
	α		0.035		
	y		-0.239		
	y*		0.166		
	reer		-0.749***		
FR	tradebalance		1.000	1.000	1998Q1-2013Q3
	α		-0.352***	-0.426***	
	y		-0.073	0.249***	
	y*		0.036	-0.245***	
	reer		0.356***	0.019***	
DE	tradebalance	1.000			1995Q4-2013Q3
	α	-0.130**			
	y	0.116			
	y*	-1.273***			
	reer	0.199**			
GR	tradebalance			1.000	1999Q1-2013Q3
	α			-0.084	
	y			-0.051**	
	y*			0.566***	
	reer			0.175***	
GR	tradebalance		1.000		1994Q1-2007Q4
	α		-0.276***		
	y		-0.231***		
	y*		-0.186***		
	reer		-0.068*		
IT	tradebalance	1.000	1.000	1.000	1994Q1-2013Q3
	α	-0.256***	-0.125	-0.260***	
	y	0.315***	0.372***	0.245***	
	y*	-0.481***	-0.409***	-0.220***	
	reer	0.292***	0.090***	0.109***	
ES	tradebalance			1.000	1998Q1-2013Q3
	α			-0.164	
	y			0.211***	
	y*			0.051	
	reer			-0.019***	
UK	tradebalance	1.000			1994Q1-2013Q3
	α	-1.193***			
	y	-0.065***			
	y*	0.236***			
	reer	0.017*			

Abbreviations: Adjustment of the trade balance variable (the aggregate trade balance, the intra balance, or the extra balance) to the disequilibrium error (α), domestic GDP per capita (y), foreign GDP per capita (y*), real effective exchange rate (reer).

Notes: Only if the zero restriction on the trade balance variables (the aggregate trade balance, the intra balance, or the extra balance) can be rejected at the 5% significance level and the trace test confirms that the cointegration rank is equal to one, the cointegration vector is estimated. The Johansen-Juselius cointegration method with four lags (linear trends in the variables and in the cointegration relation). Red font indicates that the sign of the coefficient is theoretically implausible. *, **, *** denote statistical significance at 10%, 5% and 1% levels.

Table 6. Testing the weak exogeneity of the trade balance variables

	Set of partner countries:			
	The whole world	EMU-12 countries	The rest of the world	Time period
FI		0.385		1991Q4-2013Q3
FR		0.000	0.000	1998Q1-2013Q3
DE	0.059			1995Q4-2013Q3
GR			0.550	1999Q1-2013Q3
GR		0.007		1994Q1-2007Q4
IT	0.004	0.209	0.000	1994Q1-2013Q3
ES			0.205	1998Q1-2013Q3
UK	0.000			1994Q1-2013Q3

Notes: Only if the zero restriction on the trade balance variables (the aggregate trade balance, the intra balance, or the extra balance) can be rejected at the 5% significance level and the trace test confirms that the cointegration rank is equal to one, the cointegration vector is estimated. If the null hypothesis cannot be rejected, the trade balance variable (the aggregate trade balance, the intra balance, or the extra balance) is weakly exogenous in the cointegration vector. This implies that the trade balance does not adjust to the disequilibrium error. We report the p-value of rejecting the null hypothesis using the Johansen-Juselius cointegration method with four lags (linear trends in the variables and in the cointegration relation).

Table 7. Granger causality test of the VAR models

	Set of partner countries:			The whole world		EMU-12 countries		The rest of the world	
	Time period:			pre-EMU	EMU	pre-EMU	EMU	pre-EMU	EMU
	Null hypothesis (below):								
FI	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.617	0.121	0.054	**0.020**	0.587	0.348
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.864	**0.003**	0.172	0.740	0.743	**0.010**
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.305	0.288	0.707	0.052	0.552	0.181
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
FR	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.053	0.126	0.077	0.326	0.104	0.063
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.003**	0.926	0.053	0.864	**0.012**	0.558
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.241	0.949	0.140	0.390	0.423	0.859
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.011**	**0.034**	0.299	0.477	0.112	**0.001**
DE	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.224	0.993	0.335	**0.023**	0.550	0.527
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.458	0.103	0.876	0.780	0.334	0.087
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.136	0.683	0.599	0.230	0.105	0.270
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.124	0.679	0.086	0.170	**0.004**	**0.026**
GR	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.397	0.202	0.290	0.645	0.355	0.703
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.873	0.094	0.543	0.494	0.673	0.160
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.440	0.581	0.944	0.790	0.576	0.233
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.000**	**0.039**	**0.003**	0.666	**0.000**	0.071
IT	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.729	0.782	0.936	0.150	0.870	0.522
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.527	0.203	0.193	0.326	0.743	0.692
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.410	0.497	0.618	0.688	0.433	0.327
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.002**	0.525	0.051	0.471	**0.001**	0.361
NL	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.580	0.177	0.898	0.566	0.293	0.665
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.134	0.064	0.483	0.948	0.727	0.894
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.104	0.982	0.307	0.719	0.887	0.629
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.001**	**0.000**	0.310	0.858	**0.046**	0.188
PT	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.484	0.393	0.193	0.921	0.365	0.187
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.191	0.423	0.111	0.753	0.955	0.581
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.569	0.849	0.825	0.363	0.180	0.151
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.000**	0.417	**0.020**	0.316	**0.000**	**0.031**
ES	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.882	0.066	0.686	0.508	0.767	0.060
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.214	0.384	0.893	0.840	0.185	0.389
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.247	**0.020**	0.743	0.226	0.372	**0.012**
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.334	0.196	0.087	0.131	0.195	**0.018**
DK	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.157	0.056	0.419	0.930	**0.005**	0.217
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.531	0.898	0.119	0.850	0.513	0.429
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.055	**0.026**	**0.019**	0.408	**0.017**	0.371
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.007**	0.147	0.145	0.204	**0.001**	**0.035**
SE	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.631	0.804	0.488	**0.042**	0.319	0.733
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.228	0.396	0.756	**0.004**	0.534	0.545
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.867	0.412	0.692	0.073	0.599	0.114
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	**0.023**	**0.000**	**0.046**	**0.002**	**0.014**	**0.001**
UK	Δy^*_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.423	0.478	0.679	0.999	0.673	0.964
	$\Delta reer_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.534	0.138	0.929	0.916	0.246	0.178
	Δy_{t-1}	$\nrightarrow$	$\Delta tradebal_t$	0.236	**0.015**	0.380	0.995	0.130	**0.047**
	$\Delta tradebal_{t-1}$	$\nrightarrow$	$\Delta tradebal_t$	0.190	**0.003**	**0.029**	0.532	**0.010**	**0.018**

Abbreviations: first difference of foreign GDP per capita (Δy^*), first difference of real effective exchange rate ($\Delta reer$), first difference of domestic GDP per capita (Δy).

Notes: The null hypothesis is that foreign output (or real effective exchange rate, domestic output, or lagged value of trade balance) does not Granger cause the trade balance. We report the p-value of rejecting the null hypothesis. Bold font indicates that the null hypothesis is rejected at the 5% significance level. All models include an intercept term. All variables are measured as period-to-period changes. Bayesian information criterion usually suggests only one lag, but we included four lags in all VAR-models.

Figure 1: Impulse responses of trade balance, Finland

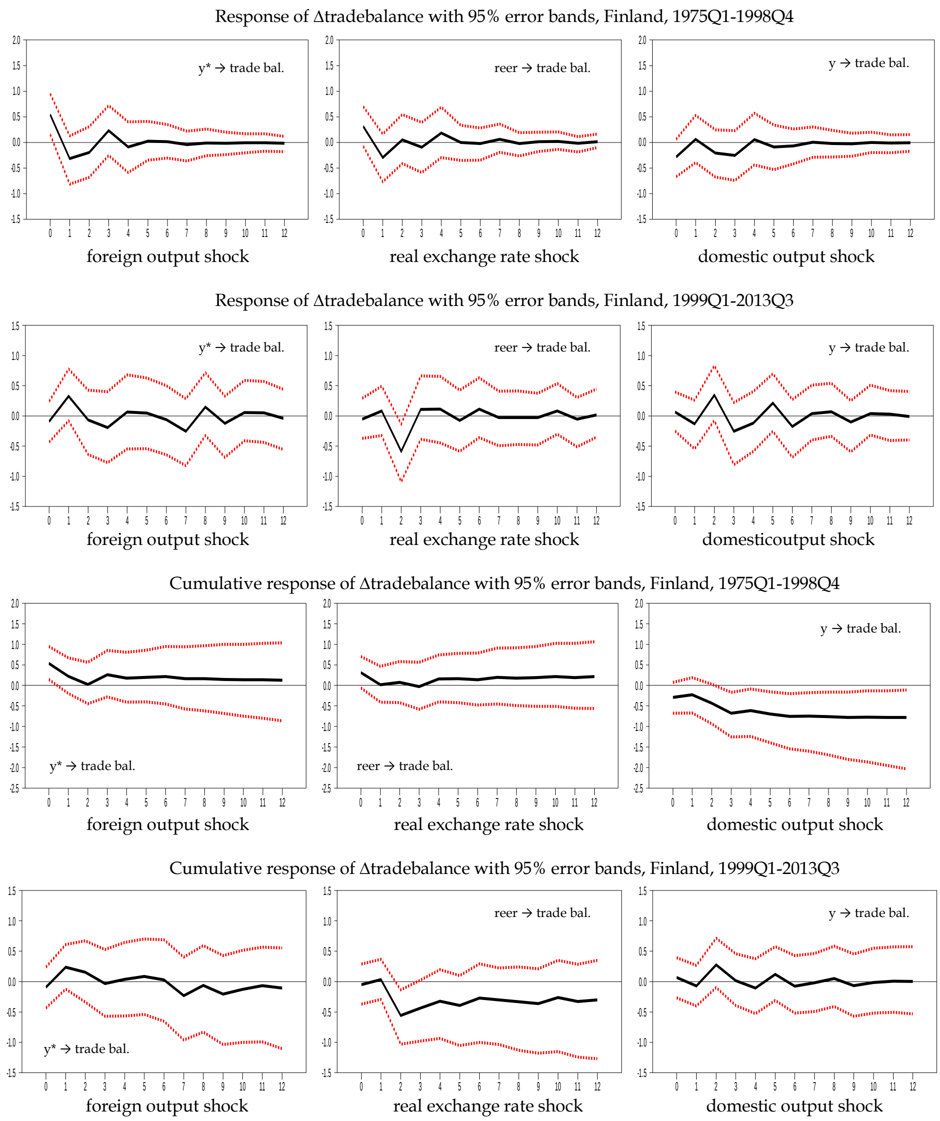

Figure 1. Impulse responses of trade balance, Finland

Figure 2: Impulse responses of intra balance and extra balance, Finland

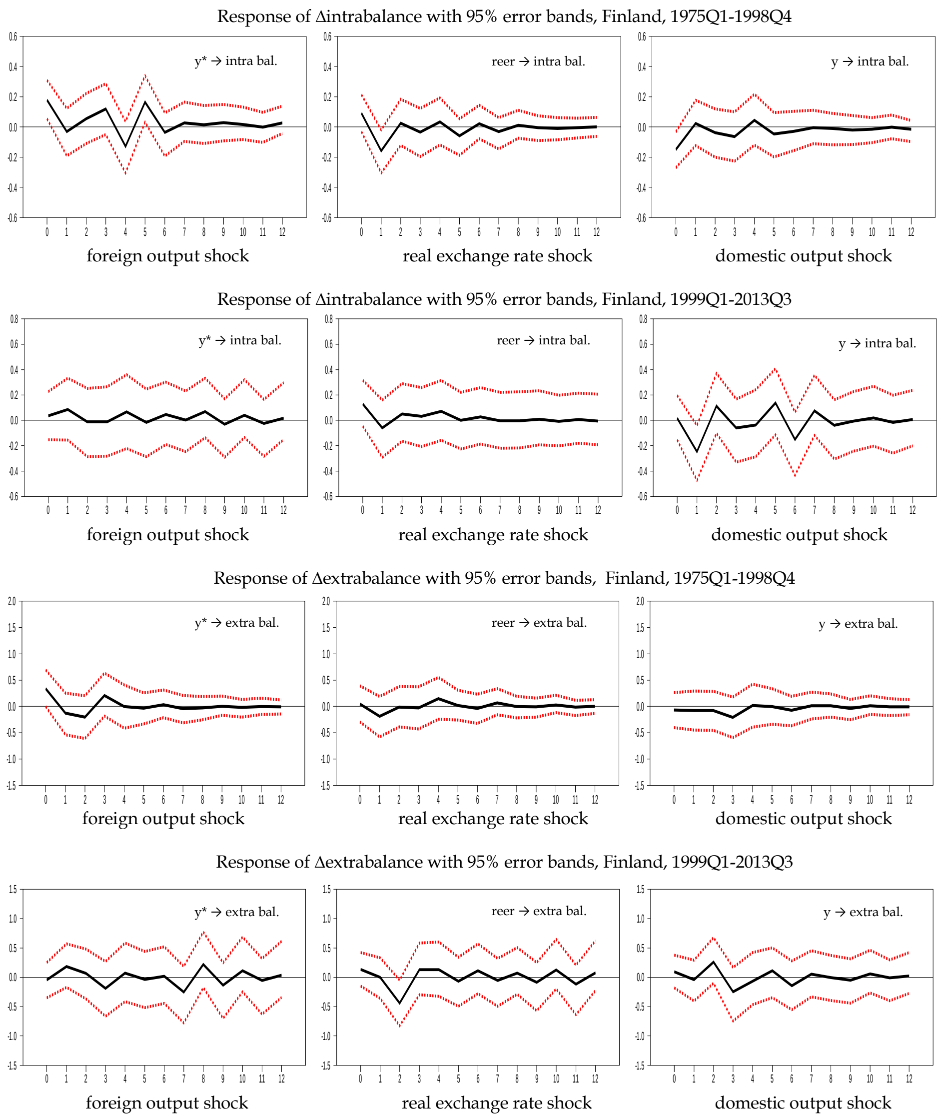

Figure 2. Impulse responses of intra balance and extra balance, Finland

Figure 3: Impulse responses of trade balance, intra balance, and extra balance, France

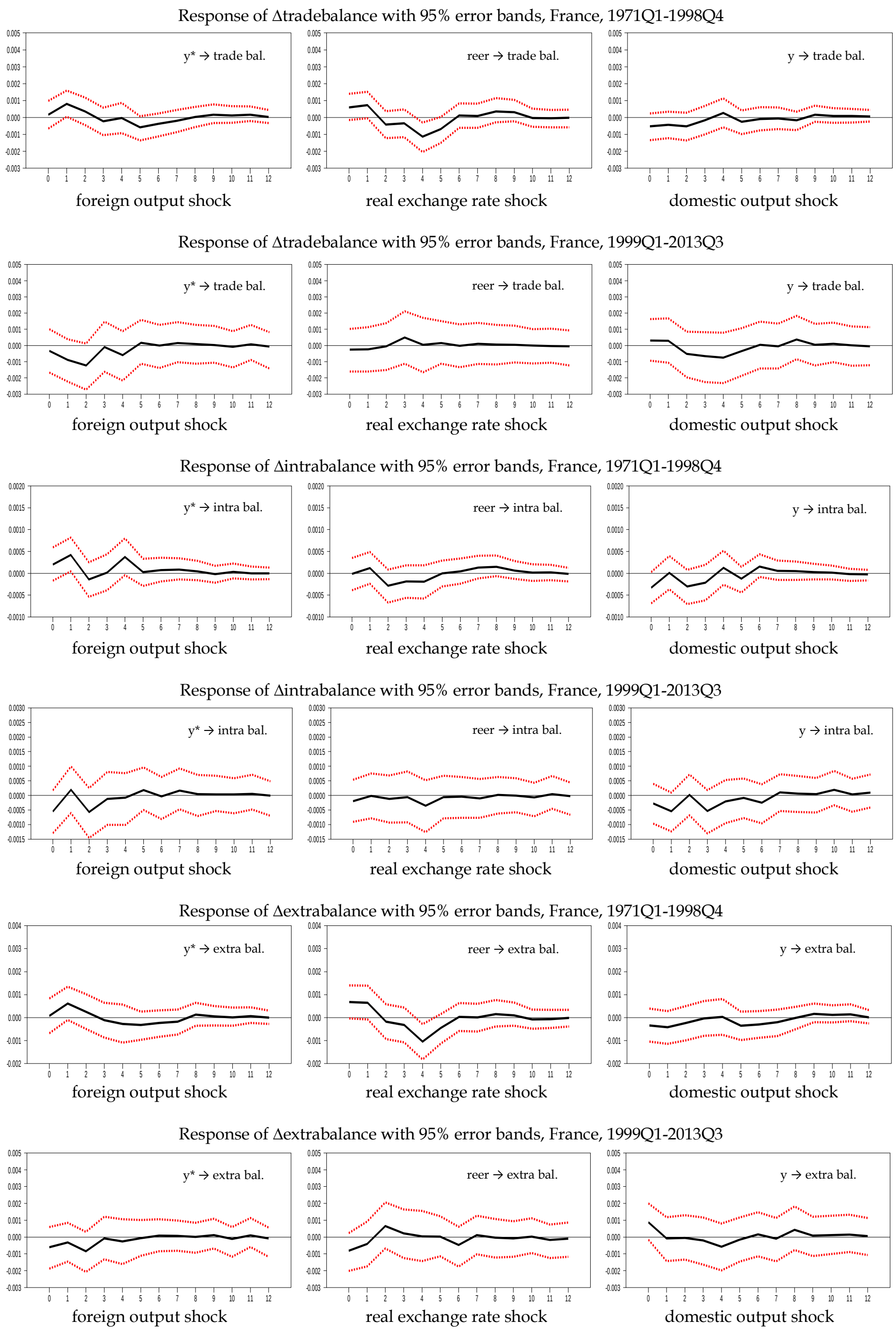

Figure 3. Impulse responses of trade balance, intra balance and extra balance, France

Figure 4: Impulse responses of trade balance, intra balance, and extra balance, Spain

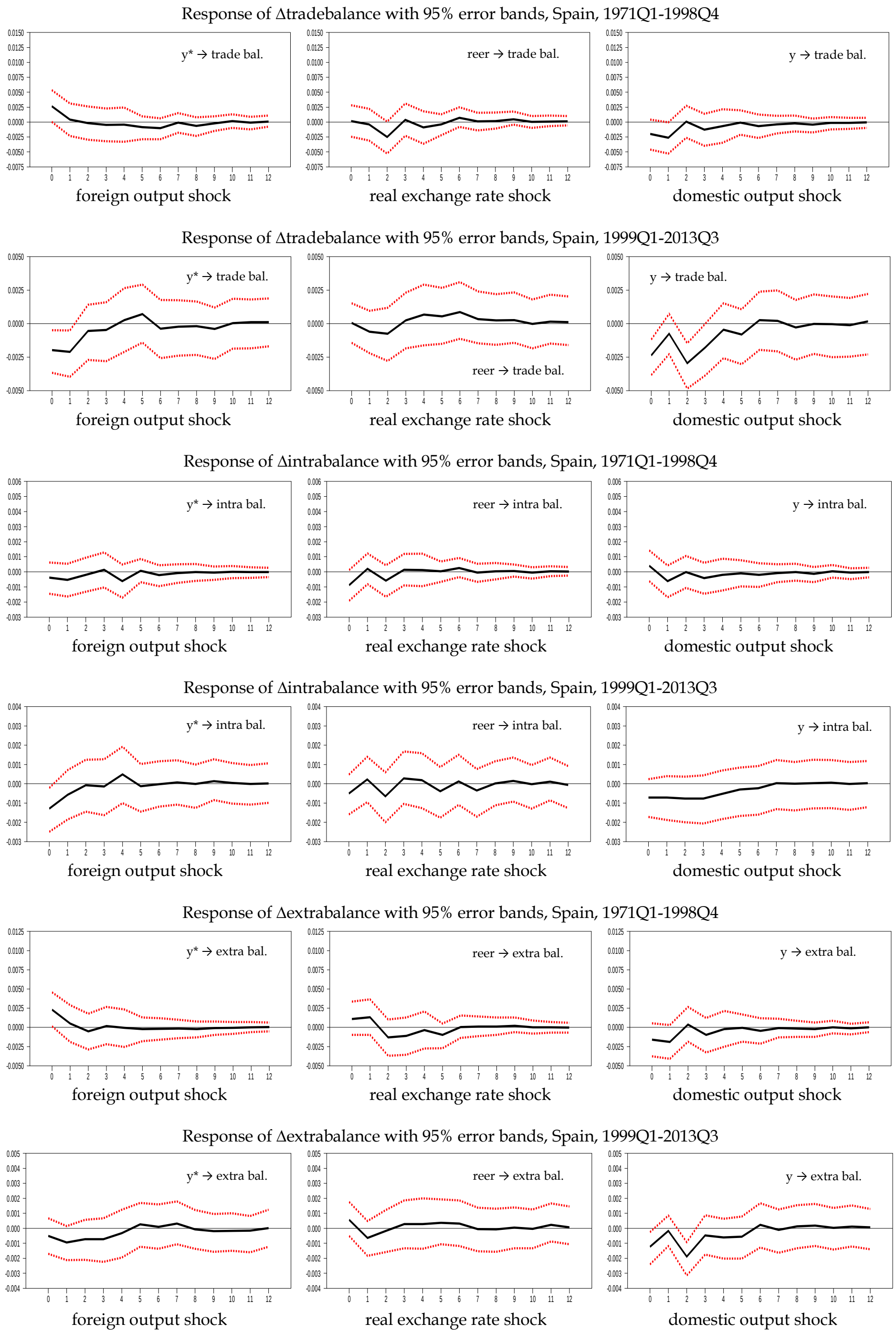

Figure 4. Impulse responses of trade balance, intra balance and extra balance, Spain

Table A1. Data description

Series	Filtering	Description	Frequency	Source
Δtradebalance	Linear X-11 filter	Δtradebalance is period-to-period change of trade balance (goods net exports). We observe goods net exports (in US dollars) for a reporting-country, trade balance, from DOTS, when World is chosen as the partner-country.	Same as below	Same as below
Δintrabalance	Linear X-11 filter	Δintrabalance is period-to-period change of intra balance, which was calculated as follows: Firstly, we calculated trade balance (in US dollars) excluding services against the euro area (EMU-12 countries) from bilateral balances. Secondly, we took quarterly data on GDPs (in national currencies) and converted these to GDPs (in US dollars) using quarterly averages of daily data on exchange rates between national currencies and US dollar. Thirdly, we calculated trade balances as ratios to GDPs.	Trade balance in US dollars: quarterly data 1960:Q1-2013:Q3; GDPs in national currency: quarterly data 1960:Q1-2013:Q3; Exchange rates: daily data 1.1.1960-9.30.2013 except for Denmark, Sweden and UK quarterly data 1960:Q1-2013:Q3	Trade balance in US dollars: Direction of Trade Statistics (IMF); GDPs in national currency: National sources via Datastream, Eurostat (for Greece), International Financial Statistics (IMF) (for the Netherlands, Portugal, Spain, Denmark and Sweden); Exchange rates: WM/Reuters via Datastream, International Financial Statistics (IMF) (for Denmark, Sweden and UK)
Δextrabalance	Linear X-11 filter	Δextrabalance is period-to-period change of extra balance, which was calculated as follows: Firstly, we calculated trade balance excluding services against the rest of the world by substracting the intra balance (in US dollars) from good net exports (in US dollars); that is extra balance equals trade balance minus intra balance. The second and third step as above.	Same as above	Same as above

Table A1 continues

Series	Filtering	Description	Frequency	Source
$\Delta reer_{world}$	Linear X-11 filter and logarithm	$\Delta reer_{world}$ is period-to-period change in CPI-based real effective exchange rate with trade-weights (41 partner countries).	Quarterly averages of monthly data 1970:Q1-2013:Q3	Bruegel
$\Delta reer_{EMU-12}$	Linear X-11 filter and logarithm	$\Delta reer_{EMU-12}$ is period-to-period change in CPI-based real effective exchange rate in which set of partner countries consist of EMU-12 countries with trade-weights.	Quarterly averages of monthly data 1970:Q1-2013:Q3	Zsolt Darvas (Bruegel)
$\Delta reer_{RoW}$	Linear X-11 filter and logarithm	$\Delta reer_{RoW}$ is period-to-period change in CPI-based real effective exchange rate in which set of partner countries consist of 29 non-EMU countries with trade-weights.	Quarterly averages of monthly data 1970:Q1-2013:Q3	Zsolt Darvas (Bruegel)
Δy	Linear X-11 filter and logarithm	GDP per capita period-to-period changes in the home country	Quarterly data on levels 1960:Q1-2013:Q3	International Financial Statistics (IMF), National sources via Datastream (for Austria, Finland and Ireland), Eurostat (pre-2011:Q2 period for Greece)
Δy^*_{world}	Linear X-11 filter and logarithm	GDP per capita period-to-period changes in the world economy.	Quarterly data on growth rates 1969:Q1-2013:Q1	International Financial Statistics (IMF)
Δy^*_{EMU-12}	Linear X-11 filter and logarithm	GDP per capita period-to-period changes in the euro area (EMU-12 countries). The pre-1996:Q1 period: GDP-weighted average of EMU-12 GDP per capita year-to-year changes (different serie for every EMU countries as the reporting country is always excluded); Since then: Eurozone-12 GDP per capita year-to-year changes (same serie for all countries).	Quarterly data on levels 1960:Q1-2013:Q3	The pre-1996:Q1 period: International Financial Statistics (IMF), National sources via Datastream (for Austria, Finland and Ireland), Eurostat (pre-2011:Q2 period for Greece); Since then: Eurostat Eurozone-12
Δy^*_{RoW}	Linear X-11 filter and logarithm	GDP per capita perio-to-period changes in the rest of the the world. Let α be the share of the EMU-12 countries of the world economy, Δy_{world} the growth rate of the world economy, and Δy_{emu12} the growth rate of the EMU-12 countries. Then the following equality holds: $\Delta y_{row}=1/(1-\alpha)\Delta y_{world}+\alpha/(\alpha-1)\Delta y_{EMU-12}$. We applied this formula and used a constant weight, α, which is the sum of Austria, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain GDPs in 1995 divided by the World GDP in 1995.	Same as above	Data on GDP levels in 1995: World Development Indicators (World Bank). Other series same as above.

Table A2. The share of intra-euro area trade

Year		1984	1993	2002	2011
FI	exports	0.24	0.34	0.33	0.29
	imports	0.28	0.35	0.33	0.34
FR	exports	0.43	0.49	0.49	0.48
	imports	0.47	0.51	0.57	0.56
DE	exports	0.46	0.45	0.43	0.40
	imports	0.45	0.45	0.42	0.43
GR	exports	0.49	0.54	0.30	0.28
	imports	0.46	0.51	0.46	0.40
IT	exports	0.43	0.49	0.45	0.41
	imports	0.42	0.51	0.50	0.44
NL	exports	0.64	0.63	0.63	0.62
	imports	0.47	0.50	0.42	0.34
PT	exports	0.47	0.64	0.67	0.64
	imports	0.37	0.65	0.70	0.66
ES	exports	0.43	0.60	0.58	0.54
	imports	0.29	0.55	0.57	0.47
DK	exports	0.35	0.46	0.43	0.38
	imports	0.44	0.49	0.51	0.45
SE	exports	0.41	0.45	0.39	0.39
	imports	0.45	0.50	0.49	0.46
UK	exports	0.47	0.49	0.53	0.46
	imports	0.48	0.46	0.47	0.42

Figure A 1

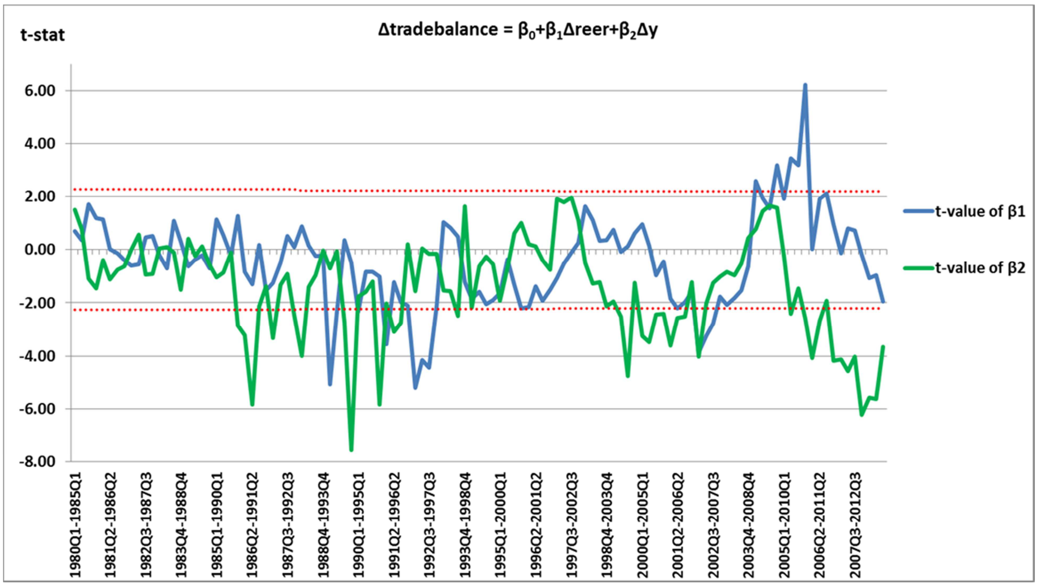

Figure A1. Cross-section regressions for the EU-15 countries with 5-year rolling averages (t-stats)