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## Trade creation, trade diversion and imbalances in the EMU

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## ABSTRACT

The aim of this paper is to provide a unified explanation for the mixed evidence on the euro effect on trade and the development of imbalances in the European Monetary Union (EMU). It is argued that the two phenomena are the result of trade creation and trade diversion effects generated by the euro introduction and by globalisation-induced changes in trade patterns. Trade creation and trade diversion effects are estimated as structural changes in the relation between trade flows and financial opening, growth, prices, and measures of globalization. While most of these effects point to the increase in imbalances, financial opening is found to positively affect intra-EMU trade. On the other hand, GDP growth and global changes in production technology reduced intra-EMU trade. The results suggest that policies aimed at rebalancing the EMU should be strengthened and supported by measures aimed at improving the competitiveness of the single market as a whole.

## 1. Introduction

Since the euro was introduced in 1999, countries belonging to the Economic and Monetary Union (EMU) have experienced substantial changes in their trade patterns. The most significant of these changes is the development of persistent trade and current account deficits in peripheral countries. This is associated with high surpluses in core countries, above all in Germany and the Netherlands.<sup>1</sup> This process continued until the global financial crisis, when the sudden stop in capital flows showed that the growth process of the periphery was not based on improvements in macroeconomic fundamentals. After the global financial crisis, peripheral countries in the EMU started to adjust their imbalances. The adjustment was mainly driven by consolidation policies imposed by the reform of the Stability and Growth Pact (the so called six-pack). Consolidation policies allowed some countries to move closer to their equilibrium current account level (Gossè and Serrano 2014). However, they affected trade balances mostly through recession-induced import compression, with little or no effect on the structural competitiveness of these countries (Canofari et al. 2015).

Alongside the development of imbalances, a second, mostly overlooked, phenomenon is the continuous reduction of the share of intra-EMU trade for the original twelve members of the area. On the one hand, this could simply be explained by the globalization process, with the EMU experiencing both a lower GDP growth and a generalized

competitiveness loss with respect to the most important emerging markets. On the other hand, the creation of the monetary union may have resulted in peculiar developments within the area, fostering the reduction of intra-area shares. More specifically, trade creation and trade diversion effects associated with the introduction of the single currency could have been negative, leading to a reduction of intra-EMU trade shares. This interpretation might explain the most recent evidence on the euro effect on trade (Kelejian et al. 2012, Sousa, 2012, Camarero et al. 2014a/b, Glick and Rose 2015). This evidence finds little or no impact of the euro introduction on the relative size of intra-area trade flows.

The importance of looking at intra-EMU trade flows from this perspective is linked to the expectation that, by having a larger single market, the monetary union should have brought about an increase in trade. What we observe instead is an opposite tendency, with most of the countries trading more intensively with extra-EMU and extra-EU markets. This tendency became more marked after the European sovereign debt crisis forced many member states to reduce their domestic demand due to fiscal consolidation requirements. This led to a reduction in the size of the single market and to a record-level current account surplus for the euro area, driven by German net exports in particular.

In this paper, we argue that the reduction of intra-EMU shares and the development of imbalances are partly the result of regional

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<sup>1</sup> With reference to the first 12 members of the EMU, peripheral countries include Greece, Ireland, Italy, Spain and Portugal. The remaining countries represent the core of the EMU12.

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differences in trade creation (an increase in trade among EMU countries) and trade diversion effects (relocation of trade from non-EMU to EMU countries) associated with the introduction of the single currency. Therefore, the aim of the paper is to assess the role of the EMU to explain the development of both trade imbalances and intra-EMU trade shares of its member states.

The standard approach to the estimation of the euro effect on trade relies on the use of dummy variables assessing trade creation and trade diversion effects in gravity models of bilateral trade (see, for example, [Cafiso 2011](#)). However, this approach has not led to clear-cut conclusions as the results of this literature are strongly influenced by the econometric design and by a publication bias in favour of positive impacts ([Havranek 2010](#)). This view is stressed by [Glick and Rose \(2015\)](#) who analyse most of the previous empirical studies and conclude that results change largely among estimation techniques.

While relying on a gravity model, we partially deviate from the standard approach by estimating trade creation and trade diversion effects originating from the variables representing the main causes of imbalances. The applied literature identifies three main determinants of the rise in imbalances among EMU countries. First, the role of financial integration and financial flows from core countries, above all from Germany, being driven by the reduced risk premium and the positive interest rate differential with peripheral countries. This is a direct effect of the introduction of the single currency. Second, the divergence in the competitive position between the core and the periphery in terms of unit labour costs (ULC) and other measures of price and non-price competitiveness ([Dullien and Fritsche 2009](#), [Belke and Dräger 2013](#), [Algieri 2014](#)). This effect is also connected to the introduction of the euro as the single currency hampered the individual countries' ability to use competitive devaluations to boost export and slow down imports. Furthermore, the constraints of the Stability and Growth Pact and its reforms reduced the room for expansionary fiscal policies and structural reforms. Third, the effect of the globalization process, with increased competition from emerging countries fostered by the development of Global Value Chains (GVC) ([Guerrieri and Esposito 2012](#), [Chen et al. 2013](#)) and by the reduction of transport costs. In this respect, the ability of EMU countries to face the globalization challenges may be reduced by the same factors affecting competitiveness.

The estimation of trade creation and trade diversion effects is done by interacting the standard dummy variables used to estimate the euro effect on trade with the above-mentioned causes of imbalances. In addition, by estimating separate impacts for core and peripheral countries of the EMU, we provide a clear picture of the effect of these variables on the development of trade imbalances. This strategy allows us to overcome the problems pointed out by [Glick and Rose \(2015\)](#). It also helps us to better define the mechanism through which the introduction of the single currency should have affected trade performances in terms of imbalances and trade shares. The econometric analysis is carried out on a sample of bilateral exports among 38 countries, including most of the EU and a group of extra-EU advanced and emerging countries. The time period for this is 1992–2013, with a specific focus on the years following the introduction of the euro in 1999 and the 2008–2009 global financial crisis. While relying on stationary panel techniques, our specification controls for cross-sectional dependence by introducing group heterogeneity in time-specific shocks. Additionally, we assess the potential endogeneity bias due to reverse causality between output and trade by using an IV-GMM approach.

The results indicate that financial integration had positive impact on intra-EMU trade whereas globalization forces – most likely connected with the pervasive skill-biased technical change (SBTC) and the development of GVC ([Acemoglu 1998, 2002](#); [Timmer et al. 2013, 2014](#)) – acted in the opposite way. The results further indicate that all these factors contributed to the increase of both intra and extra-EMU imbalances. The structure of the paper is as follows. [Section 2](#)

summarizes the main literature on the euro effect on trade, as well as on the determinants of imbalances in Europe. [Section 3](#) describes the dataset used in the econometric analysis and provides a description of the evolution of intra-EMU trade in light of the developments of growth, competitiveness, and financial integration. The econometric strategy is presented in [Section 4](#), while the results are discussed in [Section 5](#). [Section 6](#) provides summary conclusions and policy implications.

## 2. The euro effect on trade and imbalances: theoretical background

Since the introduction of the euro, numerous empirical analyses have been carried out to estimate the effects of the single currency on total trade – the so-called Rose effects ([Rose 2000](#)). They are all based on the estimation of trade creation and trade diversion effects through dummy variables accounting for a level shift in the amount of trade when one or both trading partners become members of the EMU. A positive effect is expected due to trade cost reductions associated with the elimination of exchange rate movements and volatility. The results, nevertheless, are not univocal. Earlier literature ([Glick and Rose 2002](#), [De Nardis et al. 2008](#), [Baldwin 2006](#), [Chintrakam 2008](#); see [Havranek 2010](#) for a survey), based on a standard version of the gravity model ([Anderson 2010](#)), finds a positive effect of the euro on trade flows. Nevertheless, as pointed out by [Havranek \(2010\)](#), the results of this literature are strongly influenced by the econometric design and by a publication bias, implying that the true effect might be lower than those found in most of the studies.

Recent works take into account some methodological problems in the measurement of the euro effect. [Kelejian et al. \(2012\)](#) use a spatial econometrics framework to control for spatial correlation, and they find almost no significant effect of euro membership on exports. [De Sousa \(2012\)](#) estimates a time-varying impact and finds that the euro effect fades over time. [Camarero et al. \(2014a/b\)](#) apply panel cointegration techniques and find a much smaller, but still positive, effect of the single currency on intra-EMU trade flows.

Leaving aside methodological problems, the lack of precision of euro effect estimates may be due to the presence of different and compensating effects. Some effects are connected with the creation of the EMU while others are related to the globalization process, like the development of GVCs ([Baldwin 2013](#), [Timmer et al. 2013, 2014](#)) and SBTC ([Acemoglu 1998, 2002](#)). Few studies provide some indications on the economic factors behind the euro effect. [Camarero et al. \(2014a\)](#) and [Kelejian et al. \(2012\)](#) point to the competition effect for the most productive firms. [De Sousa \(2012\)](#) argues that trade and financial liberalisation at a global level reduces the importance of currency unions and their effect on trade. Additional insight can be found by looking at the literature on trade and current account imbalances in the EMU.

Until the global financial crisis, the development of imbalances was considered a result of the proper functioning of a monetary union. This belief was in line with the convergence assumption implied in the main theoretical contributions (see [Blanchard and Giavazzi 2002](#)). According to this view, the single currency should have favoured the catching up process, thanks to the increase in financial flows from the core to the periphery, stimulated by the convergence of interest rates. What happened instead is that, in most cases, financial flows generated investment bubbles, and caused a consumption boom not supported by improvements in the productive structure ([Giavazzi and Spaventa 2010](#), [Croci Angelini and Farina 2012](#)).

The process of financial integration is one of the main features in the creation of the EMU. The evidence suggests that, in general, this process leads to deterioration in trade balances ([Jaumotte and Sodriwiboon 2010](#)). Studies on the EMU find that this negative outcome is due to the role of financial transactions in transmitting negative shocks across countries ([Hobza and Zeugner 2014](#)) and in

fostering the development of asset bubbles and excessive domestic demand (Crocì Angelini and Farina 2012, Giavazzi and Spaventa 2010).

Together with financial opening, divergences in both price and non-price competitiveness are considered to be a fundamental reason for the rise of imbalances among European countries. The lack of structural reforms in the periphery has been found to be the main cause for the divergence in competitiveness dynamics (Zemanek et al. 2010, Belke and Dräger 2013, Berger and Nitsch 2013). Structural reforms are important not only to foster technological upgrading within firms but also to correct the distortions caused by dysfunctional labour markets. With substantial wage differential among tradable and non-tradable sectors and dysfunctional labour markets, contagion effects from the former to the latter might cause competitiveness losses even though the productivity dynamics in the tradable sectors are satisfactory. As for non-price competitiveness, Algieri (2014 and 2015) finds that it plays an important role in the deterioration of the export performance of the EMU periphery and Italy in particular.

The competitiveness loss has interacted with changes associated with the globalization process. To list some of these changes, Chen et al. (2013) as well as Guerrieri and Esposito (2012, 2013) stress the role of asymmetric trade developments with countries outside the euro area and point to the integration with Central and Eastern Europe in terms of GVC (see also Timmer et al. 2014). Another such change is the increased import competition from Chinese products. These effects have clearly acted in the direction of reducing intra-EMU trade and increasing imbalances.

After the global financial crisis, some progress at the European level has been achieved in terms of financial regulation, banking union, and management of large public debts. Nevertheless, trade and current account imbalances have been strongly reduced thanks mainly to the implementation of fiscal consolidation measures. These measures affected the external balance primarily through demand compression and wage moderation. Although nominal devaluation is considered a necessary step to restore competitiveness in peripheral countries and to re-balance external flows (European Commission 2012, Sinn 2014), there is skepticism over the effect of cost reductions when the previous accumulation of deficits was due to demand booms driven by financial integration (Sanchez and Varoudakis, 2013). The implication is that the recovery of GDP growth will most likely bring about a new increase in imbalances.

We can summarize the main factors affecting the development of trade relations within and outside the euro area as follows: first, financial integration should bring about positive trade creation and trade diversion effects although it is likely to foster imbalances; second, divergences in price competitiveness which have been fostered – although not exclusively – by the introduction of the single currency and the European constraints on national fiscal policies; third, changes at global level caused by technological developments and the emergence of more competitive trading partners outside the EMU.

While the first two factors are directly connected with the introduction of the single currency, the third factor is the result of the interplay between local (i.e. within EMU) and global factors.

### 3. Data and descriptive evidence

In this section, we select the variables representing the effects previously described and provide descriptive evidence for their connection with imbalances and intra-EMU trade. Price competitiveness can be measured by calculating bilateral real exchange rates deflated by ULC indexes. Since we analyse trade in goods, ULC in industry is the relevant measure as total ULC also includes price developments in the non-tradable sector (Lopez-Garcia and di Mauro 2015). The GDP, as a measure of the economic mass, is fundamental in explaining physiological changes in trade shares and balances. To measure financial integration, we use the sum of total external assets and liabilities (Lane

and Milesi-Ferretti 2007). On the other hand, we use the stock of fixed capital as a synthetic measure of globalization-induced technological changes. This variable has been used in the applied literature as a proxy for some non-price competitiveness factors due to its close relation to technological upgrading (Algieri 2014, 2015, Muscatelli et al. 1995). Nevertheless, we believe that fixed capital is better suited to measure technological changes at global level such as SBTC (Acemoglu 1998, 2002) and the development of GVC. A positive relation between capital stock and SBTC is implicit in the capital skill complementarity assumption. The positive relation with GVC is derived from the evidence that capital intensive industries are those where the international fragmentation of production takes place most extensively (Timmer et al. 2014). As for non-price competitiveness, product quality is one of the most important features, however, this variable is unobserved. An index of export quality have been calculated by Henn, Papageorgiou and Spatafora (2013) following the methodology developed by Khandelwal (2010). However, data are available only for the period 1996–2010 and do not cover all countries in the sample.

To partially take into account some features of product quality, we use a synthetic measure of human capital, calculated using both years of schooling and returns to education (see Feenstra et al. 2015). Finally, since the introduction of the single currency implies the elimination of exchange rate fluctuation, we include a measure of exchange rate volatility. The latter is calculated as the standard deviation of the log differences in monthly exchange rates. The exact definition of the variables as well as their source is shown in Table A1 in the Appendix A.

Referring to trade flows, Table 1 shows their distribution by origin and destination for the 38 countries used in the econometric analysis. Countries are aggregated according to six broad groups: EMU core and periphery; new members, i.e. countries that joined the EMU after 2002; other EU countries; non-EU advanced economies; and emerging markets (see Section 4). The share of intra-EMU trade fell by 0.5% between 1999 and 2007 and by an additional 4% between 2007 and 2013. Such dynamics is concentrated in the original 12 member states of the area as the new member states slightly increased their share of intra-EMU trade in both sub-periods. Up to 2007, the reduction of intra-EMU trade shares was mainly due to the lower-than-average growth of the periphery's export, in particular toward core countries. Conversely, the latter experienced only a marginal reduction in their export share within the EMU thanks to slight increase in core-core trade.

Between 2007 and 2013, the reduction of intra-area trade shares affected both core and peripheral countries. The higher loss is recorded in the periphery's import from the other countries of the area, in particular core countries. Interestingly enough, the share of trade among core countries increased at an even faster pace during this period.

Looking at trade relations with countries outside the EMU, we see that advanced economies lost shares in the currency area, whereas the emerging markets increased their importance both as exporters and importers. In this case, the highest increase was recorded before the global financial crisis. It must be noted that emerging markets increased their importance also with respect to the other advanced economies and as a single trading block (i.e. intra-emerging markets trade).

The evolution of global trade provides three main features associated with the reduction of intra-EMU trade: first, the growing importance of emerging markets in world trade, especially between 1999 and 2007; second, the loss of importance of the EMU periphery as exporter within the area and the simultaneous increase in the share trade among core countries; third, the contraction of peripheral countries' imports after the global financial crisis. While the second factor has clearly contributed to the rise of imbalances, the growth of emerging markets has also played a role because their export share increased relatively more in the periphery of the EMU.

**Table 1**

Distribution of export and import flows.

Source: own elaboration on COMTRADE (accessed through WITS)

1999								
exp/imp	EMU-Core	EMU-Per	Other EMU	EMU	Other EU	Advanced	EM	All
EMU-Core	12.0	5.5	0.4	<b>17.9</b>	6.0	5.5	1.5	30.9
EMU-Per	4.7	1.6	0.1	<b>6.5</b>	1.9	2.0	0.4	10.8
Other EMU	0.3	0.1	0.0	<b>0.4</b>	0.2	0.0	0.0	0.6
EMU	<b>17.1</b>	<b>7.2</b>	<b>0.5</b>	<b>24.8</b>	8.0	7.5	2.0	42.4
Other EU	4.9	1.8	0.2	<b>6.8</b>	1.4	2.5	0.5	11.2
Advanced	5.2	1.6	0.1	<b>6.8</b>	2.5	17.4	6.5	33.2
EM	1.6	0.6	0.1	2.3	0.7	8.9	1.3	13.2
All	28.8	11.2	0.8	40.8	12.7	36.3	10.2	100.0
2007								
EMU-Core	11.8	5.3	0.6	<b>17.7</b>	6.5	4.7	2.7	31.6
EMU-Per	4.1	1.6	0.2	<b>5.9</b>	1.8	1.7	0.7	10.1
Other EMU	0.5	0.1	0.1	<b>0.7</b>	0.4	0.1	0.1	1.2
EMU	<b>16.4</b>	<b>7.1</b>	<b>0.8</b>	<b>24.3</b>	8.7	6.4	3.5	42.9
Other EU	4.7	1.7	0.4	<b>6.8</b>	1.9	2.0	0.8	11.5
Advanced	4.0	1.1	0.1	5.2	1.9	10.3	7.1	24.5
EM	3.3	1.3	0.2	4.7	1.6	10.6	4.2	21.0
All	28.4	11.2	1.5	41.0	14.1	29.3	15.6	100.0
2013								
EMU-Core	10.7	3.6	0.5	<b>14.8</b>	5.8	4.7	3.8	29.0
EMU-Per	3.5	1.1	0.1	<b>4.7</b>	1.5	1.7	0.9	8.9
Other EMU	0.5	0.1	0.1	<b>0.8</b>	0.4	0.1	0.2	1.5
EMU	<b>14.7</b>	<b>4.8</b>	<b>0.8</b>	<b>20.3</b>	7.7	6.5	4.9	39.4
Other EU	4.6	1.2	0.4	6.2	1.9	1.3	0.9	10.4
Advanced	3.5	0.8	0.1	4.4	0.9	9.4	9.4	24.2
EM	3.5	1.0	0.2	4.8	1.3	13.2	6.8	26.0
All	26.3	7.8	1.5	35.7	11.9	30.4	22.1	100.0

**Table 2**

Cumulative growth of explanatory variables.

Source: see [Appendix Table A.2](#)

Growth 1999–2007							
	EMU-Core	EMU-Per	Other EMU	Other EU	Advanced	EM	All
GDP	31.9	56.3	148.2	56.7	41.9	202.3	56.7
Real GDP	16.8	22.6	66.0	29.7	21.0	78.2	27.0
FO	150.5	205.7	413.5	200.4	113.2	229.7	152.1
Fixed Capital	14.1	28.0	42.8	17.2	21.2	67.5	31.7
Human Capital	2.9	5.8	6.6	4.6	2.9	6.5	3.7
RER	-9.8	12.1	-6.7	7.5	-25.2	25.6	-10.3
Vol	-22.6	-27.2	-34.1	-13.0	2.5	-48.5	-19.1
Growth 2007–2013							
GDP	10.9	-3.0	18.4	1.1	18.6	98.8	27.9
Real GDP	2.0	-8.6	1.1	1.4	5.1	41.3	8.0
FO	19.5	14.7	36.1	8.2	41.3	101.0	28.5
Fixed Capital	7.1	6.1	12.8	11.0	7.3	66.5	25.9
Human Capital	1.9	4.2	3.6	2.5	1.9	4.8	2.4
RER	-3.9	-5.9	-0.9	-11.2	-9.4	24.3	-1.0
Vol	24.1	26.6	-20.8	13.1	-13.4	35.7	13.4

The previous evidence indicates that the reduction of intra-EMU trade and the development of imbalances may be the result of the interaction between global changes, especially in terms of emergence of new actors, and changes in the relative importance of core and peripheral countries within the EMU. We now provide the first look at the potential factors explaining this evidence according to the literature described in [Section 2](#). In [Table 2](#), we report the dynamics of GDP (both nominal and real), financial opening, fixed and human capital, real exchange rates, and nominal exchange rates volatility.

During 1999–2007, the whole EMU experienced below-average GDP growth, both in nominal and real terms. Core countries grew less than the periphery, due also to the lower inflation rate. On the other hand, the new members of the EMU as well as other EU countries

experienced above-average growth rates, especially in constant prices. Financial integration increased by 150% on average and, in terms of GDP, the strongest increases were recorded in the EMU periphery and new member states. Fixed capital experienced below average growth in the original 12 members of the EMU. However, like in the case of the real GDP, the periphery experienced a higher growth than core countries. The low growth of the core countries' capital stock is mainly driven by Germany. As for price competitiveness, the real exchange rate fell in core countries, although not as much as in the other advanced economies. Conversely, it grew by 12% in the periphery. This divergence can be attributed to the dynamics of manufacturing ULC, which are typical indicators for the development of intra-EMU imbalances. On the other hand, the stock of human capital experienced



above average growth in the EMU periphery as well as in both EU and non-EU emerging countries.

Between 2007 and 2013, the picture partially changed due, on the one hand, to the global financial crisis and, on the other, to the asymmetric development within the EMU. Along with this, the periphery implemented restrictive fiscal policies in order to consolidate public finances. This resulted in negative growth and disinflation. Due to spillover effects, this also affected the economic performance of the rest of the EMU. The restrictive fiscal policy and the low growth in the EMU caused a sensible slowdown in the accumulation of fixed and human capital, with possible long-run effects on the growth of potential output (European Commission 2015). Finally, in terms of real exchange rate, imbalances within the EMU-12 countries were partially reduced, although, due mainly to the euro dollar exchange rate dynamics, the area did not catch up with the other advanced economies.

The evidence just shown indicates that the trade dynamics of EMU countries may be connected with changes taking place both at the European and the global level. The main difference between the EMU and the rest of the world seems to lie in the much higher rate of growth of the periphery's financial assets and liabilities. This outcome has been fostered by the introduction of the single currency and the consequent elimination of the exchange rate risk. At the same time, the evolution of price competitiveness seems to be partially due to the introduction of the single currency. As a possible result, core countries, whose exchange rate has been undervalued since the introduction of the euro increased their cost competitiveness. The opposite process may have happened in the periphery. As for GDP and fixed capital, the connection with the euro introduction is weaker as the lack of structural reforms – whether or not due to public finances constraints – interacted with global changes. Finally, human capital seem to follow a standard catching up process.

#### 4. Econometric model and strategy

The aim of the empirical analysis is to estimate trade creation and trade diversion effects of financial opening, growth and competitiveness in the EMU and to assess whether they can explain both the rise and fall of trade imbalances and the evolution of intra-EMU trade shares. The econometric analysis is carried out on a sample of bilateral trade flows among a group of 38 countries. The sample includes the whole EU (excluding Croatia, Malta, and Cyprus), and a group of extra-EU countries comprised of seven advanced economies (Australia, Canada, Japan, New Zealand, Norway, Switzerland, and the United States) and six emerging countries, including the BRICs (Brazil, Russia, India and China), Mexico and Korea. We focus on bilateral trade flows using a gravity-type approach (Anderson and van Wincoop 2003, Anderson 2010) augmented by adding the variables described in Section 3. The specification is the following:

$$\exp_{i,j,t} = \alpha + \beta_1 mass_{i,j,t} + \beta_2 rer_{i,j,t} + \beta_3 fo_{i,t} + \beta_4 fo_{j,t} + \beta_5 vol_{i,j,t} + \beta_6 pkrel_{i,j,t} + \beta_7 hkre_{i,j,t} + \Omega_{i,j,t} \quad (1)$$

where the log of export at current prices from country  $i$  toward country  $j$  ( $\exp_{i,j,t}$ ) is regressed on the the economic size of the two countries ( $mass_{i,j,t}$ ) – given by the log-sum of their nominal GDPs in industry – and the log of bilateral real exchange rate ( $rer_{i,j,t}$ ). For the latter, industry ULC are used as price deflators. In addition to these basic variables, we add a country-specific measure for financial opening ( $fo_{it}$  and  $fo_{jt}$ ), a measure of exchange rate volatility ( $vol_{i,j,t}$ ), the log difference between importer's and exporter's capital stock ( $fkrel_{i,j,t}$ ) and the ratio of exporter to importer human capital ( $hkrel_{i,j,t}$ ). As highlighted in the previous paragraphs, these additional variables capture the main EMU-specific and global processes. For the economic mass we use industry GDP because the size of the non-tradable sector might lead to biased estimates of gravity effects (Liu et al. 2010).

Details on the description and dynamics of these variables are in Section 3 and in the Appendix Table A1.

The specification in Eq. (1) assumes common elasticities for all 38 countries and provides information on the evolution of intra-EMU trade shares and imbalances only to the extent that they reflect differences in the evolution of the explanatory variables. Nevertheless, due to the introduction of the single currency, additional trade creation and trade diversion effects resulting in different elasticities may exist within the EMU and between the EMU and third countries. The increase in financial flows in the EMU is the result of two factors. The first of these is the convergence of interest rates brought about by the elimination of exchange rate fluctuations and by the reduced perception of specific country risk factors. The second factor is the elimination of frictions and regulatory changes favouring intra-EMU financial flows. In addition, the single currency and the constraints of the Stability and Growth Pact (SGP) have certainly affected the member states' competitiveness as well as their growth process. These features imply that specific effects due to the euro introduction may be present in terms of trade creation and trade diversion. Further, considering the extensive literature on imbalances, different trade creation and trade diversion effects of the explanatory variables between core and peripheral countries may also exist because of changes in the growth model of the two groups after the introduction of the euro. This would provide an explanation, in a single framework, for the dynamics of both trade shares and trade balances.

Trade creation and trade diversion effects of growth, competitiveness and financial integration are estimated by interacting them with an EMU dummy and with a trade diversion dummy (TD). The former dummy is equal to one if both trading partners belong to the monetary union, whereas the latter dummy is equal to one when only one of the two trading partners belongs to the EMU. The resulting specification is the following:

$$\begin{aligned} \exp_{i,j,t} = & \alpha + \beta_1 mass_{i,j,t-1} + \beta_1 EMU * mass_{i,j,t-1} + \beta_3 TD * mass_{i,j,t-1} \\ & + \beta_4 rer_{i,j,t-1} + \beta_5 EMU * rer_{i,j,t-1} + \beta_6 TD * rer_{i,j,t-1} + \\ & \beta_7 fo_{i,t-1} + \beta_8 EMU * fo_{i,t-1} + \beta_9 TD * fo_{i,t-1} + \beta_{10} fo_{j,t-1} + \beta_{11} EMU * fo_{j,t-1} \\ & + \beta_{12} TD * fo_{j,t-1} + \\ & \beta_{13} krel_{i,j,t-1} + \beta_{14} EMU * krel_{i,j,t-1} + \beta_{15} TD * krel_{i,j,t-1} + \beta_{16} EMU * hkrel_{i,j,t-1} \\ & + \beta_{17} TD * hkrel_{i,j,t-1} + \beta_{18} vol_{i,j,t} + \Omega_{i,j,t} \end{aligned} \quad (2)$$

In what follows, we will call the interactions with the EMU dummy trade creation effects, and the interactions with the TD dummy trade diversion effects. Positive effects are those leading to an increase in intra-EMU trade while negative effects lead to the opposite. In the following step, we test whether differences between core and peripheral countries exist in terms of trade creation and trade diversion effects. This is done by further splitting the EMU and TD dummies according to the core–periphery classification:

$$\begin{aligned} \exp_{i,j,t} = & \alpha + \beta_1 mass_{i,j,t-1} + \beta_2 rer_{i,j,t-1} + \beta_3 EMUc * rer_{i,j,t-1} + \beta_4 EMUp \\ & * rer_{i,j,t-1} + \beta_5 TDC * rer_{i,j,t-1} + \beta_6 TDP * rer_{i,j,t-1} \\ & + \beta_7 fo_{i,t-1} + \beta_8 EMUc * fo_{i,t-1} + \beta_9 EMUp * fo_{i,t-1} + \beta_{10} TDC * fo_{i,t-1} + \beta_{11} TDP \\ & * fo_{i,t-1} + \beta_{12} fo_{j,t-1} + \beta_{13} EMUc * fo_{j,t-1} + \\ & \beta_{14} EMUp * fo_{j,t-1} + \beta_{15} TDC * fo_{j,t-1} + \beta_{16} TDP * fo_{j,t-1} + \beta_{17} krel_{i,j,t} + \beta_{18} EMUc \\ & * krel_{i,j,t-1} + \\ & \beta_{19} EMUp * krel_{i,j,t-1} + \beta_{20} TDC * krel_{i,j,t-1} + \beta_{21} TDP * krel_{i,j,t-1} + \beta_{22} hkrel_{i,j,t} \\ & + \beta_{23} EMUc * hkrel_{i,j,t-1} + \\ & \beta_{24} EMUp * hkrel_{i,j,t-1} + \beta_{25} TDC * hkrel_{i,j,t-1} + \beta_{26} TDP * hkrel_{i,j,t-1} + \beta_{27} vol_{i,j,t} \\ & + \Omega_{i,j,t} \end{aligned} \quad (3)$$

where the terms  $EMUc$  and  $TDC$  are the EMU and trade diversion effects for core countries whereas  $EMUp$  and  $TDp$  are the same effects for the periphery. In both Eqs. (2) and (3), the exchange rate volatility is not interacted because it is never significant.

There are many ways to estimate a gravity equation, depending on the specific features of the data. In the case of data showing a relevant number of zero trade flows, non-linear techniques have become the workhorse. Among them, the Poisson Pseudo Maximum Likelihood estimator (PPML) (Santos Silva and Tenreyro, 2006, 2011, Staub and Winkelmann 2012) and Heckman (1979) style selection models are the most used techniques. We do not rely on non-linear models because in our sample, the number of zeros is irrelevant ( $< 20$ ) and the selection into the EMU is mostly explained by geographical factors that can be captured by a system of dummy variables. When these two problems are not relevant, linear panel techniques can be applied. In this context, the main econometric issues are related to the non-stationarity of the series, and the presence of both serial correlation within units and cross-sectional dependence (CSD) across units.

Some studies have used panel cointegration techniques in a gravity framework to test the euro effect (Camarero et al. 2014a, 2014b, Geldi, 2012). These estimators allow to control for CSD by directly modelling the common stochastic trends, but in addition to the non-stationarity of the series, they require a long time span. Further, these approaches work better when the number of units in the sample is not too large. As shown in Table A2 in the Appendix A, the variables used in our analysis are mostly stationary. For this reason, we rely on an alternative strategy. In the case of stationary panels, CSD can be controlled by adding common time dummies to a standard fixed effects (FE) model. This solution is not fully satisfactory as it assumes that countries respond in the same way to common shocks. Such assumption is often not enough to eliminate CSD from the residuals. Our strategy consists of creating interactions between time dummies and regional dummies in order to introduce some heterogeneity in the responses to common shocks. The best specification for this purpose is the one introduced by Baltagi et al. (2003). This includes pair-specific fixed effects as well as time dummies interacted with both reporter and partner effects. Since this specification introduces a high degree of potential collinearity and is also likely to eliminate some useful information, we prefer to use an intermediate approach. More specifically, we introduce interactions between time-specific effects and regional dummies classified according to the definition used in Tables 1–2. Each time dummy is then split into 36 categories (six reporter's categories by six partner's categories). The resulting specification is as follows:

$$\Omega_{i,j,t} = \sum \delta_{i,j} + \eta_{i,REG_{i,j}} + \varepsilon_{i,j,t} \quad (4)$$

Eq. (4) also provides an effective control for the multilateral resistance term (see Anderson and van Wincoop 2003, Baltagi et al. 2003). The problem of serial correlation is addressed by calculating heteroscedasticity and autocorrelation consistent (HAC) standard errors.

The final issue to deal with is the potential endogeneity due to reverse causality between trade and output. While some studies (Cyrus 2002) show that this problem does not affect the GDP coefficients, we take this issue into account by estimating Eq. (1) with a standard FE approach and with a Generalised Method of Moments FE (GMM-FE) approach. In the latter, the economic mass is instrumented by its first and second lags. Since the series are stationary and both the serial and cross-sectional correlations are accounted for, the FE model will return unbiased and consistent estimates of the parameters.

## 5. Discussion of the results

In Table 3, we report the estimation results of Eq. (1) for the overall period 1992–2013 and for the sub-periods 1992–2007, 1999–2007 and 1999–2013. The GMM estimation works fine in terms of the instruments' validity and the over-identifying restrictions are satisfied.

The impact of mass is not statistically different from the one estimated with the standard FE, confirming that the endogeneity problem is not significant. Hence, from now on, we base our discussion on the FE results.<sup>2</sup> The Pesaran (2004) test indicates that no CSD is present in the residuals.

As for the estimated coefficients, both the economic mass and the real exchange rate have the expected effect – positive for the former and negative for the latter. The impact of mass increases significantly when including the years following the global financial crisis of 2008 (columns 1 and 3), in line with the view that the recent re-balance of net trade has been largely influenced by the demand contraction induced by the restrictive policy stance (Esposito and Messori 2016). On the contrary, there are no significant differences in the effect of the real exchange rate among sub-periods. Both the exporter's and importer's financial opening exert a positive effect on trade but for the former, the coefficient is significant only in the sub-sample 1999–2007. On the contrary, the effect of the importer's financial opening is always significant and particularly strong during the period 1999–2007. This result suggests that financial flows were particularly important to stimulate import demand before the global financial crisis. Exchange rate volatility is not significant and seems to have a counter-intuitive positive impact in the years after the crisis. This might be due to appreciation of the euro / dollar exchange rate in the years 2010–2013, which diverted trade toward countries with non-fixed exchange rates. The relative capital stock has the expected positive impact, suggesting that global technological factors have played an important role for export competitiveness. A similar result holds for human capital.

Based on these coefficients, we can provide the first indication of the determinants of trade imbalances. Looking at the evolution of the explanatory variables (Table 2) up to 2007, we find that imbalances are due to divergences in the real exchange rate and to the higher impact of financial opening on imports than on exports. Since financial opening in the periphery increased at a much faster rate with respect to the core, the resulting effect is a high deterioration of trade balances.

The impact of the explanatory variables on intra-EMU trade shares is shown in Table 4, where estimation results for Eq. (2) are reported. For each variable, the main coefficient indicates the effect of the variable before the introduction of the euro and that of trade among extra-EMU countries. For the economic mass, we find negative trade creation and trade diversion effects as the interaction with the EMU dummy is negative and the one with the TD dummy is positive. The elasticity of trade to the real exchange rate turns to zero in the sample 1999–2013. At the same time, after the introduction of the euro, we find a lower than average effect of the bilateral real exchange rate for trade relations between EMU and non-EMU countries (columns 3 and 4). These two results suggest that, on the one hand, price competitiveness played a minor role in explaining intra-EMU trade flows after the global financial crisis and, on the other hand, that the price elasticity of EMU exports outside the area fell substantially after 1999.

As for financial opening, we see a clear positive impact on intra-EMU trade shares both for import and export. The impact is mostly driven by the trade diversion effect as the elasticity of both import and export to financial opening falls more intensively in the case of trade between EMU and non-EMU countries. This confirms that the process of financial integration at the European level favoured intra-EMU trade flows. The relative capital stock seems to have a slightly higher impact on trade between EMU and non-EMU countries, especially during the '1990s, leading to negative trade diversion. Positive trade creation and trade diversion effects are, on the other hand, exerted by the relative human capital until the global financial crisis.

<sup>2</sup> The choice is further justified by the problem of instruments' collinearity in IV/GMM estimates when continuous endogenous variables are split into different categories. This problem leads to weak instrumentation and failure to satisfy the over-identifying restrictions.

**Table 3**  
Estimation results for Eq. (1).

	FE				GMM-FE			
	1992–2013	1992–2007	1999–2013	1999–2007	1992–2013	1992–2007	1999–2013	1999–2007
mass <sub>ijt-1</sub>	0.578*** [0.019]	0.463*** [0.025]	0.546*** [0.020]	0.425*** [0.031]	0.567*** [0.022]	0.407*** [0.034]	0.548*** [0.023]	0.366*** [0.042]
reer <sub>ijt-1</sub>	-0.130*** [0.016]	-0.118*** [0.020]	-0.169*** [0.018]	-0.124*** [0.026]	-0.137*** [0.016]	-0.130*** [0.020]	-0.169*** [0.018]	-0.124*** [0.026]
vol <sub>ijt-1</sub>	0.253 [0.136]	-0.193 [0.123]	0.332 [0.261]	-0.241 [0.233]	0.154 [0.144]	-0.119 [0.135]	0.297 [0.262]	-0.198 [0.235]
fo <sub>it-1</sub>	0.048* [0.025]	0.015 [0.035]	0.052** [0.025]	0.042 [0.037]	0.049* [0.026]	0.051 [0.036]	0.051* [0.026]	0.079* [0.041]
fo <sub>jt-1</sub>	0.049* [0.026]	0.095** [0.033]	0.053* [0.028]	0.174*** [0.040]	0.050* [0.026]	0.143*** [0.035]	0.052* [0.029]	0.211*** [0.043]
fkrel <sub>ijt-1</sub>	0.169*** [0.036]	0.164** [0.055]	0.203*** [0.041]	0.165** [0.073]	0.178*** [0.037]	0.154** [0.056]	0.203*** [0.041]	0.165** [0.073]
hkrel <sub>ijt-1</sub>	0.238 [0.166]	1.221*** [0.268]	0.159 [0.182]	1.118*** [0.309]	0.228 [0.168]	1.234*** [0.275]	0.158 [0.182]	1.138*** [0.309]
R <sup>2</sup>	0.772	0.708	0.762	0.726	0.769	0.709	0.762	0.726
Under id.					2698	1741	2234	1375
Weak id.					37138	8830	41983	8775
J					2.3	2.2	1.9	1.2
CSD	1.15	1.22	0.98	1.45	1.23	1.38	1.11	1.49
N	25139	16923	20760	12544	24196	15980	20758	12542

Standard errors in brackets. \*Significant at 10%; \*\*Significant at 5%; \*\*\*Significant at 1%. J=Hansen test of over-identifying restrictions. Under id.= Kleibergen-Paap LM underidentification test. Weak id.= Kleibergen-Paap Wald weak identification test. CSD=Pesaran (2004) test for cross sectional dependence.

We now turn to the estimates of Eq. (3). In this specification, the EMU and TD dummies are further split according to the core-periphery classification of the original twelve members of the EMU. More specifically, in the cases of *rer*, *mass*, importer's financial opening and *krel* the EMU dummy is split according to the importer's group whereas for the exporter financial opening and the relative human capital it is split according to the exporter's group. EMUc and TDc refer to core countries' import whereas EMUp and TDp refer to peripheral countries' import. EMUc2, EMUp2, TDc2 and TDc2 are the same dummies coded according to the exporter's group.

The choice to code the dummies for *rer* and *mass* according to the importer's group is based on the evidence that, between 1999 and 2007, the periphery's import grew at faster pace with respect to export (see Esposito and Messori 2016). At the same time, import fell dramatically after 2008 in the same group whereas the export dynamics was more uniform among countries. From a theoretical point of view, this is in line with the argument that trade and current account imbalances in the periphery increased because of a demand boom based on optimistic growth expectation and asset bubbles (Crocchi Angelini and Farina 2012) rather than on improved export competitiveness.

As for the capital stock, in advanced economies like the EMU12 the increased international fragmentation of production is mostly observed by looking at import indicators. This is because these economies have specialised mostly in high value added stages of production such as R & D, product design, customer services and marketing while increasing the share of imported material inputs (De Backer and Miroudot 2014). The dummy for the exporter's financial opening is obviously coded according to the exporter's group. This classification is also applied to the relative human capital because of its value as a measure of export quality. For each sub-period, the first specification considers only Greece, Ireland, Portugal and Spain as peripheral countries, whereas the second specification also includes Italy.

Estimation results of Eq. (3) are reported in Table 5. For the economic mass, the negative trade creation effect originates from core countries' imports while the trade diversion effect is concentrated in the periphery. These two effects point to an increase in imbalances for both intra- and extra-EMU trade. The reason is that core countries' imports from other EMU members respond less to the economic mass, while periphery's imports from outside the EMU respond more. This is

coherent with the evidence on the import displacement effect of China's and other emerging countries' export toward South European markets (Chen et al. 2013, Guerrieri and Esposito 2014).

As for the real exchange rate, we can see that its insignificance in explaining intra-EMU imports holds only for core countries. This means that price competitiveness has contributed to the widening of imbalances by increasing the periphery's imports from all countries of the area.<sup>3</sup> We further find that the negative trade diversion effect is not statistically different between the two groups.

The exporter's financial opening has a positive trade creation effect for core countries, especially in the sample 1999–2007. A similar effect holds for the periphery. However, for the latter this effect is mostly concentrated in the years '1990s whereas negative trade creation effects are significant in the sample 1999–2013. The periphery also experienced stronger negative trade diversion effects affecting both import and export. Overall, the combined effect of financial opening on trade flows points to an increase in intra-EMU trade associated with a rise in imbalances. This is because positive effects are concentrated in the core's exports and the periphery's imports.

Turning to the relative capital stock, the negative trade diversion effect is also concentrated in the periphery. In the latter we further find a negative trade creation effect which is significant in most sub-samples. The outcome might be due to the emergence of Central and Eastern European countries as trading partners due to the development of GVC. Finally, the positive trade creation and trade diversion effects of human capital are concentrated – when significant – in the core's imports.

To sum up, the results indicate that opposite forces have affected the dynamics of intra-EMU trade shares. Financial opening has a strong trade creation effect whereas economic growth, competitiveness and global technological factors cause a reduction of intra-EMU trade. Additionally, these effects appear to be non-uniform among countries and they all seem to have contributed to the initial increase and subsequent fall of trade imbalances.

<sup>3</sup> It must be noted that when dummies are coded according to the exporter's group the real exchange rate turns insignificant for both core and periphery. This means that price competitiveness exerted no direct effect on the export performances within the EMU.

**Table 4**  
Estimation results for Eq. (2).

	1992–2013	1992–2007	1999–2013	1999–2007
mass <sub>ijt-1</sub>	0.563*** [0.019]	0.447*** [0.025]	0.529*** [0.021]	0.414*** [0.031]
EMU*mass <sub>ijt-1</sub>	-0.018* [0.010]	-0.033*** [0.010]	-0.022 [0.015]	-0.046** [0.016]
TD*mass <sub>ijt-1</sub>	0.019*** [0.006]	0.013** [0.005]	0.022** [0.008]	0.011 [0.007]
reer <sub>ijt-1</sub>	-0.131*** [0.017]	-0.114*** [0.020]	-0.197*** [0.023]	-0.143*** [0.030]
EMU*reer <sub>ijt-1</sub>	0.082 [0.052]	0.082 [0.051]	0.172** [0.059]	0.072 [0.060]
TD*reer <sub>ijt-1</sub>	-0.002 [0.025]	0.012 [0.024]	0.070** [0.030]	0.064** [0.032]
vol <sub>ijt-1</sub>	0.126 [0.136]	-0.152 [0.123]	0.291 [0.262]	-0.263 [0.239]
fo <sub>it-1</sub>	0.059** [0.026]	0.015 [0.035]	0.083** [0.026]	0.054 [0.037]
EMU*fo <sub>it-1</sub>	0.032* [0.019]	0.056** [0.018]	-0.027 [0.027]	0.056** [0.028]
TD*fo <sub>it-1</sub>	-0.062*** [0.011]	-0.059*** [0.010]	-0.066*** [0.015]	-0.043** [0.014]
fo <sub>jt-1</sub>	0.048* [0.026]	0.101** [0.033]	0.066** [0.029]	0.179*** [0.040]
EMU*fo <sub>jt-1</sub>	0.023 [0.015]	0.039** [0.013]	-0.02 [0.024]	0.032* [0.018]
TD*fo <sub>jt-1</sub>	-0.038** [0.012]	-0.034*** [0.010]	-0.045** [0.014]	-0.031** [0.013]
krel <sub>ijt-1</sub>	0.162*** [0.037]	0.170** [0.056]	0.184*** [0.042]	0.156** [0.073]
EMU*krel <sub>ijt-1</sub>	0.001 [0.010]	-0.006 [0.010]	0.000 [0.014]	-0.011 [0.014]
TD*krel <sub>ijt-1</sub>	0.013* [0.007]	0.011** [0.005]	0.011 [0.009]	0.003 [0.007]
hkrel <sub>ijt-1</sub>	0.192 [0.168]	1.252*** [0.278]	0.173 [0.188]	1.140*** [0.309]
EMU*hkrel <sub>ijt-1</sub>	-0.078 [0.108]	0.186** [0.087]	-0.106 [0.156]	0.015 [0.122]
TD*hkrel <sub>ijt-1</sub>	-0.063 [0.071]	0.054 [0.065]	-0.091 [0.099]	-0.187** [0.082]
R <sup>2</sup> c	0.773	0.709	0.764	0.727
CSD	0.98	0.93	1.50	1.32
N	25139	16923	20760	12544

Standard errors in brackets. \*Significant at 10%; \*\*Significant at 5%; \*\*\*Significant at 1%. CSD=[Pesaran \(2004\)](#) test for cross sectional dependence. EMU=1 if exporter and importer belong to the EMU. TD=1 if only one of the two trading partners belongs to the EMU.

## 6. Conclusions and policy recommendations

The evolution of trade flow among the original members of the European Monetary Union has been characterized by the initial rise and subsequent fall of trade and current account balances on the one hand, and a continuous reduction in the share of intra-EMU trade with respect to total trade on the other. While the first factor has been widely investigated because of the connection to the area's prospects for recovery, the reduction of intra-EMU trade shares has received little attention.

In this paper, we have argued that the reduction of intra-EMU shares and the development of imbalances are – at least partially – the result of core–periphery differences in trade creation and trade diversion effects associated with the introduction of the single currency and with the ongoing globalization process. Differing from the literature on the euro effect on trade, these effects have been estimated by testing the significance of structural changes for the countries that joined the monetary union on the variables representing the main causes of imbalances – financial integration, divergences in price/non-price competitiveness, and global technological changes. The divergence between core and peripheral countries of the EMU has been taken into account by allowing coefficients to vary between the two groups.

The results have shown that financial opening had a clear positive effect on intra-EMU trade but, at the same time, favoured the development of imbalances by stimulating imports more than exports. On the contrary, after the introduction of the euro, the elasticity of trade to GDP growth became smaller for intra-EMU trade whereas it increased for trade between EMU and non-EMU countries. This led to a reduction of intra-EMU trade shares. A similar effect holds for the capital stock, which accounts for technological changes at regional and global levels, such as skill-biased technical change and development of the GVC. Both effects differed between core and periphery and led to an increase in imbalances. Finally, price competitiveness contributed to the rise of imbalances as appreciations of the real exchange rate increased the periphery's imports, whereas core countries imports were unaffected.

Our findings have important policy implications. The reduction of intra-EMU trade is a relevant issue since one of the expected outcomes of the monetary union is to bring about an increase in trade and financial flows as a result of the increase in the size of the single market and the decrease in trade dependency on third countries. However, the EMU is increasingly behaving as an export-led economy, especially in more recent years, due, in particular, to increasing external surplus recorded by the German economy. This growth model, typical of emerging countries, is not sustainable in the long run for mature economies, especially because it does not match the evolution of trade and current account dynamics in the rest of the world.

Although other factors, like the development of global value chains and the emergence of China as one of the main world exporters, have contributed to the results of the paper, the creation of the Monetary Union might have weakened the ability of countries to face the challenges of globalization. The elimination of monetary policy for the individual countries and the European constraints on public finances have reduced the EMU's ability to implement structural reform and improve price competitiveness, especially in the periphery.

Our results beg criticism toward the responses of European institutions to the problem of structural differences in trade and competitiveness. After the global financial crisis, some progress at the European level has been achieved in terms of financial regulation, creation of banking union, and management of large public debts. In order to avoid the development of imbalances, the Macroeconomic Imbalances Procedure (MIP), as a part of the six-pack, has been introduced in 2011. Nevertheless, the effectiveness of these procedures can be questioned because the six-pack and the MIP are based on the view that symmetric adjustments (i.e. reductions of both large deficits and large surpluses) are not desirable as the rebalancing process should not compromise the competitiveness of the EMU as a whole ([European Commission 2012](#)). In addition, the MIP and, to a lesser extent, the new fiscal rules appear to suffer from weak enforcement power. This argument is backed by the fact that the former has so far failed to address the problem of the German surplus and the latter has failed to impose adjustments on the French budget deficit.

Indeed, trade and current account imbalances have been strongly reduced, thanks mainly to the implementation of fiscal consolidation measures, which affected the external balance primarily through demand compression and wage moderation. This is not a virtuous adjustment because it is mostly based on recessionary forces. The obvious implication is that imbalances will rise again once the GDP growth stably returns to positive values. In this respect, the new European policy tools, and the MIP in particular, do not seem to provide the proper answer to the problem. This is because they do not introduce coordination of fiscal policies and leave the burden of adjustment to the individual countries.

In order to stimulate intra-area trade and structurally re-balance the competitive positions of core and peripheral countries, measures aimed at improving the competitiveness of the internal market should be implemented. In addition, more resources should be devoted, at a European level, to finance structural reforms and improve the compe-



**Table 5**  
Estimation results for Eq. (3).

	1992–2013		1992–2007		1999–2013		1999–2007	
	GIPS	GIIPS	GIPS	GIIPS	GIPS	GIIPS	GIPS	GIIPS
mass <sub>ijt-1</sub>	0.554*** [0.019]	0.556*** [0.019]	0.441*** [0.025]	0.439*** [0.025]	0.519*** [0.021]	0.522*** [0.021]	0.406*** [0.031]	0.407*** [0.031]
EMUc*mass <sub>ijt-1</sub>	-0.01 [0.010]	-0.008 [0.010]	-0.017** [0.008]	-0.021** [0.008]	-0.021 [0.014]	-0.015 [0.015]	-0.028** [0.012]	-0.031** [0.013]
EMUp*mass <sub>ijt-1</sub>	0.001 [0.030]	0.005 [0.026]	-0.001 [0.023]	-0.017 [0.021]	-0.025 [0.037]	-0.002 [0.034]	-0.032 [0.027]	-0.015 [0.025]
TDc*mass <sub>ijt-1</sub>	0.01 [0.007]	0.008 [0.007]	0.005 [0.006]	0.003 [0.006]	0.011 [0.010]	0.01 [0.011]	-0.012 [0.008]	-0.016* [0.009]
TDp*mass <sub>ijt-1</sub>	0.047*** [0.011]	0.048*** [0.009]	0.036*** [0.009]	0.036*** [0.007]	0.045*** [0.012]	0.051*** [0.011]	0.023** [0.010]	0.029** [0.009]
reer <sub>ijt-1</sub>	-0.135*** [0.018]	-0.134*** [0.018]	-0.115*** [0.021]	-0.115*** [0.020]	-0.205*** [0.023]	-0.201*** [0.023]	-0.154*** [0.030]	-0.149*** [0.030]
EMUc*reer <sub>ijt-1</sub>	0.173** [0.061]	0.180** [0.065]	0.165** [0.069]	0.127 [0.077]	0.254*** [0.066]	0.255*** [0.070]	0.207** [0.081]	0.15 [0.091]
EMUp*reer <sub>ijt-1</sub>	-0.126 [0.122]	-0.078 [0.106]	-0.249** [0.108]	-0.123 [0.098]	-0.01 [0.128]	0.017 [0.112]	-0.257** [0.119]	-0.198* [0.110]
TDc*reer <sub>ijt-1</sub>	0.002 [0.028]	-0.001 [0.030]	0.018 [0.026]	0.019 [0.028]	0.073** [0.033]	0.071** [0.035]	0.065* [0.035]	0.069* [0.038]
TDp*reer <sub>ijt-1</sub>	0.011 [0.045]	0.022 [0.040]	0.02 [0.048]	0.046 [0.040]	0.095* [0.050]	0.090** [0.045]	0.097* [0.055]	0.093* [0.048]
vol <sub>ijt-1</sub>	0.109 [0.136]	0.119 [0.136]	-0.140 [0.124]	-0.143 [0.123]	0.267 [0.261]	0.211 [0.262]	-0.139 [0.239]	-0.168 [0.238]
fo <sub>it-1</sub>	0.082** [0.027]	0.071** [0.026]	0.03 [0.037]	0.026 [0.036]	0.099*** [0.027]	0.099*** [0.026]	0.099** [0.039]	0.071* [0.037]
EMU2c*fo <sub>it-1</sub>	0.063** [0.021]	0.067** [0.021]	0.042** [0.019]	0.044** [0.019]	0.034 [0.033]	0.041 [0.034]	0.073** [0.027]	0.068** [0.027]
EMU2p*fo <sub>it-1</sub>	-0.04 [0.026]	-0.027 [0.025]	0.049* [0.025]	0.074*** [0.022]	-0.129*** [0.032]	-0.120*** [0.034]	-0.011 [0.035]	0.032 [0.033]
TD2c*fo <sub>it-1</sub>	-0.047*** [0.012]	-0.041** [0.013]	-0.040*** [0.011]	-0.034** [0.012]	-0.047** [0.017]	-0.042** [0.019]	-0.007 [0.015]	-0.001 [0.017]
TD2p*fo <sub>it-1</sub>	-0.118*** [0.020]	-0.120*** [0.019]	-0.112*** [0.019]	-0.113*** [0.017]	-0.140*** [0.022]	-0.137*** [0.022]	-0.119*** [0.023]	-0.109*** [0.022]
fo <sub>jt-1</sub>	0.060** [0.027]	0.057** [0.026]	0.111** [0.035]	0.106** [0.034]	0.082** [0.030]	0.076** [0.030]	0.201*** [0.042]	0.189*** [0.041]
EMUc*fo <sub>jt-1</sub>	0.014 [0.017]	0.004 [0.017]	0.030* [0.017]	0.019 [0.018]	-0.023 [0.023]	-0.038 [0.026]	0.031 [0.023]	0.022 [0.026]
EMUp*fo <sub>jt-1</sub>	-0.048 [0.043]	-0.031 [0.047]	-0.038 [0.036]	0.000 [0.037]	-0.079* [0.047]	-0.065 [0.053]	-0.068* [0.039]	-0.032 [0.041]
TDc*fo <sub>jt-1</sub>	-0.029** [0.013]	-0.021 [0.015]	-0.022* [0.011]	-0.025* [0.013]	-0.042** [0.019]	-0.021 [0.019]	-0.021 [0.015]	-0.019 [0.017]
TDp*fo <sub>jt-1</sub>	-0.066*** [0.018]	-0.071*** [0.018]	-0.066*** [0.016]	-0.053*** [0.015]	-0.050** [0.021]	-0.074*** [0.022]	-0.050** [0.019]	-0.048** [0.019]
krel <sub>ijt-1</sub>	0.161*** [0.037]	0.160*** [0.037]	0.170** [0.057]	0.164** [0.057]	0.181*** [0.042]	0.184*** [0.042]	0.152** [0.073]	0.153** [0.073]
EMUc*krel <sub>ijt-1</sub>	0.005 [0.010]	0.006 [0.011]	0.006 [0.011]	0.009 [0.012]	0.002 [0.013]	0.007 [0.015]	0.003 [0.013]	0.012 [0.015]
EMUp*krel <sub>ijt-1</sub>	-0.061** [0.022]	-0.053** [0.020]	-0.068*** [0.019]	-0.052** [0.017]	-0.040 [0.026]	-0.039* [0.023]	-0.056** [0.021]	-0.057** [0.019]
TDc*krel <sub>ijt-1</sub>	0.012* [0.007]	0.007 [0.009]	0.009 [0.006]	-0.001 [0.007]	0.010 [0.011]	0.010 [0.012]	-0.001 [0.008]	-0.006 [0.010]
TDp*krel <sub>ijt-1</sub>	0.012 [0.009]	0.023** [0.010]	0.017** [0.008]	0.033*** [0.009]	0.007 [0.010]	0.007 [0.011]	0.006 [0.009]	0.013 [0.010]
hkrel <sub>ijt-1</sub>	0.163 [0.169]	0.164 [0.169]	1.245*** [0.279]	1.265*** [0.280]	0.132 [0.189]	0.146 [0.189]	1.112*** [0.310]	1.139*** [0.311]
EMUc2*hkrel <sub>ijt-1</sub>	-0.001 [0.120]	-0.002 [0.129]	0.120 [0.094]	0.214** [0.102]	-0.251 [0.179]	-0.191 [0.197]	-0.06 [0.140]	-0.009 [0.156]
EMUp2*hkrel <sub>ijt-1</sub>	-0.062 [0.223]	0.106 [0.196]	0.083 [0.169]	0.054 [0.163]	-0.208 [0.282]	-0.064 [0.264]	-0.171 [0.211]	-0.165 [0.208]
TDc2*hkrel <sub>ijt-1</sub>	-0.126* [0.075]	-0.081 [0.082]	0.035 [0.062]	0.107 [0.069]	-0.137 [0.115]	-0.128 [0.126]	-0.196** [0.082]	-0.177* [0.090]
TDp2*hkrel <sub>ijt-1</sub>	0.046 [0.122]	0.015 [0.127]	0.073 [0.112]	0.024 [0.117]	-0.097 [0.151]	-0.086 [0.162]	-0.124 [0.134]	-0.113 [0.142]
R <sup>2</sup> c	0.774	0.774	0.71	0.71	0.764	0.764	0.729	0.728
CSD	1.23	1.14	0.77	0.75	1.29	1.40	1.13	1.23
N	25139	25139	16923	16923	20760	20760	12544	12544

Standard errors in brackets. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%. CSD=Pesaran (2004) test for cross sectional dependence. EMUc=1 if importer is a core country of the EMU; EMUp=1 if importer is a peripheral country of the EMU. TDc=1 if a country is a core country of the EMU and the other is an extra-EMU country; TDp=1 if a country belongs to the periphery of the EMU and the other is an extra-EMU country; EMUc2=1 if exporter is a core country of the EMU; EMUp2=1 if exporter is a peripheral country of the EMU. GIPS=Greece, Ireland, Portugal, Spain. GIIPS=GIPS+Italy.

**Table A1**

Data sources.

Variable description	Source
Trade flows (exp)	UNCOMTRADE accessed through WITS
GDP at current and constant (2010) prices	Eurostat (EU, Norway, Switzerland), OECD (USA, Japan, Australia, Canada, New Zealand), Fred Federal Reserve (China, Brazil, India, Russia, Mexico)
Financial opening=Net foreign assets+net foreign liabilities	Lane and Milesi-Ferretti (2007), updates from IMF-IFS.
Nominal Exchange rates (NER)	IMF-International financial Statistics
Exchange rate volatility (vol): standard deviation of the log difference in monthly nominal exchange rates	IMF-International Financial Statistics
Capital Stock in constant (2010) prices	AMECO (EU, Norway), OECD (Switzerland, USA, Japan, Australia, Canada, New Zealand), Federal Reserve, Oxford Economics based on national statistical institutes data (China, Brazil, India, Russia, Mexico)
Human Capital Index: based on years of schooling and return to education	Feenstra et al. 2015
Real exchange rate=NER*ULCind <sub>i</sub> /ULCind <sub>j</sub>	IMF-International financial Statistics (NER), Eurostat (EU, Norway, Switzerland), OECD (USA, Japan, Australia, Canada, New Zealand), Fred Federal Reserve (Industry ULCs for China, Brazil, India, Russia, Mexico)

**Table A2**

Unit root tests.

	exp	mass	rer	fo	vol	pkrel	hkrel
1992–2013	20.4	32.0	21.3	5.3	89.4	5.3	12.3
1998–2013	22.0	26.5	24.4	7.0	112.2	3.5	10.7

$H_0$ : series have a unit root. Critical values: 5%=1.64; 1%=2.32. The test is based on a fixed effect AR(1) specification (see Bond et al. 2005) augmented with the heterogeneous time specific effects shown in Eq. (2) to control for CSD. The statistics is distributed as a  $N(0,1)$ .

titiveness of the single market.

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## Appendix A

See Appendix Tables A1 and A2.

## Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.econmod.2016.09.014>.

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