The Euro Effects on Intra-EU Trade Flows and Balance: Evidence from the Cross Sectionally Dependent Panel Gravity Models*

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Abstract

Recently, there has been an intense policy debate on the euro effects on trade flows. Following recent developments in panel data studies, we propose the unified cross-sectionally dependent panel gravity models. The desirable feature of this approach is to control for time-varying multilateral resistance, trade costs and globalisation trends through the use of both unobserved factors and an endogenously selected multilateral resistance cluster, which represent strong and weak forms of cross-section dependence, respectively. This approach also enables us to consistently estimate the impacts of time-invariant bilateral trade barriers. Applying the proposed approach to the dataset over 1960-2008 for 91 country-pairs of 14 EU countries, we find that the euro impact on trade amounts to 7-10% only, far less than those reported by earlier studies. Furthermore, the euro is found to promote EU integration by eliminating exchange rate-related uncertainties. Finally, the euro has a negative impact on the trade balance of the South, though such effect seems to be rather modest as compared to unprecedented current account deficits experienced by peripheral countries. An obvious policy implication is that countries considering to join the Euro would benefit from the ongoing process of integration, but should also be wary of regarding promises of an imminent acceleration of intra-EU trade.

JEL Classification: C33, F14.

Key Words: Heterogeneous Gravity Panel Data Models, Cross-section Dependence, Multilateral Resistance, The Euro Effects on Trade Flows, Balances and the EU Integration.

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1 Introduction

With the formation of the euro in 1999, the literature on the common currency effects on trade has been rapidly growing. By eliminating exchange rate volatility and reducing the trade costs, a currency union is expected to boost trades among member countries. An important policy issue is what are the right magnitude and the nature of the Euro's trade impact, both of which are not only important for member countries but also for EU members that have not joined yet. See Baldwin (2006) for an extensive survey.

However, most of earlier studies implicitly made a strong assumption that bilateral trade flows are independent of the rest of the trading world. Anderson and van Wincoop (2003) highlighted an importance of controlling for the regional interaction structure in estimating gravity models, and propose to include multilateral resistance terms that capture the fact that bilateral trade flows depend on bilateral barriers as well as trade barriers across all trading partners. Baldwin (2006) also stressed that many of omitted pair-specific variables clearly reflect time-varying factors such as multilateral trade costs.

To address such an important issue of how best to simultaneously model (unobserved and time-varying) multilateral resistance and bilateral heterogeneity, we follow two alternative methodologies: the factor-based approach proposed by Serlenga and Shin (2007, hereafter SS) and the spatial-based techniques advanced by Behrens, Ertur and Kock (2012, hereafter BEK). SS developed the cross-sectionally correlated panel gravity model by taking into account an issue of cross-section dependence through the use of observed and unobserved factors. SS then proposed to combine the PCCE estimator proposed by Pesaran (2006) with the instrument variables estimator advanced by Hausman and Taylor (1981) in order to consistently estimate the impacts of both time-varying and time-invariant regressors. On the other hand, the spatial dependence may arise due to the so-called third country or neighbour effects. BEK propose the modified spatial technique and derived the spatial weight matrix directly from the structural gravity model. By capturing multilateral resistance through the spatial dependence, they showed that the Canada-US border effects are significantly lower than paradoxically large estimates reported by McCallum (1995).

Chudik *et al.* (2011) show that the factor-based models exhibit the strong form of cross section dependence (hereafter CSD) whilst the spatial-based models can accommodate only weak CSD. Notice, however, that the factor-based procedure can be extended to cope with the weak spatial effects. Bailey *et al.* (2013) develop estimation methods that can distinguish the relationship between spatial units that is purely spatial from that which is due to the effect of common factors, and propose the multi-step procedure. Recently, Kapetanios, Mitchell and Shin(2014, hereafter KMS) proposed a flexible nonlinear panel data model which can generate strong and/or weak CSD endogenously. In this regard Mastromarco, Serlenga and Shin (2015, hereafter MSS) propose the novel framework for accommodating both weak and strong CSD in modelling technical efficiency by combining an endogenous threshold regime selection mechanism advanced by KMS and the exogenously driven factor-based approach. We follow this research trend and develop the unified framework for modelling multilateral resistance and bilateral heterogeneity by accommodating both weak and strong CSD in the error components.

The recent European sovereign-debt crises have exacerbated the difference between core and peripheral economies in the EU. Especially, peripheral countries suffer from the high level of current account deficits and government debts. Such negative economic outlooks ignite intense political debates to questioning the existence of the Euro or the exit of weakest countries.[1] It can be argued that the creation of EMU and the subsequent introduction of the euro may correspond to the start of deterioration of current accounts for peripheral countries (*e.g.* Jaumotte and Sodsriwiboon, 2010), though the EU integration, in general, and the euro, in particular, have clearly boosted the total intra-trade flows.[2]

It is, therefore, important to analyse whether and how much the euro contributes to the deterioration of the current account of peripheral against core countries, and if so, through which channels. However, such an important issue has not been carefully addressed in the empirical literature. This is a rather surprising omission given that there exist a huge literature studying the euro impacts on trade flows and a growing literature on identifying the determinants of the persistence of current account imbalances in the EU. A number of empirical studies have attempted to investigate the current account imbalances in the EU, *e.g.*, Jaumotte and Sodsriwiboon (2010), Schmitz and von Hagen (2011), Chen *et al.* (2013), Berger and Nitsch (2014) and Nieminen (2014). However, all of these approaches are inappropriate to unravel such an important issue as their dependent variables are not suitably constructed to directly evaluate the impacts of the common currency on regional trade balances. Furthermore, in the literature on trade/current account balances, an empirically important issue of CSD in modelling the multilateral resistance and bilateral heterogeneity, has so far been ignored.

In this paper, we focus narrowly on uncovering an unambiguous effect of the Euro on trade flows and trade balances. In Appendix we demonstrate that the proper gravity regression specifications should be developed in order to provide an unequivocal interpretation of the euros' impact on regional trade flows and trade balances. This requires us to formulate the appropriate gravity specifications for trade imbalances by carefully dividing the group of countries of interest and selecting the smaller bilateral pairs. Through this simple and novel identification scheme we are able to address the high profile political issue such as "does the euro help to aggravate the terms of trade of peripheral relative to core countries in the EU?" Furthermore, we develop the framework under which we can examine that the euro boosts the within-core trades more than the within-peripheral or the between trades by augmenting the gravity equations with the regional and interaction dummies. Once we resolve such gravity specification and identification issues, the implementation of our proposed CSD panel model, described in details in Section 3, is straightforward. Given that there is no study addressing this high profile issue as general as ours, the proposed approach can shed further lights on the empirical literature on the effects of the common

[1]Standard Eurobarometer (2013) shows that the public opinion loses its confidence in the EU, especially in Southern countries. These trends are clearly reflected in the latest European election outcomes in May 2014 as we have seen the rise of Euro-scepticisms with Anti-European parties (*The Economist*, 31 May 2014). Recently, Syriza won a legislative election for the first time in Greece. New leftwing government secured eurozone bailout extensions for 4 months, facing months of negotiations with its creditors over how to ease its unsustainable debt levels and austerity programmes.

[2]Moreover, trade liberalisation and currency union may provide an incentive for small and medium firms of peripheral countries with lower productivity to enter international markets by lowering export costs and trade barriers (e.g. the new good hypothesis in Baldwin. 2006).

currency on trade flows and trade balances.

We apply the proposed cross-sectionally dependent panel gravity model to the dataset over the period 1960-2008 (49 years) for 91 country-pairs of 14 EU countries. Our main empirical findings are summarised as follows: Firstly, once we control for time-varying multilateral resistance terms and trade costs appropriately through cross-sectionally correlated unobserved factors as well as endogenously selected multilateral resistance cluster, we find that the Euro impact on trade amounts to 7-10% only. This magnitude is consistent with broad evidence compiled by Baldwin (2006). Secondly, we find that the introduction of the euro has boosted trades among the Southern countries twice more than among the North. This evidence might corroborate the thesis that the potential trade-creating effects of the euro should be viewed in the proper historical and multilateral perspective rather than simply focusing on the formation of a monetary union as an isolated event, *e.g.* Berger and Nitsch (2008).

Turning to the impacts of bilateral resistance terms, we find that the impacts of both distance and common language on trade are significantly negative and positive whereas the border impact is no longer significant. Further investigation of time-varying impacts of these variables reveals that border and language effects started to decline more sharply especially after 1970, though both effects became flat approximately after the introduction of the euro, suggesting that the ongoing EU integration may reach near-completion stage (*e.g.* Frankel, 2005). On the other hand, distance impacts have not shown any pattern of downward trending, rather slightly rising from the mid 1990's. This generally supports broad empirical evidence that the notion of the death of distance is difficult to identify in current trade data (Disdier and Head, 2008; Jacks, 2009). Finally, we observe that average trades in the North have been higher than those in the South, though their gap has been narrower with the EU integration. The implication of these findings is that the Euro helps to reduce effects of conventional bilateral trade barriers and thus promote the EU integration by eliminating exchange rate-related uncertainties and transaction costs.

Finally and importantly, we find that the euro has exerted a negative impact on the trade balance of the South, as expected, though its magnitude seems to be rather modest as compared to the steep deterioration of current accounts of peripheral countries. The accumulation of deficits can be explained mostly by the documented increase in capital inflows, which have financed mainly non-tradable sectors, giving rise to an increased demand for imports and the loss of competitiveness for trading sectors, see Holinski *et al.* (2012), Hale and Obstfeld (2014) and Hobza and Zeugner (2014). Increasing current account deficits and the large public debt may also reflect market rigidities and imperfections in peripheral countries. The introduction of euro has facilitated the accumulation of these imbalances; not only peripheral countries borrow more but core countries also expand their lending to facilitate peripheral deficits, thereby increasing the financial fragility in the EU. Therefore, to ensure that capital flows from relatively rich to poor countries promote economic convergence, we should develop appropriate macroeconomic conditions.

The worsening of trade balance during the EU integration process is an evidence of the absence of real adjustment mechanisms, which calls for structural policy interventions aimed at correcting rigidities in the labour and productive structure as well as allocation problems in the financial sector, together with close monitoring of capital flow imbalances.

The paper is organised as follows: Section 2 reviews the literature on the Euro's Trade Effects. Section 3 describes the cross-sectionally dependent panel gravity models and proposes the estimation methodologies. Section 4 provides main empirical findings. Section 5 concludes. In Appendix we provide the appropriate panel gravity specifications for unequivocally analysing the euro impacts on trade flows and trade balances

2 Literature Review

There has been an intense policy debate on the Euro effects on trade flows between Euro and non-Euro nations.[3] Baldwin (2006) offers an extensive survey, covering the infamous Rose (2001)'s huge trading effect over 200% [4] as well as recent studies reporting relatively smaller effects. It is widely acknowledged that the Rose's estimate of the currency union effect on trade is severely (upward) biased. In particular, his estimates are heavily inflated by the presence of small (*e.g.* Panama) or very small (*e.g.* Kiribati, Mayotte) countries (Frankel, 2008). An important issue is why a currency union raises trades so much. In 2003 the UK Treasury made a bold prediction that the pro-trade effect of using the Euro on UK would be over 40%. One suspects that these results be seriously interpreted to mean that trade among its members would have collapsed in the late 1990s without the Euro (Santos Silva and Tenreyro, 2010). Thus, it is unclear whether one can uncover similar findings for the European monetary union involving the substantially large economies such as Germany and France.

The gravity model popularised by Rose (2001) attempts to provide the main link between trade flows and trade barriers, though his original approach has attracted the number of strong criticisms. The main critiques are classified as follows: inverse causality or endogeneity; missing or omitted variables; and incorrect model specification (nonlinearity or threshold effects). Now, the general consensus is that the currency union effect seems to be far less than those reported earlier by Rose and others, once all these methodological issues are appropriately accommodated.

Frankel (2005) claims that there are other third factors, such as common language, colonial history, and political/institutional link, that may influence both currency choice and trade link. In this regard, high correlations reported in earlier studies may be spurious as an artifact of reverse causality. To address this issue, a number of studies have employed different techniques such as Heckman selection and instrumental variables, though they still obtained the substantial Euro effects on trade, *e.g.* Persson (2001) and Alesina *et al.* (2002).[5]

A more important issue is omitted variables bias. Omitted pro-bilateral trade variables are likely to be correlated with the currency union dummy, as the formation of currency unions is not random, but rather driven by some factors which are likely to be omitted from the gravity regression. The implication

[3]The euro area contains 17 EU member states. In 1999 eleven countries adopted the euro while Greece entered in 2001. Slovenia joined in 2007, Cyprus and Malta in 2008, Slovakia in 2009 and Estonia in 2011. Denmark and the UK have 'opt-outs' from joining whereas Sweden has not yet qualified to be part of the euro area.

[4]Rose (2001) estimates a gravity equation using data for 186 countries from 1970 to 1990 and finds that countries in a currency union trade three times as much.

[5]Surprisingly, however, the Heckman instrumental variable approach generates huge estimates of the currency effects, sometimes even larger than the Rose effect.

is that the Euro effect will capture general economic integration among the member states, not merely the currency effect. Several studies tried to reduce the endogenous effect of currency unions by introducing country-pair and year fixed effects in the gravity regression. Micco *et al.* (2003) provide the first evaluation of the Euro effect, finding that the common currency boosts trade among Euro members by 4% in the short-run and 16% in the long-run. The subsequent studies by de Nardis and Vicarelli (2003), Flam and Nordström (2006), Berger and Nitsch (2008), and de Nardis *et al.* (2008), show that the range of the estimated Euro effects is still very wide from 2% to more than 70%.

Anderson and van Wincoop (2003) propose the 'micro foundation' of the gravity equation by introducing the multilateral resistance terms, which are relative trade barriers - the bilateral barrier relative to average trade barriers that both countries face with all their trading partners. Hence, the standard gravity model is seriously lacking if multilateral resistance terms and/or trade costs are ignored or seriously misspecified.[6] Furthermore, Baldwin (2006) stresses an importance of taking into account time-varying multilateral resistance terms, and criticises the conventional fixed effect estimation because many of omitted pair-specific variables clearly reflect time-varying factors such as multilateral trade costs. The use of time-invariant effects only may still leave a time-series trace in the residual, which is likely to be correlated with the currency union dummy (*e.g.* Baldwin and Taglioni, 2006).

A number of studies have attempted to capture such time-varying effects. Bun and Klaassen (2007) claim that upward trends in omitted trade determinants may cause the Euro effect to be substantially upward-biased. To deal with the heterogeneous effects of time varying omitted components across country-pairs, they introduce a time trend with heterogeneous coefficients, and find that the Euro effect on trade falls dramatically from 51% to 3% for the dataset over the period, 1967-2002. Moreover, Berger and Nitsch (2008) find no impact of the Euro on trade when including a linear trend in the gravity regression over the period, 1948-2003, and conclude that the Euro-12 countries have already been integrated strongly even before the Euro was created.

In sum, a large number of existing studies have established an importance of appropriately taking into account unobserved and time-varying multilateral resistance and bilateral heterogeneity, simultaneously. This immediately raises another important issue of how to explicitly and appropriately model cross-section dependence among trade flows. Recently, Herwartz and Weber (2010) propose to capture multilateral resistance terms and omitted trade costs via unobserved time-varying country-pair specific random walk factors, and develop the Kalman-filter extension of the gravity model. They find that aggregate trade (export) within the Euro area increases between 2000 and 2002 by 15 to 25 percent compared with trade with non-members. Camarero *et al.* (2012) suggest to estimate a gravity equation by a panel-based cointegration approach that allows for cross-section dependence through the common factors. Applying the continuously updated estimator of Bai *et al.* (2009) to the bilateral dataset for 26 OECD countries over the period 1967-2008, they find that the Euro

[6] The empirical gravity literature has simply added the remoteness variable, defined as a weighted average distance from all trading partners with the weights being based on the size of the trading partners, *e.g.* Frankel and Wei (1998) and Melitz (2007). Such atheoretical remoteness indices fail to capture any of the relative trade barriers in a coherent manner.

appears to generate somewhat lower trade effects.[7]

Alternatively, BEH derive a quantity-based structural gravity equation system in which both trade flows and error terms are allowed to be cross-sectionally correlated, and propose the modified spatial techniques by adopting a broader definition of the spatial weight matrix, called the interaction matrix, which can be derived directly from a theoretical model. By controlling for cross-sectional interdependence and thus directly capturing multilateral resistance, they find that the measured Canada–US border effects are significantly lower than paradoxically large estimates reported by McCallum (1995).[8]

Taken together, an euro effect on trade is expected to be smaller than previously thought once multilateral resistance and bilateral heterogeneity are well-captured through appropriately modelling cross-sectional correlation of trade flows. In retrospect, SS is the first paper to propose the cross-sectionally dependent panel gravity model by explicitly incorporating both observed and unobserved factors which are designed to control for time-varying multilateral resistance, trade costs and globalisation trends, simultaneously. In order to consistently estimate the parameters on both time-varying and time-invariant regressors, SS propose to combine the consistent estimator proposed by Pesaran (2006) with the instrument variables estimators advanced by Hausman and Taylor (1981).[9] By applying the proposed approach to the dataset for 91 country-pairs of 14 EU countries over the period 1960-2001, SS find that the euro does not exert any significant effect on intra-EU trade, though their sample covers only three years' data after the introduction of the euro in 1999.

The recent European sovereign-debt crises reveals that peripheral countries suffer from the high level of current account deficits and government debts. Current account imbalances are the outcome of cross-country differences in saving patterns, investment patterns and the degree of risk of assets. These differences are leading to good or bad imbalances (*e.g.* Blanchard and Milesi-Ferretti, 2009; Lane, 2012). Using a simple intertemporal model, Blanchard and Giavazzi (2002) show that for a converging country the recommended level of current account deficit increases with the expected output growth. This is because poorer countries' growth potential attracts foreign capital which finance current account deficits. They provide evidence that the relation between the current account balance and income per capita was much stronger during the 1994–2000 period than during the 1985–1993 period for the euro area. Schmitz and von Hagen (2011) find that the net capital flows follow differences in per

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[7]The approach by Camaero et al. (2012) can be regarded as an extension of Bun and Klaasen (2007), who estimate the cointegrating relationship without controlling for CSD. But, the euro impact is estimated at 16%, substantially higher than 3% by Bun and Klaasen (2007).

[8]BEH also argue that their approach - unconstrained linearized gravity equation with cross-sectionally correlated trade flows - is better suited than the two-stage gravity equation system with nonlinear constraints in unobservable price indices advanced by Anderson and von Wincoop (2003).

[9]Bertoli and Fernández-Huertas Moraga (2013) propose an empirical framework in which the common factor setup can be derived from the theoretical gravity model, thus justifying the link between factors with heterogeneous loadings and multilateral resistance terms. In this context, they apply the CCE estimator proposed by Pesaran (2006) to the gravity model of migration flows using high-frequency data during the Spanish immigration boom between 1997 and 2009, and document evidence that controlling for multilateral resistance to migration tend to produce much larger policy effects. These studies also demonstrate that ignoring the multilateral resistance generates biased estimates of the determinants of migration.

capita income among the EU-15 countries by employing trade balances against euro area and the rest of the world over the period 1981-2005, and that this elasticity increased following the inception of the euro, concluding that the widening of current account balances within the euro area should be considered a sign of the proper functioning of economic integration. Niemen (2014) augments the previous studies by including a larger set of explanatory variables, and finds that the main results by Schmitz and von Hagen (2011) largely disappear; namely, the euro has not increased the elasticity of trade flows to per capita income among EU-15 countries over the period, 1984-2011.

On the other hand, when large deficit countries grow much slowly than surplus countries, consumption growth in the former necessarily rises faster than income growth, a process that is likely to end up with a crisis. Even at the early stage of the EMU, Jones (2003) warned against the potential danger of peripheral countries accumulating excessive deficits. Giavazzi and Spaventa (2010) argue that this trend underlies the sovereign debt crisis observed within the euro zone. They also show that if foreign borrowing is not necessarily devoted to the production of tradable goods, then the deficit country cannot successfully generate the required trade surpluses in future. Holinski *et al.* (2012) document that the current account of the euro area has been roughly balanced over the period 1992-2007, which implies that the deficits were almost exclusively financed from the surpluses in other euro area countries. The increasing current account surpluses in the North are due to upward trends in the trade surplus and its net factor income receipts while the increasing current account deficits in the South are mainly driven by the decline in transfers and the increase in net factor payments. As about two-thirds of the current account deficit of the South is due to its net factor income payments, they conclude that the main cause of the massive current account deficits in the South is due to the loss of transfer receipts and the increased net factor payments rather than the trade balance dynamics.[10]

Two main explanations are proposed for the persistence of current account deficits among EU periphery members: (i) the loss of competitiveness (declining export performance due to real exchange rate deterioration) and (ii) the unsustainable credit expansion driven by cheap capital flow as well as fiscal excess. The competitiveness argument emphasises that the trade and current account imbalances depend on a structural imbalance between export-led countries which run surpluses (Austria, Belgium, Finland, Germany, the Netherlands) and domestic demand-led countries which run deficits (Italy, Spain, Greece, Portugal, and Ireland), see Obstfeld and Rogoff (2009) and Shambaugh *et al.* (2012). With the currency union, competitiveness, measured by a country's real exchange rate, became function only of inflation. Hence, with the introduction of euro, core countries, which kept their inflation rates low, realise a competitive advantage which leads to trade and current account surpluses. Conversely, periphery EU members, with high inflation rates, lost competitiveness and increase their trade and current account deficits. In order to finance these deficits, these countries needed to externally borrow through the capital account which largely stemmed from the North (Gros, 2012).[11] This loss-of-competitiveness argument

[10] See also Jaumotte and Sodsriwiboon (2010) for similar descriptive evidence, showing that of the 10% average decline in the current account, the trade balance contributed 2.8%, net income contributed 3.6%, and net transfers 3.6%.

[11] Such external borrowing could either occur via private banking channels (Ireland and

explains rising financial and trade imbalances between the EMU's creditor and debtor countries as the causal factor via the current account.

However, a second explanation, found within the broader international political economy and financial liberalisation literature, argues that the loss of competitiveness was a consequence of credit expansion. This literature suggests that the source of rising imbalances between core and peripheral countries stems from the influence of the monetary union on nominal interest rates, which expanded the availability of cheap credit for the private and public sector. Increase in financial integration in the euro area favours inflows of foreign capital to non-tradable sectors of periphery countries, thus boosting demand for imports and increasing prices in non-tradable goods and services (*e.g.* Galier and Vicard, 2014). The trade and current account imbalances in peripheral countries after the euro's inception is hence caused mainly by capital inflows financing debt repayment, financing consumption and an inflated housing bubble (*e.g.* Hughes Hallett and Marinez Oliva, 2013). According to the model advanced by Hale and Obstfeld (2014), the introduction of euro encourages core countries to become the financial intermediaries by increasing borrowing from outside EMU as well raising lending to the periphery through debt markets and bank lending.[12] This also provides the support for the hypothesis of Aguiar *et al.* (2014) that, for countries with a history of high inflation (*e.g.* Greece and Italy), an increase in inflation credibility after joining the euro leads to sharp reduction in inflation together with a prolonged build up of sovereign debt due to raising the maximum borrowing limit of the country and reducing any incentive to save. In this regard, peripheral countries gain the higher inflation commitment of a monetary union, but ending up with a sovereign borrowing boom. In sum, it is argued that the euro has facilitated and financed the accumulation of these imbalances such that peripheral countries borrow more, but core countries expand their lending to facilitate peripheral deficits, thereby increasing their financial fragility. Indeed the recent EU crisis has highlighted the role of these intra-EU payments imbalances for the survival of the EMU.

There are a number of empirical studies that attempt to identify main determinants of the current account balances, see Jaumotte and Sodsriwiboon (2010), Schmitz and von Hagen (2011), Chen *et al.* (2013), Berger and Nitsch (2014) and Nieminen (2014) among others. In particular, Berger and Nitsch (2014) employ the bilateral trade data on 18 EU countries over the period, 1948-2008, finding that, as a result of introduction of the euro, the trade imbalances among the euro area members, defined as the absolute difference between export and import, widened (about 2-3%) and became more persistent (about 25%). Up to our knowledge, however, there is no single study that directly investigates the impact of the euro on the regional EU trade or current account balances.

Notice that the current account of the euro area has been roughly balanced against the rest of the world over the EMU and the euro period whereas current account deficits of peripheral countries have reached unprecedented levels, see Holinski *et al.* (2012). In this regard, it is rather surprising to find out that such

Spain) or through public borrowing channels (Italy and Greece).

[12]Chen et al. (2013) argue that the global investors primarily invested in core countries such as Germany whereas private capital flows from core countries financed the deficits in peripheral countries. They find evidence that there were differences on how the rise of China, higher oil prices, and the integration of Central and Eastern European countries affected the trade performance of peripheral countries compared to Germany.

an important issue of estimating the euro's impacts on trade and current account imbalances of peripheral against core countries in the EU and *vice versa*, has been almost neglected in the empirical literature. However, the aforementioned studies are inappropriate to unravel such an issue as their dependent variables are not suitably constructed to directly evaluate the impacts of the common currency on regional trade balances.[13] As is clear from Appendix A.2, in order to provide an unequivocal interpretation of the euros' impact on the trade imbalances of the South against the North, we should develop the proper gravity regression specification for bilateral export and import flows. Furthermore, the literature on trade/current account balances seems to completely ignore an important issue of CSD in modelling the multilateral resistance and bilateral heterogeneity, and apply the standard pooled OLS or the FE estimation. Given the growing evidence of CSD in the panel data models (*e.g.* Bailey *et al.*, 2013; MSS), the empirical results of most existing studies are highly likely to be misleading in the presence of CSD.

Given the availability of a longer sample, we wish to redress this important issue by extending the cross-sectionally dependent panel gravity model and addressing all of the issues related to unobserved and time-varying multilateral resistance and bilateral heterogeneity as surveyed above. We also aim to make contributions by deriving the proper gravity specification for an unequivocal analysis of the euros' impact on regional EU trade imbalances and then applying the proposed CSD panel gravity modelling approach.

3 Cross Sectionally Correlated Panel Gravity Models

An Euro effect on trade flows and trade balances should be carefully examined under the appropriate econometric framework that is expected to deal with time-varying and cross-sectionally correlated multilateral resistance and bilateral heterogeneity in a robust manner.[14] In what follows, we describe two alternative approaches, the spatial-based techniques developed by BEK and the factor-based approach proposed by SS. Then, following recent research trends (Bailey *et al.* 2013; Mastromarco *et al.*, 2014), we propose the unified framework for accommodating both weak and strong CSD in the panel gravity models.

Consider the factor-based panel data model:

$$y_{it} = \beta'\mathbf{x}_{it} + \gamma'\mathbf{z}_i + \pi_i'\mathbf{s}_t + \varepsilon_{it},\ i = 1, ..., N,\ t = 1, ..., T, \tag{1}$$

$$\varepsilon_{it} = \alpha_i + \varphi_i'\theta_t + v_{it}, \tag{2}$$

[13] For example, as the dependent variable, Jaumotte and Sodsriwiboon (2010) construct the individual country's current account against all countries over GDP; Schmitz and von Hagen (2011) the ratio of trade balance to GDP against the euro area (intra balance) and the trade balance against the rest of the world (extra balance); Berger and Nitsch (2014) trade balance and absolute value over total trade; Chen et al. (2013) bilateral export and bilateral import flows with respect to the rest of the world (50 top trading countries).

[14] The multilateral resistance function and trade costs are not only difficult to measure, but also vary over time. A number of *ad hoc* approaches have been proposed. Simply, time trends are added as a proxy, *e.g.* Bun and Klaassen (2007) and Berger and Nitsch (2008). Alternatively, regional remoteness indices are considered (*e.g.* Melitz, 2007). On the other hand this issue has been almost neglected in the trade balance literature.

where $\mathbf{x}_{it} = (x_{1,it}, ..., x_{k,it})'$ is a $k \times 1$ vector of variables that vary across individuals and over time periods, $\mathbf{s}_t = (s_{1,t}, ..., s_{s,t})'$ is an $s \times 1$ vector of observed factors, $\mathbf{z}_i = (z_{1,i}, ..., z_{g,i})'$ is a $g \times 1$ vector of individual-specific variables, $\beta = (\beta_1, ..., \beta_k)'$, $\gamma = (\gamma_1, ..., \gamma_g)'$ and $\pi_i = (\pi_{1,i}, ..., \pi_{s,i})'$ are the associated column vectors of parameters, α_i is an individual effect that might be correlated with regressors, $\mathbf{x}_{it}$ and $\mathbf{z}_i$, θ_t is the $c \times 1$ vector of unobserved common factors with the heterogeneous loading vector, $\varphi_i = (\varphi_{1,i}, ..., \varphi_{c,i})'$, and v_{it} is a zero mean idiosyncratic disturbance with constant variance. Chudik *et al.* (2011) show that these factor models exhibit the strong form of cross section dependence (hereafter, CSD).

To avoid the potential biases associated with the cross-sectionally dependent factor structure, (1), we consider the use of the two leading approaches developed by Pesaran (2006) and Bai (2009). Hence, we consider the following cross-sectionally augmented regression of (2):

$$y_{it} = \beta'\mathbf{x}_{it} + \gamma'\mathbf{z}_i + \lambda_i'\mathbf{f}_t + \tilde{\alpha}_i + \tilde{v}_{it}, \; i = 1, ..., N, \; t = 1, ..., T, \tag{3}$$

where $\mathbf{f}_t$ is the $\ell \times 1$ vector of augmented factors with $\ell = s + 1 + k$ and $\lambda_i = (\lambda_{1,i}, ..., \lambda_{\ell,i})'$, $\bar{y}_t = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} y_{it}$, $\bar{\mathbf{x}}_t = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} \mathbf{x}_{it}$, $\lambda_i' = (\pi_i' - (\varphi_i/\bar{\varphi})\,\bar{\pi}', (\varphi_i/\bar{\varphi}), -(\varphi_i/\bar{\varphi})\,\beta')'$ with $\bar{\varphi} = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} \varphi_i$ and $\bar{\pi} = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} \pi_i$, $\tilde{\alpha}_i = \alpha_i - (\varphi_i/\bar{\varphi})\,\bar{\alpha} - (\varphi_i/\bar{\varphi})\,\gamma'\bar{\mathbf{z}}$ with $\bar{\alpha} = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} \alpha_i$ and $\bar{\mathbf{z}} = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} \mathbf{z}_i$, and $\tilde{v}_{it} = v_{it} - (\varphi_i/\bar{\varphi})\,\bar{v}_t$ with $\bar{v}_t = N^{-1}\sum_{t=1}^{T}\sum_{i=1}^{N} v_{it}$. Using (3), we can estimate β consistently by the Pesaran's Pooled Common Correlated Effects (PCCE) estimator or the Bai's (2009) interactive principal component (IPC) estimator as follows:

$$\hat{\boldsymbol{\beta}}_{CSD} = \left(\sum_{t=1}^{T}\sum_{i=1}^{N} \mathbf{x}_i'\mathbf{M}_T\mathbf{x}_i\right)^{-1}\left(\sum_{t=1}^{T}\sum_{i=1}^{N} \mathbf{x}_i'\mathbf{M}_T\mathbf{y}_i\right), \; \hat{\boldsymbol{\beta}}_{CSD} = \hat{\boldsymbol{\beta}}_{CSDPCCE} \; or \; \hat{\beta}_{IPC} \tag{4}$$

where $\mathbf{y}_i = (y_{i1}, ..., y_{iT})'$, $\mathbf{x}_i = (\mathbf{x}_{i1}, ..., \mathbf{x}_{iT})'$, $\mathbf{M}_T = \mathbf{I}_T - \mathbf{H}_T\left(\mathbf{H}_T'\mathbf{H}_T\right)^{-1}\mathbf{H}_T'$, $\mathbf{H}_T = (\mathbf{1}_T, \mathbf{f})$, $\mathbf{1}_T = (1, ..., 1)'$ and $\mathbf{f} = (\mathbf{f}_1', ..., \mathbf{f}_T')'$. Notice that $\mathbf{f}_t = (\mathbf{s}_t', \bar{y}_t, \bar{\mathbf{x}}_t')'$ for PCCE and $\mathbf{f}_t = \left(\mathbf{s}_t', \hat{\theta}_t'\right)'$ for IPC.

Alternatively, the CSD among trade flows can be investigated through employing the spatial techniques. This approach assumes that the structure of CSD is related to the location and the distance on the basis of a pre-specified weight matrix. Hence, CSD is represented mainly by means of a spatial process, which explicitly relates each unit to its neighbours. The most popular approaches are the Spatial Autoregressive (SAR), the Spatial Moving Average (SMA), and the Spatial Error Component (SEC) specifications. The spatial panel data model is estimated using the maximum likelihood (ML) or the generalized method of moments (GMM) techniques (e.g., Elhorst, 2011). We follow BEK and consider a spatial panel data gravity (SARAR) model, which combines a spatial lagged variable and a spatial autoregressive error term:

$$y_{it} = \rho y_{it}^* + \beta'\mathbf{x}_{it} + \gamma'\mathbf{z}_i + \tilde{\alpha}_i + v_{it}, \; i = 1, ..., N, \; t = 1, ..., T, \tag{5}$$

$$v_{it} = \lambda v_{it}^* + u_{it} \tag{6}$$

where $y_{it}^* = \sum_{j \neq i}^{N} w_{ij} y_{jt}$ is the spatial lagged variable, and $v_{it}^* = \sum_{j \neq i}^{N} w_{ij} v_{jt}$ is the spatial autoregressive error term, w_{ij}'s are the spatial weight with the row-sum normalisation, $\sum_i w_{ij} = 1$, and u_{it} is a zero mean idiosyncratic disturbance with constant variance. This approach is especially designed to deal with weak CSD across variables and errors. ρ is the spatial lag coefficient and λ is the spatial error component coefficient. These coefficients capture the spatial spillover effects and measure the influence of the weighted average of neighboring observations. Chudik *et al.* (2011) show that a weak cross dependent process arises when pairwise correlations take non-zero values only across finite units that do not spread widely as the sample size rises.

Notice that the factor-based procedure can be extended to cope with the weak spatial effects (e.g., Holly *et al.*, 2010). This can be achieved by applying the spatial model to the (de-factored) residuals, because the spatial dependence is dominated by the common factor error structure. Bailey *et al.* (2013) develop methods that can distinguish the relationship between spatial units that is purely spatial from that which is due to the effect of common factors, and propose the multi-step estimation and testing procedure. They find that this approach can successfully uncover genuine spatial correlations in the study of US house prices. Recently, Kapetanios *et al.* (2014) propose an alternative nonlinear panel data model which can generate strong and/or weak CSD endogenously. This approach allows for considerable flexibility in terms of the genesis of the herding or clustering type behavior.

Following these research trends, MSS propose the novel framework for accommodating both weak and strong CSD in modelling technical efficiency in stochastic frontier panels by combining the exogenously driven factor-based approach and an endogenous threshold regime selection mechanism simultaneously. We thus consider the following unified modelling approach:

$$y_{it} = \beta' \mathbf{x}_{it} + \gamma' \mathbf{z}_i + \pi_i' \mathbf{s}_t + \varepsilon_{it},\ i = 1, ..., N,\ t = 1, ..., T, \tag{7}$$

$$\varepsilon_{it} = u_{it} + v_{it}, \tag{8}$$

$$u_{it} = \alpha_i + \rho \tilde{u}_{it}(r) + \varphi_i' \theta_t, \tag{9}$$

$$\tilde{u}_{it}(r) = \frac{1}{m_{it}} \sum_{j=1}^{N} I\left(|u_{it-1} - u_{jt-1}| \geq r\right) u_{jt-1}, \tag{10}$$

where $\tilde{u}_{it}(r)$ represents a spatial or cluster effect, r is the threshold parameter (determined endogenously) and v_{it} is an idiosyncratic disturbance. MSS develop the consistent estimation techniques, which involve the iterative estimations of (7) and (9) until convergence. The resulting CSD-consistent estimators are denoted respectively as the PCCE-KMS and the IPC-KMS estimator.

The proposed specifications can be expected to deal with complex interdependence across all trading partners in a flexible manner. In particular, the term, $\tilde{u}_{it}(r)$ in (9) is defined as the cross-sectional local average of the unobserved trade barrier among 'distant' trading partners, and thus it may be thought of capturing the multilateral resistance term via the spatial spillover effects. For example, as discussed by Behrens *et al.* (2012), if the trade barriers between country k and country j (k different from i and j) are reduced, then the trade flows between country j and country k increase while the trade flows between country i and j decrease. In this regard, we expect the sign of ρ to be negative because 'multilateral resistance' drives the trade flows towards alternative destinations. Determining how countries relate to each other requires us to select a suitable metric for dealing with any kind of interactions in any network structure on the basis of a dissimilarity (or similarity) measure. Our approach is expected to select this metric in an appropriate manner. We allow the trading partners to cluster and these clusters to evolve over time. The distinguishing feature of our approach lies in the use of both weak and strong CSD components through $\tilde{u}_{it}(r)$ and θ_t in modelling multilateral resistance and bilateral heterogeneity in a robust manner.

The panel gravity specification includes both time-varying and time-invariant regressors. This raises the issue that both PCCE and IPC estimators are unable to estimate the coefficients, γ on time-invariant variables because they are the extended fixed effect estimators. In this regard, SS combine the PCCE estimation with the instrumental variables estimation proposed by Hausman and Taylor (1981, HT), and develop the PCCE-HT estimator. Baltagi (2010) further proposes the PCCE-AM estimator by employing the additional instrument variables proposed by Amemiya and MaCurdy (1986, AM). We can also develop the corresponding counterparts, using the Bai's IPC estimator, which we denote by IPC-HT and IPC-AM estimators, respectively.

Conformable with HT, we decompose $\mathbf{x}_{it} = (\mathbf{x}'_{1it}, \mathbf{x}'_{2it})'$ and $\mathbf{z}_i = (\mathbf{z}'_{1i}, \mathbf{z}'_{2i})'$ in (7), where $\mathbf{x}_{1it}$, $\mathbf{x}_{2it}$ are $k_1 \times 1$ and $k_2 \times 1$ vectors, and $\mathbf{z}_{1i}$, $\mathbf{z}_{2i}$ are $g_1 \times 1$ and $g_2 \times 1$ vectors with $k_1 \geq g_2$. Under the standard assumptions that $\mathbf{x}_{1it}$ and $\mathbf{z}_{1i}$ are uncorrelated with α_i, but $\mathbf{x}_{2it}$ and $\mathbf{z}_{2i}$ are correlated with α_i, we estimate γ consistently using instrumental variables in the following regression:

$$d_{it} = \gamma'_1 \mathbf{z}_{1i} + \gamma'_2 \mathbf{z}_{2i} + \alpha^*_i + u^*_{it} = \mu + \gamma' \mathbf{z}_i + \varepsilon^*_{it},\ i = 1, ..., N,\ t = 1, ..., T, \quad (11)$$

where $d_{it} = y_{it} - \boldsymbol{\beta}'_{CSD}\mathbf{x}_{it} - \lambda'_i \mathbf{f}_t$, $\mu = E(\alpha^*_i)$ and $\varepsilon^*_{it} = (\alpha^*_i - \mu) + u^*_{it}$ is a zero mean process by construction. In matrix notation we have:

$$\mathbf{d} = \mu \mathbf{1}_{NT} + \mathbf{Z}_1 \gamma_1 + \mathbf{Z}_2 \gamma_2 + \varepsilon^*, \quad (12)$$

where $\mathbf{d} = (\mathbf{d}'_1, ..., \mathbf{d}'_N)'$, $\mathbf{d}_i = (d_{i1}, ..., d_{iT})'$, $\mathbf{Z}_j = \left((\mathbf{z}'_{j1} \otimes \mathbf{1}_T)', ..., (\mathbf{z}'_{jN} \otimes \mathbf{1}_T)' \right)'$, $j = 1, 2$, $\mathbf{1}_{NT} = (\mathbf{1}'_T, ..., \mathbf{1}'_T)'$, $\mathbf{1}_T = (1, ..., 1)'$, and $\varepsilon^* = \left(\varepsilon^{*\prime}_1, ..., \varepsilon^{*\prime}_N \right)'$ with $\varepsilon^*_i = (\varepsilon^*_{i1}, ..., \varepsilon^*_{iT})'$. Replacing $\mathbf{d}$ by its consistent estimate, $\hat{\mathbf{d}} = \left\{ \hat{d}_{it}, i = 1, ..., N,\ t = 1, ..., T, \right\}$, where $\hat{d}_{it} = y_{it} - \hat{\boldsymbol{\beta}}'_{CSD}\mathbf{x}_{it} - \hat{\lambda}'_i \mathbf{f}_t$ with $\hat{\lambda}_i$ the OLS estimator of λ_i consistently estimated from the regression of $\left(y_{it} - \hat{\beta}'_{CSD}\mathbf{x}_{it} \right)$ on $(1, \mathbf{f}_t)$ for $i = 1, ..., N$, we have:

$$\hat{\mathbf{d}} = \mu \mathbf{1}_{NT} + \mathbf{Z}_1 \gamma_1 + \mathbf{Z}_2 \gamma_2 + \varepsilon^+ = \mathbf{C}\delta + \varepsilon^+, \quad (13)$$

where $\varepsilon^+ = \varepsilon^* + \left(\hat{\mathbf{d}} - \mathbf{d} \right)$, $\mathbf{C} = (\mathbf{1}_{NT}, \mathbf{Z}_1, \mathbf{Z}_2)$ and $\delta = (\mu, \gamma'_1, \gamma'_2)'$.

To deal with nonzero correlation between $\mathbf{Z}_2$ and α, we need to find the $NT \times (1 + g_1 + h)$ matrix of instrument variables:

$$\mathbf{W} = [\mathbf{1}_{NT}, \mathbf{Z}_1, \mathbf{W}_2],$$

where $\mathbf{W}_2$ is an $NT \times h$ matrix of instrument variables for $\mathbf{Z}_2$ with $h \geq g_2$ for identification. First, we consider the $NT \times (k_1 + \ell)$ HT instrument matrix:

$$\mathbf{W}^{HT}_2 = \left[\mathbf{P}\mathbf{X}_1, \mathbf{P}\hat{\xi}_1, \mathbf{P}\hat{\xi}_2, ..., \mathbf{P}\hat{\xi}_\ell \right]$$

where $\mathbf{P} = \mathbf{D}(\mathbf{D}'\mathbf{D})^{-1}\mathbf{D}'$ is the $NT \times NT$ idempotent matrix with $\mathbf{D} = \mathbf{I}_N \otimes \mathbf{1}_T$, $\mathbf{I}_N$ an $N \times N$ identity matrix, and $\hat{\xi}_j = \left(\hat{\lambda}_{j,1}\mathbf{f}_j', \hat{\lambda}_{j,2}\mathbf{f}_j', ..., \hat{\lambda}_{j,N}\mathbf{f}_j'\right)'$, $j = 1, ..., \ell$, where $\mathbf{f}_j = (f_{j,1}, ..., f_{j,T})'$. Next, we derive the $NT \times (k_1 + \ell + Tk_1 + T\ell)$ AM instrument matrix by

$$\mathbf{W}_2^{AM} = \left[\mathbf{W}_2^{HT}, (\mathbf{QX}_1)^*, \left(\mathbf{Q}\hat{\xi}_1\right)^*, \left(\mathbf{Q}\hat{\xi}_2\right)^*, ..., \left(\mathbf{Q}\hat{\xi}_\ell\right)^*\right] \tag{14}$$

where $\mathbf{Q} = \mathbf{I}_{NT} - \mathbf{P}$ and $(\mathbf{QX}_1)^* = (\mathbf{QX}_{11}, \mathbf{QX}_{12}, ..., \mathbf{QX}_{1T})$ is the $NT \times k_1T$ matrix with $\mathbf{QX}_{1t} = (\mathbf{QX}_{11t}, ..., \mathbf{QX}_{1kt})'$.

To derive the consistent estimator of δ, we premultiply $\mathbf{W}'$ by (13)

$$\mathbf{W}'\hat{\mathbf{d}} = \mathbf{W}'\mathbf{C}\delta + \mathbf{W}'\varepsilon^+. \tag{15}$$

Therefore, the GLS estimator of δ is obtained by

$$\hat{\delta}_{GLS} = \left[\mathbf{C}'\mathbf{W}\mathbf{V}^{-1}\mathbf{W}'\mathbf{C}\right]^{-1}\mathbf{C}'\mathbf{W}\mathbf{V}^{-1}\mathbf{W}'\hat{\mathbf{d}}, \tag{16}$$

where $\mathbf{V} = Var(\mathbf{W}'\varepsilon^+)$. To obtain the feasible GLS estimator we replace $\mathbf{V}$ by its consistent estimator. In practice, estimates of δ and $\mathbf{V}$ can be obtained iteratively until convergence, see also SS for further details.

Notice that the HT-IV estimator employs only the individual mean of $\mathbf{X}_1$ to be uncorrelated with the effects, α_i^* whereas the AM-IV estimator exploits such moment conditions to be held at every time period. Hence, the validity of the AM instruments requires a stronger exogeneity assumption for $\mathbf{X}_1$, under which the AM-IV estimator is more efficient than HT-IV. The validity of the AM instruments can be easily tested via the Hausman statistics testing for the difference between HT-IV and AM-IV estimators as follows:

$$H_{AM} = \left(\hat{\delta}_{AM} - \hat{\delta}_{HT}\right)'\left[Var\left(\hat{\delta}_{HT}\right) - Var\left(\hat{\delta}_{AM}\right)\right]^{-1}\left(\hat{\delta}_{AM} - \hat{\delta}_{HT}\right)$$

which follows the asymptotic χ_g^2 distribution with the degree of freedom g being the number of coefficients tested.

4 Empirical Applications

We extend the dataset analysed by Serlenga and Shin (2007) to cover the longer period 1960-2008 (49 years) for 91 country-pairs amongst 14 EU member countries (Austria, Belgium-Luxemburg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom).[15] Our sample period consists of several important economic integrations, such as the Custom Union in 1958, the European Monetary System in 1979 and the Single Market in 1993, all of which can be regarded as promoting intra-EU trades (Eurostat, 2008).[16]

[15] Denmark, Sweden and The UK constitute a meaningful control group since these non-member countries, as part of the EU, experienced similar history and faced similar legislation and regulation to euro-area countries.

[16] To mitigate the potentially negative impacts of the ongoing global financial crisis on our analysis, however, we exclude the data after 2008. Both imports and exports in the Euro area fell by around one-fifth in 2009 (Statistical Yearbook, 2010).

Focusing on the EU trade patterns since the Euro, we find from Eurostat (2003) that the EU trade fell by only 0.7% per annum during 2000-2003, though the global trades sharply contracted following the world-wide recession in 2001 and 2002 (trade flows of US, Japan and Canada, recorded an annual reduction of around 6.7%). The EU trades grew strongly during 2003-2007, thanks to upswing in the world trade taking place after 2003 and the accession of 12 new member states in 2004 and 2007. In particular, the intra-EU trade increased by almost 40% during 2003-2004, mainly due to the 25% real appreciation of the Euro against the US dollar (Eurostat, 2003). The Euro area trade in goods grew significantly over the last decade - increased to 32% of Euro area GDP in 2008 from 26 % in 1999 (Unctad, 2012). Furthermore, trade growth was faster than real GDP growth, leading to an increasing openness ratio of the Euro area (as measured by the sum of imports and exports as a share of GDP), which reached 82% in 2008 as compared to 64% in 1999 (World Bank, 2012). These tight trade linkages can be explained partially by both single market and single currency (ECB Bulletin, 2010).

Table 1 presents summary figures of the EU trade shares and growths. First, the intra-EU trade has been a considerable part of the total EU trade as its share reached over 60% since 1990s. Second, the US is still the leading trade partner of the EU, though its leading role has recently been challenged by China and Russia, as the US share of extra-EU trade decreased significantly from 21.9% in 2000 to 15.1% in 2008. Third, the trade grows faster than real GDP in the 2000s. Finally, the share of exports is slightly higher than that of imports.

In a regional perspective, we observe that peripheral countries have always suffered from trade deficits against core over the whole sample period. Furthermore, the average growths of intra-EU exports and imports registered opposite patterns for the peripheral and core countries; the export of the former grew faster than its import till the 90's, then slowing down. As a result the trade balance of the periphery ameliorated until 1990, but it became worsening afterwards. Figure 1 displays an inverse-U shape of the peripheral countries' trade balance. This pattern is generally consistent with the hypothesis that the fixed exchange rate regime (*e.g.* the EMU) is likely to be associated with the larger trade imbalances. Furthermore, we find that their trade deficits are more pronounced against EMU core countries than non-EMU countries.

Table 1 and Figure 1 about here

The creation of EMU and the subsequent introduction of the euro may correspond to the start of the current account deterioration of the South (*e.g.* Jaumotte and Sodsriwiboon, 2010). To further examine this issue we collect the aggregate current account and trade balances of peripheral and core EU countries against the rest of the world.[17] From Figure 2 we observe: First, trade balances of the periphery tracked its current account balances very closely until the late 90's. Second, since the launch of the euro, current account balances of the periphery became more worsened than its trade balances.[18] Finally, from

[17]The data on bilateral current accounts are not available. As Intra-EU trade balance pattern closely follows that of trade balance against the rest of the world (e.g. Chen et al., 2013), this approximate analysis is expected to provide qualitatively similar evidence.

[18]Such downward trends of trade and current account balances of the peripheral countries are accompanied by the deterioration of their net foreign asset position (see Figure 1 in Chen *et al.*, 2013).

2006 onwards, the gap between trade and current account balances of the South became wider as the South trade deficits started to be somewhat improving while its current account deficits continued to rise. This pattern is broadly consistent with Holinski *et al.* (2012) who document that it is not the trade balance dynamics that cause the massive current account deficits in the South but rather the loss of transfer receipts and the increased net factor payments.

Figure 2 about here

4.1 The effect of the Euro on bilateral trade flows

We now examine the Euro's trading effects by applying the cross-sectionally dependent panel data methodology developed in Section 3 and Appendix A.1.[19] When estimating the panel data gravity model, we consider three cases. In the first case, we consider the model without unobserved time-varying factors in (7) with $\varepsilon_{it} = \alpha_i + v_{it}$ in which case we consider the FE estimation.[20] Next, we consider the model which explicitly incorporates unobserved time-varying factors in (7) with $\varepsilon_{it} = \alpha_i + \varphi_i'\theta_t + v_{it}$, and employ two consistent PCCE and the IPC estimators. Finally, we apply the proposed model given by (7)-(10), which is designed to control for both weak and strong CSD in modelling time-varying unobserved multilateral trade barriers. In this case we apply the PCCE-KMS and IPC-KMS estimators.

Table 2 presents the estimation and test results for the bilateral trade flows. We select the final preferred model on the basis of the CD diagnostic test advanced by Pesaran (2013). As expected, the FE estimation results suffer from strong evidence of CSD. Surprisingly, the CD tests applied to the defactored residuals from the PCCE and IPC estimation, also reject the null hypothesis of no weak CSD convincingly. Finally, the CD test fails to reject the null of no weak CSD for both PCCE-KMS and IPC-KMS estimators, suggesting that our proposed methodology is able to successfully deal with both strong and weak CSD in the dataset.

Given the CD test results, we focus on the PCCE-KMS and IPC-KMS results. In the former we consider $\mathbf{f}_t = \left\{t, RERT_t, \overline{TGDP}_t, \overline{SIM}_t, \overline{RLF}_t, \overline{CEE}_t\right\}'$ in (3), where the bar over variables indicates their cross-sectional average, t is the linear trend and $RERT_t$ is an observed factor defined as the (logarithm of) real exchange rates that would capture relative price effects between the EU currencies and the US dollar.[21] To derive IPC estimators, we first extract six common PC factors using the Bai and Ng (2002) procedure, and use them as $\mathbf{f}_t$

[19]The dependent variable is the bilateral total trade flows defined as the sum of the logarithms of real export and import flows. The regressors are: the sum of the logarithms of reporter and partner's GDP ($TGDP$) which proxies for trade mass; similarity in size (SIM) and difference in relative factor endowment (RLF) are introduced following recent advancements of New Trade Theory; the logarithm of real exchange rate (RER) proxying for relative price effects; a dummy for European Community membership (CEE) and a dummy for European Monetary Union (EMU); time-invariant bilateral resistance terms such as a dummy for common language (LAN), for common border (BOR), and the logarithm of geographical distance (DIS). See the Data Appendix in SS for details.

[20]The fixed effects (FE) model takes into account the bilateral trade heterogeneity only. So these results are presented mainly for comparison with existing studies. We have also estimated the two-way FE model with $\varepsilon_{it} = \alpha_i + \theta_t + v_{it}$. We find that these estimation results (available upon request) are mostly misleading. As highlighted by SS, this is mainly due to its failure to accommodate (heterogeneous) cross-section dependence.

[21]After estimating a number of specifications augmented with several combinations of fac-

in (3) together with t and $RERT_t$. Furthermore, to consistently estimate the impacts of individual-specific variables jointly under the maintained assumption that LAN is the only time invariant variable correlated with individual effects, we use the instrument variables, $HT = \left\{IV, \hat{\xi}_{it}\right\}$, where $IV = \{RER_{it}, RLF_{it}\}$, $\hat{\xi}_{it} = \hat{\lambda}_i f_t$, and $\hat{\lambda}_i$ are estimated loadings. We also consider an additional instrument set denoted AM performing the AM transformation to the HT set.[22]

Both PCCE-KMS and IPC-KMS estimation results are mostly statistically significant and consistent with our *a priori* expectations. The impact of $TGDP$ (the sum of home and foreign country GDPs) on trade is positive. Similarity in size (SIM) boosts trade flows. The impact of relative difference in factor endowments between trading partners (RLF) is very small and insignificant, which is a plausible finding given that the impact of RLF on total trade flows (the sum of inter- and intra-industry trades) might not be unambiguous.[23] Combined together, these results may suggest that the intra-industry trade has become the main part of the intra-EU trade.[24] Thirdly, a depreciation of the home currency (increase in RER) leads to a modest increase in trade flows, which is consistent as the export component of the total trade is slightly higher than the import component (see Table 1). Fourthly and importantly, the impacts of EMU and CEE are significant, but they become substantially smaller than the FE counterpart. The Euro impact drops sharply from 0.212 to 0.108 and 0.070 for the PCCE-KMS and IPC-KMS estimators. This range is consistent with a broad evidence compiled by Baldwin (2006) and recent studies reviewed in Section 2. Similarly, the estimated impacts of CEE (0.369 for PCCE-KMS and 0.068 for IPC-KMS estimator) are significantly lower than the FE estimate (0.591).

Furthermore, the PCCE-KMS and IPC-KMS estimators produce estimates of the threshold parameter, r and the spatial autoregressive parameter, ρ in (9). The threshold coefficient ($r = 1.594$) is close to the standard deviation of unconditional distribution of the trade flows of 1.9, suggesting that the trading partners group, $\tilde{u}_{it}(r)$, selected endogenously, consists of rather distant countries. Consistent with our *prior*, the spillover coefficient, ρ, is significantly negative, implying the strong negative spillover effects of multilateral resistance trade barriers. This finding might provide a support for the hypothesis that multilateral resistance more likely to be induced by trade flows-related distance rather than the geographical distance (*e.g.* Behrens *et al.*, 2012; Bertoli and Moraga, 2013).

Finally, turning to time-invariant regressors and focussing on more efficient AM-IV estimates as confirmed by the Hausman test results, we find that distance and common language dummies exert significantly negative and positive

tors, we have selected the final specification on the basis of overall statistical significance and empirical coherence. See also Ertur and Musolesi (2013) for similar analysis.

[22] The AM-IV set is created as follows: We can construct up to $T(k_1 + \ell)$ additional instruments, where $\ell = 5$ in CEEP and $\ell = 6$ in PC. Due to the low cross-variation between $(\mathbf{QX}_1)^*$ and $\left(\mathbf{Q}\hat{\xi}\right)^*$, we only consider the subset of $T(k_1 + \ell)$ to avoid collinearity. Beginning with the first T years we include as many instruments as possible. The final selection is made on the basis of the Sargan test results.

[23] This is because the larger difference may result in the higher (lower) volume of inter- (intra-) industry trade.

[24] The share of the intra-trade has increased from 37.2% in 1960 to around 60% from 1990 onwards (see Table 1).

impacts on trade whereas the border impact is no longer significant. We therefore conclude that all these estimation results are broadly consistent with our *a priori* expectations and survey evidence reviewed in Section 2.

Table 2 about here

The euro's effect on regional trade flows Next, to evaluate the euro effects on the regional trade flows, we consider the divide between the North (Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, the Netherlands, Sweden and the UK) and the South (Greece, Ireland, Italy, Portugal and Spain).[25] We then construct three regional dummies, denoted NN (1 when both countries belong to the North, and 0 otherwise), NS (1 when one country belongs to the North and another belongs to the South or *vice versa,* and 0 otherwise) and SS (1 when both countries belong to the South, and 0 otherwise). To decompose the total effects of the euro into the three regional (namely, the within-North, the within-South and the between North-South) effects, we construct three interaction dummies, denoted by $euro_{NN} = euro \times NN$, $euro_{NS} = euro \times NS$, and $euro_{SS} = euro \times SS$, respectively. Thus, we augment the gravity specification in (18) as follows:[26]

$$y_{it} = \boldsymbol{\beta}'\mathbf{x}_{it} + \boldsymbol{\beta}_w'\mathbf{w}_{it} + \boldsymbol{\gamma}'\mathbf{z}_i + \boldsymbol{\gamma}_d'\mathbf{d}_i + \varepsilon_{it},\ i = 1, ..., N(N-1)/2, \quad (17)$$

where $\mathbf{w}_{it} = (euro_{NN}, euro_{NS}, euro_{SS})'$ and $\mathbf{d}_i = (NN, SS)'$. This specification, (17) also enables us to estimate the average time-invariant regional trade effects of NN and SS. Similarly, we construct three regional dummies interacted with CEE (a dummy for European Community membership), namely, $CEE_{NN} = CEE \times NN$, $CEE_{NS} = CEE \times NS$, and $CEE_{SS} = CEE \times SS$, and decompose the total effects of the trade union into the three regional effects.

The estimation results for the augmented gravity specification in (17) are summarised in Table 3. Panel A shows that the euro has boosted the within-South trades twice more than the within-North trades. This evidence might corroborate the thesis that the trade increase within the Euro area reflects a continuation of a the long-run historical trend, probably linked to the broader set of EU's economic integration policies and institutional changes.[27] Indeed, most

[25] Our choice of including the Irish economy in the South is mainly guided by its experience during the European integration and recent financial crises as they are the five largest net debtors' in the eurozone.

[26] Since the dummies are mutually exclusive, it is easily seen that the euro dummy is the sum of three interactions:

$$euro_{it} = euro_{it} \times NN_i + euro_{it} \times SS_i + euro_{it} \times NS_i.$$

Hence, the total impact coefficient of the euro is equal to the weighted average of the impact coefficients of the regional interaction dummies as follows:

$$\beta_{euro} = \left(\frac{1}{N_{SS}} \times \beta_{euroSS} + \frac{1}{N_{NS}} \times \beta_{euroNS} + \frac{1}{N_{NN}} \times \beta_{euroNN} \right)$$

where the weights are determined by the frequency of each groups.

[27] The European Economic Community members attempted to limit currency volatility after the collapse of the Bretton Woods system in 1971. The so-called "snake in the tunnel" was the first example of European monetary cooperation, aiming at limiting fluctuations between different European currencies. The tunnel consisted of bands of 2.25% up and down, inside which currencies were allowed to trade. The system started in April 1972 with 9 members (Belgium, France, Italy, Luxembourg, the Netherlands, West Germany, the UK and Ireland).

countries in the North had been more integrated well before the introduction of the euro, as confirmed by the results in Panel B displaying that trade flows are, on average, higher in the North than in the South. In fact, when the euro was planned in the 1990s, German politicians wanted a currency zone comprising only Germany, the Benelux countries and France. Hence, the effect of the euro may have been well-anticipated in the North, leading to a lower euro effect on trades among the North.

Table 3 about here

The effect of the Euro on the EU integration We investigate an issue related to the time-varying effects of bilateral trade barriers on trade, which is expected to shed lights on the currency union effect on trade through bilateral resistance channels. In this regard we examine the following hypothesis: if the Euro had a positive effect on internal European trade (by reducing overall trade barriers), this might have caused a decrease in trade impacts of bilateral trade barriers (*e.g.* Cafiso, 2011). Consequently, we investigate whether the trend line of the bilateral resistance coefficients is more downward-sloping after 1999 than before 1999. To this end we re-estimate the model, (13), by the cross-section regression at each time period, and obtain time-varying coefficients. This estimation can be easily conducted within our framework after consistently estimating $\hat{d}_{it}$ in (13) by PCCE or IPC estimation.

Figure 3a displays these time-varying estimation results obtained by applying the AM-IV estimation where we employ k_1 instruments at each time period (see footnote 22). The border and language effects are steadily decreasing, especially after 1970. This downward trend may reflect the progressive lessening of restrictions on labor mobility within EU that encouraged migration and thus reduced the relative importance of border-linked trade costs and cultural differences. In fact, net migration in the EU registers an increasing trend after 1990, probably capturing the effect of the Maastricht Treaty in 1993 (World Bank, 2012).[28] However, the slope of both effects became flat approximately after the introduction of the euro (vertical line), which suggests that the ongoing EU integration may reach near-completion stage. This is consistent with the currency union formation hypothesis by Frankel (2005) that countries who decide to join a currency union are self-selected on the basis of distinctive features shared by countries that have been EU members during the pre-Euro period. Hence, countries are likely to foster integration by enhancing standards of harmonization and reducing regulatory barriers.

Turning to the distance effects on trade, we find that its impact have been on a rather (slight) rising trend from the middle of 1990's. This is broadly consistent with the meta-study by Disdier and Head (2008), who document that the trade elasticity with respect to distance does not decline over time, but rather increases. This may confirm that the notion of the death of distance has been difficult to identify in present-day trade data (Jacks, 2009).

Finally, we observe that trade volumes in the North have been higher on average than those in the South, though the coefficients on NN and SS dummies

[28]The Treaty of Maastricht in 1993 introduced the concept of citizenship of the European Union which confers every Union citizen a fundamental and personal right to move and reside freely without reference to an economic activity.

display an opposite trending pattern (see Figure 3b). This pattern confirms that the gap between NN and SS impacts narrows as the EU integration intensifies. After the euro, we also find that the coefficients of NN and SS tend to converge slowly but steadily, which may reflect a further ongoing regional integration.

Overall, we might conclude that the introduction of the Euro helps to promote more EU integration by reducing bilateral trade barriers and eliminating exchange rate-related uncertainties and transaction costs.

Figure 3 about here

4.2 The effect of the Euro on bilateral trade balances

We now wish to evaluate the euro effects on the regional trade balances. To this end we consider the same divide between the South (Greece, Ireland, Italy, Portugal and Spain) and the North (Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, the Netherlands, Sweden and the UK). Following the identification scheme developed in Appendix A.2, we should estimate the gravity regression of bilateral export flows from the South to the North and of bilateral import flows of the South from the North, respectively, using $5 \times 9 = 45$ sub-pairs. Thus, we are able to provide an unequivocal interpretation of the euros' impact on the trade imbalances of the South against the North. Obviously, we will get the mirror image for the South.

Tables 4 and 5 present the estimation and test results for the bilateral export and import flows of the South. The CD diagnostic test rejects the null hypothesis of no CSD for the FE, PCCE and IPC estimators, but it fails to reject the null of no CSD for PCCE-KMS and IPC-KMS estimators. Hence, we focus on the PCCE-KMS and IPC-KMS estimation results. The spillover effects of multilateral resistance (measured by $\hat{\rho}$) are significant and negative for both export and import flows. Both PCCE-KMS and IPC-KMS estimation results are mostly statistically significant except for SIM and RLF. Also there are a few discrepancies between two estimation results; the euro effect on export flows is small and positive for $PCCE$ while it is significant and negative for IPC; the euro effect on import flows is significant and positive for $PCCE$ and IPC, but the former is substantially higher than the latter.

Tables 4-5 about here

Turning to the trade balance effects In Table 6, we find that the impacts of both EMU and CEE are significant and negative, implying that the introduction of the euro leads to the significant trade deficits of the South with respect the North (around 15 to 18%). We also find that the trade union renders the South suffering from the trade deficits against the North (around 11 to 12%). Furthermore, since the impact of the euro on the export flows of the South is mostly negative, we may argue that EMU may be a partial cause behind the competitiveness loss of the Southern exporters. Finally, as expected, a depreciation of the home currency (increase in RER) leads to significant improvement of the terms of trade of the South.

Table 6 about here

As reviewed in Section 2, there are two main approaches to an analysis of rising current account imbalances between core and periphery EU members, and their respective policy implications are also substantially different. Under the current political regime, more emphasis has been placed on the role of price competitiveness in the process of current account rebalancing within the EMU. The peripheral countries should restore competitiveness by bringing inflation and unit labour cost growth below the euro area average. This is often seen as a long and painful process, which could even drive individual member states towards deflation. The focus on competitiveness thus leads to a plea for structural reforms on product and labour markets, that would speed up the adjustment of relative prices. However, after the crisis, most of the euro area countries have already achieved the balanced current account (even a surplus for Ireland), even though the adjustment of relative prices has been slow and partial. Moreover, real effective exchange rates have not returned to the levels at the start of EMU, and, therefore, losses in price competitiveness have not been fully restored yet.

Our estimation results for trade balances of the South are broadly consistent with this evidence, and show that the effect of euro on trade competitiveness deterioration of the South has been rather modest.[29] Together with the higher positive effect of euro on the within-South total trade flows, this finding may suggest that the introduction of the euro has enhanced the economic integration between core and peripheral countries, with a larger effect on total trades and a modest deterioration of competitiveness for the South. These results call for more emphasis on credit growth and macro prudential policy, in addition to the current focus on for competitiveness and structural reforms as policy advice.

5 Conclusions

The investigation of unobserved multilateral resistance terms in conjunction with omitted trade determinants has assumed a prominent role in the literature on the Euro's trade effects (Baldwin, 2006). In this paper we follow recent developments in panel data studies (Pesaran, 2006; Bai, 2009; Bailey *et al*, 2013, KMS, MSS), and extend the cross-sectionally dependent panel gravity models advanced by Serlenga and Shin (2007). The desirable feature of this approach is to control for time-varying multilateral resistance, trade costs and globalisation trends explicitly through the use of observed and unobserved factors as well as an endogenous threshold selection of multilateral clusters, which represent strong and weak forms of cross-section dependence. Furthermore, this approach allows us to consistently estimate the impacts of (potentially endogenous) bilateral trade barriers through combining the PCCE-KMS and IPC-KMS estimators with the HT and AM IV estimators.

Applying the proposed cross-sectionally dependent panel gravity model to the dataset over the period 1960-2008 (49 years) for 91 country-pairs amongst 14 EU member countries, we obtain stylised findings as follows: Firstly, as expected, the sum of home and foreign country GDPs significantly boosts trade

[29]Recently, Hobza and Zeugner (2014) construct a novel database of bilateral financial flows among euro area countries and their major world partners and explore the role of financial links in the accumulation of current account imbalances in the euro area. Using the exploratory data analysis and the spatial correlation they show that financial flows have been key in driving the specific pattern of intra-euro area imbalances, overriding the traditional role of trade flows in determining external balances of countries. These results suggest that the surplus countries financed the periphery in the euro area by more than their bilateral trade balances, and effectively intermediated flows coming from the rest of the world.

while a depreciation of the home currency increases trade flows. Secondly, the impact of difference in relative factor endowments is no longer significant whilst the effect of similarity turns out to be substantially larger. This suggests that similarity (in terms of countries' GDP rather than relative factor endowments) helps to ease the integration process by capturing trade ties across countries. Thirdly, the impacts of both distance and common language on trade are significantly negative and positive, attesting the validity of these proxies to capture bilateral trade barriers, though the border impact is no longer significant. Finally and importantly, the Euro's trade effect amounts to 7-10% only. We also find that the custom union effect is substantially reduced to 10% from 31% (without accommodating cross-section dependence). These modest effects of both currency and custom unions provide a support for the thesis that the trade increase within the Euro area may reflect a continuation of a long-run historical trend, probably linked to the broader set of EU's economic integration policies and institutional changes.

We also find that the impact of the euro on the trade balance of the South against the North is significant and negative, implying that the euro leads to trade deficits of the South (around 15 to 18%), though the effect of euro on trade competitiveness deterioration of the South seems to have been rather modest as compared to massive and unsustainable current account imbalances observed between core and periphery EU members. Our finding is qualitatively consistent with the exploratory data analysis by Holinski et al. (2012) and Hobza and Zeugner (2014), who demonstrate that the main cause of the massive current account deficits in the South is due to either the increased net factor payments or financial flows rather than the trade balance dynamics. In particular, given the availability of bilateral financial or current account flows, the application of our proposed CSD panel gravity model will be likely to shed further lights on the complex dynamic spillover and interlinkage among trade, current account and financial imbalances.

While the advent of the Euro might be a necessary condition for the European integration process to continue beyond the single market agenda in the early 1990s, the Euro's repercussions on trade are difficult to understand without taking proper account of the process of the underlying European institutions. The introduction of euro, by deepening a financial integration, has facilitated cheap capital flows and caused the loss of competitiveness due to deterioration of real exchange rate in countries with high inflation. The consequence was massive current imbalances in the EU, suggesting that mutually more prudent macroeconomic management is required such that future current account surpluses will be generated through enhancing productivity in export sectors and boosting the long-term productivity in economy. An obvious policy implication is that countries considering joining the Euro would benefit from the ongoing process of integration, but should also be wary of regarding promises of an imminent acceleration of intra-area trade and of unexpected build-up of unsustainable current imbalances.

Appendices

A Appendix: The Panel Gravity Model Specifications

In our empirical application we consider the following gravity model specification:

$$y_{it} = \boldsymbol{\beta}_1'\mathbf{x}_{1,it} + \boldsymbol{\beta}_2'\mathbf{x}_{2,it} + \boldsymbol{\gamma}_1'\mathbf{z}_{1,i} + \boldsymbol{\gamma}_2'\mathbf{z}_{2,i} + \pi_i'\mathbf{s}_t + \varepsilon_{it}, \tag{18}$$

where y_{it} is the bilateral total trade flows (the sum of bilateral export and import flows) or the bilateral trade balances (the difference between bilateral export and import flows), $\mathbf{x}_{1it}$, $\mathbf{x}_{2it}$ are $k_1 \times 1$ and $k_2 \times 1$ vectors of time-varying regressors, $\mathbf{z}_{1i}$, $\mathbf{z}_{2i}$ are $g_1 \times 1$ and $g_2 \times 1$ vectors of time invariant regressors, $\mathbf{s}_t$ is an $s \times 1$ vector of observed factors, and ε_{it} is the cross-sectionally correlated error components given by (8)-(10). Conformable with HT, we maintain the standard assumptions that $\mathbf{x}_{1it}$ and $\mathbf{z}_{1i}$ are uncorrelated with α_i, $\mathbf{x}_{2it}$ and $\mathbf{z}_{2i}$ are correlated with α_i, and $k_1 \geq g_2$.

In order to uncover an unambiguous effect of the Euro on bilateral trade flows and trade balances, we should develop the appropriate gravity regression specifications respectively for trade flows and trade balances. For the bilateral total trade flows SS estimate the gravity mode in (18),[30] and employ only the half of the total pairs $(91 = (14 \times 13)/2)$ due to the symmetry of the bilateral trade flows. We first establish that the SS approach is a valid approach for investigating an unambiguous effect of the Euro on bilateral trade flows. We then develop the appropriate specifications for measuring the regional impacts of the euro on trade flows and trade balances. For regional trade flows we augment the gravity equations with the regional dummies interacted with the euro dummy. For the regional trade balance, however, we should select the smaller unique subset of pairs to avoid the fundamental identification failure.

Once we resolve such important specification and identification issues in relation to the impact of the common currency on trade flows and balances, the implementation of our proposed CSD panel gravity model, described in Section 3, is straightforward. Given that there is no study addressing this high profile issue in a very satisfactory manner, we believe that our proposed approach can shed further lights on the empirical literature on the trade or current account balances.

A.1 For the bilateral total trade flows

Suppose that we run the gravity regression for the bilateral export and import flows, denoted y_{it}^{EX} and y_{it}^{IM}, respectively, using the total $N(N-1)$ pairs out of N countries. For convenience we consider the following simpler version of (18)

[30] SS prefer to use the double index specification over the 'triple-way model' popularised by Matyas (1997) where time, exporter and importer effects are specified as fixed and unobservable. As demonstrated by Baltagi et al. (2003) and Egger and Pfaffermayr (2003), if the triple index specification is extended to include bilateral trade interaction effects, then it is identical to the double index specification with time and bilateral effects only. Furthermore, if we are interested mainly in uncovering the effects of the common currency on trades, the double index specification should be more appropriate.

with the common time-varying regressors:

$$y_{it}^{EX} = \boldsymbol{\beta}^{EX\prime}\mathbf{x}_{it} + \varepsilon_{it}^{EX},\ i = 1, ..., N(N-1),\ t = 1, ..., T, \tag{19}$$

$$y_{it}^{IM} = \boldsymbol{\beta}^{IM\prime}\mathbf{x}_{it} + \varepsilon_{it}^{IM},\ i = 1, ..., N(N-1),\ t = 1, ..., T. \tag{20}$$

We will show that (19) and (20) are observationally equivalent such that both estimation results are equivalent.

To show this equivalence, we decompose N countries into two groups, A and B. We then construct the matrices of the bilateral export and import flows with zero diagonals as

$$EX = \begin{bmatrix} EX_{A\to B} & EX_{B\to A} \end{bmatrix}' \text{ and } IM = \begin{bmatrix} IM_{A\leftarrow B} & IM_{B\leftarrow A} \end{bmatrix}'$$

where $EX_{A\to B} = IM_{B\leftarrow A}$ and $EX_{B\to A} = IM_{A\leftarrow B}$ by construction.

We first run the export and import gravity regressions from A's perspective as follows:

$$EX_{A\to B} = X\beta_A^{EX} + \varepsilon_A^{EX}, \tag{21}$$

$$IM_{A\leftarrow B} = X\beta_A^{IM} + \varepsilon_A^{IM}. \tag{22}$$

Here we obtain the regression coefficients by

$$\hat{\beta}_A^{EX} = (X'X)^{-1} X'EX_{A\to B} \text{ and } \hat{\beta}_A^{IM} = (X'X)^{-1} X'IM_{A\leftarrow B}.$$

Similarly, we run the export and import regressions for the group B:

$$EX_{B\to A} = X\beta_B^{EX} + \varepsilon_B^{EX} \tag{23}$$

$$IM_{B\leftarrow A} = X\beta_B^{IM} + \varepsilon_B^{IM} \tag{24}$$

and obtain:

$$\hat{\beta}_B^{EX} = (X'X)^{-1} X'EX_{B\to A} \text{ and } \hat{\beta}_B^{IM} = (X'X)^{-1} X'IM_{B\leftarrow A}.$$

Then, it is easily seen that

$$\hat{\beta}_A^{EX} = \hat{\beta}_B^{IM} \text{ and } \hat{\beta}_B^{EX} = \hat{\beta}_A^{IM} \tag{25}$$

because $EX_{A\to B} = IM_{B\leftarrow A}$ and $EX_{B\to A} = IM_{A\leftarrow B}$.

Next, we run the following gravity regressions using the total $N(N-1)$ pairs:

$$EX = X\beta^{EX} + \varepsilon^{EX} \tag{26}$$

$$IM = X\beta^{IM} + \varepsilon^{IM}. \tag{27}$$

Then, it follows that

$$\hat{\beta}^{EX} = (X'X)^{-1} X'EX = \frac{1}{2}\left(\hat{\beta}_A^{EX} + \hat{\beta}_B^{EX}\right),$$

and similarly,

$$\hat{\beta}^{IM} = (X'X)^{-1} X'IM = \frac{1}{2}\left(\hat{\beta}_A^{IM} + \hat{\beta}_B^{IM}\right).$$

Using (25), it is easily seen that $\hat{\beta}^{EX} = \hat{\beta}^{IM}$, which confirms that the estimation results for (19) and (20) are equivalent when the total pairs are employed.

This analysis demonstrates that we are estimating the hybrid average impact of X on bilateral export and import flows, due to the equivalence in (25),[31] whenever we use the export or import flows specification. Therefore, the more appropriate approach is to estimate the gravity specification in (18) for bilateral total trade flows using the half of the total pairs.

A.2 For the bilateral trade balances

We turn to measuring the euro effects on regional trade balances. For convenience we consider the same groups, A and B. For group A (see (21) and (22)), it is straightforward to derive the impacts on the total trade flows (β_A^T) and the trade imbalances (β_A^{TB}) from the regressions of $(EX_{A\to B} + IM_{A\to B})$ and $(EX_{A\to B} - IM_{A\to B})$ on the common regressors, X, respectively:

$$\hat{\beta}_A^T = (X'X)^{-1} X'(EX_{A\to B} + IM_{A\to B}) = \hat{\beta}_A^{EX} + \hat{\beta}_A^{IM}, \quad (28)$$

$$\hat{\beta}_A^{TB} = (X'X)^{-1} X'(EX_{A\to B} - IM_{A\to B}) = \hat{\beta}_A^{EX} - \hat{\beta}_A^{IM}. \quad (29)$$

Suppose that $\beta_A^{TB} > 0$, implying that the impact on export flows is stronger than the impact on import flows for the group A. We thus set the null hypothesis of no trade imbalance for group A as

$$H_0^A : \beta_A^{TB} = 0. \quad (30)$$

Similarly, we can derive: $\hat{\beta}_B^{TB} = \hat{\beta}_B^{EX} - \hat{\beta}_B^{IM}$, and set the null of no trade imbalance for the group B as

$$H_0^B : \beta_B^{TB} = 0.$$

Then, it is easily seen that

$$\beta_{TB}^B = \beta_B^{EX} - \beta_B^{IM} = \beta_A^{IM} - \beta_A^{EX} = -\beta_A^{TB}. \quad (31)$$

When using the total pairs to estimate the impact of the Euro on the trade imbalance, it is easily seen that $\hat{\beta}^{EX} = \hat{\beta}^{IM}$, and thus $\hat{\beta}^{TB} = 0$ by construction, so that the regional trade balance effects of the euro cannot be identified.

However, the current approach suffers from the fundamental identification failure: even when we employ the half of the total pairs, we always end up with the same result in (31) irrespective of the different group classification. To demonstrate this we consider the 4 country example with Germany, France, Italy and Spain. First, we group the countries into A = {Germany, France}

[31] Notice that the number of studies use export flows as a dependent variable and run the gravity regression for all of bilateral pairs, *e.g.* Feenstra *et al.* (2001), Egger (2004), and Carrère (2006).

and B = {Italy, Spain}, and consider the lower triangular part of the bilateral export flows matrix:

$$\begin{bmatrix} 0 & & & \\ EX_{G\to F} & 0 & & \\ EX_{G\to I} & EX_{F\to I} & 0 & \\ EX_{G\to S} & EX_{F\to S} & EX_{I\to S} & 0 \end{bmatrix} \tag{32}$$

Next, we group the countries into C = {Germany, Italy} and D = {France, Spain}, and consider the lower triangular counterpart given by

$$\begin{bmatrix} 0 & & & \\ EX_{G\to I} & 0 & & \\ EX_{G\to F} & EX_{I\to F} & 0 & \\ EX_{G\to S} & EX_{I\to S} & EX_{F\to S} & 0 \end{bmatrix} \tag{33}$$

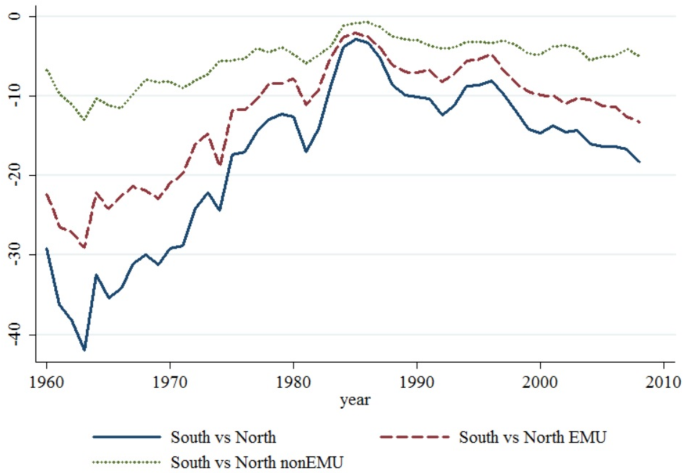
If we select all six export flows in the gravity regression, six export flows selected for group A are equivalent to those for group C. Hence, the result in (31) cannot identify whether it represents the first or the second group classification.[32]

We now provide the simple and novel technique for identifying the euro's impact on the (regional) trade balances. To achieve this goal, we should select the unique smaller group of sub-pairs. We now select the sub-block of four export flows, namely, $\begin{bmatrix} EX_{G\to I} & EX_{F\to I} \\ EX_{G\to S} & EX_{F\to S} \end{bmatrix}$ in (32) and $\begin{bmatrix} EX_{G\to F} & EX_{I\to F} \\ EX_{G\to S} & EX_{I\to S} \end{bmatrix}$ in (33). Clearly, the first block consists of the export flows from group A to group B and the second contains the export flows from group C to group D. Similarly, we select the sub-block of import flows, namely, $\begin{bmatrix} IM_{G\leftarrow I} & IM_{F\leftarrow I} \\ IM_{G\leftarrow S} & IM_{F\leftarrow S} \end{bmatrix}$ and $\begin{bmatrix} IM_{G\leftarrow F} & IM_{I\to F} \\ IM_{G\leftarrow S} & IM_{I\to S} \end{bmatrix}$ such that the first block consists of the import flows of group A from group B and the second the import flows of group C from group D.

This identification scheme enables us to estimate the gravity specification for bilateral export flows from group A to group B. Similarly for bilateral import flows of group A from group B. Thus, we are able to provide an unequivocal interpretation of the impact on the trade imbalances of group A against group B. Obviously, we will get the mirror image for group B. Therefore, our proposed approach is expected to represent a significant improvement over the current empirical literature on the trade or current account imbalances, which fails to provide any clear-cut conclusion in terms of directional regional imbalances, e.g. Schmitz and von Hagen (2011) and Berger and Nitsch (2014). Furthermore, our approach can be easily implemented in any pairwise studies by selecting the appropriate group of sub-pairs.

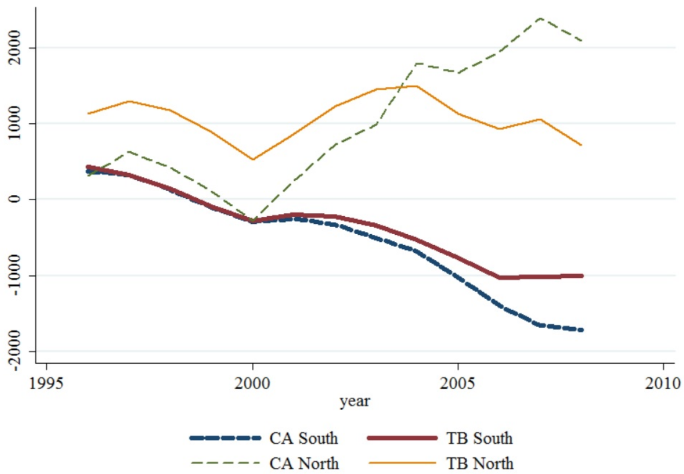
[32]It is also clear that the use of regional interaction dummies employed in the regional total trade flows specification cannot be applied for the trade balance.

Figure 1: Aggregate trade balance of the South



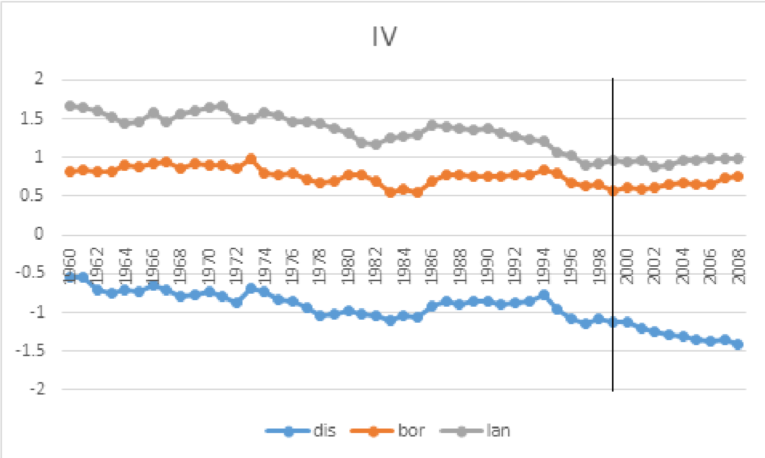
Notes: We plot the aggregate trade balance of the South against the North. We then decompose it into the respective trade balance of the South against North EMU and non-EMU countries. The aggregate trade balance is computed as the sum of the trade balance of individual countries in the South at each year. Source: OECD - Monthly Statistics of International Trade.

Figure 2: Current accounts and trade balances of the South and the North against the rest of the world

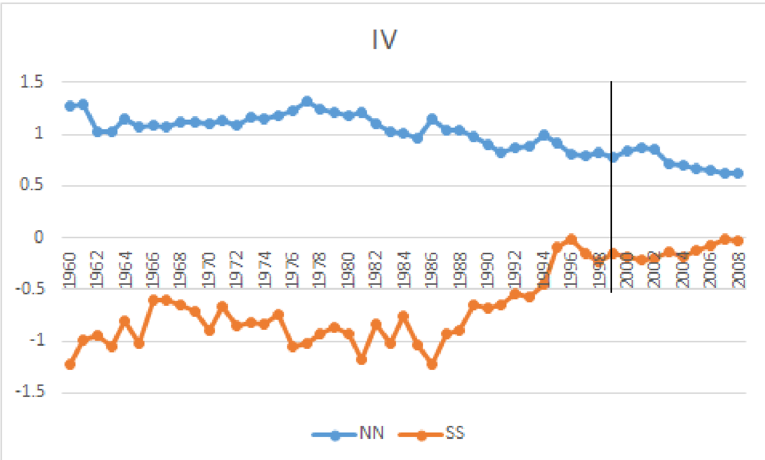


Notes: The aggregate current accounts and trade balances are computed as the sum of those of individual countries in the South and the North at each year. Millions of US dollars. Source: OECD - Main Economic Indicators.

Figure 3: Time-varying effects of bilateral trade barriers on intra-EU trade flows



(a) Time-invariant trade barriers



(b) Regional dummies

Notes: Panel (a) displays the time-varying effects of bilateral trade barriers (distance, border and language) while Panel (b) shows the time-varying coefficients on the regional dummy variables NN (equal to one when both countries belong to the North and zero otherwise) and SS (equal to one when both belong to the South and zero otherwise). These are estimated in two steps: first, we estimate the panel gravity model by PCCE-KMS and then estimate the cross-section regression by the AM-IV at each time period. See also notes to Table 2.

Table 1: Descriptive Statistics

Panel A	1960[33]	1970[2]	1980[3]	1990[4]	2000[5]	2008[6]
Share of US on Extra-EU trade	16.5	26.3	33.8	19	21.9	15.1
Share of Intra-EU on EU trade	37.2	49.8	50.5	59.7	61.7	61
Share of Export on Intra-EU trade	52.4	51.6	51.1	49.7	51.2	50.1
Panel B		60/70	70/80	80/90	90/00	00/08
Average Growth of GDP		5.2	3.4	2.4	2.7	2.2
Average Growth of Intra-EU trade		9.8	7.3	8.2	4.3	6.2
Average Growth of Total EU trade		10.3	20.1	7.2	3.9	8.1
Average Growth of Bilateral Exch. Rate		0.12	7.9	-1.4	-3.7	-2.3
Panel C - Peripheral and Core Countries						
Southern Countries	1960	1970	1980	1990	2000	2008
Average GDP per capita	8.3	8.8	9.2	9.4	9.7	9.8
Average Intra-EU Trade Balance	-0.45	-0.45	-0.19	-0.16	-0.23	-0.28
		60/70	70/80	80/90	90/00	00/08
Average Growth of GDP per capita		5.5	3.3	2.3	2.8	1.7
Average Growth of Intra-EU Export		11.1	10.5	10.3	4.7	5.7
Average Growth of Intra-EU Import		11.2	8.0	9.9	5.4	6.4
Average Growth of Intra-EU Trade		11.2	8.0	10.5	5.1	6.2
Northern Countries	1960	1970	1980	1990	2000	2008
Average GDP per capita	9.2	9.6	9.8	10.1	10.3	10.4
Average Intra-EU Trade Balance	0.25	0.25	0.11	0.09	0.13	0.16
		60/70	70/80	80/90	90/00	00/08
Average Growth of GDP per capita		3.9	2.5	2.2	2.0	1.6
Average Growth of Intra-EU Export		9.3	6.5	7.0	3.8	6.2
Average Growth of Intra-EU Import		9.3	7.9	7.2	3.4	5.9
Average Growth of Intra-EU Trade		9.0	6.9	7.0	3.9	6.2
South and North Exchanges		60/70	70/80	80/90	90/00	00/08
South-South Trade Growth		12.1	10.6	12.5	6.9	7.8
South-North Trade Growth		10.5	7.5	9.1	5.0	5.6
North-North Trade Growth		8.2	6.1	5.8	3.4	6.5
South→North Export		10.8	10.1	9.3	3.8	5.1
South←North Import		10.8	6.4	8.8	4.8	6.1

Notes: Panel A: 1 refers to EU6 (Belgium, France, Germany, Italy, Luxemburg, Netherlands) from 1960 to 1969; 2 refers to EU6 from 1970 to 1973 and EU9 (EU6 plus Denmark, Ireland and UK) from 1973 to 1979; 3 refers to EU9 in 1980, EU10 (EU9 plus Greece) from 1981 to 1985, and EU12 (EU10 plus Portugal and Spain) from 1986 to 1989; 4 refers to EU12 from 1990 to 1994 and EU15 (EU12 plus Austria, Finland and Sweden) from 1995 to 1999; 5 refers to EU15 from 2000 to 2001; 6 refers to EU15 from 2001 to 2004 and EU25 (EU15 plus Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) and EU27 (EU25 plus Romania and Bulgaria) from 2007 to 2008, respectively. Sources: Statistical Yearbook, Eurostat (1997) and Trade Policy Review of the European Union: A Report by the Secretariat of the WTO, WTO (2002), Unctatd (2012), World Bank (2012).
Panel C: Entries are group/decade averages of the respective measures. 7 Includes both South-North and North-South exchanges.

Table 2: The panel gravity model estimation results for bilateral trade flows

	FE	PCCE	PCCE-KMS	HT	AM	IPC	IPC-KMS	HT	AM
gdp	2.089***	1.824***	1.868***			1.636***	1.612***		
	[0.011]	[0.043]	[0.045]			[0.053]	[0.066]		
sim	0.412***	0.192	0.228 ***			0.371***	0.371***		
	[0.121]	[0.130]	[0.064]			[0.144]	[0.128]		
rlf	0.078***	0.011	0.009 *			-0.006	-0.008*		
	[0.026]	[0.022]	[0.005]			[0.006]	[0.005]		
rer	-0.028**	0.133***	0.146***			0.100***	0.091**		
	[0.014]	[0.018]	[0.015]			[0.040]	[0.040]		
cee	0.591***	0.355***	0.369***			0.097***	0.0675***		
	[0.014]	[0.011]	[0.009]			[0.017]	[0.017]		
emu	0.212***	0.112***	0.108***			0.071***	0.070***		
	[0.015]	[0.011]	[0.012]			[0.023]	[0.018]		
		OLS				OLS			
con		1.674		0.017	1.542	11.917***		8.766***	11.528***
		[1.897]		[2.174]	[1.846]	[2.013]		[2.281]	[1.716]
dis		-1.483***		-1.258***	-1.468***	-1.707***		-1.281***	-1.654***
		[0.261]		[0.296]	[0.252]	[0.277]		[0.313]	[0.235]
bor		0.238		-0.66	0.18	0.406		-1.301	0.196
		[0.532]		[0.855]	[0.423]	[0.564]		[1.358]	[0.307]
lan		1.512***		4.081**	1.677***	1.217**		6.102**	1.820***
		[0.641]		[2.087]	[0.725]	[0.680]		[3.110]	[0.468]
r			1.594				1.594		
ρ			-0.8715***				-0.525***		
CD	92.85	8.28	2.28			12.25	2.5		
	(0.000)	(0.000)	(0.131)			(0.000)	(0.114)		
Sargan				$\chi^2_6 = 9.2680.1$	$\chi^2_{56} = 9.2647.7$			$\chi^2_9 = 12.71$	$\chi^2_{57} = 45.04$
				(0.159)	(0.774)			(0.176)	(0.874)
Hausman					$\chi^2_3 = 2.19$				$\chi^2_3 = 3.921$
					(0.700)				(0.417)

Notes: The dependent variable is the sum of logarithms of bilateral real export and of real import flows. We estimate the gravity regression using 91 pairs over the period 1960-2008. The fixed effects (FE) estimation results are obtained from the panel data gravity model without unobserved time-varying factors in (7) with $\varepsilon_{it} = \alpha_i + v_{it}$. The PCCE (Pesaran, 2006) and the IPC (Bai, 2009) estimators are obtained from the panel data gravity model with unobserved time-varying factors in (7) with $\varepsilon_{it} = \alpha_i + \varphi_i'\theta_t + v_{it}$. See also (4). To approximate unobserved factors, θ_t, we employ: $\mathbf{f}_t = \left\{RERT_t, \overline{TGDP_t}, \overline{SIM}_t, \overline{RLF}_t, \overline{CEE}_t, trend\right\}$ for PCCE and $\mathbf{f}_t = \left\{PC_{1_t}, PC_{2_t}, PC_{3t}, PC_{4t}, PC_{5t}, PC_{6_t}, RERT_t, trend\right\}$, where the bar over variables indicate their cross-section averages, and $PC_1, ..., PC_6$ are the six principal component factors extracted by the Bai and Ng (2002) procedure. The PCCE-KMS and IPC-KMS estimators are obtained from the unified model given by (7)-(10). To derive the HT estimates we use the following set of instruments $IV = \{RER_{it}, RLF_{it}, \lambda_i'\mathbf{f}_t\}$ where $\lambda_i'\mathbf{f}_t = \left\{\lambda_i RERT_t, \lambda_i\overline{TGDP_t}, \lambda_i\overline{SIM}_t, \lambda_i\overline{RLF}_t, \lambda_i trend\right\}$ in the $PCCE$ case $\lambda_i'\mathbf{f}_t = \{\lambda_i PC_{1t}, \lambda_i PC_{2t}, \lambda_i PC_{3t}, \lambda_i PC_{4t}, \lambda_i PC_{5t}, \lambda_i PC_{6t}, \lambda_i RERT_t, \lambda_i trend\}$ in the IPC case. The AM estimates are derived using a subset of time observations of RLF_{it} and only one time observation for each $\mathbf{f}_t$ in the set $\lambda_i'\mathbf{f}_t$ to avoid collinearity. Figures in [] indicate the standard errors. ***, ** and * denote 1, 5, and 10 percent level of significance, respectively. CD stands for the diagnostic test statistic for the null hypothesis of no CSD advanced by Pesaran (2013). Sargan denotes the Sargan statistic testing for the validity of over-identifying restrictions. Hausman is the Hausman statistic testing for the legitimacy of the AM estimator against the HT estimator. The corresponding p-values are provided in parenthesis.

Table 3: The panel gravity model estimation results for bilateral trade flows with regional and interaction dummies

				Panel A					
	FE	PCCE	PCCE-KMS			IPC	IPC-KMS		
ceeNN	0.35***	0.277***	0.297***			0.163***	0.133***		
	[0.037]	[0.003]	[0.005]			[0.021]	[0.003]		
ceeNS	0.646***	0.438***	0.439***			0.024	0.005		
	[0.038]	[0.005]	[0.007]			[0.023]	[0.004]		
ceeSS	1.585***	0.391***	0.429***			0.062	-0.006		
	[0.082]	[0.019]	[0.027]			[0.059]	[0.010]		
euroNN	0.165***	0.089***	0.091***			0.088***	0.089***		
	[0.051]	[0.004]	[0.005]			[0.03]	[0.003]		
euroNS	0.114***	0.107***	0.106***			0.044	0.043		
	[0.047]	[0.005]	[0.007]			[0.027]	[0.004]		
euroSS	0.482***	0.209***	0.165***			0.192***	0.174***		
	[0.102]	[0.014]	[0.019]			[0.063]	[0.009]		
					Panel B				
		OLS		HT	AM	OLS		HT	AM
con		6.309		5.392**	5.392**	6.252**		8.490***	9.155***
		[4.273]		[2.653]	[2.653]	[2.467]		[2.371]	[2.041]
dis		-0.988*		-0.853**	-0.853**	-0.979**		-1.246***	-1.350***
		[0.564]		[0.354]	[0.354]	[0.328]		[0.315]	[0.270]
bor		0.411		-0.842	-0.842	0.321		-0.471	0.513
		[0.961]		[0.907]	[0.907]	[0.562]		[1.019]	[0.493]
NN		1.131*		0.892**	0.892**	1.114***		0.218	0.407
		[0.625]		[0.322]	[0.322]	[0.286]		0.339]	[0.303]
SS		-0.966		-0.822	-0.822	-0.956***		-0.677	-0.789**
		[0.962]		[0.528]	[0.528]	[0.439]		[0.484]	[0.419]
lan		1.625		4.879**	4.879**	1.858*		4.233**	1.681***
		[1.103]		[2.056]	[2.056]	[1.049]		[2.271]	[0.832]
r			1.594				1.594		
ρ			-0.898***				-0.499***		
CD	87.12	8.49	2.291			12.58	2.521		
	(0.000)	(0.000)	(0.131)			(0.000)	(0.112)		
Sargan				$\chi^2_6 = 2.71$	$\chi^2_{40} = 7.88$			$\chi^2_9 = 15.44$	$\chi^2_{48} = 47.1$
				(0.910)	(0.999)			(0.090)	(0.510)
Hausman					$\chi^2_5 = 0.665$				$\chi^2_5 = 0.709$
					(0.955)				(0.999)

Notes: The dependent variable is the sum of logarithms of bilateral real export and of real import flows. Three regional dummies are denoted by NN (1 when both countries belong to the North, and 0 otherwise), NS (1 when one country belongs to the North and another belongs to the South or *vice versa,* and 0 otherwise) and SS (1 when both countries belong to the South, and 0 otherwise). We then construct three euro interaction dummies by NNemu = NN×emu, NSemu = NS×emu and SSemu = SS×emu and the cee interaction dummies by NNcee = NN×cee, NScee = NS×cee and SScee = SS×cee. All the estimation results are obtained from the augmented gravity specification in (17). See also notes to Table 2.

Table 4: The panel gravity model estimation results for bilateral export flows of the South to the North

	FE	PCCE	PCCE-KMS	HT	AM	IPC	IPC-KMS	HT	AM
gdp	1.278***	1.162***	1.241***			0.846***	0.911***		
	[0.023]	[0.040]	[0.033]			[0.061]	[0.057]		
sim	0.447***	0.371***	0.265 ***			-0.032	-0.034		
	[0.116]	[0.129]	[0.084]			[0.163]	[0.157]		
rlf	0.013	0.055**	0.049**			0.011	0.015		
	[0.028]	[0.028]	[0.018]			[0.017]	[0.015]		
rer	-0.115***	0.314***	0.305***			0.367***	0.367***		
	[0.025]	[0.024]	[0.018]			[0.040]	[0.045]		
cee	0.281***	0.134***	0.136***			0.098***	0.0947***		
	[0.031]	[0.006]	[0.005]			[0.023]	[0.020]		
emu	-0.133***	0.015*	0.021**			-0.085***	-0.100***		
	[0.034]	[0.010]	[0.010]			[0.030]	[0.025]		
		OLS				OLS			
con		-4.955**		-14.790***	-5.113**	5.885***		6.740**	5.830***
		[2.783]		[4.629]	[2.881]	[2.503]		[2.952]	[2.249]
dis		-0.763**		0.027	-0.742**	-0.802***		-0.917**	-0.795***
		[0.374]		[0.619]	[0.367]	[0.336]		[0.402]	[0.307]
bor		-0.486		-1.970*	-0.526*	0.171		0.387	0.158
		[0.562]		[1.369]	[0.362]	[0.506]		[0.569]	[0.225]
lan		1.947*		2.171***	3.332***	0.650		-0.560	0.728
		[1.042]		[6.938]	[0.930]	[0.937]		[2.989]	[0.927]
r			0.72				0.72		
ρ			-0.302***				-0.624***		
CD	29.45	9.26	3.15			8.88	1.87		
	(0.000)	(0.002)	(0.076)			(0.003)	(0.172)		
Sargan				$\chi^2_1 = 0.18$	$\chi^2_{17} = 25.63$			$\chi^2_2 = 4.48$	$\chi^2_7 = 8.38$
				(0.675)	(0.059)			(0.106)	(0.300)
Hausman					$\chi^2_{15} = 0.62$				$\chi^2_5 = 0.06$
					(0.960)				(0.999)

Notes: The dependent variable is the logarithm of bilateral real export flows of the South to the North. We divide between the North (Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, the Netherlands, Sweden and the UK) and the South (Greece, Ireland, Italy, Portugal and Spain). We estimate the gravity regression for the South using $5 \times 9 = 45$ sub-pairs selected over the period 1960-2008. To approximate unobserved factors, we employ: $\mathbf{f}_t = \left\{RERT_t, \overline{TGDP}_t, \overline{SIM}_t, \overline{RLF}_t, \overline{RER}_t\right\}$ for PCCE and $\mathbf{f}_t = \{PC_1, PC_2, PC_3, PC_4, PC_5, RERT_t, trend\}$ for IPC. $PC_1, ..., PC_5$ are the five principal component factors extracted by the Bai and Ng (2002) procedure from the residuals of the trade balance regression. To derive the HT and AM estimates we use the following set of instruments, and $IV = \{RLF_{it}, \lambda_i \; trend\}$ $IV = \{RER_{it}, GDP_{it}, \lambda_i \; PC_3\}$ for PC. See also notes to Table 2.

Table 5: The panel gravity model estimation results for bilateral import flows of the South from the North

	FE	PCCE	PCCE-KMS	HT	AM	IPC	IPC-KMS	HT	AM
gdp	1.011***	1.229***	1.160***			0.964***	1.028***		
	[0.016]	[0.056]	[0.040]			[0.056]	[0.053]		
sim	-0.862***	0.106	0.089 ***			0.335**	0.296***		
	[0.081]	[0.112]	[0.073]			[0.148]	[0.116]		
rlf	0.018	-0.027	-0.025			-0.010	-0.006		
	[0.020]	[0.037]	[0.022]			[0.015]	[0.012]		
rer	-0.0370***	-0.076***	-0.088**			-0.286***	-0.276***		
	[0.018]	[0.028]	[0.023]			[0.037]	[0.042]		
cee	0.349***	0.252***	0.257***			0.211***	0.206***		
	[0.022]	[0.007]	[0.005]			[0.021]	[0.020]		
emu	0.244***	0.214***	0.209***			0.065***	0.053***		
	[0.024]	[0.015]	[0.010]			[0.027]	[0.021]		
		OLS				OLS			
con		-9.434***		-29.256**	-9.131***	6.679***		3.564*	6.699***
		[2.405]		[14.189]	[2.134]	[2.053]		[2.298]	[1.235]
dis		-0.339		2.325	-0.380*	-0.910***		-0.491*	-0.913***
		[0.323]		[1.905]	[0.283]	[0.276]		[0.309]	[0.168]
bor		-0.496		-5.498	-0.419*	-0.158		-0.945	-0.153
		[0.486]		[5.288]	[0.293]	[0.415]		[0.790]	[0.180]
lan		2.385***		30.418	1.956***	1.980***		6.386**	1.952***
		[0.901]		[27.562]	[0.826]	[0.769]		[4.181]	[0.762]
r			0.72				0.72		
ρ			-0.891***				-0.789***		
CD	57.28	8.46	2.38			10.69	2.03		
	(0.000)	(0.004)	(0.123)			(0.001)	(0.154)		
Sargan				$\chi^2_1 = 0.000$	$\chi^2_{17} = 26.46$			$\chi^2_2 = 2.42$	$\chi^2_7 = 4.98$
				(0.982)	(0.066)			(0.034)	(0.662)
Hausman					$\chi^2_{16} = 2.10$				$\chi^2_5 = 2.84$
					(0.717)				(0.584)

Notes: The dependent variable is the logarithm of bilateral real import flows of the South from the North. See also notes to Tables 2 and 4.

Table 6: The panel gravity model estimation results for bilateral trade balance of the South against North

	FE	PCCE	PCCE-KMS	HT	AM	IPC	IPC-KMS	HT	AM
gdp	0.268***	-0.067*	0.081***			-0.117**	-0.117**		
	[0.024]	[0.046]	[0.034]			[0.064]	[0.058]		
sim	1.309***	0.265**	0.177***			-0.367**	-0.329**		
	[0.117]	[0.116]	[0.071]			[0.171]	[0.158]		
rlf	-0.005	0.081***	0.074***			0.021	0.021		
	[0.029]	[0.015]	[0.009]			[0.017]	[0.017]		
rer	-0.078***	0.390***	0.394***			0.653***	0.644***		
	[0.025]	[0.024]	[0.020]			[0.042]	[0.041]		
cee	-0.068***	-0.117***	-0.121***			-0.113***	-0.112***		
	[0.032]	[0.007]	[0.006]			[0.024]***	[0.022]		
emu	-0.377***	-0.199***	-0.188***			-0.150***	-0.152***		
	[0.035]	[0.010]	[0.007]			[0.031]	[0.028]		
		OLS				OLS			
cons		-0.795		-3.118	4.055	-0.795		0.748	-1.201
		[2.916]		[13.047]	[1.627]	[2.916]		[3.203]	[2.348]
dis		0.108		0.597	-0.367	0.108		-0.100	0.162
		[0.391]		[1.753]	[0.225]	[0.391]		[0.438]	[0.326]
bor		0.330		-1.908	-0.098	0.330		0.719	0.227
		[0.589]		[3.207]	[0.207]	[0.589]		[0.608]	[0.264]
lan		-1.330		10.306	0.163	-1.330		-3.511	-0.756
		[1.092]		[17.183]	[0.626]	[1.092]		[3.369]	[1.203]
r			0.71				0.72		
ρ			-0.000				-0.000		
CD	19.85	6.01	3.59			8.49	3.44		
	(0.000)	(0.014)	(0.058)			(0.004)	(0.064)		
Sargan				$\chi^2_1 = 0.56$	$\chi^2_{17} = 14.73$			$\chi^2_2 = 10.83$	$\chi^2_7 = 10.41$
				(0.452)	(0.066)			(0.004)	(0.166)
Hausman					$\chi^2_{16} = 0.52$				$\chi^2_5 = 0.05$
					(0.972)				(0.999)

Notes: The dependent variable is the difference between logarithms of bilateral real export and import flows of the South against the North. See also notes to Tables 2, 4 and 5.

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