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Explaining and correcting trade imbalances between the Northern and Southern Eurozone: An empirical investigation

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Abstract

In this paper we take a novel approach to examining the trade imbalances between the Southern Eurozone countries and the Northern Eurozone countries by aggregating them into a Southern Group and Northern Group. We then explore three possible causes of the trade imbalances, which are the fiscal channel, the investment channel and the competitiveness channel. We find that all three channels are important in explaining the emergence and correction of trade imbalances. In particular, we find that an increase in fiscal deficits in the North are twice as effective in reducing trade imbalances than fiscal consolidation in the South. By contrast, increased investment in the North has a similar impact to reduced investment in the South in correcting the trade imbalances. Finally, we find that a depreciation of the South's real exchange rate is associated with a long run deterioration in the Southern Group's trade balance suggesting that the South needs to seek non-price competitiveness channels to address its trade imbalances.

KEYWORDS

Eurozone, fiscal deficits, investment, national debts, real exchange rate, trade imbalances

1 | INTRODUCTION

In view of the *Eurozone Current Account core–periphery dualism*[1] the divergence in current account balances between the Southern and Core Eurozone economies has received quite a lot of attention in the literature. Hope (2016) reports strong evidence that the introduction of the euro heavily contributed to divergences of the current account balances between the core and the periphery. In this paper, we take a novel approach to the issue of dualism by aggregating data from the North and the South to investigate the long-run determination of the trade balance in the Eurozone area by dividing it into the Northern Group (Germany, Belgium, the Netherlands and Finland) and a Southern Group (Italy, Spain, Greece, Portugal and France). We investigate the long-run determination of the trade balance of the Southern Group *vis-à-vis* the Northern Group focusing on the fiscal, the investment and the competitive channels. This aggregate approach to looking at the bilateral trade balance builds upon the work of Boonman et al. (2022) who test a theoretical model to look at the roles of consumption, portfolio optimization by economic agents, fiscal balances, changes in money demand and risk premia as

explanations of trade imbalances between the Southern and Eurozone countries.

In relation to the competitiveness channel of the trade balance determination, the empirical literature is somewhat divided. Arghyrou and Chortareas (2008) present evidence in favour of the real exchange rates as a key factor affecting the current account balances in the Eurozone. On the other hand, Comunale and Hessel (2014) report that changes in the real exchange rate may have an influence in the Eurozone area, with changes in differences in domestic demand being important in explaining the trade balance. Belke and Dreger (2011) report that a lack of competitiveness is a key determinant of trade imbalances and that a real appreciation leads to external deficits. Carrasco and Hernandez-del-Valle (2017) report that in the case of Germany economic and financial integration and non-price competitiveness have played a key role in the evolution of the external trade balances.

We provide a new perspective on these issues by treating the Northern and Southern Eurozone as aggregate economies enabling us to test for the predictions of the fiscal channel, the investment channel and the competitiveness channel as determinants of the long-run trade balance in the presence of structural breaks among the variables after employing a number of different co-integrating methodologies. As we demonstrate, adopting an aggregate approach by dividing the Eurozone area into a Northern Group, which is characterized by persistent surpluses in their bilateral trade balances and a Southern Group with persistent trade account deficits, can lead to superior econometric insights by reducing the standard errors in estimates of the coefficients. We also find that by aggregating the countries into two groups, we are able to better search for structural breaks in the data and this has not been previously done in the literature, which focuses more on bilateral trade balances between the individual countries. We also compare the results from our aggregation approach with results obtained from a panel data approach. This provides a check for the robustness of our results and also as a means to benchmark the contribution made by using a more aggregate approach.

The paper is set out as follows: in section 2 we set out the theoretical model and the theoretical predictions, looking at the implications of the fiscal channel, the investment channel and the real exchange rate channel. In section 3, we outline how we aggregate the data and provide an interpretation and analysis of trends in the data. Section 4 outlines our empirical methodology including the use of the ARDL, Fully Modified OLS, VECM and Panel Fully Modified OLS approaches. Section 5 presents our empirical results and section 6 concludes.

2 | THEORY AND ECONOMIC PREDICTIONS

Our theoretical specification reflects elements from both the fiscal the investment and the competitiveness channels through which the Eurozone has contributed to the creation of trade account imbalances between the Northern and Southern Eurozone. In relation to the fiscal channel, we employ Equation 1 below (in logs), which is based on a reformulation of the national income accounting identity for an open economy and is constructed in such a way as to reflect relative variables between the Southern and the Northern Group of economies.

$$tb_t = \beta_0 + \beta_1 s_t^g + \beta_2 n_t^g + \beta_3 i_t^s + \beta_4 i_t^n + u_t, \tag{1}$$

where tb_t the trade balance (log of exports minus log of imports) of the Southern Group relative to the Northern Group, s_t^g and n_t^g are the national debts of the Southern and the Northern Group respectively, i_t^s and i_t^n the Southern and Northern levels of investment respectively and finally u_t a disturbance term. If $\beta_1, \beta_3 < 0$ there is evidence of a deterioration of the trade balance in the Southern Group triggered from an increase in its national debt level (due to fiscal deficits) and investment in the Southern Group. If $\beta_2, \beta_4 > 0$ an increase in the national debt and investment in the Northern Group will improve the trade balance in the Southern Group.

In relation to the competitiveness channel, we utilize the theoretical approach of Boyd et al., (2001) and consider a logarithmic transformation of the balance of trade since such a specification provides an exact measurement of the Marshall-Lerner condition instead of an approximation. The ratio of nominal exports to imports that is, the TB_t is given by Equation (2):

$$TB_t = \frac{\left[X_t P_t^s\right]}{\left[M_t P_t^n\right] E_t}, \tag{2}$$

where E_t the nominal exchange rate (normalized to unity measured as domestic currency units per unit of foreign currency), X_t denotes the volume of exports, M_t the volume of imports and P_t^S, P_t^N the Southern Group and Northern Group prices respectively. Taking a logarithmic transformation of Equation (2) we derive Equation (3):

$$tb_t = x_t - m_t - q_t \tag{3}$$

$$where\ q_t = \left(-p_t^S + p_t^N\right)$$

where q_t is the real exchange rate and prices are in logs.

Assume that the long-run relationships for imports and exports (in logarithms) are given by Equations (4) and (5).

$$x_t = \alpha_x + \beta^* y_t^* + \eta_x q_t, \tag{4}$$

$$m_t = \alpha_m + \beta y_t - \eta_m q_t, \tag{5}$$

where y_t and y_t^* the domestic and foreign real income respectively and η_x is the price elasticity of demand for exports and η_m is the price elasticity of demand for imports. The long-run determination of the balance of trade (in logarithms) is then given by the Equation 6 below:

$$tb_t = a + \beta^* y_t^* - \beta y_t + \eta q_t, \tag{6}$$

where $a = \alpha_x - \alpha_m$ and $\eta = (\eta_x + \eta_m - 1)$ that reflects the Marshall-Lerner condition according to which, for a real depreciation (increase in q_t) to improve, the bilateral trade balance $\eta_x + \eta_m$ must be greater than unity.

Equation 7 below (in logs) after defining the real exchange rate as $\frac{P_t^n}{P_t^s}$ where P_t^n the CPI in the Northern Eurozone and P_t^s the CPI in the Southern Eurozone, implies that an increase in the real exchange rate reflects a real depreciation of the Southern Group and an increase in the Southern Group's competitiveness.

$$tb_t = a + \beta^n y_t^n - \beta^s y_t^s + \eta q_t, \tag{7}$$

According to Equation 7 an increase in the Northern Group real income (y_t^n) will improve the trade balance of the Southern Group, whereas an increase in Southern Group real income $\left(y_t^s\right)$ would deteriorate its trade balance.[2]

3 | ANALYSIS AND INTERPRETATION OF THE SOUTHERN AND NORTHERN GROUPS DATA

As Figure 1 below depicts the trade balance of the Southern Group as a whole is in persistent bilateral trade deficit with the Northern Group since 2001. It is apparent that following the adoption of the common currency the Southern Group economies experienced a heavy deterioration in their trade balances with the Northern Group at least up until 2008. The southern economies lost competitiveness as compared with the northern economies, mainly due to their differences in their labour markets. More specifically, the Southern Group had to face substantially rising relative unit labour costs compared to the Northern Group associated with higher rises in nominal wages and lower levels of productivity. Although the northern economies' productivity was not substantially higher, they had lower increases in nominal labour costs. The result was a deterioration in the current account deficits of the Southern Group, a rise in their external indebtedness due to rising fiscal deficits and high than normal levels of investment in the Southern Group financed by external borrowing. The external loss of competitiveness, rising national debts and unsustainable fiscal deficits left the Southern Group of economies vulnerable to a loss of confidence and ultimately resulted in the so called PIIGS crisis involving Portugal, Ireland, Italy, Greece and Spain.

In addition, the deterioration in the trade account of the South *vis-à-vis* the North may be partly explained by the appreciation of the Southern Group's real exchange rate against the North due to the Southern Groups'

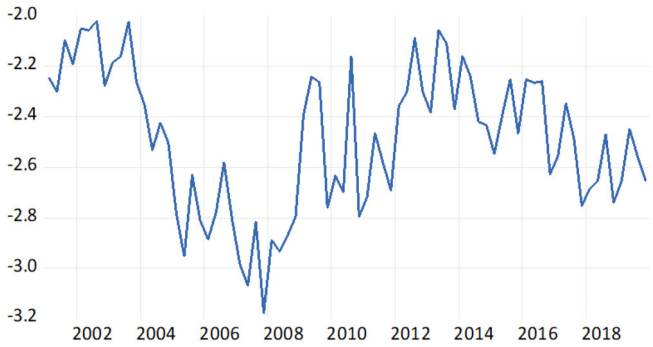

FIGURE 1 The evolution of the trade balance of the South vis-à-vis the North as a percentage of Southern GDP [Colour figure can be viewed at wileyonlinelibrary.com]

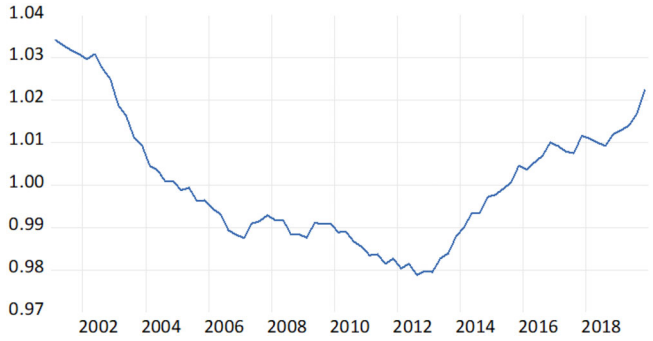

FIGURE 2 The real exchange rate of the southern group [Colour figure can be viewed at wileyonlinelibrary.com]

relatively high inflation rate as shown in Figure 2. At the same time, investment growth was substantially higher in the Southern Group up until 2008 as shown in Figure 3 when the global financial crisis intensified leading to a recession that affected the Southern Group's economies' real GDP (Figure 4) and the manner in which their governments reacted in order to support the aggregate demand.[3] Post 2008, the recession in the Southern Group led to a fall in the inflation rate relative to the North, and a gradual real depreciation of the Southern real exchange rate (Figure 2). Following this, we can observe an improvement in the Southern Group's trade balance against the Northern Group (Figure 1), which can also be attributed to the decrease in investment (Figure 3). In addition, in the aftermath of the global financial crisis the national debt of the South has widened relatively to the North (Figure 5) which reflects a deterioration of the Southern Group's ability to repay its obligations, which has also led to a sharp increase in the Southern interest rates relatively to the North. This in turn, contributes to an increase in the Southern Group's fiscal deficits and a decline in the confidence in their economies. As Figure 5 depicts there is strong persistence of the Southern national debt at about 120% of GDP, which can be attributed to high and persistent fiscal deficits in all Southern economies under investigation.

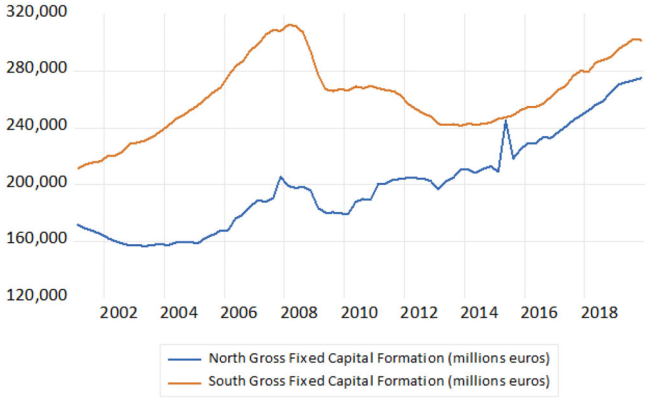

FIGURE 3 Gross fixed capital formation [Colour figure can be viewed at wileyonlinelibrary.com]

The reported association among the various forces that may be responsible for affecting the trade balance in the Southern Group needs to be examined empirically before reaching any conclusions for policy makers, this is done in section 4. Our preliminary analysis is not intended to examine why such relationships should find empirical support but mainly to point out possible mechanisms that may be consistent with the evidence, acknowledging as always that the empirical evidence can only provide support for hypotheses and is never conclusive.

For our empirical analysis, we have collected quarterly data on nine Eurozone economies for the period 2001:Q1–2019:Q4.[4] We divide the selected Eurozone countries into two groups, namely the Southern Group and the Northern Group. We use level data (in logs) for the aggregate trade balances, the national debts and the investment instead of their ratio to GDP. The ratios of most of these variables to GDP (apart from national debts) are bounded time-series whose values cannot by construction exceed unity, yet we need to perform unit root tests on these variables. Papers such as Cavaliere (2005), Cavaliere and Xu (2014), Granger (2010) have warned about the reliability of the unit root testing performed on bounded time series. The conventional tests

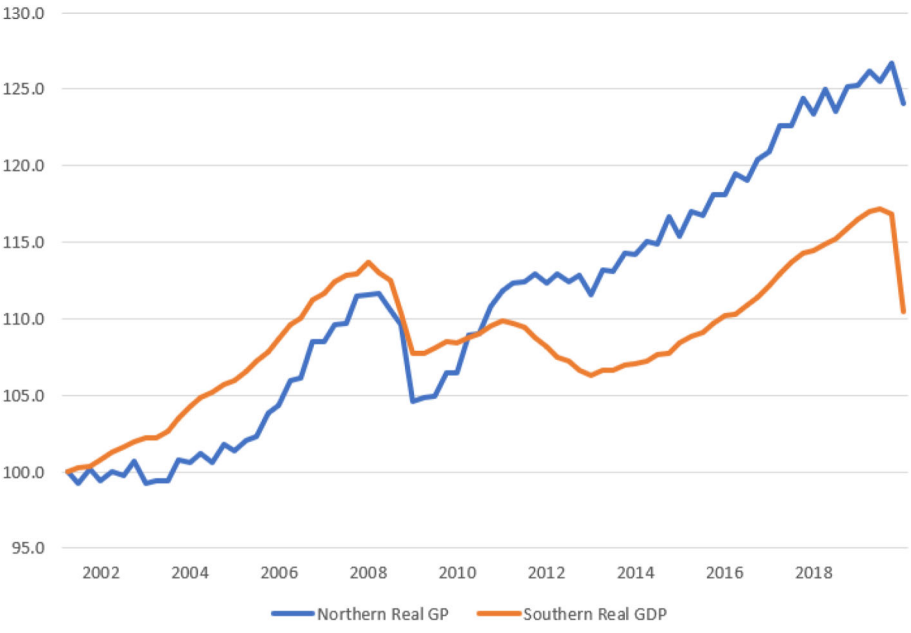

FIGURE 4 Indices of Northern and Southern real GDP's [Colour figure can be viewed at wileyonlinelibrary.com]

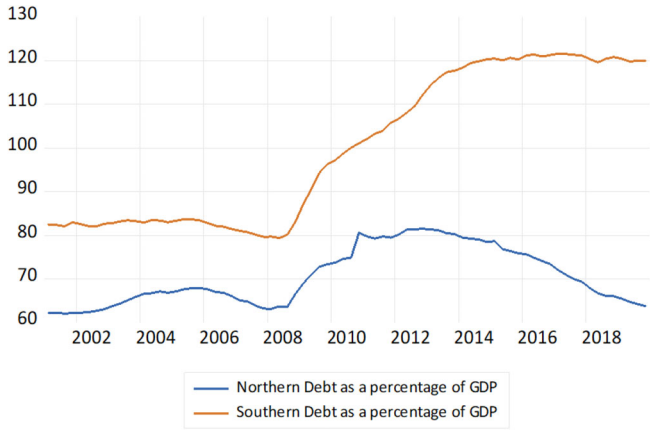

FIGURE 5 Northern and Southern National Debts [Colour figure can be viewed at wileyonlinelibrary.com]

have the tendency to reject the null of the presence of the unit root in these series. Indeed, the theoretical framework used in our analysis has by construction not been constructed in such a way so as to reflect the ratios of these variables to GDP. The aggregate trade deficit of the Southern Group relative to the Northern Group is the sum of the five individual Southern countries bilateral trade deficits vis-à-vis the Northern economies. Given that we investigate the relative importance of the fiscal stance in affecting the trade balances in the Southern Group (which may also imply the relative probability to default for each Group) this is reflected by the aggregate of the five southern economies' national debt balances for the Southern Group and the aggregate of the four national debt balances for the Northern Group. In a similar manner, the Southern Group and the Northern Group investment is respectively constructed as the sum of the southern and northern economies' gross fixed capital formation. The Southern Consumer Price Index (CPI) is constructed as the GDP weighted average of the five Southern economies' CPI and the Northern CPI as the GDP weighted average of the four Northern economies' CPI. The real exchange rate is defined as the ratio of the Northern to Southern CPI since the euro is the common currency. Finally, the Southern Group's real GDP is the sum of the Southern economies real GDP and the Northern Group's real GDP is the sum of the real GDP of the four Northern economies' GDP. For the panel data regression analysis, we use relevant data from each separate economy.

4 | METHODOLOGY

The potential long-run relationship among the variables in Equations 1 and 7 is tested based on four different co-integration methodologies, namely on the ARDL as proposed by Pesaran et al. (2001), the FM-OLS, the VECM as developed by Johansen and Juselius (1994) and the Panel FM-OLS estimator.

All variables have been tested for a unit root. We have performed the ADF, the PP, the KPSS and the Break Point Unit Root Test. All four tests have revealed that the Southern fiscal stance, the Northern fiscal stance, the northern investment and the northern real GDP are I (1). Related to the real exchange rate the ADF and the KPSS tests have both indicated an I(0) variable whereas the break point test and the PP test indicated an I(1) variable. In addition, the Southern Group's real GDP is indicated as I(1) from the PP tests and I(0) from all other approaches. Finally, the Southern Group's investment is indicated as I(0) from KPSS and I(1) from all other tests.[5]

Given the strong evidence from the unit root tests that the variables can overall be considered as I(1) we initially perform the VECM to test for a long-run relationship among the variables. However, given the lack of consensus from all tests we also employ the ARDL approach, which has many advantages compared to other methods for testing co-integration such as the Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) approaches. More specifically, the ARDL has the advantage of avoiding any classification between I (0) and I(1) variables and is a statistically significant approach to co-integration for relatively small data samples.

For the Vector Error Correction Model (VECM) the following form is employed.[6]

$$\Delta\chi_t = \Gamma_1^m \Delta\chi_{t-1} + \Gamma_2^m \Delta\chi_{t-2} + \ldots + \Gamma_{k-1}^m \Delta\chi_{t-k+1} + \Pi\chi_{t-m} + \varepsilon_t,$$

where $\chi_t = \left(tb_t, s_t^g, n_t^g, i_t^s, i_t^n\right)$ is a $(5x1)$ vector of variables from Equation (1) and where $\chi_t = \left(tb_t, y_t^n, y_t^s, q_t\right)$ a $(4x1)$ vector of variables for Equation (7), and m denotes the lag placement of the ECM term, Δ denotes the difference, and $\Pi = a\beta'$ with a and β (pxr) matrices with $r < p$, where p the number of variables and r the number of stationary co-integrated relationships.

For the ARDL co-integration equation the following form is employed:

$$\Delta tb_t = -\sum_{h=1}^{p-1} \gamma_i \Delta tb_{t-h} + \sum_{j=1}^{k} \sum_{h=0}^{q_{j-1}} \Delta X_{j,t-h'} \beta_{j,h} - \widehat{\theta} EC_{t-1} + \epsilon_t,$$

where X_j a vector consisting of all explanatory variables in equations (1) an (7). EC_{t-1} is the error correction term, (p) the number of lags of the dependent variable and (q) the number of lags of the independent variables.

TABLE 1 Trade balance long-run relationship Equation 1

	ARDL	FMOLS	VECM	PANEL
Fiscal South (β_1)	−0.78 (1.92)[c]	−0.98 (−1.90)[c]	−2.21 (−4.47)[a]	−0.83 (1.41)[c]
Fiscal North (β_2)	1.48 (3.36)[a]	2.15 (4.20)[a]	3.25 (6.41)[a]	2.05 (4.21)[a]
Investment South (β_3)	−0.18 (−7.03)[a]	−0.17 (−6.37)[a]	−0.20 (−9.00)[a]	−0.98 (−2.36)[a]
Investment North (β_4)	0.15 (4.21)[a]	0.10 (2.34)[a]	0.22 (5.24)[a]	0.77 (1.98)[b]
CointEq(−1)	−0.98 (−5.61)[a]	—	−0.71 (−5.47)[a]	—

Note: *t* statistics in parentheses.
[a]Significant at 1%.
[b]Significant at 5%.
[c]Significant at 10%.

In addition, to provide robustness for the empirical results we also employ the Fully Modified Ordinary Least Square (FM-OLS) approach. The FM-OLS approach allows for the estimation of one co-integration vector even if multiple co-integrating vectors could be considered. Similar to the ARDL technique, the estimator is not affected by the presence of stationary and non-stationary variables. In addition, as reported by Phillips and Hansen (1990), the FM-OLS provides an optimal estimation technique of co-integration (even in small sample sizes) since the method modifies ordinary least squares to account for serial correlation effects and for the endogeneity in the regressors.[7] To test for structural breaks in the relationship among the variables in Equations 1 and 7, we rely on the methodology proposed by Bai and Perron (1998, 2003) since, as indicated by Zivot and Andrews (1992), the break date(s) should not be selected exogenously as they are correlated with the data. Employing the Bai and Perron methodology we allow for an endogenous determination of the possible number(s) and location(s) of the breaks. After performing the structural break test for the variables employed in Equations 7 and 1 the break points appear to occur in 2010: Q2 and 2010: Q3 respectively. The 2010: Q3 break point coincides with the fact that there was a significant change in the composition of bond holdings in the Southern Group (especially in Portugal, Spain, and Greece) where the Southern holdings of bonds held by Northern residents ultimately declined to as much as 64% by 2013:Q3 as northern banks and northern investors rapidly reduced their exposure to the South in the aftermath of the global financial crisis (and the commencement of the GIIPS crisis). The first break point (i.e., 2010 Q2) coincides with the significant widening of the 10-year interest differential between the South and the North along with the widening of the gap in the real GDP between the two regions. Finally, in order to further test the validity of our empirical results we also perform the panel fully modified ordinary least squares (FM-OLS) estimator. By employing a panel data technique more variability can be explored from the cross-sectional elements of the dataset.

5 | EMPIRICAL RESULTS

Table 1 presents the results from the long-run statistical association among the variables in Equation 1 as generated from the four different co-integration tests. There is strong evidence that an increase in the national debt of the Northern Group has a beneficial effect on the Southern trade balance since the coefficient β_2 is positive and highly significant throughout all empirical tests. This is also the case for coefficient β_4 where there is strong evidence that an increase in Northern investment boosts Northern GDP and thereby increases imports from the South thus improving the Southern trade balance. Related to the fiscal stance in the Southern Group the coefficient β_1 is negative and highly significant especially in the VECM estimation. The ARDL and the FMOLS approaches reveal a negative coefficient at 10% significance level.

Turning to the Southern Group's investment, the coefficient β_3 is negative and highly significant, throughout the entire range of tests, suggesting that an increase in investment in the Southern region significantly deteriorates its trade balance through a mixture of increased imports and heavy external financing. This could be considered as evidence challenging the Feldstein-Horioka puzzle.[8] This result has also been reported by Litsios and Pilbeam (2017) for the countries of Greece, Portugal and Spain, suggesting that the way investment is financed should be a key policy issue in order to alleviate current account deficits in the Southern region.

It is worth noting that in the cases of the ARDL and the VECM the coefficients of the error correction term are negative and statistically significant. Overall, the evidence suggests that the system adjusts towards the long-run equilibrium at a high speed. Given that causality in

TABLE 2 Trade balance long-run relationship Equation 7

	ARDL	FMOLS	VECM	PANEL
Real GDP South (β^s)	−0.89 (−7.17)[a]	−0.81 (−9.95)[a]	−9.97 (−11.56)[a]	−4.84 (−6.59)[a]
Real GDP North (β^n)	0.65 (8.86)[a]	0.60 (13.95)[a]	0.72 (12.02)[a]	5.34 (7.20)[a]
Real Exchange Rate (q)	−8.01 (−4.38)[a]	−6.60 (−4.39)[a]	−10.62 (−3.39)[a]	−0.05 (−2.37)[a]
CointEq(−1)	−0.48 (−4.98)[a]	—	−0.67 (−3.66)[a]	—

Note: t statistics in parentheses.
[a]Significant at 1%.
[b]Significant at 5%,
[c]Significant at 10%.

TABLE 3 Structural break estimation of the long-run coefficients Equation 1

	ARDL	FMOLS	PANEL
Fiscal South (β_1)	−1.38 (−1.80)[c]	−1.01 (−1.96)[b]	−0.77 (−0.91)
Fiscal North (β_2)	2.61 (3.34)[a]	2.15 (4.21)[a]	2.27 (5.34)[a]
Investment South (β_3)	−0.15 (−4.53)[a]	−0.17 (−6.39)[a]	−0.81 (−3.55)[a]
Investment North (β_4)	0.12 (2:00)[b]	0.11 (2.44)[a]	0.92 (2.59)[a]
Dummy 2010: Q3	0.76 (2.27)[b]	0.13 (0.89)	0.20 (1.17)
CointEq(−1)	−0.53 (−5.75)[a]	—	—

Note: t statistics in parentheses.
[a]Significant at 1%.
[b]Significant at 5%.
[c]Significant at 10%.

the long-run exists only when the coefficient of the error correction is statistically significant and different from zero our evidence suggests that there is long-run causality from fiscal balances, and investment to the trade balance in the Southern Group of economies.

Table 2 reports our estimates of Equation 7. There is a positive and highly significant coefficient (β^n) for the northern real income (GDP) and a negative and highly significant coefficient (β^s**)** for the Southern GDP implying that an increase in the Northern Group's real income improves the Southern trade balance (through increased exports) whereas an increase in the Southern Group real income deteriorates its trade balance through increased imports. Interestingly, the coefficient for the real exchange rate (q) is negative and highly significant throughout the whole range of tests revealing that a real long-run depreciation in the South, deteriorates its trade balance in the long-run. The negative effect on the long-run trade balance could be attributed to the fact that the value effect may outperform the volume effect of the trade balance accompanied by inelastic import and export demands with respect to the real exchange rate.

However, the results should need to be interpreted with some degree of caution due to possible misspecification errors if structural breaks in the parameters generating the process are not considered. To further test the validity of our results, we also proceed by testing for structural breaks among the variables in Equations 1 and 7. Given the evidence of the presence of structural breaks (2010: Q3 for Equation 1 and 2010: Q2 for Equation 7) the VECM representation cannot be used in the analysis. Thus, we proceed with the ARDL, the FMOLS and the Panel FM-OLS co-integration techniques. As Table 3 and Table 4 indicate, all previous results remain valid. It is worth noting that the magnitude of all coefficients along with their level of significance have not changed significantly across the three empirical specifications as compared to the results reported in Tables 1 and 2. The coefficients of the two Dummy variables are positive but not highly significant across the various tests.

Appendices A, B, C and D present additional evidence related to the reliability of the estimations presented in Tables 1–4. More specifically, Table A1 in Appendix A shows the ARDL Bound Tests for the variables in Equations 1 and 7 (with and without structural breaks), revealing strong evidence of co-integration. Additional tests related to the statistical viability of the results are reported in Table A2 indicating that there is no serial correlation of the residuals, no evidence of heteroskedasticity and that the residuals are normally distributed. Finally, given the importance of model stability for both econometric inference and for policy analysis the corresponding CUSUM tests on the recursive residuals are presented in Figure A1, show that there is strong evidence in

	ARDL	FMOLS	PANEL
Real GDP South (β^s)	−0.88 (−7.80)[a]	−0.81 (−10.41)[a]	−4.84 (−6.59)[a]
Real GDP North (β^n)	0.62 (11.73)[a]	0.60 (14.49)[a]	5.36 (7.20)[b]
Real Exchange Rate (q)	−7.25 (−4.13)[a]	−6.33 (−4.37)[a]	−0.05 (−2.31)[a]
Dummy 2010 Q2	0.56 (2.72)[a]	−0.02 (−0.14)	0.26 (0.61)
CointEq(−1)	−0.48 (−5.74)[a]	—	—

TABLE 4 Structural break estimation of the long-run coefficients Equation 7

Note: t statistics in parentheses.
[a]Significant at 1%.
[b]Significant at 5%.
[c]Significant at 10%.

favour of the long-run structural stability for the models' coefficients.

In relation to the FM-OLS estimations, Table B1 reveals strong evidence of co-integration among the variables across all versions of the model specifications. Strong evidence of co-integration for Equations 1 and 7 (without structural breaks) is also reported from the VECM in Table C1 where a single co-integration equation is identified. In addition, Figures C1 and C2 confirm that the VECM estimates appear to be stable since the inverted roots of the AR Characteristic Polynomials lie inside the unit circle. Finally, Tables C2 and C3 confirm that there is no evidence of heteroskedasticity, serial correlation and that the residuals are normally distributed. In relation to our Panel FM-OLS estimations Tables D1–D8 in Appendix D present evidence of co-integration among the variables in Equations 1 and 7 (with and without the structural break).

6 | CONCLUSION AND POLICY RECOMMENDATIONS

In this paper we have examined the determination of the trade balance of the Southern Group *vis-à-vis* the Northern Group in the long-run by looking at the investment channel, the fiscal channel and the competitiveness channel. In contrast to previous studies, we focus on a bilateral relationship by aggregating data from Greece, Italy, Portugal, Spain and France to represent the Southern Group and Germany, Belgium, the Netherlands and Finland as representing the Northern Group. In addition, we consider structural breaks in the aggregated series between the two regions and employ a battery of empirical techniques to test for the validity of the reported estimates.

Our results clearly indicate that a fiscal expansion in the Northern Group will have a positive impact on the Southern trade balance while a fiscal expansion in the Southern Group deteriorates its trade balance. Moreover, our empirical results suggest that a fiscal expansion is the Northern Group has nearly twice the effect of improving the trade balance of the Southern Group than a fiscal contraction in the Southern Group. Our results highlight the importance of fiscal surveillance within the Eurozone as an important mechanism to correction the persistent deficits of the Southern Group.

Our empirical evidence also suggests that an increase in the Southern Group's investment deteriorates the trade balance in the Southern Group which occurs because of the direct effect on Southern GDP and import consumption and the indirect effect of financing some of this investment through capital inflows which while improving the capital and financial account implies a further deterioration of the trade account of the balance of payments. From a policy perspective, it is clear that the way investment is financed should be a key policy issue in the Southern region. Investment that can improve a country's ability to export and also produce goods that substitute for imported goods has the potential to offset the negative direct effects of investment on the trade balance because of the induced increase in imports caused by the increase in the Southern Group's real income. In addition, our empirical results suggests that higher investment in the Northern eurozone can play a role in reducing the trade deficits in the Southern Group of countries.

In respect of the competitiveness channel our evidence suggests that a depreciation of the real exchange rate is not associated with an improvement in the long run competitiveness of the Southern Group's trade balance. As such, the Southern Group of countries should think of other *non-price* means of improving their competitiveness such as a greater focus on improving the quality of their exports and import substitutes, structural reforms and supply side economic policies particularly in relation to their labour and good markets. Such policies will over time have the additional benefit of improving their fiscal balances resulting in further improvements to their trade balances.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] De Santis & Cesaroni, 2016

[2] Lower case letters indicate logarithms.

[3] Note that in 2015 there is a spike (outlier) in the Gross Fixed Capital Formation (GFCF) of the Northern Group attributed to the substantial increase in GFCF in Netherlands (in the second quarter of 2015) due to a big number of multinationals that were active in capital-intensive industries.

[4] Data is collected from OECD and the World Bank.

[5] All tests are available upon request.

[6] Some of the advantages of the VECM are that it reduces the multicollinearity effect in time series, that the estimated coefficients can be classified into short-run and long-run effects, and that the long-run relationships of the selected macroeconomic series are reflected in the level matrix Π and so can be used for further co-integration analysis. See Juselius (2006).

[7] See Hargreaves (1994) for an overview of methods of estimating co-integrating relationships.

[8] See Feldstein and Horioka (1980).

[9] To estimate Equation 1 and Equation 7 we firstly test for the non-stationarity of the variables by performing panel unit root tests. We initially perform Levin, Lin, and Chu (2002) (LLC), Im, Pesaran, and Shin (2001) (IPS), ADF and PP Fisher Chi-square tests, all of which have the null hypothesis of a unit root. For robustness purposes, we also conduct the Hadri Z-stat test under the null that the panel data does not possess a unit root. The panel unit root tests, which indicate that overall the variables can be treated as I(1), are available upon request.

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APPENDIX A

ARDL tests

TABLE A1 ARDL bound tests (null hypothesis: No long-run relationships exist)

Equation 1 (No break)		
F statistic	**4.60**	**k = 4**
Critical value bounds	**I(0) Bound**	**I(1) Bound**
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37
Equation 7 (No Break)		
F Statistic	**4.67**	**k = 3**
Critical value bounds	**I(0) Bound**	**I(1) Bound**
10%	2.37	3.2
5%	2.79	3.67
2.5%	3.15	4.08
1%	3.65	4.66
	Equation 1 (Break 2010: Q3)	
F Statistic	**4.31**	**k = 5**
Critical value bounds	**I(0) Bound**	**I(1) Bound**
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15
	Equation 7 (Break 2010: Q2)	
F Statistic	**5.09**	**k = 4**
Critical value bounds	I(0) Bound	I(1) Bound
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

TABLE A2 Misspecification tests

	Equation 1 (no break)	**Equation 7 (no break)**	**Equation 1 (break 2010: Q3)**	**Equation 7 (break 2010: Q2)**
Breusch-Godfrey serial correlation LM test	$prob\,(\chi)^2 = 0.18$	$prob\,(\chi)^2 = 0.57$	$prob\,(\chi)^2 = 0.62$	$prob\,(\chi)^2 = 0.38$
Breusch-Pagan-Godfrey Heteroskedasticity test	$prob\,(\chi)^2 = 0.37$	$prob\,(\chi)^2 = 0.67$	$prob\,(\chi)^2 = 0.94$	$prob\,(\chi)^2 = 0.67$
Jarque-Bera Normality test	Prob = 0.35	Prob = 0.60	Prob = 0.34	Prob = 0.10

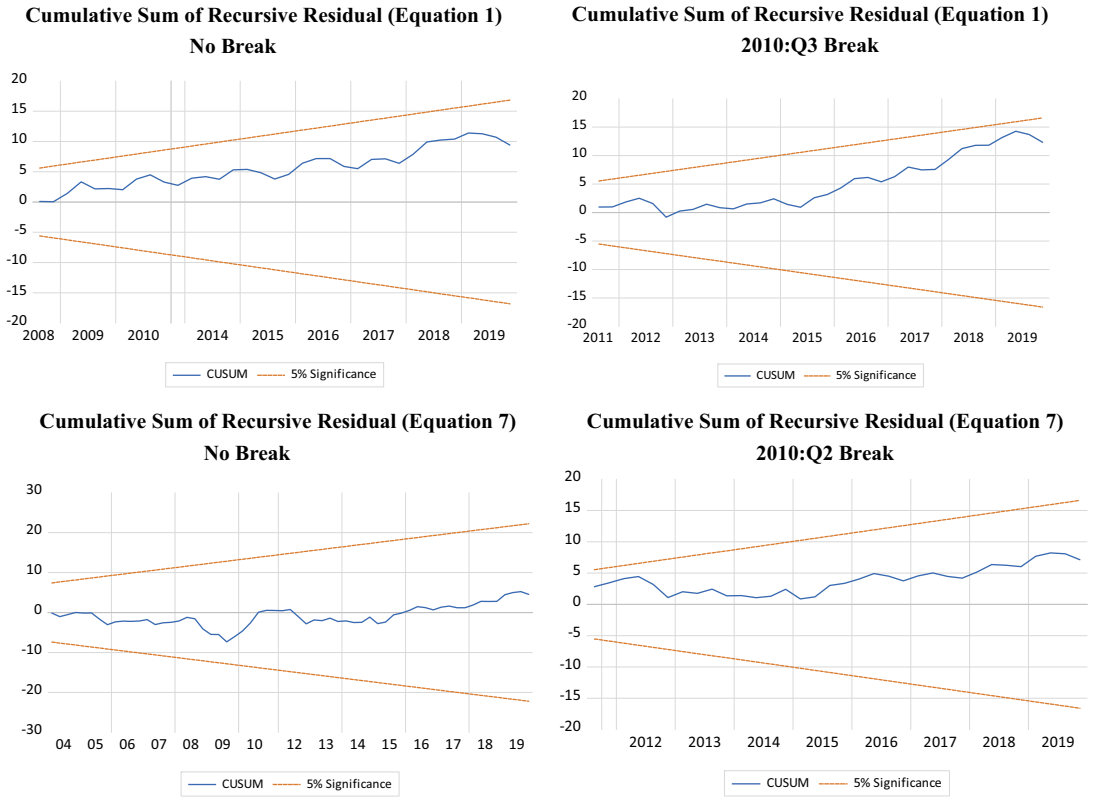

FIGURE A1 Stability tests. [Colour figure can be viewed at wileyonlinelibrary.com]

APPENDIX B

FMOLS tests

TABLE B1 Co-integration tests

	Equation 1 (no break)	Equation 7 (no break)	Equation 1 (dummy 2010: Q3)	Equation 7 (dummy 2010: Q2)
Engle-Granger	Prob = 0.03[b]	Prob = 0.01[b]	Prob = 0.03[b]	Prob = 0.04[b]
Phillips-Ouliaris	Prob = 0.05[b]	Prob = 0.001[a]	Prob = 0.07[c]	Prob = 0.004[a]

[a]Significant at 1%.
[b]Significant at 5%.
[c]Significant at 10%.

APPENDIX C

Vector error correction model

TABLE C1 Co-integration tests

Hypothesized no of co-integrated relationships	Max-Eigen statistic	5% critical value
Equation 1 No Break		
None[a]	39.44	33.87
At most 1	22.49	27.58
At most 2	20.92	21.13
At most 3	5.208	14.26
Equation 7 No Break		
None[a]	31.67	30.81
At most 1	20.49	24.25
At most 2	16.89	17.14
At most 3	2.40	3.84

[a]Denotes rejection of the hypothesis at the 0.05 level.

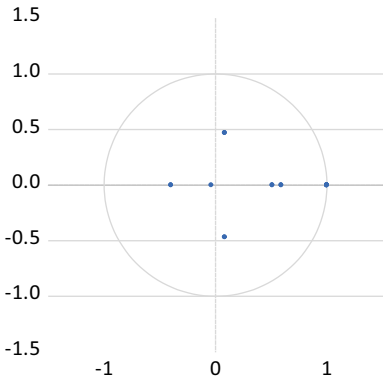

FIGURE C1 Inverse roots of AR characteristic polynomial (Equation 1 No break) [Colour figure can be viewed at wileyonlinelibrary.com]

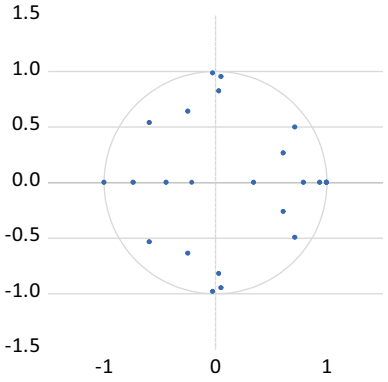

FIGURE C2 Inverse roots of AR characteristic polynomial (Equation 7 No break) [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE C2 Misspecification tests Equation 1 (no break)

Breusch-Godfrey serial correlation LM test	$\boldsymbol{prob(\chi)^2 = 0.10}$
Breusch-Pagan-Godfrey Heteroskedasticity	$prob(\chi)^2 = 0.37$
Jarque-Bera Normality test	Prob = 0.79

TABLE C3 Misspecification tests Equation 7 (no break)

Breusch-Godfrey serial correlation LM test	$\boldsymbol{prob(\chi)^2 = 0.42}$
Breusch-Pagan-Godfrey Heteroskedasticity	$prob(\chi)^2 = 0.30$
Jarque-Bera Normality test	Prob = 0.14

APPENDIX D

Panel FM-OLS[9]

TABLE D1 Pedroni residual co-integration test (no deterministic trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	**Prob**	**Statistic**	**Prob**
Panel v-Statistic	1.760469	0.0392	1.700798	0.0445
Panel rho-Statistic	−2.159698	0.0154	−2.718235	0.0033
Panel PP-Statistic	−2.663901	0.0039	−3.123889	0.0009
Panel ADF-Statistic	−0.988217	0.1615	−1.113979	0.1326
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	**Prob**		
Group rho-Statistic	−2.004515	0.0225		
Group PP-Statistic	−3.109858	0.0009		
Group ADF-Statistic	−0.822111	0.2055		

Series: Fiscal Balance South, Fiscal Balance North, Investment South, Investment North.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D2 Pedroni residual co-integration test (deterministic intercept and trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	5.857839	0.0000	3.842999	0.0001
Panel rho-Statistic	−1.627867	0.0518	−1.599636	0.0548
Panel PP-Statistic	−2.063754	0.0195	−2.076760	0.0189
Panel ADF-Statistic	−0.988416	0.1615	−0.434417	0.3320
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−0.216788	0.4142		
Group PP-Statistic	−1.004781	0.1575		
Group ADF-Statistic	1.167162	0.8784		

Series: Fiscal Balance South, Fiscal Balance North, Investment South, Investment North.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D3 Pedroni residual Co-integration test break series included (no deterministic trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	0.549160	0.2914	0.591676	0.2770
Panel rho-Statistic	−1.470735	0.0707	−1.795848	0.0363
Panel PP-Statistic	−2.384406	0.0086	−2.686347	0.0036
Panel ADF-Statistic	−2.021139	0.0216	−2.322867	0.0101
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−1.128769	0.1295		
Group PP-Statistic	−2.594008	0.0047		
Group ADF-Statistic	−2.128786	0.0166		

Series: Fiscal Balance South, Fiscal Balance North, Investment South, Investment North.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D4 Pedroni residual co-integration test break series included (deterministic intercept and trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	5.095708	0.0000	3.278233	0.0005
Panel rho-Statistic	−2.200167	0.0139	−1.572472	0.0579
Panel PP-Statistic	−2.766139	0.0028	−2.235654	0.0127
Panel ADF-Statistic	1.794996	0.9637	2.246243	0.9877
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−0.482971	0.3146		
Group PP-Statistic	−1.336026	0.0908		
Group ADF-Statistic	3.050025	0.9989		

Series: Fiscal Balance South, Fiscal Balance North, Investment South, Investment North.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D5 Pedroni residual Co-integration test (no deterministic trend)

Alternative hypothesis: Common AR coefficients. (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	0.720550	0.2356	0.467190	0.3202
Panel rho-Statistic	−1.117346	0.1319	−0.527052	0.2991
Panel PP-Statistic	−0.752419	0.2259	−0.227370	0.4101
Panel ADF-Statistic	2.729751	0.9968	2.892125	0.9981
Alternative hypothesis: individual AR coefficients. (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−2.157977	0.0155		
Group PP-Statistic	−0.941246	0.1733		
Group ADF-Statistic	3.196323	0.9993		

Series:Southern GDP, Northern GDP, Real exchange rate.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D6 Pedroni residual Co-integration test (deterministic intercept and trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	10.42414	0.0000	10.66230	0.0000
Panel rho-Statistic	−24.29646	0.0000	−23.65357	0.0000
Panel PP-Statistic	−18.24707	0.0000	−17.79783	0.0000
Panel ADF-Statistic	−1.700779	0.0445	−1.502179	0.0665
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−21.10385	0.0000		
Group PP-Statistic	−17.80862	0.0000		
Group ADF-Statistic	−1.256899	0.1044		

Series: Southern GDP, Northern GDP, Real exchange rate.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D7 Pedroni residual co-integration with break series test (no deterministic trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	0.002706	0.4989	−0.168940	0.5671
Panel rho-Statistic	−0.108519	0.4568	0.315193	0.6237
Panel PP-Statistic	0.084773	0.5338	0.537302	0.7045
Panel ADF-Statistic	4.070112	1.0000	4.116490	1.0000
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−0.998703	0.1590		
Group PP-Statistic	−0.052242	0.4792		
Group ADF-Statistic	5.090970	1.0000		

Series: Southern GDP, Northern GDP, Real exchange rate.
Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.

TABLE D8 Pedroni residual co-integration with break series test (deterministic intercept and trend)

Alternative hypothesis: Common AR coefficients (within-dimension)				
	Weighted			
	Statistic	Prob	Statistic	Prob
Panel v-Statistic	8.942408	0.0000	9.076829	0.0000
Panel rho-Statistic	−20.36689	0.0000	−20.04048	0.0000
Panel PP-Statistic	−17.21617	0.0000	−16.93892	0.0000
Panel ADF-Statistic	−3.962065	0.0000	−3.875226	0.0001
Alternative hypothesis: individual AR coefficients (between-dimension)				
	Statistic	Prob		
Group rho-Statistic	−18.08843	0.0000		
Group PP-Statistic	−16.64200	0.0000		
Group ADF-Statistic	−3.956711	0.0000		

Series: Southern GDP, Northern GDP, Real exchange rate.

Note: The 5% critical value is −1.645 since the residual based test is the one-tailed test. 'Panel v' is a non-parametric variance ratio statistic; 'Panel rho' and 'Panel PP' are analogous to the non-parametric Phillips-Perron and *t* statistics; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group r' and 'Group PP' are the non-parametric Phillips-Perron and *t* statistics and 'Group ADF' is the standard parametric ADF statistic.