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An empirical analysis of the nexus between investment, fiscal balances and current account balances in Greece, Portugal and Spain

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Abstract

We provide new evidence that current account balances in Greece, Portugal and Spain have become non-stationary after the adoption of the euro implying that there is no long-run stable relationship between savings and investment contrary to the Feldstein-Horioka puzzle. This can be taken as evidence of unsustainable current account balances and loss of solvency for the underlying economies. Using the ARDL methodology we also report a statistical association between fiscal balances and current account balances, which implies that fiscal austerity can help these economies to reduce their current account deficits and restore their competitiveness. Our empirical evidence also suggests a particularly strong significant negative association between domestic investment and current account deficits in all three economies. The magnitude of this latter effect may have important policy implications concerning the ways in which investment is financed in order to alleviate current account deficits and improve the external competitiveness of these economies.

Keywords: International Financial Integration, Twin deficits, Feldstein-Horioka, ARDL, co-integration.

JEL Classification: C.22, C.32, E.62, F.21, F.32, F.34, H.62

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1. Introduction

The twin deficit hypothesis, that is the association of increased fiscal deficits with rising current account deficits, has received much empirical scrutiny in the literature producing a mix of results for different countries. In light of the Eurozone crisis and the apparent current account imbalances between the 'core' and 'periphery' countries, it is important to investigate empirically the nexus between fiscal balances and current account balances and draw conclusions on whether fiscal austerity measures in the form of tougher controls on government expenditure and/or increases in taxation can affect external imbalances in highly indebted economies of the south Eurozone periphery.

The Eurozone crisis has many causes ranging from structural flaws within the Eurozone to the financial crisis post 2007 and resulting global recession. There is a clear division between core Eurozone economies (mainly represented by Germany) and the periphery typified by Greece, Spain and Portugal. After joining the Eurozone the periphery started losing its competitiveness through poorer performance in labour markets and their relatively higher rates of inflation compared to Germany. High levels of consumption, especially in Greece and Portugal, accompanied by low rates of private saving generated a private sector deficit financed by borrowing from abroad. Public debt started to accumulate both pre and post the global financial crisis. At the same time, the three economies experienced large current account deficits with subsequent high external debt creation. In this paper we aims to shed light on the statistical association between fiscal balances and current account balances and investigate the extent to which investment is associated with large current account deficits in Greece, Spain and Portugal[1].

[1] We do not incorporate Italy in our analysis since Italy can be considered to be a periphery country with several distinct macroeconomic characteristics. More specifically, unlike Greece, Spain and Portugal, Italy did not report a substantial fiscal deficit in 2009 (that is greater than 10% of GDP), when the financial crisis emerged. In addition, since the adoption of the euro Italy had a better inflation differential with Germany with the ultimate result of suffering a less severe loss in competitiveness as compared with the other three peripheral economies. This later fact is also empirically confirmed by Busetti *et al* (2006) who argue that Italy can be considered to be a separate case.

Our research aims to contribute to the existing literature in a number of ways. First, we employ a time series approach to explore the extent to which the current account balances of Greece, Spain and Portugal contain a unit root. Such evidence is informative about these countries' solvency and the sustainability of their external debt. By employing unit root tests we provide empirical evidence that after adopting the euro, the current account balances of the three economies have become non-stationary implying that savings and investment react differently to shocks. Second, we investigate both the occurrence and the intensity of the twin deficit hypothesis. Third we provide empirical evidence on the Feldstein-Horioka puzzle for the selected economies. The empirical evidence concerning the relationship between government fiscal balances, investment and current account balances is undertaken using the ARDL co-integration methodology, which has a distinct advantage compared with other co-integration approaches like Engle and Granger (1987), Johansen (1988), and Johansen and Juselius (1990) that have been employed in previous studies[2]. Finally, to check the robustness of our results from the ARDL co-integration approach, as previously applied to the individual countries, we also perform the FM-OLS panel co-integration test for the three economies.

The paper is organised as follows: Section 2 provides a brief review of the literature on the twin deficit hypothesis and the Feldstein Horioka puzzle for the economies under consideration. Section 3 presents the Twin Deficit Hypothesis and the Feldstein Horioka puzzle. Section 4 presents the unit root tests on current account balances both for the pre and the post euro era for Greece, Spain and Portugal. Section 5 presents the ARDL co-integration methodology for each economy and interprets the results. Section 6 presents the results from the panel co-integration test and Section 7 concludes.

[2] For more information about the advantages of the ARDL methodology for testing co-integration see section 5.

2. Literature Review

Empirical studies focusing on the relationship between fiscal and current account deficits in the southern Eurozone periphery often provide inconclusive results. The lack of consensus has to do not only with the particular countries examined but also with the various underlying structural forces that may give rise to different correlations and the different empirical techniques that have been used.

Algieri (2013) examines the euro area's Mezzogiorno focusing on Greece, Ireland, Italy, Portugal and Spain (GIIPS group) after employing the traditional Granger causality test (1969) and the alternative Toda-Yamamoto (1995) methodology for each individual country. Evidence is found in favour of the Ricardian theory according to which there is no clear relationship between the fiscal balances and the current account balances. Bitzis *et al* (2008) apply the Johansen (1996) and the Johansen and Juselius (1990) co-integration methodology along with the Error Correction Model and find little evidence that fiscal expansion worsens the Greek current account deficit. On the other hand, Kalou and Paleologou (2010) using a multivariate Vector Error Correction Model (VECM), allowing for endogenous determination of structural breaks, report evidence in favour of the twin deficit hypothesis for Greece. Trachanas and Katrakilidis (2013) provide empirical evidence in favour of the twin deficit hypothesis for Portugal, Ireland, Greece and Spain after allowing for the presence of structural breaks and asymmetric responses to shocks. Vamvoukas (1999) and Pantelidis *et al* (2009) confirm the twin deficit hypothesis for Greece for the period 1960-2007, whereas evidence in favour of Ricardian equivalence for European Union member states is found by Papadogonas and Stournaras (2006).

Kosteletou (2013) provides some empirical support for the idea that fiscal policy can be used to eliminate external disequilibrium in the southern Eurozone countries after employing a panel data methodology for the period 1991- 2011. According to Kosteletou (2013) a deterioration in the government fiscal balance following an expansionary fiscal policy, and the opportunity to finance the increased expenditure requirements through

international borrowing, increases the supply and stock of domestic bonds and deteriorates the current account.

Schmitz and Hagen (2009) investigate current account imbalances and financial integration in the euro area focussing on net capital flows among the euro-area countries (including Greece, Spain and Portugal). They report that the elasticity with respect to per-capita incomes of net capital flows between euro area countries has increased implying greater financial integration since the introduction of the euro. The idea that Eurozone imbalances have been financed by movements of capital from surplus to deficit Eurozone countries is given further empirical support in the study of Chen *et al* (2013) who also find that China has displaced exports from the Southern European economies, which combined with an appreciation of the Euro, has contributed to a deterioration of their current account deficits. Schmitz (2014) finds that countries that are close to a financial centre such as London and also part of a currency union are able to raise external finance more easily, his sample includes Greece, Spain and Portugal.

Turning to the current account sustainability of the Eurozone economies the literature is quite scarce. Chen (2011) has examined whether or not the current account deficits for several OECD economies can be characterized by a unit root process with regime switching, indicating that the current account of Portugal and Spain do not follow a sustainable path. In addition, after testing for the importance of nonlinearities to current account sustainability in European Economies, Chen (2014) reported that with the exception of Finland, Portugal and Spain the current account-GDP ratios of the European countries exhibit structural break nonlinearity and that Greece and Portugal (among other economies) do exhibit size nonlinearity.

3. The Twin Deficit Hypothesis and the Feldstein Horioka puzzle

The starting point for understanding the twin deficit hypothesis is the national income identity for a small open economy, which depicts that national income is the sum of

domestic and foreign expenditure on the goods and services produced in the domestic economy. The national income identity is given by:

$$Y = C + I + G + X - M \qquad (1)$$

where Y stands for national income, C for private consumption, I for national investment, G for government expenditure, X for exports and M for imports.

The difference between exports of goods and services and imports of goods and services gives the current account balance (CA)

$$CA = X - M \qquad (2)$$

Equation (1) implies that the current account is also equal to the difference between national income and domestic residents' spending, that is:

.

$$Y - (C + I + G) = CA \qquad (3)$$

A country will have a current account deficit if it is consuming more than it is producing and it will need to finance this by net capital inflows from abroad.

Let S stand for national savings defined as $S = Y - C - G$. Equation (3) can be written as:

$$S - I = CA \qquad (4)$$

The above equation highlights the fact that the current account is equal to the difference between national savings and national investment.

Following Feldstein and Horioka (1980) the relationship between national savings and national investment has been widely explored based on the following regression equation[3]:

$$\frac{I}{Y} = \alpha + \beta \frac{S}{Y} + e \qquad (5)$$

Where $\frac{I}{Y}$ is the ratio of investment to GDP, $\frac{S}{Y}$ the ratio of national savings to GDP and e is an i.i.d. error term with zero mean and constant variance. Feldstein and Horioka suggest that savings and investment are highly correlated with a correlation coefficient of 0.89 on a cross-section of 16 OECD economies for the period 1960-74. According to Feldstein and Horioka this may be indicative of limited capital mobility for industrialized economies. The relationship between savings and investment has mainly been examined in the literature through panel co-integration techniques both for OECD and European Union groups of countries delivering mixed results. Within this empirical framework the evidence suggests that co-integration between investment and savings has not been rejected, when tested indirectly as in Coakley *et al* (1996) and Jansen (2000), but is rejected while tested directly by means of the Johansen test on savings and investment as in Ho (2002a and 2002b) and Blanchard and Giavazzi (2002).

By contrast, time series approaches on individual countries are quite limited[4] particularly with respect to the three indebted economies Greece, Spain and Portugal following the adoption of the euro. To investigate the relationship between savings and investment in the underlying economies we test for a unit root on current account balances based on Gundlach and Sinn (1992). Expressing equation (4) as a ratio of savings, investment and the current account to GDP and substituting into equation (5) the following equation can be derived:

$$\frac{CA}{Y} = -\alpha + [1 - \beta]\frac{S}{Y} - e \qquad (6)$$

[3] Feldstein and Horioka report evidence against world capital mobility on OECD economies and in favour of a strong correlation between savings and investment for the countries under investigation. For an interpretation of the Feldstein and Horioka puzzle for EU member states see Aristovnik and Djurić (2010).
[4] See for example Obstfeld (1986), Miller (1988), Leachman (1991) and Banerjee and Zanghieri (2003).

Equation (6) can be used to empirically assess the degree to which investment and savings are associated in the long run. According to Gundlach and Sinn (1992) if the current account balance to GDP turns out to be integrated of order one i.e. I(1) $(\beta \neq 1)$ then savings and investment rates exhibit different reactions to shocks. On the other hand, if the current account balance to GDP is generated by a stationary process i.e. I(0) $(\beta = 1)$ and the error term is assumed to be stationary (Felsdtein-Horioka assumption) then savings and investment rates will not exhibit different reactions to shocks. Testing empirically the relationship between savings and investment in these countries could trigger further experiments on testing the statistical association between national investment and current account balances especially after the adoption of the euro. To proceed with such an experiment national savings are divided between private savings $S^p = Y - T - C$ and public savings (i.e. the fiscal balance) $S^g = T - G$ where T depicts tax revenues for the government and G government expenditure. The above definitions of private and government savings can be used to rewrite equation (4) as follows:

$$(S^p - I) + (T - G) = CA \qquad (7)$$

Equation (7) shows that if domestic investment is financed entirely by private savings then the current account and the government balance move together i.e. they become 'twins'. However, especially for small open economies with high degree of capital mobility, several intermediate cases may arise where investment could be partially financed by private savings and international financial markets or in the case of low saving countries both investment and the financial needs of the public sector can be heavily financed from abroad.

The investigation of both the occurrence and the intensity of the relationship between a country's fiscal balance and its current account balance i.e. the twin deficits can be examined empirically. However, the underlying forces through which variations in a small open economy's fiscal stance are associated with developments in the country's current account balances remains a controversial issue. Two main competing views give rise to different behavioural relationships that may exist. One is the traditional view

arguing that budget deficits may lead to current account deficits either directly through an increase in imports or indirectly through a loss of competitiveness following an increase in interest rates and a currency appreciation. This traditional view is contested by advocates of the Ricardian equivalence hypothesis, see Barro (1989), according to which a deterioration in the fiscal deficit due to reduced taxation will be offset by an increase in private savings with no ultimate effect on the current account.

To empirically test the long-run association between budget and current account balances and to provide further evidence on the Feldstein-Horioka puzzle for the underlying economies we estimates equation (8) following Fidrmuc (2003). This is of a particular interest given the fact that there was a collapse of savings in Portugal, Spain and Greece after the adoption of euro, due to loss of competitiveness and high public sector deficits in the aftermath of the recent financial crisis.

$$ca_t = \beta_0 + \beta_1 s_t^g + \beta_2 i_t + u_t \qquad (8)$$

where ca_t the ratio of current account to GDP, s_t^g the ratio of fiscal balances to GDP, i_t the ratio of national investment to GDP and u_t a disturbance term. It is worth noting that the average propensity to save is often taken as constant in the theoretical models underlying the twin deficits issue. From the theoretical point of view the consumption/saving behaviour of the private sector could undergo a structural change in the long run. Such a change is generally reflected as a shift in the intercept of equation (8)[5].

If $\beta_1 > 0$ there will be an improvement in the ca (a positive s_t^g means a fall in fiscal deficit and rise in the ca surplus) and if $\beta_2 < 0$ then there is empirical evidence that an increase in investment deteriorates the current account balance. In addition, if the absolute value of the coefficients of both variables is close to one, the more integrated in international financial markets the three economies may be. The empirical evidence could have important policy implications for the stance of fiscal policy that should be adopted

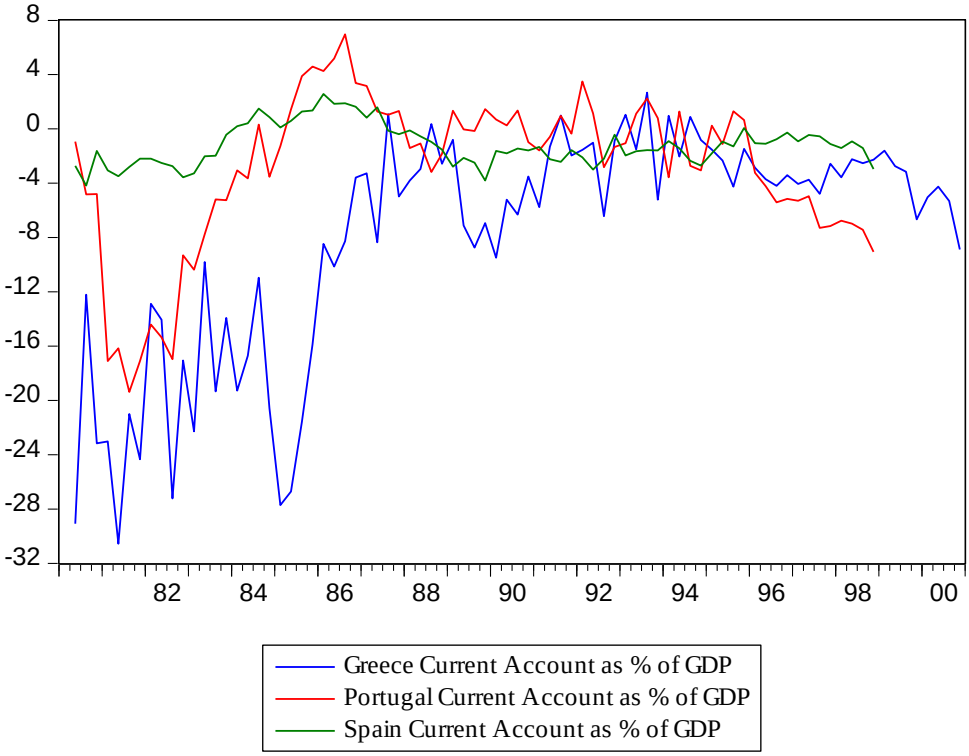
[5] See Bagnai (2006).

by Portugal, Spain and Greece in their attempts to reduce current account deficits and improve their competitiveness. In addition, the empirical results can act as triggers for further research into understanding the underlying structural forces that give rise to the various correlations.

4. Unit root tests for the Current account

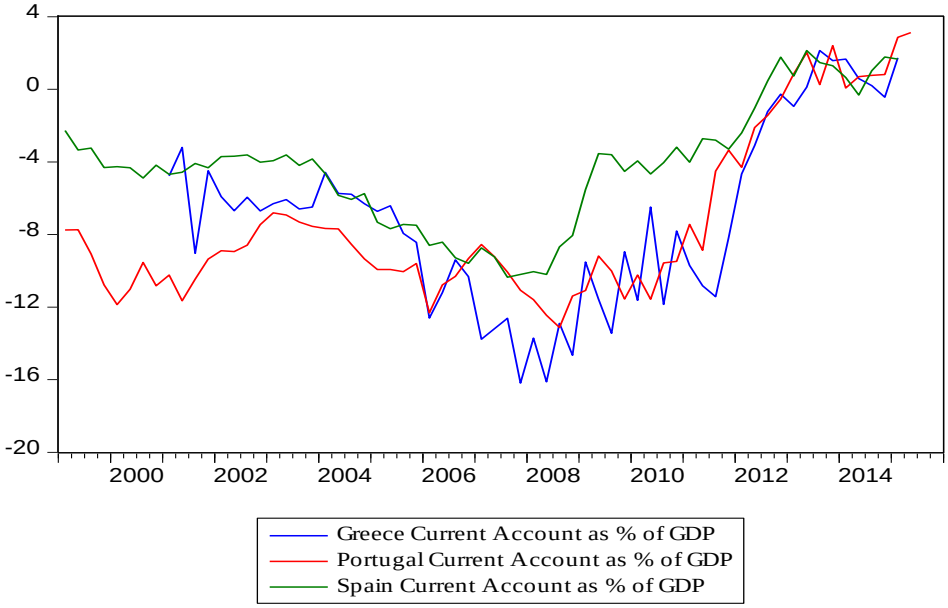
In this section unit root tests on current account balances are undertaken for Greece, Spain and Portugal. If the current account balance turns out to be integrated of order 1 i.e. I (1) then there is no long-run stable relationship between national savings and investment. Quarterly data for current account balances as percentage of GDP were collected from Datastream for the three economies under consideration. Given data availability the dataset was divided in two periods to reflect pre and post euro regimes. For Spain and Portugal the pre-euro era covers the period 1980Q2 to 1998Q4 and the post euro era the period 1999Q1 to 2015Q2. For Greece the pre euro era covers the period 1980Q2 to 2000Q4 and the post euro era the period 2001Q1 to 2015Q2. Figures 1 and 2 show the pre and post euro era current account balances for Greece, Portugal and Spain.

Figure 1 Current Account Balances as % of GDP (pre euro era)



Source: Datastream

Figure 2 Current Account Balances as % of GDP (post euro era)



Source: Datastream

Table 1 depicts various unit root tests for the current account balances for Greece, Spain and Portugal for the pre euro era. We initially perform the Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) tests under the null hypothesis of a unit root[6]. However according to Perron (1989) while examining the time series properties of data we should also consider the possibility of structural breaks. Consequently, we also perform a general Dickey-Fuller test with intercept break and a one-time break dummy with unknown break dates.

Table 1: Unit root tests for Current Account as a percentage of GDP (pre-euro era)

	ADF			
	Levels		**1st Differences**	
	No Intercept	**Intercept**	**No Intercept**	**Intercept**
Greece	-2.22(4)††	-2.21(4)	-6.08(3)*	-6.14(3)*
Spain	-2.04(4) ††	-2.47(4)	-3.90(3)*	-3.86(3)*
Portugal	-2.70(4)*	-2.72(4)*	-4.75(3)*	-4.72(3)*
	PP			
	Levels		**1st Differences**	
	No Intercept	**Intercept**	**No Intercept**	**Intercept**
Greece	-4.64*	-5.49*	-24.69*	-24.33*
Spain	-4.56*	-5.48*	-20.42*	-20.26*
Portugal	-3.98*	-4.35*	-18.04*	-17.67*
	Break Point Unit Root Test			
	Levels		**1st Differences**	
	Intercept		**Intercept**	
Greece	-5.92(5)*	Break 1985Q4	-6.60(3)*	Break 1986Q3
Spain	-2.99(4)	Break 1988Q3	-4.73(3) ††	Break 1984Q3
Portugal	-3.09(4)	Break 1995Q3	-13.82(2)*	Break 1986Q4

Note: Entries in parenthesis indicate the chosen number of lags.
(*) indicates that the test is significant at 1% (††) significant at 5% (†) significant at 10% level.

For Greece the ADF, the PP and the structural break tests all indicate strong evidence that the current account balance is stationary in levels i.e. I(0) for the pre-euro era. Consequently the evidence suggest that the Greek current account balance in the pre-euro era was stationary, providing evidence of solvency i.e. a stable relationship between savings and investment.

[6] We allow for a non-zero mean current account balance to avoid a potential bias towards the non-rejection of the null hypothesis of a unit root. According to Gundlach and Sinn (1992) this may be relevant for economies with persistent current account deficits or surpluses.

Table 2: Unit root tests for Current Account as a percentage of GDP (post-euro era)

	ADF			
	Levels		**1st Differences**	
	No Intercept	**Intercept**	**No Intercept**	**Intercept**
Greece	-1.12(5)	-1.36(5)	-2.33(4) ††	-2.45(5) ††
Spain	-1.15(4)	-1.11(4)	-2.81(3)*	-2.85(3) †
Portugal	-1.36(4)	-0.17(4)	-3.32(3)*	-3.62(3)*
	PP			
	Levels		**1st Differences**	
	No Intercept	**Intercept**	**No Intercept**	**Intercept**
Greece	-2.67*	-3.70*	-15.56*	-15.65*
Spain	-1.17	-1.92	-11.23*	-11.96*
Portugal	-1.24	-2.26	-14.66*	-16.80*
	Break Point Unit Root Test			
	Levels		**1st Differences**	
	Intercept		**Intercept**	
Greece	-3.18(5) Break 2011Q4		-4.89(3) †† Break 2007Q4	
Spain	-2.45(4) Break 2010Q3		-5.77(6)* Break 2008Q2	
Portugal	-3.64(4) Break 2011Q2		-4.52(3) †† Break 2010Q2	

Note: Entries in parenthesis indicate the chosen number of lags.
(*) indicates that the test is significant at 1% (††) significant at 5% (†) significant at 10% level.

Turning to the post-euro era as depicted in Table 2, the ADF test and the structural break test both suggest that the current account of Greece is non-stationary. Evidence of stationarity comes only from the PP test. Consequently, there is evidence that savings and investment in Greece have different reactions to shocks than in the pre-euro era implying that after joining the Eurozone the solvency of the Greek economy has deteriorated.

Examining Spain and Portugal evidence from the ADF and the PP tests suggest that their pre euro current account balances were also stationary i.e. I (0). On the other hand, all tests clearly indicate that after joining the Eurozone their current account balances turn out to be I(1).

Overall the results from the unit root tests on current account balances must be interpreted with caution. There is evidence of a high statistical association between savings and investment for the three economies before joining the Eurozone given that their current account balances were stationary, implying some degree of solvency for these economies and providing evidence of external deficit sustainability. However, this

may not necessarily be an indicator of international capital immobility as suggested by Feldstein and Horioka. As Levy (2003) reports, unless an economy violates its dynamic budget constraint (something not apparent for the pre-euro area) there is nothing mysterious in the investment-saving co-movement and a test of such co-integration should mainly be interpreted as a test of a country's economic solvency.

In a bivariate setup we also report evidence of no stationarity of the current account, following the adoption of the euro, indicating a loss of solvency[7]. However, in a highly stylized theoretical setup, under the assumption of negative initial net foreign assets, an infinite horizon economy may run perpetual current account deficits. In order not to be engaged in a Ponzi scheme, the economy should pay periodically part of the interest accrued on its net foreign debt and ensure that its foreign debt grows at a rate less that the interest rate. It then follows that the economy should generate trade surpluses in order to serve part of its interest obligations with the rest of the world (domestic output should also grow overtime).

Even if we consider this stylized approach, evidence can still support our empirical result that in the post-euro era the solvency of Greece, Portugal and Spain has deteriorated. The debt of an economy could be perceived as sustainable when its burden i.e. the ratio of debt-to-GDP is not indefinitely increasing. The stock of debt can increase and still be perceived as sustainable as long as it rises along with the GDP. In that sense, assuming for simplicity that an economy maintains a steady debt to output ratio so that $B_{s+1} = (1+g)B_s$ where g is the growth rate of output, B net foreign assets and s an index for time, then from the current account identity it can be derived that the country need pay out only the excess of the interest rate over the growth rate[8]. Under such circumstances, a measure of the burden that a foreign debt imposes on the economy is given by

[7]Given that current account balances may also considered to have become unsustainable, for robustness purposes the long-run relationship between savings and investment should also be investigated within a multiple variable setup (possibly within a tri-variate framework with the presence of output) so as to avoid the omitted variables problem in co-integration as reported by Levy (2003). We leave such an experiment for future research.

[8]In a finite horizon setup s will range from $s = t$ to T (with T a terminal time period) and in an infinite horizon case from $s = t$ to infinity.

$-(r-g)B_s/Y_s$ where r is the rate of interest. The higher this burden the more difficult it is for the debtor country to repay its debt, and the more unsustainable its debt may be perceived[9]. A debt crisis occurs when the markets start to believe that borrowers are not sound anymore and head for an exit.

Based on the above measure, Table 3 below reports the trade surpluses needed for Germany (as a representative of the Eurozone core) and Greece, Portugal and Spain to service their debts as for the year 2015. For g we use the average growth rate of GDP for the post-euro era up to 2015 for each economy. Given the stochastic nature of the real world a challenging issue is how to measure the interest rate that discounts a country's future output. As Obstfeld (1996) indicates a riskless interest rate would not be a proper measurement since the future output growth rate g is not known. For this reason a better proxy for the rate of interest is the rate of return on equities. Consequently, for the calculation of r in the above formula we take the average of the Dow Jones Euro Stoxx Price Index from ECB for the same time period, which turns out to 7%. The GDP growth rate for all economies turns out to be less than 7% which supports the assumption that $r > g$.

Table 3. Trade surplus needed to service the debt burden (percentage of GDP)

Country	2015
Greece	9.55
Portugal	6.40
Spain	3.96
Germany	3.55

Source: Authors' calculations. $g_{Greece} = 1.6\%$; $g_{Portugal} = 2\%$; $g_{Spain} = 3\%$; $g_{Germany} = 2\%$

Following our measure it seems that the trade surplus needed to service the external debt burden is quite high for Greece, Portugal and Spain and greater as compared with Germany. Greece comes with the highest rate 9.55% due to its huge Debt-to-GDP ratio of 176.9% and Portugal follows with a rate of 6.40% (Debt-to-GDP ratio of 128%). Spain comes last with the lowest but still significant rate of 3.96%. Given the evidence it would

[9] See Obstfeld (1996) for an explicit derivation of the debt burden. Debt sustainability analysis is quite a complex task. For a more detailed exposition see Cohen (1985) and Wyplosz (2007).

be hard to describe the debts as sustainable especially since the trade balances for all three economies have constantly been in deficit since the introduction of the euro.

5. ARDL bounds co-integration approach and results

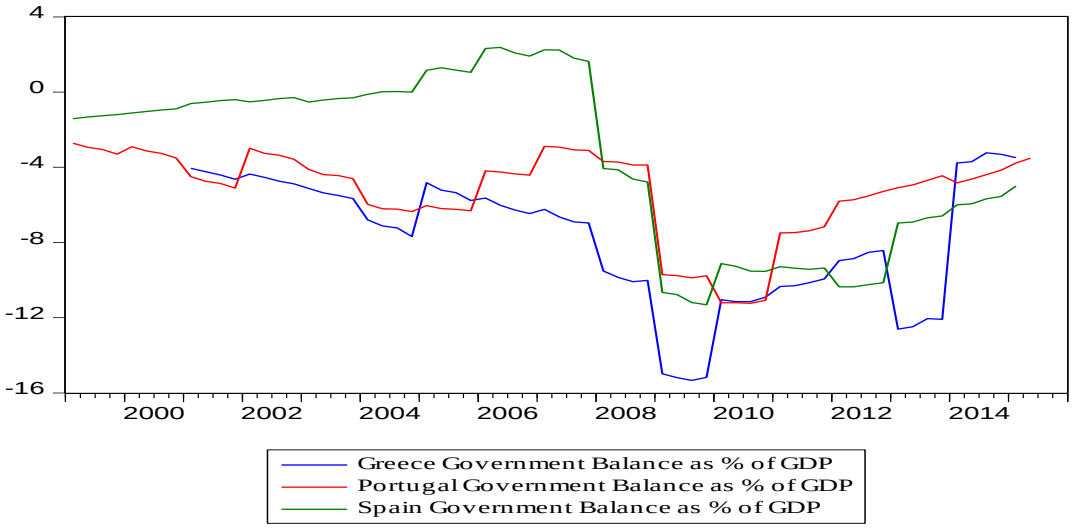
Given the statistical evidence in section 4, we further investigate the degree to which investment and the financing needs of the public sector in Greece, Spain and Portugal are financed by international financial markets. Estimating equation (8) can provide evidence on the statistical association between national investment and the current account as well as on the occurrence and intensity of the twin deficit hypothesis.

As indicated in section 3, if the coefficient β_2 in equation 8 is close to -1, then investment expenditure is heavily financed by international financial markets contrary to the Feldstein-Horioka puzzle. In a similar notion, if coefficient β_1 is positive and close to 1 there would be strong evidence in favour of the twin deficit hypothesis. In both cases this would suggest high degree of integration in international financial markets.

Figures 3 and 4 show government fiscal balances s_t^g and gross fixed capital formation i_t as percentages of GDP for Greece, Portugal and Spain[10]. To proceed with the estimation of equation (8) the time series of s_t^g and i_t are also tested for unit roots for the post euro era. As depicted in Table 4, there is overall strong evidence that s_t^g is I(1) for all economies[11] and the overall evidence in Table 5 from the various tests suggests that i_t can also be considered to be I(1).

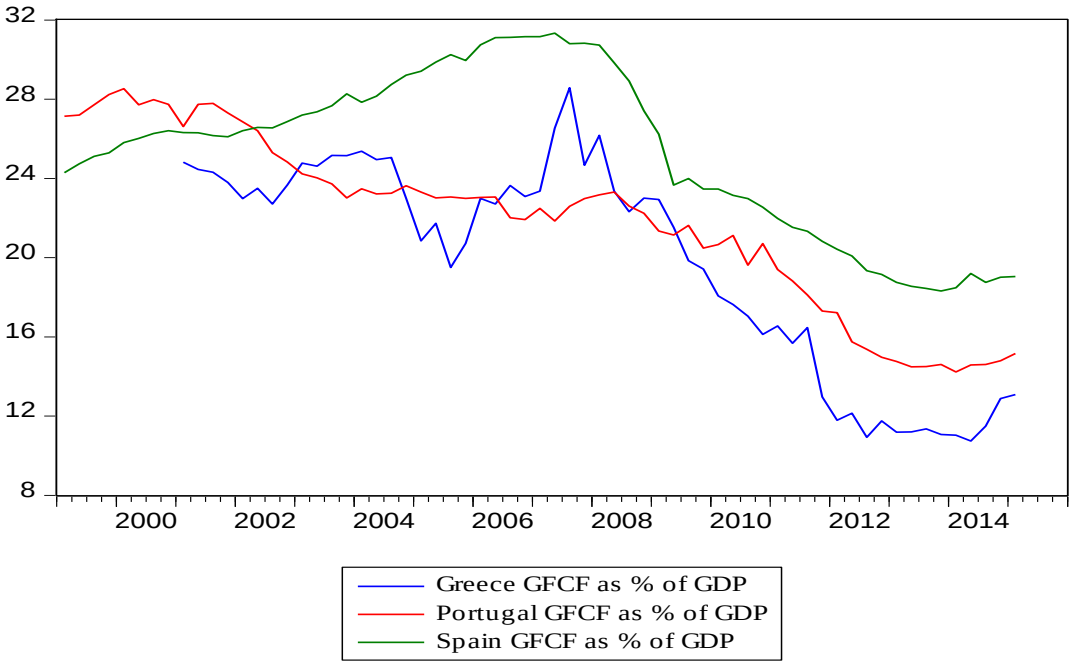
[10] Due to overall data availability, in this section we focus only on the post-euro era.
[11] Some evidence of stationarity for Spain comes only from the break point test.

Figure 3 Government Fiscal Balance as % of GDP (post euro era)



Source: Datastream

Figure 4 Gross Fixed Capital Formation as % of GDP (post euro era)



Source: Datastream

Table 4: Unit root tests for government fiscal balance as percentage of GDP (post-euro era)

	ADF			
	Levels		1st Differences	
	No Intercept	Intercept	No Intercept	Intercept
Greece	-0.77(0)	-1.80(0)	-7.37(0)*	-7.30(0)*
Spain	-0.72(0)	-1.16(0)	-7.83(0)*	-7.78(0)*
Portugal	-0.70(0)	-1.91(0)	-7.93(0)*	-7.86(0)*
	PP			
	Levels		1st Differences	
	No Intercept	Intercept	No Intercept	Intercept
Greece	-0.77	-1.90	-7.37*	-7.30*
Spain	-0.72	-1.17	-7.83*	-7.78*
Portugal	-0.70	-1.91	-7.93*	-7.86*
	Break Point Unit Root Test			
	Levels		1st Differences	
	Intercept		Intercept	
Greece	-2.74(0) Break 2013Q4		-9.56(0)* Break 2014Q1	
Spain	-5.04(0)* Break 2007Q4		-10.10(0)* Break 2009Q1	
Portugal	-2.24(0) Break 2008Q4		-8.94(0)* Break 2011Q1	

Note: Entries in parenthesis indicate the chosen number of lags.
(*) indicates that the test is significant at 1% (††) significant at 5% (†) significant at 10% level.
Source: Datastream.

Table 5: Unit root tests for investment as percentage of GDP (post-euro era)

	ADF			
	Levels		**1st Differences**	
	No Intercept	**Intercept**	**No Intercept**	**Intercept**
Greece	-1.02(4)	-0.82(4)	-2.87(3)*	-2.97(3)††
Spain	-0.80(5)	-1.80(4)	-2.06(4) ††	-2.15(4)
Portugal	-2.58(0) †	-1.17(3)	-2.46(2) ††	-3.11(2) ††
	PP			
	Levels		**1st Differences**	
	No Intercept	**Intercept**	**No Intercept**	**Intercept**
Greece	-1.62†	-1.70	-9.87*	-16.21*
Spain	-0.83	-0.02	-8.21*	-8.09*
Portugal	-2.69*	-0.01	-8.17*	-9.12*
	Break Point Unit Root Test			
	Levels		**1st Differences**	
	Intercept		**Intercept**	
Greece	-3.09(4) Break 2008Q1		-3.69(3) Break 2008Q1	
Spain	-3.77(6) Break 2008Q1		-3.81(5) Break 2008Q1	
Portugal	-2.97(3) Break 2008Q2		-9.33(0)* Break 2008Q2	

Note: Entries in parenthesis indicate the chosen number of lags.
(*) indicates that the test is significant at 1% (††) significant at 5% (†) significant at 10% level.
Source: Datastream

Given the evidence from the unit root tests on all our variables[12] we employ the Autoregressive Distributed Lag (ARDL) bounds testing approach to co-integration as developed by Pesaran *et al* (2001) to test for a potential long-run relationship among the variables in equation (8). The ARDL approach has many advantages compared with other methods for testing co-integration such as the Engle and Granger (1987), Johansen (1988) and Johansen and Juselius (1990) approaches. In particular, the ARDL has the advantage of avoiding any classification between I(0) and I(1) variables. This is quite important because although we have strong evidence that all variables can be considered to be I(1), this is not fully supported by all the unit root tests that have been performed with regards to i_t. In addition, although a large data sample must be employed to follow the Johansen co-integration technique, the ARDL is a statistically significant approach to co-integration for relatively small data samples. This is of a particular importance since we

[12] According to Trehan and Walsh (1991) evidence of a unit root in the fiscal or external deficit implies that the public or the external debt may be unsustainable i.e. violate the present value borrowing constraint. Evidence from the unit roots tests for Greece, Spain and Portugal for these variables for the post euro era suggests that external or public indebtedness may not be sustainable.

focus on the post euro era for Greece, Spain and Portugal. Finally, in contrast to the Johansen co-integration, the ARDL method permits different optimal lags for each variable employed. Consequently the ARDL co-integration equation employed for our empirical work is given by equation (9):

$$\Delta ca_t = -\sum_{h=1}^{p-1} \gamma_i \, \Delta ca_{t-h} + \sum_{j=1}^{k} \sum_{h=0}^{q_{j-1}} \Delta X_{j,t-h'} \beta_{j,h} - \hat{\theta} EC_{t-1} + \epsilon_t \quad (9)$$

where X_j a vector consisting of fiscal balances to GDP i.e.(s^g) and the ratio of investment to GDP i.e. (i), EC_{t-1} the error correction term, (p) the number of lags of the dependent variable and (q) the number of lags of independent variables.

Table 6. ARDL Bound Test (Null Hypothesis: No long-run relationships exist)

GREECE		
F Statistic	4.53	k=2
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**
10%	2.63	3.35
5%	3.10	3.87
2.5%	3.55	4.38
1%	4.13	5.00
SPAIN		
F Statistic	13.17	k=2
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**
10%	2.63	3.35
5%	3.10	3.87
2.5%	3.55	4.38
1%	4.13	5.00
PORTUGAL		
F Statistic	5.62	k=2
Critical Value Bounds	**I(0) Bound**	**I(1) Bound**
10%	2.63	3.35
5%	3.10	3.87
2.5%	3.55	4.38
1%	4.13	5.00

We test initially for a possible long-run equilibrium relationship among the variables employed in equation (8). The optimal lag length is chosen based on the Schwarz

Criterion (SC). The F-statistics along with the critical value bounds are presented in Table 6[13]. The F-statistic for Spain and Portugal is greater than the upper level bound I(1) for all levels of significance. For Greece, the F-statistic is slightly lower that the upper level bound only at 1% significance level. Consequently, we can conclude that in all three economies there is strong evidence of co-integration i.e. of a long run relationship among current account balances, fiscal balances and investment.

Following the evidence of co-integration, we proceed to estimate the long run relationship among the variables. The estimated coefficients are reported in Table 7. The results suggest that for all three economies β_1 is positive and significant and β_2 is negative and significant. Given the importance of model stability both for econometric inference and policy analysis the corresponding CUSUM tests on the recursive residuals are presented in Figure 5, which shows that there is strong evidence in favour of the long-run structural stability for the model's coefficients[14]. It is worth noting that for all three economies the coefficient of the error correction term turns out to be significant. The evidence suggests that the system adjusts towards the long-run equilibrium at a speed of 55% or more per quarter for all three economies. Given that causality in 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 current account.

[13] The results are also confirmed following the Akaike Criterion.

[14] Model instability may be caused either from an omission of an important variable or from possible regime shifts. The constancy over time of the regression relationship estimated from our model is also confirmed by the CUSUMSQ test.

Table 7. ARDL Co-integration results

GREECE		
Variable	**Coefficient**	**Prob.**
s_t^g	$\beta_1 = 0.52$	0.0290
i_t	$\beta_2 = -0.67$	0.0000
$EC_{(-1)}$	$\hat{\theta} = -0.74$	0.0000
SPAIN		
Variable	**Coefficient**	**Prob.**
s_t^g	$\beta_1 = 0.19$	0.0127
i_t	$\beta_2 = -0.94$	0.0000
$EC_{(-1)}$	$\hat{\theta} = -0.90$	0.0000
PORTUGAL		
Variable	**Coefficient**	**Prob.**
s_t^g	$\beta_1 = 0.57$	0.0192
i_t	$\beta_2 = -0.94$	0.0000
$EC_{(-1)}$	$\hat{\theta} = -0.55$	0.0000

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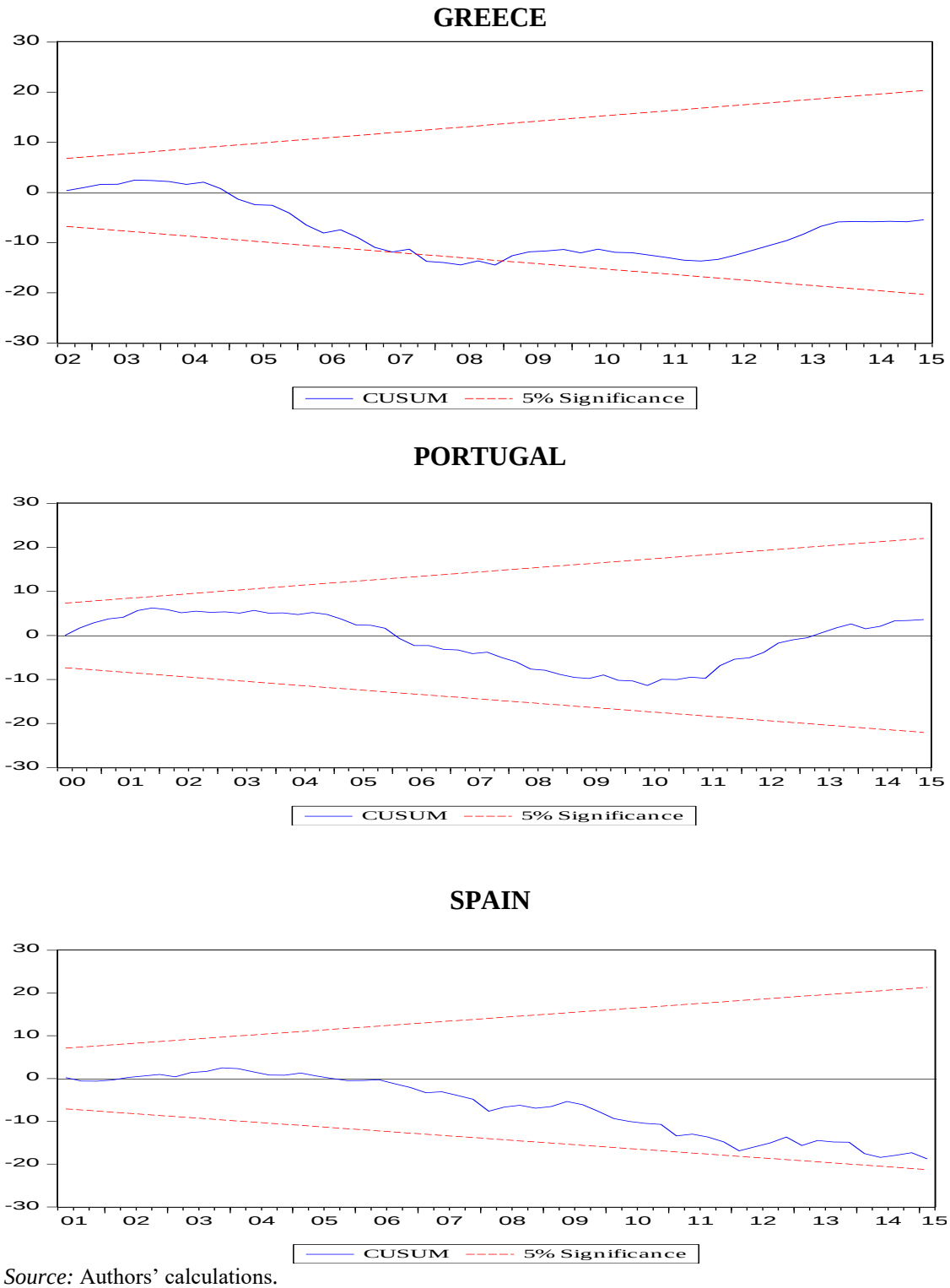
Figure 5. CUSUM tests



Source: Authors' calculations.

The results for the government fiscal balance coefficients are supportive of the twin deficit hypothesis. The coefficients for Portugal and Greece are 0.57 and 0.52 respectively while for Spain it is 0.19 and all are statistically significant. In the context of the current account imbalances in the Eurozone this suggests that a tightening of the fiscal policy in the three economies will lead to an improvement in their current account deficits, although for Spain the effect is more limited.

Turning to investment, our evidence suggests that the coefficients for all three countries are negative and significant. This implies that an increase in investment significantly deteriorates the current account balance. Interestingly, the coefficient for Spain and Portugal is -0.94, which indicates that increased investment requires heavy external financing from the capital and financial accounts. The investment coefficient for Greece is -0.67 although not so close to minus unity as for the other two economies, it still reveals that investment expenditure is heavily associated with a deterioration in the current account.

Overall, our results highlight the fact that the fiscal stance and the investment expenditure are both associated with current account balances. A tighter fiscal stance, either in the form of an increase in taxation or a reduction in government expenditure, will reduce the current account deficits in the underlying economies. Interestingly, there is a strong negative association between investment expenditure and current account deficits following the adoption of the euro. Our empirical evidence suggests that the Feldstein-Horiaka puzzle does not hold for the three economies and suggests that further research is needed to investigate the underlying mechanisms through which the three economies can finance investment opportunities from domestic sources with a view to restoring their competitiveness.

6. Panel co-integration test

To further test for the existence of a long-run relationship between the current account balance the fiscal balance and investment expressed as percentages of GDP we also proceed with a panel co-integration test. By employing a panel data technique more variability can be explored from the cross sectional elements of the dataset. The balanced panel runs from 1999Q1 to 2015Q2. To estimate equation (8) 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 (2003) (IPS), ADF and PP Fisher Chi-square tests[15], 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. Table 8 presents the various panel unit root tests, which indicate that overall the variables can be treated as I(1).

[15] See Maddala and WU (1999) and Choi (2001).

Table 8. Panel Unit Root Tests

			ca_t	s_t^g	i_t
LLC	Level	Intercept	1.83	-0.67	1.13
		Intercept with Trend	1.00	1.20	-1.45
	Difference	Intercept	7.99	1.94	3.81
		Intercept with Trend	11.59	2.70	6.44
IPS	Level	Intercept	1.41	-0.96	0.45
		Intercept with Trend	20.5	0.62	-0.01
	Difference	Intercept	-2.41*	-2.55*	-2.27*
		Intercept with Trend	-1.48*	-1.70*	-0.96*
ADF	Level	Intercept	1.25	7.79	2.99
		Intercept with Trend	0.64	3.92	3.85
	Difference	Intercept	15.54*	16.77*	14.83*
		Intercept with Trend	9.72	11.62*	7.52
PP	Level	Intercept	19.43*	5.56	1.14
		Intercept with Trend	17.04*	1.58	8.24
	Difference	Intercept	144*	114*	143*
		Intercept with Trend	95.0*	101*	133*
HADRI	Level	Intercept	2.56*	4.57*	7.13*
		Intercept with Trend	6.79*	2.47*	6.13*
	Difference	Intercept	0.71	-0.06	0.96
		Intercept with Trend	1.02	1.08	1.98

Note: (*) indicates that the test is significant at all critical values. ***Source*:** Authors' calculations.

Given the evidence of non-stationarity, we proceed by testing for the possibility of co-integration among the variables. We performed the Pedroni (1999) panel co-integration test, which is based on the null hypothesis of no co-integration. The results are reported in Table 9 and indicate strong evidence of co-integration. Consequently, we proceed with the co-integration estimates using the fully modified ordinary least squares (FM-OLS) group mean estimator. The results are reported in Table 10 and reveal that both coefficients are statistically significant.

Table 9. Pedroni Co-integration Test

	Intercept		Intercept and Trend		Intercept		Intercept and Trend	
	Statistic	Prob.	Statistic	Prob	Weighted Statistic	Prob.	Weighted Statistic	Prob
Panel V	0.94	0.1721	0.0002	0.4999	1.05	0.1460	0.26	0.3959
Panel Rho	-8.40	0.0000	-9.75	0.0000	-7.88	0.0000	-9.55	0.0000
Panel PP	-7.03	0.0000	-9.72	0.0000	-6.62	0.0000	-9.46	0.0000
Panel ADF	-2.89	0.0001	-3.50	0.0002	-2.69	0.0003	-3.64	0.0001
Group Rho	-8.47	0.0000	-8.76	0.0000				
Group PP	-8.27	0.0000	-10.1	0.0000				
Group ADF	-3.34	0.0004	-3.81	0.0001				

Note: The 5 percent critical value is –1.645 since the residual based test is the one-tailed test.
Negative values suggest the rejection of the null hypothesis of no cointegration.
'Panel V' is a non-parametric variance ratio statistic; 'panel Rho' and 'panel PP' are analogous to the non-parametric Phillips-Perron ρ and t-statistics ; 'panel ADF' is the parametric statistic based on the Augmented Dickey- Fuller ADF statistic; 'Group Rho' and 'Group PP' are the non-parametric Phillips-Perron ρ and t statistics and 'Group ADF' is the standard parametric ADF statistic.

Table 10. Co-integration Results (Panel FM-OLS)

Variable	Coefficient	Prob.
s_t^g	$\beta_1 = 046$	0.0000
i_t	$\beta_2 = -0.80$	0.0000

The coefficient for the government fiscal balance turns out to be 0.46 indicating that for the three economies there is a statistical association between the fiscal deficit and current account deficit (s_t^g and ca_t).

We also find strong evidence of a negative association between investment expenditure and current account with the investment coefficient equal to -0.80. The reported R-

squared statistic is 0.55 implying that 55% of the variation in the current account is explained by fiscal balances and investment. The results from the panel data experiment are in line with those coming from the ARDL model in Section 5. Our results suggest that a tightening of fiscal policy in the three economies ,through an increase in taxation and/or a reduction of government expenditure is associated with an improvement in their current account balances. Our results do, of course, need to be interpreted with some degree of caution since as, Banerjee and Carrion-i-Silvestre (2015) point out, the results from panel cointegration statistics may be affected by misspecification errors if structural breaks in the parameters generating the process are not considered. Following the empirical results the apparent improvement in current account balances in all three economies especially after 2010 is partly attributable to the austerity measures such as increased taxes and reduced public spending. Finally, the magnitude of the negative effect that investment has on current account balances is consistent with the evidence coming from the ARDL model.

7. Concluding remarks

This paper has investigated the nexus between fiscal and current account balances in the long-run and provided empirical evidence on the Feldstein-Horioka puzzle for a group of three highly indebted small open economies of the southern Eurozone area.

From the unit root tests on the current account balances, expressed as a ratio of GDP, we report clear evidence that after joining the Eurozone the current account balances of all three countries contain a unit root implying that there is no long run stable relationship between savings and investment rates. This can be taken as evidence of unsustainable current account balances and a loss of solvency for the underlying economies. Our results suggests that the way that investment is financed should be a key policy concern as it impacts on current account imbalances and this in turn raises questions about these countries' continued membership of the Eurozone.

Unlike other studies, we use the ARDL co-integration methodology to confirm clear evidence in favour of a statistical association between government fiscal balances and current account balances. As such, our study provides empirical justification for the fiscal austerity currently being employed in the three economies as a plausible method to remedy their current account imbalances. Given the evidence, further research should focus on whether reducing government expenditure or increasing taxation in these economies can contribute more towards improving their current accounts. However there are, of course, implications of such policies for rates of economic growth and their impact on unemployment that should also be considered.

Our empirical evidence also suggests that an increase in domestic investment significantly deteriorates the current account in all three economies, which implies that capital inflows have been used to finance investment in the three economies. This could be considered as evidence challenging the Feldstein-Horioka puzzle. The magnitude of this effect suggests that the way investment is financed should be a key policy issue in order to alleviate current account deficits for these economies.

Given the above evidence on the effect that fiscal balances and investment have on the current account balances in the long run, further research should also focus on the dynamic interaction over time between fiscal austerity and investment. In addition, an interesting agenda for future research would be to examine the behavioural relationships that give rise to our results. This would involve building a theoretical framework that incorporates variables from both the real and the financial sector of the economies. Given the fact that the three indebted economies belong to a currency union the effects of greater financial and economic integration in the Eurozone also merit greater scrutiny.

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