Cuadernos de Economía (2018) 41, 275-290

Asociación Cuadernos de economía

Cuadernos de economía

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ARTÍCULO

Causality and the long-term relationship between external balance and public balance in the Eurozone

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JEL CODES
H62; F32; F41

KEYWORDS:
Twin deficits hypothesis;
European external imbalances;
Fiscal deficits;
ARDL bound testing

Abstract: After the beginning of the financial crisis, European external imbalances —mainly in the southern countries— were explicitly or implicitly linked to the behaviour of the public finances under the so-called twin deficits hypothesis. At a theoretical level, a worsening of a government's budgetary balance exerts upward pressure on real interest rates, which attracts capital flows –because of the relatively higher returns– resulting in an appreciation of the domestic currency and a worsening of external balances. In this article, we analyse the causality and long-term relationship between external balance and some fiscal variables for a set of ten Eurozone countries. According to our results, there is no evidence of a common causality pattern between the public balance and the external balance among different groups of Eurozone countries. In addition, when the analysis is carried out at individual level, only Spain and Finland present a long-term relationship between fiscal variables and the external balance. However, these relationships do not behave as predicted by the twin deficits hypothesis. These results call into question those symmetrical fiscal policies aimed (explicitly or implicitly) at correcting external imbalances in these countries.

CÓDIGOS JEL
H62; F32; F41

PALABRAS CLAVE
Hipótesis de los déficits gemelos;
Desequilibrios externos europeos;
Déficit fiscal;
Pruebas de límites ARDL.

Resumen: Después del inicio de la crisis financiera global, los desequilibrios externos europeos —principalmente en los países del sur de la eurozona— fueron explícita o implícitamente relacionados con el comportamiento de las finanzas públicas dentro de la hipótesis de los déficits gemelos. A nivel teórico, un empeoramiento del balance presupuestario del sector público ejercería presión al alza en las tasas de interés reales, lo que atraería flujos de capital —ante unos rendimientos relativos mayores— resultando en una apreciación de la moneda doméstica y un deterioro del balance externo. En este artículo, analizamos la causalidad y la relación de largo plazo entre el balance externo y algunas variables fiscales para un conjunto de diez países de la eurozona. De acuerdo con nuestros resultados, no existe evidencia de un patrón común de causalidad entre el balance público y el balance externo entre diferentes subgrupos de países de la eurozona. Adicionalmente, cuando el análisis se realiza a nivel individual, únicamente España y Finlandia presentan una relación de largo plazo entre las variables fiscales y el balance externo. No obstante, estás relaciones no se comportan como predice la hipótesis de los déficits gemelos. Los resultados llevan a cuestionar la implementación de políticas fiscales simétricas buscando (explícita o implícitamente) corregir los desequilibrios externos en estos países.

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This work was supported by the Consejo Nacional de Ciencia y Tecnología (CONACyT, Mexico) under the grant for Postdoctoral Researchers at the Instituto Politécnico Nacional and by the Sistema Nacional de Investigadores (SNI-CONACyT).

I. Introduction

After the beginning of the financial crisis, European external imbalances – mainly in the southern countries – were explicitly or implicitly associated with the unsustainability of public finance; in other words, there was a focus on the so-called twin deficits hypothesis. The twin deficits hypothesis refers to the positive macroeconomic relationship between the current account balance and the government budget balance that was originally used to analyse the trade deficit in the United States (US) during the 1980s (Gordon 1986).

At a theoretical level, the twin deficits hypothesis works as follows. When the public deficit increases, the real interest rate in the domestic economy increases, which attracts capital flows from abroad, resulting in an appreciation of the domestic currency. This appreciation of the domestic currency incentivizes imports and discourages exports, leading to a worsening of the external balance (Salvatore 2006). Therefore, the government budgetary deficit causes an external deficit. Thus, within this view, a tax increase that reduces the government's budgetary deficit will have, as a consequence, an improvement in the current account balance. However, supporters of the Ricardian equivalence hypothesis point out that, on the contrary, a tax increase with no alteration in public expenditure will leave the external deficit unaltered (Enders and Lee 1990).

In the European case, the process of economic and financial integration created a positive expectation about the future performance of the (relatively less developed) peripheral countries as part of the expected catching-up. The expected catching-up process attracted capital flows from the core Eurozone countries, exerting downward pressure on interest rates and incentivizing private and public indebtedness that was counterbalanced by the emergence of current account imbalances. Accordingly, an analysis of the relationship between government budgetary balance and external balance becomes relevant in the context of the European integration process.

In this article we contribute to the twin deficits hypothesis debate in the euro area countries by analysing the causality and long-term relationship between external balance and different measures of public balance in ten Eurozone countries. To this aim, we implement Granger causality testing (Granger 1969) in a panel framework, and autoregressive distributed lag (ARDL) modelling as proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001).

This paper differs from and improves previous works in two ways. On the one hand, we analyse the twin deficits hypothesis in the Eurozone over a longer span of time by using the database of Mauro et al. (2013), which splits overall public balance into the primary public balance and the interest paid on public debt. On the other hand, we cross-check the results of the causality and cointegration tests in order to strengthen our findings.

The article is structured as follows. In the second section, we present a theoretical framework and a literature review on the twin deficits hypothesis for the case of the Eurozone. In the third section, we explain the methodology and data sources. In the fourth section, we show our econometric results. Finally, in the last section, we make some concluding remarks. According to our results, there is no evidence of a common causality pattern between public balance and external balance among different groups of Eurozone countries. In addition, when performing an analysis at the individual level, only Spain and Finland show a long-term relationship between fiscal variables and the external balance. However, for neither country is there evidence of a long-term relationship between public finance and external imbalances as predicted by the twin deficits hypothesis.

II. Twin Deficits in the Eurozone: Theory and Evidence

We base our theoretical framework on a national account system. Within this framework, the external balance (EB) is given by private savings $(S_{private})$ plus public savings (S_{public}) minus investment (I):

$$EB = S_{private} + S_{public} - I \quad (1)$$

Disaggregating, the external balance is the sum of the trade balance (TB), the net primary income (NPI) and the net current transfers (NCT):

$$EB = TB + NPI + NCT \quad (2)$$

Moreover, private savings are given by the difference between disposable income $(Y-T)$ and consumption (C), while public savings are the difference between taxes (T) and government expenditure (G):

$$S_{private} = Y - T - C \quad (3)$$

$$S_{public} = T - G \quad (4)$$

Rewriting Equation 1 according to Equations 2-4 we have:

$$(TB + NPI + NCT) = (Y - T - C) + (T - G) - I \quad (5)$$

However, for the twin deficits hypothesis to hold one-to-one, we assume private savings equals investment $(Y - T - C = I)$ so that:

$$(TB + NPI + NCT) = (T - G) \quad (6)$$

Equation (6) is the twin deficit hypothesis that we aim to prove. If the hypothesis holds, any change in public balance will be reflected in a change in external balance with the same sign.

In the economic literature, different articles have reported on empirical analyses of the relationship between fiscal and external balances, without conclusive results. For instance, Salvatore (2006) finds that, for the United Kingdom and France, current account imbalances are inversely related to the government budgetary deficit, whereas for the United States, Japan, Germany, Italy and Canada fiscal balances do not contemporaneously affect current account balances. However, Salvatore points out that current account balances for the G-7 group respond with lags in the way that is indicated by the twin deficits theory. For the US case, Kim and Roubini (2008) show that an expansionary fiscal shock

or a government budgetary deficit shock improves the current account and depreciates the real exchange rate, which they call twin divergence and which is explained by the prevalence of output shocks.

Along the same lines, evidence on the relationship between the fiscal balance and the external balance for Eurozone countries is mixed (Blanchard 2007; Barnes, Lawson, and Radziwill 2010; Brissimis et al. 2012; Hein, Truger, and van Treeck 2012; Kosteletou 2013). On the one hand, some papers have highlighted a positive relationship between the two variables. For instance, Kosteletou (2013) finds evidence of twin deficits in peripheral and core European countries in a panel data framework. Moreover, Bluedorn and Leigh (2011) point out that a fiscal consolidation of 1% of GDP improves the current account balance in a sample of 17 OECD countries that includes 13 European Union countries. Furthermore, Beetsma, Giuliodori, and Klaassen (2008), using a panel VAR, demonstrate that an increase in public expenditure worsens the trade balance in a sample of 14 European countries. Additionally, Barnes, Lawson, and Radziwill (2010) highlight that, while there is a relationship between the current account balance and the fiscal balance, the effects of this relationship are less than one-for-one.

On the other hand, Algieri (2013) points out that, at least for southern Eurozone countries, there is no clear nexus between the fiscal balance and the external balance when following Toda and Yamamoto's (1995) approach to Granger causality testing. If this is the case, the origin of the external imbalances in the Eurozone must be found in private savings and investment decisions rather than in the public balance (Hein, Truger, and van Treeck 2012).

In the next section we analyse the causality and long-term relationship –as stated in Equation 6– for a set of Eurozone countries. To do this, we use the Mauro et al. (2013) database, which contains historical data that decomposes the overall public balance into the primary public balance and the interest paid on public debt.

III. Data and Empirical Tests

We focus on the analysis of the twin deficits hypothesis in ten Eurozone countries (Austria, Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal and Spain) for the period 1960-2011. Our sample includes the first 12 Eurozone member states excluding Luxembourg and Ireland. The two main reasons to justify the selection of this sample are the following. First, Luxembourg was excluded as a consequence of data unavailability for the fiscal variables in the Mauro et al. (2013) database. Second, Ireland, commonly included in the European periphery group, was excluded because of its different composition of the current account in comparison to what has been observed to the rest of the member states.

During the 1960-2011 period, Eurozone countries were involved in at least three shocks affecting the behaviour of the fiscal variables. Firstly, within the third stage of the Economic and Monetary Union, the introduction of the Stability and Growth Pact established explicit upper limits on both, public debt and fiscal deficit, to achieve sustainable fiscal finances in medium-term. Secondly, after the burst of global financial crisis and due to the high levels of private indebtedness and the expected deleveraging, national governments implemented expansionary fiscal policies to smooth the economic cycle which increased fiscal deficits and public debt. Finally, the levels of indebtedness reached, in some European countries, during the so-called European sovereign debt crisis forced the implementation of fiscal consolidation plans.

As stated above, under the twin deficits hypothesis, causality goes from the fiscal variables to the external balance. We aim to test this hypothesis of causality in the euro area, as well as the existence of a long-term relationship between the external balance and the fiscal variables.

We use data from the macro-economic database (AMECO) for the external balance (hereinafter EB), and use, as a proxy for EB, the balance on current transactions with the rest of the world, which is the sum of the net exports of goods and services, the net primary income and the net current transfers, the latter two from the rest of the world. In the case of fiscal variables, a novelty of this article is the use of the database from Mauro et al. (2013). Mauro et al. (2013) compile historical data for the government primary balance (hereinafter PB), interest paid on the public debt (hereinafter IE), and overall government balance (hereinafter CB), which is the difference between the primary balance and the interest paid on the public debt. Data are available with annual frequency for all variables for the period 1960-2011.

Our empirical strategy is as follows. First, we analyse causality[1] between the fiscal variables (primary budget balance, interest paid on debt and overall budget balance) and the external balance. We implement the Granger causality test (Granger, 1969) in a panel data framework. In this case, we assume homogeneity of the coefficients across cross-sections. We perform the Granger causality test, treating our panel data as a stacked set of data without letting data from one cross-section enter the lagged values of data from the next cross-section. Assuming homogeneous coefficients is a very strong restriction. However, given the unavailability of data and the asymptotic properties of the Granger test, we preferred to implement the analysis using a panel data framework. Nonetheless, in order to lessen the homogeneity condition constraint on the coefficients, Granger causality testing is implemented in the whole group (ten countries) as well as in a sub-group of core countries (Austria, Belgium, Finland, France, Germany and the Netherlands) and in a sub-group of peripheral countries (Greece, Italy, Portugal and Spain), with greater homogeneity being expected within the two sub-groups.

Secondly, we implement autoregressive distributed lag (ARDL) bound testing as proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001) to investigate the long-term relationship between the external balance and the fiscal variables (the primary balance and interest paid on debt). ARDL bound testing presents three advantages in relation to other popular cointegration techniques

[1] To clarify, in an econometric sense, Granger causality implies predictive causality, i.e., the ability to predict another variable better using the history of both variables.

(Ang 2009; Narayan 2005; Pesaran, Shin, and Smith 2001; Pesaran and Shin 1999): 1) the variables I(0), I(1), or a combination of both, can be used; 2) there is the possibility of cointegration even when the independent variables are endogenous; and 3) the estimates of the short-term model are consistent with their long-term parameters in a small sample (a minimum of 30 observations is required).

In applying ARDL bound testing we follow a three-step procedure. In the first step, we implement unit root tests to verify the order of integration of the variables. For the ARDL bound technique, the variables must be I(0) or I(1). In the second step, we select the optimal number of lags for the different variables using the Akaike Information Criterion (AIC), with a maximum of 4 lags. Finally, once the optimal number of lags has been selected, we estimate the model and test for cointegration. The first condition for the variable to be cointegrated is that the estimated F-statistic lies above the upper bound, i.e. F-stat > I(1) bound. The second condition for cointegration is that the error correction term is negative, implying that exogenous variables return to long-term equilibrium. We estimate an ARDL model as follows:

$$EB_t^i = \alpha_1^i + \sum_{j=0}^{p} \beta_j^i \quad EB_{t-j}^i + \sum_{j=0}^{p} \gamma_j^i \quad PB_{t-j}^i + \sum_{j=0}^{p} \delta_j^i \quad IE_{t-j}^i + \sigma_1^i EB_{t-1}^i + \sigma_2^i PB_{t-j}^i + \sigma_3^i IE_{t-1}^i + \mu_t^i$$

(7)

where the superscript *i* identifies the parameters and variables for country *i*, *p* is the optimal lag length and Δ indicates the first difference of the variable. EB, PB and IE stand for external balance, primary public balance and interest paid on debt, respectively. The null hypothesis indicates that no long-term relationship exists ($H_0 : \sigma_1^i = \sigma_2^i = \sigma_3^i = 0; H_1 = \sigma_1^i \neq 0, \bar{\sigma}_2^i \neq 0, \bar{\sigma}_3^i \neq 0$). Additionally, a short-term error correction model is estimated:

$$EB_t^i = \alpha_1^i + \sum_{j=0}^{p} \beta_j^i \quad EB_{t-j}^i + \sum_{j=0}^{p} \gamma_j^i \quad PB_{t-j}^i + \sum_{j=0}^{p} \delta_j^i \quad IE_{t-j}^i + \tau^i ECM_{t-1}^i + \mu_t^i$$

(8)

There is a reason for cross-checking the results from the two techniques: if there is evidence of cointegration then one-way or bi-directional Granger causality should be expected, but this does not apply the other way around.

IV. Results

Granger (non-)causality testing is performed with the variables I(0). In this regard, our first step is to test for the presence of the unit root in the panel framework. Table 1 shows the results of applying Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003) to the whole group of countries, the sub-group of core countries, and the sub-group of peripheral countries. Table 2 shows the results of Granger causality testing in a panel framework for the three different groups of countries after differentiating in accordance with the integration order of the series. As can be seen, at 5% statistical significance none of the hypotheses of non-causality are rejected, with the only exception being causality from IE to EB. These results are in line with those of Algieri (2013), who points out that there is no clear nexus between fiscal balance and external balance.

Table 1. Panel Unit Root Tests

External balance (EB)			**Primary public balance (PB)**		
Whole group (10 countries)					
	Levels	1st diff		Levels	1st diff
Levin et al. stat	-0.762	-22.065	Levin et al. stat	-3.581	-23.282
(p-value)	0.223	0.000	(p-value)	0.000	0.000
Im et al. stat	-1.931	-20.191	Im et al. Stat	-4.682	-22.645
(p-value)	0.027	0.000	(p-value)	0.000	0.000
Core sub-group (6 countries)					
	Levels	1st diff		Levels	1st diff
Levin et al. stat	0.466	-16.946	Levin et al. stat	-4.132	-18.899
(p-value)	0.679	0.000	(p-value)	0.000	0.000
Im et al. stat	-0.662	-16.252	Im et al. Stat	-4.986	-18.195
(p-value)	0.254	0.000	(p-value)	0.000	0.000
Peripheral sub-group (4 countries)					
	Levels	1st diff		Levels	1st diff
Levin et al. stat	-1.620	-14.105	Levin et al. stat	-0.853	-13.598
(p-value)	0.053	0.000	(p-value)	0.197	0.000
Im et al. stat	-2.239	-12.029	Im et al. Stat	-1.310	-13.524
(p-value)	0.013	0.000	(p-value)	0.095	0.000
Interest paid on debt (IE)			**Overall public balance (CB)**		
Whole group (10 countries)					
	Levels	1st diff		Levels	1st diff
Levin et al. stat	-1.026	-8.558	Levin et al. stat	-2.798	-22.497
(p-value)	0.152	0.000	(p-value)	0.003	0.000
Im et al. Stat	0.516	-9.110	Im et al. Stat	-3.422	-22.367
(p-value)	0.697	0.000	(p-value)	0.000	0.000
Core sub-group (6 countries)					
	Levels	1st diff		Levels	1st diff
Levin et al. stat	-0.444	-7.095	Levin et al. stat	-2.924	-17.888
(p-value)	0.329	0.000	(p-value)	0.002	0.000
Im et al. stat	0.823	-7.974	Im et al. Stat	-3.366	-17.518
(p-value)	0.795	0.000	(p-value)	0.000	0.000
Peripheral sub-group (4 countries)					
	Levels	1st diff		Levels	1st diff
Levin et al. stat	-1.131	-4.813	Levin et al. stat	-0.969	-13.614
(p-value)	0.129	0.000	(p-value)	0.166	0.000
Im et al. stat	-0.188	-4.643	Im et al. Stat	-1.296	-13.911
(p-value)	0.426	0.000	(p-value)	0.098	0.000

Note: individual effects are the only exogenous variables; automatic lag lenght selection based on Schwartz information criterion; Newey-West automatic bandwidth selection and Bartlett kernel.

Table 2. Panel Granger (non-)causality tests

Group 1: EB and PB		F-Statistic	Prob.
Whole group (10 countries)	PB does not Granger Cause EB	1.503	0.221
	EB does not Granger Cause PB	3.193	0.075
Core group (6 countries)	PB does not Granger Cause EB	0.372	0.542
	EB does not Granger Cause PB	2.503	0.115
Peripheral group (4 countries)	PB does not Granger Cause EB	0.387	0.680
	EB does not Granger Cause PB	2.591	0.078
Group 2: EB and IE		F-Statistic	Prob.
Whole group (10 countries)	IE does not Granger Cause EB	4.477	0.035
	EB does not Granger Cause IE	1.944	0.164
Core group (6 countries)	IE does not Granger Cause EB	2.910	0.089
	EB does not Granger Cause IE	3.497	0.063
Peripheral group (4 countries)	IE does not Granger Cause EB	2.197	0.140
	EB does not Granger Cause IE	1.559	0.213
Group 3: EB and CB		F-Statistic	Prob.
Whole group (10 countries)	CB does not Granger Cause EB	2.258	0.134
	EB does not Granger Cause CB	2.563	0.110
Core group (6 countries)	CB does not Granger Cause EB	3.278	0.071
	EB does not Granger Cause CB	2.125	0.146
Peripheral group (4 countries)	CB does not Granger Cause EB	0.543	0.582
	EB does not Granger Cause CB	2.317	0.101

Note: Lag length selection based on Schwartz Information Criterion

Continuing the empirical analysis, one of the conditions for ARDL bound testing is that the variables do not have an integration order higher than one. In Tables 3A and 3B we present the results of implementing the augmented Dickey-Fuller (Dickey and Fuller 1979a, 1981b; hereinafter ADF) and Phillips-Perron (Phillips and Perron 1988; hereinafter PP) individual unit root tests. As shown in Tables 3A and 3B, no variable has an integration order higher than one.

Table 3A. Unit Root Tests

	External balance (eb)					**Government primary balance (pb)**				
					Austria					
Level	ADF stat	-1.93	PP stat	-1.82	Integration order	ADF stat	-3.97	PP stat	-3.69	Integration order
	Prob.	0.31	Prob.	0.37		Prob.	0.00	Prob.	0.01	
1st diff	ADF stat	-8.32	PP stat	-8.37	I(1)	ADF stat	-7.36	PP stat	-12.93	I(0)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
					Belgium					
Level	ADF stat	-1.81	PP stat	-1.92	Integration order	ADF stat	-1.92	PP stat	-1.79	Integration order
	Prob.	0.37	Prob.	0.32		Prob.	0.32	Prob.	0.38	
1st diff	ADF stat	-7.18	PP stat	-7.20	I(1)	ADF stat	-9.27	PP stat	-9.27	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
					Finland					
Level	ADF stat	-1.68	PP stat	-1.81	Integration order	ADF stat	-3.13	PP stat	-2.53	Integration order
	Prob.	0.43	Prob.	0.37		Prob.	0.03	Prob.	0.11	
1st diff	ADF stat	-6.02	PP stat	-5.95	I(1)	ADF stat	-6.18	PP stat	-6.31	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	

France										
Level	ADF stat	-2.19	PP stat	-2.15	Integration order	ADF stat	-2.90	PP stat	-2.95	Integration order
	Prob.	0.21	Prob.	0.23		Prob.	0.05	Prob.	0.05	
1st diff	ADF stat	-8.33	PP stat	-8.33	I(1)	ADF stat	-7.97	PP stat	-8.25	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Germany										
Level	ADF stat	-1.39	PP stat	-1.61	Integration order	ADF stat	-4.21	PP stat	-4.21	Integration order
	Prob.	0.58	Prob.	0.47		Prob.	0.00	Prob.	0.00	
1st diff	ADF stat	-6.29	PP stat	-6.29	I(1)	ADF stat	-8.97	PP stat	-13.69	I(0)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Greece										
Level	ADF stat	-1.02	PP stat	-0.93	Integration order	ADF stat	-2.58	PP stat	-2.58	Integration order
	Prob.	0.74	Prob.	0.77		Prob.	0.10	Prob.	0.10	
1st diff	ADF stat	-6.90	PP stat	-6.94	I(1)	ADF stat	-7.62	PP stat	-7.84	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Italy										
Level	ADF stat	-2.78	PP stat	-2.78	Integration order	ADF stat	-1.60	PP stat	-1.51	Integration order
	Prob.	0.07	Prob.	0.07		Prob.	0.48	Prob.	0.52	
1st diff	ADF stat	-7.58	PP stat	-8.36	I(1)	ADF stat	-7.97	PP stat	-8.03	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Netherlands										
Level	ADF stat	-1.56	PP stat	-1.49	Integration order	ADF stat	-3.68	PP stat	-3.68	Integration order
	Prob.	0.49	Prob.	0.53		Prob.	0.01	Prob.	0.01	
1st diff	ADF stat	-7.98	PP stat	-8.02	I(1)	ADF stat	-8.72	PP stat	-10.50	I(0)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Portugal										
Level	ADF stat	-3.11	PP stat	-3.17	Integration order	ADF stat	-1.58	PP stat	-3.25	Integration order
	Prob.	0.03	Prob.	0.03		Prob.	0.48	Prob.	0.02	
1st diff	ADF stat	-8.07	PP stat	-8.79	I(0)	ADF stat	-8.63	PP stat	-11.59	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Spain										
Level	ADF stat	-3.11	PP stat	-2.86	Integration order	ADF stat	-2.62	PP stat	-1.61	Integration order
	Prob.	0.03	Prob.	0.06		Prob.	0.10	Prob.	0.47	
1st diff	ADF stat	-4.84	PP stat	-5.27	I(1)	ADF stat	-5.80	PP stat	-5.71	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	

Note: SIC was used for lag length selection for ADF. In the case of PP, spectral estimation method using Bartlett kernel and Newey-West for bandwidth. Estimated with constant in leves and witouth exogenous variables in 1st difference.

Table 3B. Unit Root Tests

	Interest paid on public debt (ie)					Current government balance (cb=pb-ie)				
Austria										
Level	ADF stat	-1.45	PP stat	-1.43	Integration order	ADF stat	-2.56	PP stat	-2.40	Integration order
	Prob.	0.55	Prob.	0.56		Prob.	0.11	Prob.	0.15	
1st diff	ADF stat	-5.32	PP stat	-5.62	I(1)	ADF stat	-7.26	PP stat	-9.39	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Belgium										
Level	ADF stat	-1.21	PP stat	-1.26	Integration order	ADF stat	-1.63	PP stat	-1.54	Integration order
	Prob.	0.66	Prob.	0.64		Prob.	0.46	Prob.	0.51	
1st diff	ADF stat	-3.66	PP stat	-3.59	I(1)	ADF stat	-8.58	PP stat	-8.57	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Finland										
Level	ADF stat	-1.29	PP stat	-1.33	Integration order	ADF stat	-3.23	PP stat	-2.66	Integration order
	Prob.	0.63	Prob.	0.61		Prob.	0.02	Prob.	0.09	
1st diff	ADF stat	-4.12	PP stat	-4.11	I(1)	ADF stat	-5.82	PP stat	-5.84	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
France										
Level	ADF stat	-0.82	PP stat	-0.97	Integration order	ADF stat	-1.94	PP stat	-1.93	Integration order
	Prob.	0.80	Prob.	0.76		Prob.	0.31	Prob.	0.32	
1st diff	ADF stat	-5.57	PP stat	-5.70	I(1)	ADF stat	-7.57	PP stat	-7.61	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Germany										
Level	ADF stat	-1.38	PP stat	-1.96	Integration order	ADF stat	-3.50	PP stat	-3.50	Integration order
	Prob.	0.58	Prob.	0.30		Prob.	0.01	Prob.	0.01	
1st diff	ADF stat	-4.06	PP stat	-4.09	I(1)	ADF stat	-8.89	PP stat	-12.69	I(0)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Greece										
Level	ADF stat	-1.59	PP stat	-1.29	Integration order	ADF stat	-2.27	PP stat	-2.22	Integration order
	Prob.	0.48	Prob.	0.63		Prob.	0.19	Prob.	0.20	
1st diff	ADF stat	-2.13	PP stat	-4.76	I(1)	ADF stat	-8.03	PP stat	-8.28	I(1)
	Prob.	0.03	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Italy										
Level	ADF stat	-1.52	PP stat	-1.37	Integration order	ADF stat	-1.73	PP stat	-1.76	Integration order
	Prob.	0.52	Prob.	0.59		Prob.	0.41	Prob.	0.40	
1st diff	ADF stat	-3.91	PP stat	-3.95	I(1)	ADF stat	-7.83	PP stat	-7.79	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Netherlands										
Level	ADF stat	-1.22	PP stat	-1.16	Integration order	ADF stat	-3.49	PP stat	-3.46	Integration order
	Prob.	0.66	Prob.	0.69		Prob.	0.01	Prob.	0.01	
1st diff	ADF stat	-3.63	PP stat	-3.57	I(1)	ADF stat	-8.84	PP stat	-9.98	I(0)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	
Portugal										
Level	ADF stat	-1.50	PP stat	-1.37	Integration order	ADF stat	-1.86	PP stat	-3.53	Integration order
	Prob.	0.53	Prob.	0.59		Prob.	0.35	Prob.	0.01	
1st diff	ADF stat	-4.71	PP stat	-4.68	I(1)	ADF stat	-9.02	PP stat	-15.12	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	

Spain										
Level	ADF stat	-1.79	PP stat	-1.33	Integration order	ADF stat	-2.50	PP stat	-1.55	Integration order
	Prob.	0.38	Prob.	0.61		Prob.	0.12	Prob.	0.50	
1st diff	ADF stat	-3.43	PP stat	-3.52	I(1)	ADF stat	-5.71	PP stat	-5.63	I(1)
	Prob.	0.00	Prob.	0.00		Prob.	0.00	Prob.	0.00	

Note: SIC was used for lag length selection for ADF. In the case of PP, spectral estimation method using Bartlett kernel and Newey-West for bandwidth. Estimated with constant in leves and witouth exogenous variables in 1st difference.

Table 4 presents the results of the ARDL bound testing for the ten countries included in our analysis. In this case, the dependent variable is the external balance (EB), while the independent variables are the primary balance (PB) and the interest paid on public debt (IE). Table 4 shows evidence of cointegration for Belgium, Finland and Spain.

Table 4. Testing for long run cointegration (ARDL bound test approach)

Dependent variable: EB; independent variables: PB, IE									
Austria		**Belgium**		**Finland**		**France**		**Germany**	
Selected Model:	ARDL(3, 1, 0)	Selected Model:	ARDL(1, 0, 1)	Selected Model:	ARDL(1, 0, 0)	Selected Model:	ARDL(4, 2, 4)	Selected Model:	ARDL(1, 0, 0)
Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC
Number of models evaluated:	180	Number of models evaluated:	180	Number of models evaluated:	180	Number of models evaluated:	180	Number of models evaluated:	180
Breusch-Godfrey LM test:	0.783(0.645)	Breusch-Godfrey LM test:	1.177(0.338)	Breusch-Godfrey LM test:	0.572(0.826)	Breusch-Godfrey LM test:	1.285(0.291)	Breusch-Godfrey LM test:	0.532(0.856)
Normality:	0.023(0.989)	Normality:	0.523(0.770)	Normality:	1.396(0.497)	Normality:	0.920(0.631)	Normality:	54.934(0.000)
F-stat (bound test):	3.0557	F-stat (bound test):	4.0293	F-stat (bound test):	4.1471	F-stat (bound test):	1.1953	F-stat (bound test):	0.8738
Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):	
I(0)	3.1	I(0)	3.1	I(0)	3.1	I(0)	3.1	I(0)	3.1
I(1)	3.87	I(1)	3.87	I(1)	3.87	I(1)	3.87	I(1)	3.87
Greece		**Italy**		**Netherlands**		**Portugal**		**Spain**	
Selected Model:	ARDL(5, 0, 5)	Selected Model:	ARDL(2, 2, 0)	Selected Model:	ARDL(1, 1, 2)	Selected Model:	ARDL(1, 0, 0)	Selected Model:	ARDL(1, 0, 0)
Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC
Number of models evaluated:	180	Number of models evaluated:	180	Number of models evaluated:	180	Number of models evaluated:	180	Number of models evaluated:	180
Breusch-Godfrey LM test:	0.984(0.483)	Breusch-Godfrey LM test:	0.818(0.614)	Breusch-Godfrey LM test:	1.303(0.269)	Breusch-Godfrey LM test:	0.564(0.832)	Breusch-Godfrey LM test:	1.019(0.447)
Normality:	1.136(0.567)	Normality:	0.231(0.891)	Normality:	0.633(0.729)	Normality:	0.570(0.752)	Normality:	0.164(0.921)
F-stat (bound test):	2.7097	F-stat (bound test):	2.435	F-stat (bound test):	1.612	F-stat (bound test):	2.771	F-stat (bound test):	4.492
Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):	
I(0)	3.1	I(0)	3.1	I(0)	3.1	I(0)	3.1	I(0)	3.1
I(1)	3.87	I(1)	3.87	I(1)	3.87	I(1)	3.87	I(1)	3.87

In this regard, Table 5 shows the long-term coefficients and the error correction coefficient. In the case of Belgium, Finland and Spain, the error correction coefficient is negative, confirming the presence of cointegration among the series. In addition, in the case of Belgium and Spain the relevant variable is the primary balance while in the case of Finland the relevant variable is the interest paid on public debt.

Table 5. ARDL Cointegrating and Long-Run Coefficients (Dep. Var.: EB; Ind. Var: PB, IE)

	Austria	**Belgium**	**Finland**	**France**	**Germany**
C	-13.102 (-0.751)	0.848 (0.878)	-6.150 (-2.596)**	3.416 (0.528)	-3.282 (0.561)
PB	5.262 (0.799)	0.293 (1.703)*	0.117 (0.373)	0.012 (0.010)	0.795 (0.787)
IE	3.989 (0.687)	0.117 (0.709)	3.813 (2.928)***	-0.645 (-0.329)	2.229 (0.893)
ECM(-1)	-0.071 (-3.418)***	-0.422 (-4.184)***	-0.210 (-3.691)***	0.089 (0.029)**	-0.113 (-1.976)*
	Greece	**Italy**	**Netherlands**	**Portugal**	**Spain**
C	4.999 (0.816)	-0.158 (-0.121)	3.584 (0.981)	-4.526 (-1.974)*	-3.840 (-1.971)*
PB	1.211 (1.077)	0.027 (0.140)	-1.787 (-1.078)	0.610 (1.372)	-1.625 (-1.988)*
IE	-2.724 (-1.632)	0.002 (0.010)	0.949 (0.842)	-0.407 (-0.793)	0.061 (0.080)
ECM(-1)	-0.113 (-3.534)***	-0.341 (-2.815)***	-0.130 (-2.627)**	-0.367 (-3.376)***	-0.143 (-3.546)***

t-statistics in parentheses. Significance: *** at 1%; ** at 5%; * at 10%

To check for robustness, in Tables 6 and 7 we present the results of ARDL bound testing including, on the one hand, only PB as an independent variable in Table 6 and, on the other hand, only IE as an independent variable in Table 7. In the first case, Table 6 (dependent variable: EB; independent variable: PB) indicates the presence of cointegration in the case of Spain, while in Table 7 there is evidence of cointegration for the cases of Belgium and Finland.

Table 6. Testing for long run cointegration (ARDL bound test approach)

Dependent variable: EB; independent variables: PB									
Austria		**Belgium**		**Finland**		**France**		**Germany**	
Selected Model:	ARDL(1, 2)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 2)	Selected Model:	ARDL(1, 0)
Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC
Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30
Breusch-Godfrey LM test:	0.675(0.740)	Breusch-Godfrey LM test:	1.180(0.334)	Breusch-Godfrey LM test:	0.750(0.674)	Breusch-Godfrey LM test:	0.671(0.743)	Breusch-Godfrey LM test:	0.872(0.566)
Normality:	0.073(0.964)	Normality:	0.157(0.924)	Normality:	1.975(0.372)	Normality:	0.231(0.891)	Normality:	42.515(0.000)
F-stat (bound test):	0.931	F-stat (bound test):	2.535	F-stat (bound test):	0.932	F-stat (bound test):	2.120	F-stat (bound test):	0.720
Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):	
I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62
I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16
Greece		**Italy**		**Netherlands**		**Portugal**		**Spain**	
Selected Model:	ARDL(5, 2)	Selected Model:	ARDL(2, 2)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)
Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC
Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30
Breusch-Godfrey LM test:	0.862(0.577)	Breusch-Godfrey LM test:	0.837(0.597)	Breusch-Godfrey LM test:	0.868(0.570)	Breusch-Godfrey LM test:	0.572(0.826)	Breusch-Godfrey LM test:	1.049(0.424)
Normality:	0.309(0.857)	Normality:	0.229(0.892)	Normality:	1.017(0.601)	Normality:	0.407(0.816)	Normality:	0.205(0.903)
F-stat (bound test):	3.862	F-stat (bound test):	3.317	F-stat (bound test):	1.727	F-stat (bound test):	3.556	F-stat (bound test):	5.886
Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):	
I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62
I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16

Table 7. Testing for long run cointegration (ARDL bound test approach)

Dependent variable: EB; independent variables: IE									
Austria		**Belgium**		**Finland**		**France**		**Germany**	
Selected Model:	ARDL(3, 2)	Selected Model:	ARDL(1, 1)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)
Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC
Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30
Breusch-Godfrey LM test:	0.990(0.472)	Breusch-Godfrey LM test:	1.153(0.352)	Breusch-Godfrey LM test:	0.590(0.811)	Breusch-Godfrey LM test:	0.736(0.686)	Breusch-Godfrey LM test:	0.598(0.805)
Normality:	0.097(0.953)	Normality:	0.636(0.727)	Normality:	1.539(0.463)	Normality:	0.344(0.842)	Normality:	55.634(0.000)
F-stat (bound test):	1.806	F-stat (bound test):	4.964	F-stat (bound test):	5.578	F-stat (bound test):	2.403	F-stat (bound test):	1.160
Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):	
I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62
I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16
Greece		**Italy**		**Netherlands**		**Portugal**		**Spain**	
Selected Model:	ARDL(1, 1)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(1, 0)	Selected Model:	ARDL(2, 1)
Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC	Model section criterion:	AIC
Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30	Number of models evaluated:	30
Breusch-Godfrey LM test:	1.495(0.180)	Breusch-Godfrey LM test:	0.829(0.604)	Breusch-Godfrey LM test:	1.115(0.377)	Breusch-Godfrey LM test:	0.346(0.962)	Breusch-Godfrey LM test:	0.852(0.585)
Normality:	0.457(0.796)	Normality:	0.051(0.975)	Normality:	1.384(0.501)	Normality:	0.544(0.762)	Normality:	0.099(0.952)
F-stat (bound test):	1.457	F-stat (bound test):	2.599	F-stat (bound test):	0.956	F-stat (bound test):	3.163	F-stat (bound test):	3.777
Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):		Critical value bound (at 5%):	
I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62	I(0)	3.62
I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16	I(1)	4.16

Finally, Tables 8 and 9 show the long-term coefficients and the error correction coefficient corresponding to Tables 6 and 7, respectively. In this case, the results of the initial analysis for the case of Finland (statistical significance of the variable IE) and Spain (statistical significance of the variable PB) are supported, while in the case of Belgium, although the ARDL test and the error correction coefficient indicate the presence of cointegration, the long-term parameters are not statistically significant.

Table 8. ARDL Cointegrating and Long-Run Coefficients (Dep. Var.: EB; Ind. Var: PB)

	Austria	**Belgium**	**Finland**	**France**	**Germany**
C	-0.832(-0.623)	1.220(2.475)**	-0.127(-0.045)	-0.822(-1.073)	1.923(1.107)
PB	0.834(0.713)	0.575(3.981)***	0.028(0.043)	-0.692(-0.978)	0.586(0.635)
ECM(-1)	-0.139(-1.708)*	-0.354(-3.148)***	-0.112(-1.693)*	-0.149(-2.577)**	-0-104(-1.528)
	Greece	**Italy**	**Netherlands**	**Portugal**	**Spain**
C	27.807(0.443)	-0.147(-0.272)	5.720(2.062)**	-6.051(-4.587)***	-3.726(-2.900)***
PB	9.162(0.486)	0.027(0.160)	-0.889(-0.681)	0.467(1.083)	-1.620(-2.018)**
ECM(-1)	0.032(3.492)	-0.363(-3.225)***	-0.126(-2.175)**	-0.335(-3.341)***	-0.160(-4.180)***

t-statistics in parentheses. Significance: *** at 1%; ** at 5%; * at 10%

Table 9. ARDL Cointegrating and Long-Run Coefficients (Dep. Var.: EB; Ind. Var: IE)

	Austria	**Belgium**	**Finland**	**France**	**Germany**
C	-1.708(-0.610)	-0.033(-0.026)	-5.967(-2.558)**	-2.454(-1.628)	-2.179(-0.394)
IE	0.733(0.535)	0.317(1.619)	3.899(2.935)***	0.895(1.372)	1.964(0.797)
ECM(-1)	-0.165(-2.382)**	-0.295(-3.940)***	-0.202(-3.731)***	-0.156(-2.189)**	-0.116(-1.931)*
	Greece	**Italy**	**Netherlands**	**Portugal**	**Spain**
C	-3.423(-0.695)	-0.519(-0.394)	3.190(0.867)	-6.725(-3.281)***	-2.114(-1.651)
IE	-0.900(-0.946)	0.048(0.236)	0.398(0.418)	-0.017(-0.033)	-0.319(-0.580)
ECM(-1)	-0.079(-2.135)**	-0.288(-2.596)**	-0.121(-1.502)	-0.315(-2.994)***	-0.245(-3.440)***

t-statistics in parentheses. Significance: *** at 1%; ** at 5%; * at 10%

As a result of the cross-checking exercise between the panel Granger tests and individual ARDL bound testing, we highlight the absence of a common pattern in the relationship between the public balance and the external balance for these Eurozone countries. However, at the individual level, there is evidence of a long-term relationship between the fiscal variables and the external balance in the case of Finland and Spain. In the case of Finland, there is a positive relationship between the interest paid on public debt and the external balance. How does this relationship work? As a result of higher interest payments, the public sector restricts its purchases, including imports of goods and services, which improves the external balance. Additionally, in the Finnish case, the increase in interest paid on debt is associated with a significant increase in public debt since the mid-1990s.

Finally, in the case of Spain, there is evidence of a negative long-term relationship between the external balance and the public balance. In this case, one can observe graphically the negative and relatively stable relationship between the two variables from 1960 to the mid-1990s at which time preparations for entering the third stage of the Economic and Monetary Union might have changed the relationship. In the period from the mid-1990s until the onset of the global financial crisis, the Spanish economy had several years of primary surplus, which was accompanied by a deterioration in the external balance. This deterioration in the external balance is largely explained by the capital inflows into the Spanish economy due to the expected catching-up process and real investment after the adoption of the single currency.

Summarising, there is no evidence of a common causality pattern between the public balance and the external balance among different groups of Eurozone countries. In addition, only Spain and Finland demonstrate a long-term relationship between fiscal variables and the external balance. Notwithstanding, these relationships are not what is predicted by the twin deficits hypothesis. These results have at least one important implication in terms of eco-

nomic policy: public finance – through short-term fiscal policies – is not the key instrument for correcting the European external balance.

Recent economic literature has focused on the analysis of the determinants of the European external imbalances (Gehringer 2015, Alessandrini et al. 2014, Belke and Dreger 2013). A key factor explaining the imbalances is the diverging trend in price and non-price competitiveness, especially in the latter (Carrasco and Hernandez-del-Valle 2017). Therefore, if rebalancing the external sector is set as a policy goal, economic authorities should implement policy measures to reduce the competitiveness gap. Thus, a competitiveness-oriented industrial policy should be discussed.

V. Discussion

In this article, we analyse the causality and long-term relationship between the external balance and some fiscal variables for a set of ten Eurozone countries. We implement Granger causality testing and ARDL bound tests in order to cross-check the results from the two techniques. The relevance of the study of the twin deficits hypothesis lies in the need to know the origin of the European external imbalances in order to implement policy actions to correct those imbalances in the medium and long term.

According to our results, there is no evidence of a common causality pattern between the public balance and the external balance among different groups of Eurozone countries. In addition, when carrying out an analysis at an individual level, only Spain and Finland demonstrate a long-term relationship between fiscal variables and the external balance. However, according to our results, these relationships are not what is predicted by the twin deficits hypothesis. Therefore, public finance – through short-term fiscal policies – is not the key instrument for correcting the European external balance.

In an economy with a floating exchange rate – that is, in a country that does not belong to a monetary union – an increase in government spending could generate upward pressure on domestic interest rates, which makes domestic assets more attractive than foreign assets, attracting capital inflows and appreciating the national currency. The result is a loss of price competitiveness and a deterioration in the external balance.

What if the country belongs to a monetary union? And what if an increase in public spending occurs in a context of high global liquidity and within an expected process of real convergence? If the country has a relatively low level of development within a monetary union, the adoption of a single currency would eliminate the currency risk, encouraging investment in this country in the expected process of real convergence. In a context of high global liquidity, an increase in government spending could have only marginal effects on the domestic interest rates –that is, interest rates would remain virtually unchanged– which implies a disconnect between increased government spending and the deterioration of the external balance that is predicted by the twin deficits hypothesis. In this context of global liquidity, the public sector and the private sector could be financed, with increasing indebtedness, at a historically low price. This could explain, at least partially, the significant increase in indebtedness –mainly in private sector– that occurred in some countries of southern Europe simultaneously with the emergence and/or increase in external imbalances.

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