ICEI

09

Public debt and economic growth: Further evidence for the euro area

Marta Gómez-Puig
Simón Sosvilla-Rivero

WP09/17

Working**Papers**

Abstract

This paper empirically investigates the short and long run impact of public debt on economic growth. We use annual data from both central and peripheral countries of the euro area (EA) for the 1961-2013 period and estimate a production function augmented with a debt stock term by applying the Autoregressive Distributed Lag (ARDL) bounds testing approach. Our results suggest different patterns across EA countries and tend to support the view that public debt always has a negative impact on the long-run performance of EA member states, whilst its short-run effect may be positive depending on the country.

JEL Classification Codes: C22, F33, H63, O40, O52

Keywords: Public debt, economic growth, bounds testing, euro area, peripheral euro area countries, central euro area countries.

Instituto Complutense de Estudios Internacionales, Universidad Complutense de Madrid. Campus de Somosaguas, Finca Mas Ferré. 28223, Pozuelo de Alarcón, Madrid, Spain.

Marta Gómez-Puig, Universitat de Barcelona, Department of Economics and Riskcenter. 08034 Barcelona, Spain. +34 934020113 / fax: +34 934039082. marta.gomezpuig@ub.edu

Simón Sosvilla-Rivero, Complutense institute for international Studies, Universidad Complutense de Madrid. 28223 Madrid, Spain sosvilla@ccee.ucm.es

Acknowledgements

This paper is based upon work supported by the Instituto de Estudios Fiscales [grants IEF 101/2014 and IEF 015/2017], the Banco de España [grant PR71/15-20229], the Spanish Ministry of Education, Culture and Sport [grant PRX16/00261] and the Spanish Ministry of Economy and Competitiveness [grant ECO2016-76203-C2-2-P]. Simón Sosvilla-Rivero thanks the members of the Department of Economics at the University of Bath for their hospitality during his research visit. Responsibility for any remaining errors rests with the authors.

ICEI Instituto Complutense de Estudios Internacionales

Index

1. Introduction

The origin of the sovereign debt crisis in the euro area (EA) goes deeper than the fiscal imbalances in member states. Some authors have pointed out that the EA faced three interlocking crises – banking, sovereign debt, and economic growth – which together challenged the viability of the currency union (Shambaugh, 2012). According to this line of thought, these crises connected with one another in several ways: the problems of weak banks and high sovereign debt were mutually reinforcing, and both were exacerbated by weak, constrained growth. Despite its relevance, an analysis of the interrelationship between sovereign and banking risk is beyond the scope of this paper. Rather, since the crisis led to an unprecedented increase in sovereign debt in EA countries[1] we will focus on the interconnection between sovereign debt and growth in 11 of them, both central (Austria, Belgium, Finland, France, Germany and the Netherlands) and peripheral member states (Greece, Ireland, Italy, Portugal, and Spain). There is a widespread consensus on the potentially adverse consequences of high levels of public debt for these countries' economic growth, but few macroeconomic policy debates have caused as much disagreement as the current austerity argument.

Overall, the theoretical literature favours the study of the effects of very high debt on the capital stock, growth, and risk, since it tends to point to a negative link between the public debt-to-Gross Domestic Product (GDP) ratio and the steady-state growth rate of GDP (see, for instance, Aizenman *et al*., 2007). However, it also stresses not only that the impact of debt on output may differ depending on the time horizon – while debt may crowd out capital and reduce output in the long run, in the short run it can stimulate aggregate demand and output [see Barro (1990), Elmendorf and Mankiw (1999) or Salotti and Trecroci (2016)] – but also that the presence of a tipping point, above which an increase in public debt has a detrimental effect on economic performance, does not mean that it has to be common across countries [see Ghosh *et al.* (2013), Eberhardt and Presbitero (2015) or Ahlborn and Schweickert (2016)]. Eberhardt and Presbitero (2015) indicate that there may be at least three reasons for the differences in the relationships between public debt and growth across countries. First, production technology may differ, and thus also the relationship between debt and growth. Second, the capacity to tolerate high levels of debt may depend on a number of country-specific characteristics, related to past crises and to the macro and institutional framework. Third, vulnerability to public debt may depend not only on debt levels, but also on debt composition (domestic versus external, foreign or domestic currency denominated or long-term versus short term), which may also differ significantly across countries.

Nevertheless, although the relevance of the heterogeneity of the debt-growth nexus (both across countries and time periods) has been stressed by the literature, and although certain authors have presented empirical analyses of this issue, hardly any empirical studies have examined the topic in EA countries. While there is a substantial body of research exploring the interconnection between debt and growth in both developed and emerging countries, few papers to date have looked at this link in the context of the EA. These exceptions make use of panel data techniques to obtaining average results for EA countries, and do not distinguish between countries or between short and long run effects.

In this context, this paper presents a new approach to add to the as yet small body of literature on the relationship between public debt accumulation and economic performance in EA countries, by examining the potential heterogeneity in the debt-growth nexus both across different EA countries and across time horizons. Therefore, our contribution to the empirical literature is twofold. First, unlike previous studies, we do not make use of panel estimation techniques to combine the power of cross section averaging with all the subtleties of temporal dependence; rather, we explore

1 By the end of 2013, on average, public debt reached about 100% of GDP in EA countries – its highest level in 50 years.

the time series dimension of the issue to obtain further evidence based on the historical experience of each country in the sample in order to detect potential heterogeneities in the relationship across EA countries. Second, our econometric methodology is data-driven, and it allows us to select the statistical model that best approximates the relationship between the variables under study for any particular country and to assess both the short and long-run effects of public debt on output performance.

The rest of the paper is organized as follows. Section 2 justifies our empirical approach on the basis of a review of the existing literature. Section 3 presents the analytical framework of the analysis and outlines the econometric methodology. Section 4 describes our data. Empirical results are presented in Section 5. Finally, Section 6 summarizes the findings and offers some concluding remarks.

2. Literature review

Under what conditions is debt growth-enhancing? This challenging question has been studied by economists for a long time, but has recently undergone a notable revival fuelled by the substantial deterioration of public finances in many economies as a result of the financial and economic crisis of 2008-2009[2].

From the theoretical perspective, there is no consensus regarding the sign of the impact of public debt on output in either the short or the long run. The "conventional" view (Elmendorf and Mankiw, 1999) states that in the short run, since output is demand-determined, government debt (manifesting deficit financing) can have a positive effect on disposable income, aggregate demand, and overall output. Moderate levels of debt are found to have a positive short-run impact on economic growth through a range of channels: improved monetary policy, strengthened institutions, enhanced private savings, deepened financial intermediation (Abbas and Christensen, 2007) or smoothed distortionary taxation over time (Barro, 1979). This positive short-run effect of budget deficits (and higher debt) is likely to be large when the output is far from capacity. However, things are different in the long run if the decrease in public savings brought about by a higher budget deficit is not fully compensated by an increase in private savings. In this situation, national savings will decrease and total investment will fall; this will have a negative effect on GDP as it will reduce capital stock, increase interest rates, and reduce labour productivity and wages. The negative effect of an increase in public debt on future GDP can be amplified if high public debt increases uncertainty or leads to expectations of future confiscation, possibly through inflation and financial repression (see Cochrane, 2011).

The above "conventional" split between the short and long-run effects of debt disregards the fact that protracted recessions may reduce future potential output (as they increase the number of discouraged workers, with the associated loss of skills, and have a negative effect on organizational capital and investment in new activities). There is, in fact, evidence that recessions have a permanent effect on the level of future GDP (see, e.g., Cerra and Saxena, 2008), which implies that running fiscal deficits (and increasing debt) may have a positive effect on output in both the short and the long run. DeLong and Summers (2012) argue that, in a low interest rate environment, an expansionary fiscal policy is likely to be self-financing.

Finally, another strand of the literature also departs from the "conventional" view and establishes a link between the long-term effect of debt and the kind of public expenditure it funds. The papers by Devarajan *et al*. (1996) and Aschauer (1989), for instance, state that in the long run, the impact of debt on the economy's performance depends on whether the public expenditure funded by government debt is productive or unproductive. Whilst the former (which includes physical infrastructure such as roads and railways, communication, information systems such as phone, internet,

2 During the crisis, public deficits increased not only because economic automatic stabilizers began to work (which meant, for instance, declining revenues) but also because of the launch of fiscal stimulus packages.

and education)[3] may have a positive impact on the economy's growth, the latter does not affect the economy's long-run performance, although it may have positive short-run implications.

From the empirical perspective, the results from the literature on the relationship between public debt and economic growth are far from conclusive either [see Panizza and Presbitero (2013) or the technical Appendix in Eberhardt and Presbitero (2015) for two excellent summaries of this literature]. Some authors (Reinhart and Rogoff, 2010 or Pattillo *et al*., 2011) present empirical evidence indicating that the relationship is described by an inverted U-shaped pattern (low levels of public debt positively affect economic growth, but high levels have a negative impact).[4] However, other empirical studies reach very different conclusions. While some of them find no evidence for a robust effect of debt on growth (Lof and Malinen, 2014), others detect an inverse relationship between the two variables (Woo and Koomar, 2015) or contend that the relationship between them is mitigated crucially by the quality of a country's institutions (Kourtellos *et al.*, 2013).

In the EA context, in a situation in which leverage was already very high[5], the recent economic recession and sovereign debt crisis has stimulated an intense debate both on the effectiveness of fiscal policies and on the possible adverse consequences of the accumulation of public debt in EA countries. Few macroeconomic policy debates have generated as much controversy as the current austerity argument, not only because pundits draw widely different conclusions for macroeconomic policy (in particular, in relation to their positions on economic austerity policies), but also because economists have not reached a consensus (see Alesina *et al*. 2015). Some suggest that now is precisely the time to apply the lessons learnt during the Great Depression and that policymakers should implement expansionary fiscal policies [see, among others, Krugman (2011), Berg and Ostry (2011) or DeLong and Summers (2012)][6] since fiscal austerity may have been the main culprit for the recessions experienced by European countries; others argue that, since the high level of public sector leverage has a negative effect on economic growth, fiscal consolidation is fundamental to restoring confidence and improving expectations about the future evolution of the economy and therefore its rate of growth [see Cochrane (2011), Teles and Mussolini (2014) and Castro *et al.*(2015), to name just a few][7].

In our reading of the empirical evidence, few papers have examined the relationship between debt and growth for EA countries despite the effects of the severe sovereign debt crisis in several member states. Checherita-Westphal and Rother (2012) and Baum *et al*. (2013) analyse the non-linearities of the debt-growth nexus estimating a standard growth model and employing a panel approach. In contrast, Dreger and Reimers (2013) base their analysis on the distinction between sustainable and non-sustainable debt periods. These three studies are unified and extended

3 Although this sort of investment might not be profitable from the point of view of the single firm (as private costs exceed private returns), the whole economy would nevertheless benefit enormously, which justifies public provision. For instance, Glomm and Ravikumar (1997), among others, contend that both government infrastructure investment and education expenditures have a significant impact on an economy's long-term growth rate.

4 In particular, in their seminal paper, Reinhart and Rogoff (2010) suggest that growth rates decrease substantially when debt-to-GDP ratios are above the 90% threshold.

5 In this regard, Gómez-Puig (2013) attempts to quantify the total level of indebtedness (public and private) in all EA countries, using a database created with the statistics provided by the European Central Bank. According to her calculations, in September 2012, total leverage (public and private) over GDP recorded levels of 710%, 487%, 413%, 360% and 353% in Ireland, Portugal, Spain, Italy and Greece respectively.

6 These authors state that deleveraging policies may even prove to be detrimental, depending on the fundamental variables of the economy. Their argument is currently supported by some politicians in southern Europe.

7 The latter approach, which supports austerity measures, has been highly influential among the EA authorities and is supported by the empirical evidence presented in some influential papers (Reinhart and Rogoff, 2010, among them).

by Antonakakis (2014). Like the other authors he uses a panel approach, but in addition to debt non-linearities, he also examines the effect of debt sustainability on economic growth in the EA. Overall, this empirical literature lends support to the presence of a common debt threshold across (similar) countries like those in the EA, and does not distinguish between short- and-long run effects.

Therefore, to our knowledge, no strong case has yet been made for analysing the effect of debt accumulation on economic growth taking into account the particular characteristics of each EA economy and examining whether the effects differ depending on the time horizon, in spite of the fact that this potential heterogeneity has been stressed by the literature. For instance, Eberhardt and Presbitero (2015) and Égert (2015) support the existence of nonlinearity in the debt-growth nexus, but state that there is no evidence at all for a threshold level common to all countries over time; while Gómez-Puig and Sosvilla-Rivero (2015) and Donayre and Taivan (2017), who analyse the causal relationship between public debt and economic growth, also suggest that the causal link is intrinsic to each country.

3. Analytical framework and econometric methodology

An important line of research, based on the empirical growth literature (e.g., Barro and Sala-i-Martin, 2004), has considered growth regressions augmented by public debt to assess whether the latter has an impact on growth over and above other determinants – population growth, human capital, financial development, innovation intensity, openness to trade, fiscal indicators, saving or investment rate and macroeconomic uncertainty, to name just a few – (see, e.g., Cecchetti *et al.*, 2011; Pattillo *et al.*, 2011; or Checherita-Westphal and Rother, 2012)

Our empirical strategy departs from this approach and explores the debt–growth nexus using an aggregate production function augmented by adding a debt variable. This allows us to test the impact of debt after controlling for the basic drivers of growth: the stock of physical capital, the labour input and a measure of human capital. The stock of physical capital and the labour input have been the two key determinants of economic growth since Solow's classic model (1956) and many empirical studies have examined their relationship with economic growth (see, e.g., Frankel, 1962). Regarding human capital, Becker (1962) stated that investment in human capital contributed to economic growth by investing in people through education and health, and Mankiw *et al*. (1992) augmented the Solow model by including accumulation of human as well as physical capital (see Savvide and Stengos, 2009).

Therefore, we extend Eberhardt and Presbitero (2015)'s approach and consider the following aggregate production function, in which public debt is included as a separate factor of production[8]:

$$Y_t = AF(K_t, L_t, H_t, D_t) \qquad (1)$$

where Y is the level of output, A is an index of technological progress, K is the stock of physical capital, L is the labour input, H is the human capital, and D is the stock of public debt.

For simplicity, the technology is assumed to be of the Cobb-Douglas form:

$$Y_t = AK_t^{\alpha_1} L_t^{\alpha_2} H_t^{\alpha_3} D_t^{\alpha_4} \qquad (2)$$

so that, after taking logs and denominating by a small letter the log of its corresponding capital letter, we obtain

$$y_t = \alpha + \alpha_1 k_t + \alpha_2 l_t + \alpha_3 h_t + \alpha_4 d_t \quad (3)$$

As can be seen, equation (3) postulates a long-run relationship between (the log of) the level of production (y_t), (the log of) the stock of physical capital (k_t), (the log of) the labour employed (l_t), (the log of) the human capital (h_t) and (the log of) the stock of public debt (d_t). In contrast to Eberhardt and Presbitero (2015), we do not impose any constraint regarding the returns to scale of production factors in the production function.

8 Eberhardt and Presbitero (2015) do not consider H in the basic equation of interest for their analysis of the debt–growth nexus.

Equation (3) can be estimated from sufficiently long time series by cointegration econometric techniques. In this paper we make use of the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration proposed by Pesaran and Shin (1999) and Pesaran, Shin and Smith (2001). This approach presents at least three significant advantages over the two alternatives commonly used in the empirical literature: the single-equation procedure developed by Engle and Granger (1987) and the maximum likelihood method postulated by Johansen (1991, 1995) which is based on a system of equations. First, both these approaches require the variables under study to be integrated of order 1; this inevitably requires a previous process of tests on the order of integration of the series, which may lead to some uncertainty in the analysis of long-run relations. In contrast, the ARDL bounds testing approach allows the analysis of long-term relationships between variables, regardless of whether they are integrated of order 0 [*I(0)*], of order 1 [*I(1)*] or mutually cointegrated. This avoids some of the common pitfalls faced in the empirical analysis of time series, such as the lack of power of unit root tests and doubts about the order of integration of the variables examined (Pesaran *et al.*, 2001). Second, the ARDL bounds testing approach allows a distinction to be made between the dependent variable and the explanatory variables, an obvious advantage over the method proposed by Engle and Granger; at the same time, like the Johansen approach, it allows simultaneous estimation of the short-run and long-run components, eliminating the problems associated with omitted variables and the presence of autocorrelation. Finally, while the estimation results obtained by the methods proposed by Engle and Granger and Johansen are not robust to small samples, Pesaran and Shin (1999) show that the short-run parameters estimated using their approach are $\sqrt{T}-$consistent and that the long-run parameters are super-consistent in small samples.

In our particular case, the application of the ARDL approach to cointegration involves estimating the following unrestricted error correction model (UECM):

$$\Delta y_t = \beta + \sum_{i=1}^{p} \gamma_i \Delta y_{t-i} + \sum_{i=1}^{q_1} \omega_i \Delta k_{t-i} + \sum_{i=1}^{q_2} \varphi_i \Delta l_{t-i} + \sum_{i=1}^{q_3} \upsilon_i \Delta h_{t-i} + \sum_{i=1}^{q_4} \phi_i \Delta d_{t-i} + \lambda_1 y_{t-1} + \lambda_2 k_{t-1} + \lambda_3 l_{t-1} + \lambda_4 h_{t-1} + \lambda_5 d_{t-1} + \varepsilon_t \qquad (4)$$

where *Δ* denotes the first difference operator, *β* is the drift component, and ε_t is assumed to be a white noise process. Note that *p* is the number of lags of the dependent variable and q_i is the number of lags of the *i-th* explanatory variable. The optimal lag structure of the first differenced regression (4) is selected by the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) to simultaneously correct for residual serial correlation and the problem of endogenous regressors (Pesaran and Shin, 1999, p. 386). In order to determine the existence of a long-run relationship between the variables under study, Pesaran, Shin and Smith (2001) propose two alternative tests. First, an *F-statistic* is used to test the joint significance of the first lag of the variables in levels used in the analysis (i.e. $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$), and then a *t-statistic* is used to test the individual significance of the lagged dependent variable in levels (i. e. $\lambda_1 = 0$).

Based on two sets of critical values: I(0) and I(1) (Pesaran, Shin, and Smith 2001), if the calculated *F*-or *t*-statistics exceed the upper bound I(1), we conclude in favour of a long-run relationship, regardless of the order of integration. However, if these statistics are below the lower bound I(0), the null hypothesis of no cointegration cannot be rejected. Finally, if the calculated *F*- and *t*-statistics fall between the lower and the upper bound, the results are inconclusive.

If cointegration exists, the conditional long-run model is derived from the reduced form equation (4) when the series in first differences are jointly equal to zero (i. e., *Δy*=*Δk*= *Δl*=*Δd*=0). The calculation of these estimated long-run coefficients is given by:

$$y_t = \delta_1 + \delta_2 k_t + \delta_3 l_t + \delta_4 h_t + \delta_5 d_t + \xi_t \quad (5)$$

Finally, if a long-run relation is found, an error correction representation exists which is estimated from the following reduced form equation:

$$\Delta y_t = \sum_{i=1}^{p} \theta_i \Delta y_{t-1} + \sum_{i=1}^{q_1} \varpi_i \Delta k_{t-1} + \sum_{i=1}^{q_2} \pi_i \Delta l_{t-1} + \\ + \sum_{i=1}^{q_3} \tau_i \Delta h_{t-1} + \sum_{i=1}^{q_4} \psi_i \Delta d_{t-1} + \eta ECM_{t-1} \quad (6)$$

4. Data

We estimate equation (4) with annual data for eleven EA countries: both central (Austria, Belgium, Finland, France, Germany and the Netherlands) and peripheral member states (Greece, Ireland, Italy, Portugal and Spain)[9]. Even though the ARDL-based estimation procedure used in the paper can be reliably used in small samples, we use long spans of data covering the period 1961-2013 (i.e., a total of 52 annual observations) to explore the dimension of historical specificity and to capture the long-run relationship associated with the concept of cointegration (see, e. g., Hakkio and Rush, 1991).

To maintain as much homogeneity as possible for a sample of 11 countries over the course of five decades, our primary source is the European Commission´s AMECO database[10]. We then strengthen our data with the use of supplementary data sourced from International Monetary Fund (International Financial Statistics) and the World Bank (World Development Indicators). We use GDP, net capital stock and public debt (all expressed at 2010 market prices) for Y, K and D, as well as civilian employment and life expectancy at birth for L and H[11]. The precise definitions and sources of the variables are given in Appendix 1.

5. Empirical Results[12]

5.1. Time series properties

Before carrying out the ARDL cointegration

9 This distinction between European central and peripheral countries has been used extensively in the empirical literature. The two groups we consider correspond roughly to the distinction made by the European Commission (1995) between those countries whose currencies continuously participated in the European Exchange Rate Mechanism (ERM) from its inception and which maintained broadly stable bilateral exchange rates with each other over the sample period, and those countries whose currencies either entered the ERM later or suspended their participation in the ERM, as well as fluctuating widely in value relative to the Deutschmark. These two groups are also roughly the ones found in Jacquemin and Sapir (1996), who applied multivariate analysis techniques to a wide set of structural and macroeconomic indicators, to form a homogeneous group of countries. Moreover, these two groups are basically the same as the ones found in Ledesma-Rodríguez et al. (2005) according to economic agents' perceptions of the commitment to maintain the exchange rate around a central parity in the ERM, and those identified by Sosvilla-Rivero and Morales-Zumaquero (2012) using cluster analysis when analysing permanent and transitory volatilities of EA sovereign yields. More recently, Belke *et al.* (2016) use the same division of core and peripheral countries to examine business cycle synchronization in the EA.

10 http://ec.europa.eu/economy_finance/db_indicators/ameco/index_en.htm

11 As explained in Appendix 1, following Sachs and Warner (1997), we use life expectancy at birth as the human-capital proxy. Other proxies commonly used for human capital such as years of secondary education, enrolment at secondary school and measures of human capital using a Mincerian equation (e. g. Morrisson and Murtin, 2007) were available on homogenous form for all EA countries under study only from 1980. Additionally, the proxy years of secondary education did not change during the sample period. As shown in Jayachandran and Lleras-Muney (2009), longer life expectancy encourages human capital accumulation, since a longer time horizon increases the value of investments that pay out over time. Moreover, better health and greater education are complementary with longer life expectancy (Becker, 2007). We also considered the index of human capital per person provided by the Penn World Table (version 8.0, Feenstra *et al.*, 2013), based on years of schooling (Barro and Lee, 2013) and returns to education (Psacharopoulos, 1994). This index is only available until 2011 and, for the countries under study, is a I(2) variable that cannot be included in our analysis. Nevertheless, life expectancy at birth correlates strongly with the index of human capital per person during the 1961-2011 period.

12 We summarize the results by pointing out the main regularities and focusing on public debt. The reader is asked to browse through Tables 1 to 3 and Appendix 2 to find evidence for a particular country of her/his special interest.

exercise, we test for the order of integration of the variables by means of the Augmented Dickey-Fuller (ADF) tests. This is necessary just to ensure that none of our variables are only stationary at second differences, since the ARDL bounds test fails to provide robust results in the presence of I(2) variables. The results decisively reject the null hypothesis of non-stationarity, suggesting that all variables can be treated as first-difference stationary[13]. Then, following Cheung and Chinn's (1997) suggestion, we confirm these results using the Kwiatkowski *et al.* (1992) (KPSS) tests, where the null is a stationary process against the alternative of a unit root[14].

The single order of integration of the variables encourages the application of the ARDL bounds testing approach to examine the long-run relationship between the variables.

5.2. Empirical results from the ARDL bounds test

The estimation proceeds in stages. In the first stage, we specify the optimal lag length for the model (in this stage, we impose the same number of lags on all variables as in Pesaran, Shin and Smith, 2001). The ARDL representation does not require symmetry of lag lengths; each variable may have a different number of lag terms. As mentioned above, we use the AIC and SBC information criteria to guide our choice of the lag length, selecting 4 as the maximum number of lags both for the dependent variable and the regressors. For the test of serial correlation in the residual, we use the maximum likelihood statistics for the first and fourth autocorrelation, denoted as $\chi^2_{SC}(1)$ and $\chi^2_{SC}(4)$ respectively. Due to constraints of space, these results are not shown here but they are available from the authors upon request.

13 These results (not shown here in order to save space, but available from the authors upon request) were confirmed using Phillips-Perron (1998) unit root tests controlling for serial correlation and the Elliott, Rothenberg, and Stock (1996) Point Optimal and Ng and Perron (2001) unit root tests for testing non-stationarity against the alternative of high persistence. These additional results are also available from the authors.

14 The results are not shown here due to space restrictions but are available from the authors upon request.

Next we test for the existence of a long-run relation between the output and its components, as suggested by equation (3).

Panel A in Table 1 gives the values of the *F*- and *t*-statistics for the case of unrestricted intercepts and no trends (case III in Pesaran, Shin and Smith, 2001)[15]. These statistics are compared with the critical value bounds provided in Tables CI and CII of Pesaran, Shin and Smith (2001) and depend on whether an intercept and/or trend is included in the estimations, suggesting the existence of a single long-term relationship in which the production level would be the dependent variable and the stock of physical capital, the labour employed, the human capital and the stock of public debt the independent variables. Then, the estimated long-run relationships between the variables are reported in Panel B in Table 1.

Some very interesting results can be drawn from the empirical evidence presented in Table 1. First, the long-term effect of debt on economic performance is in line with the findings in previous empirical literature based on panel data techniques, since it registers a negative value in all EA countries. However, the magnitude of the negative impact differs significantly across countries, implying that our conclusions need to be qualified. While comparatively high impacts are estimated in the case of France (-0.544), Portugal (-0.354), Spain (-0.336), and Austria (-0.129), in the rest of countries, although negative, the magnitude is very small with values close to zero. Ireland (-0.049), Finland (-0.049) and Germany (-0.040) are the countries with the

15 Since the hypothesis of the expected values of the first differences of the series is equal to zero cannot be rejected, there is no evidence of linear deterministic trends in the data. Therefore, we conclude that the cointegrating relationship should be formulated with the constant term unrestricted and without deterministic trend terms (case III). Nevertheless, we also consider two additional scenarios for the deterministics: unrestricted intercepts, restricted trends; and unrestricted intercepts, unrestricted trends (cases IV and V in Pesaran, Shin and Smith, 2001). These additional results are not shown here due to space constraints, but they are available from the authors upon request. Our estimation results indicate that the intercepts are always statistically significant, whereas the trends are not.

Table 1. Long-run analysis

Panel A: Bound testing to cointegration

	AT	BE	FI	FR	GE	GR	IE	IT	NL	PT	SP
ARDL(p,q_1,q_2,q_3,q_4,q_5)	(4, 3, 3, 4, 4)	(1, 2, 4, 4, 0)	(1, 4, 3, 1, 2)	(1, 0, 2, 4, 3)	(2, 2, 1, 0, 2)	(1, 3, 0, 0, 0)	(1, 2, 1, 0, 0)	(3, 2, 0, 4, 1)	(1, 4, 3, 4, 4)	(1, 3, 3, 0, 2)	(1, 3, 2, 0, 3)
***F*-statistic**	6.815*	5.045**	5.035**	4.163**	6.007*	4.509**	4.612**	5.396*	6.773*	4.323**	4.350**
***t*-statistic**	-5.291*	-3.709**	-3.822**	-3.868**	-4.702*	-3.695**	-3.744**	-3.628**	-4.286*	-3.860**	-4.064**

Panel B: Long-run coefficients

	AT	BE	FI	FR	GE	GR	IE	IT	NL	PT	SP
Intercept	0.412* (3.033)	0.398* (3.214)	0.363* (3.561)	0.450* (3.621)	0.463* (3.021)	0.155* (3.021)	0.274* (2.997)	0.232* (3.143)	0.322* (3.055)	0.174* (3.034)	0.162* (3.051)
k_t	0.296* (6.628)	0.396* (6.071)	0.426* (5.665)	0.429* (5.826)	0.497* (5.488)	0.245* (5.488)	0.232* (6.172)	0.312* (5.843)	0.444* (6.287)	0.330* (4.204)	0.489* (7.400)
l_t	0.328* (6.176)	0.452* (7.788)	0.411* (7.292)	0.428* (3.835)	0.520* (3.483)	0.312* (3.483)	0.395* (3.531)	0.472* (6.375)	0.358* (6.320)	0.373* (2.942)	0.324* (4.040)
h_t	0.085* (2.892)	0.421* (2.978)	0.538* (4.138)	0.507* (3.998)	0.584* (2.932)	0.346* (2.932)	0.131* (3.124)	0.142* (3.723)	0.357* (4.198)	0.205* (2.947)	0.353* (3.395)
d_t	-0.129* (-4.335)	-0.062* (-5.512)	-0.049* (-5.137)	-0.544* (-5.867)	-0.040* (-3.135)	-0.079* (-3.135)	-0.049* (-7.783)	-0.083* (-6.723)	-0.097* (-7.318)	-0.354* (-6.336)	-0.336* (-4.871)

Notes: AT, BE, FI, FR, GE, GR, IE, IT, NL, PT and SP stand for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain respectively.

In Panel A, p, q_1, q_2, q_3, q_4 and q_5 denote respectively the optimal lag length for Δy_{t-i}, Δk_{t-i}, Δl_{t-i}, Δh_{t-i} and Δd_{t-i} in the UECM model (4) without deterministic trend.

* and ** indicate that the calculated *F*- and *t*-statistics are above the upper critical bound at 1% and 5% respectively.

In Panel B, in the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, while * denotes statistical significance at the 1% level.

Table 2. Short-run analysis

	AT	BE	FI	FR	GE	GR	IE	IT	NL	PT	SP
Δy_{t-1}	0.336* (4.959)				0.125* (3.401)			0.282 (3.912)			
Δyt_{-2}	0.227* (3.985)							0.181 (3.568)			
Δk_t	3.464* (7.112)	2.923* (6.480)	3.914* (5.974)	0.548* (4.145)	4.531* (6.254)	4.149* (5.697)		5.308 (7.729)	3.307 (6.371)	1.942* (5.932)	3.138* (7.065)
Δk_{t-1}	1.641* (3.228)	1.968* (4.454)	4.295* (6.552)		2.949* (4.897)	2.259* (4.486)	4.149* (4.252)	3.409* (6.699)	2.119* (5.691)	1.563* (3.544)	1.134* (5.202)
Δk_{t-2}			2.068* (3.829)						0.895* (3.121)	0.868* (3.688)	0.644* (3.052)
Δl_t	0.512* (4.211)	0.545* (3.395)	0.767* (5.370)	2.707* (6.745)	0.607* (5.009)	0.311* (3.213)	0.595* (5.297)	0.147* (3.991)		0.479* (3.546)	0.171* (3.320)
Δl_{t-1}									0.097* (3.904)		0.222* (3.431)
Δl_{t-2}			0.149* (3.263)	1.358* (3.237)						0.428* (3.546)	
Δh_t			1.208* (3.913)		0.328* (3.528)					0.265* (3.650)	0.987* (3.705)
Δh_{t-1}	1.836* (3.897)	2.125* (3.791)		2.757* (3.448)			3.662* (3.331)				
Δh_{t-2}		1.874* (3.540)							0.147* (3.904)		
Δh_{t-3}		1.253* (3.544)						0.808* (3.648)	1.706* (4.305)		
Δd_t	-0.105* (-3.561)	-0.186* (-4.346)					-0.077* (-3.902)	-0.077* (-3.530)			0.030** (3.420)
Δd_{t-1}	-0.117 * (-3.560)		0.059* (4.950)	-0.054* (-3.252)	0.089* (3.326)	-0.195* (-3.731)			-0.108* (-5.242)	0.063* (3.187)	
Δd_{t-2}									0.062* (3.105)		0.037* (3.074)
Δd_{t-3}	0.077* (3.060)								0.015* (3.461)		
ECM_{t-1}	-0.518* (-7.540)	-0.301* (-4.325)	-0.543* (-5.060)	-0.594* (-4.783)	-0.543* (-5.791)	-0.190* (-5.353)	-0.175* (-6.854)	-0.262* (-8.176)	-0.359* (-7.943)	-0.130* (-6.387)	-0.176* (-6.016)
Short-run effect of public debt	-0.331* (-2.994)	-0.186* (-4.346)	0.059* (4.950)	-0.054* (-3.252)	0.375* (3.882)	-0.195* (-3.732)	-0.077* (-3.902)	-0.143* (-3.714)	-0.031* (-3.936)	0.063* (3.187)	0.067* (2.882)
Adjusted R^2	0.805	0.699	0.895	0.625	0.865	0.823	0.668	0.893	0.886	0.726	0.821
DW Test	2.104	2.168	2.181	2.070	2.073	2.017	1.988	1.987	2.213	2.164	2.105
χ^2_N	1.363 [0.506]	0.719 [0.698]	1.834 [0.400]	1.028 [0.598]	1.770 [0.413]	1.664 [0.435]	0.443 [0.801]	0.913 [0.634]	2.615 [0.271]	1.345 [0.510]	2.986 [0.225]
χ^2_{SC}	0.440 [0.802]	1.636 [0.441]	0.694 [0.707]	2.775 [0.250]	2.086 [0.352]	1.777 [0.411]	2.695 [0.260]	5.531 [0.063]	4.088 [0.130]	2.374 [0.305]	2.326 [0.313]
χ^2_H	6.783 [0.746]	8.774 [0.554]	8.374 [0.398]	11.612 [0.151]	8.899 [0.351]	2.715 [0.744]	6.677 [0.246]	13.369 [0.100]	11.771 [0.540]	4.897 [0.769]	10.292 [0.327]

Notes: AT, BE, FI, FR, GE, GR, IE, IT, NL, PT and SP stand for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain respectively.
In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown.
The short-run effects of public debt are calculated using equation (7)
* and ** denote statistical significance at the 1% and 5% level, respectively.
$\chi^2_{N,}$ χ^2_{SC} and χ^2_H are the Jarque-Bera test for normality, the Breusch-Godfrey LM test for second-order serial correlation and the Breusch-Pagan-Godfrey test for heteroskedasticity.
In the square brackets, the associated probability values are given.

lowest negative impact. Therefore, our results suggest that, even though debt has a long run negative impact on output in all EA countries, with the exception of France, Portugal, Spain and Austria its magnitude is negligible.

In order to examine the short-term dynamics of the model, we estimate an error-correction model associated with the above long-run relationship. As can be seen in Table 2, the short-run impact of debt on economic performance differs clearly across countries, both in terms of the estimated coefficients for Δd_t and in terms of the significance of lagged terms of Δd_t. In order to compare results, we follow Hendry (1995)'s suggestion and calculate the short-term effects of debt on growth as follows for the significant coefficients:

$$\text{short-term effects}= \sum_{i=1}^{q_4}\psi_i \,/\, (1-\sum_{i=1}^{p}\theta_i) \tag{7}$$

Table 2 shows that with respect to peripheral EA countries, in spite of the important long-run negative impact in Portugal and Spain, the short-term effect is positive (0.063 and 0.067), although quite small. However, in Greece, Ireland and Italy an increase in public debt has a negative effect on GDP, not only in the long run but in the short run as well. Among central EA countries, it is noticeable that in Germany and Finland the effect of public debt on GDP is positive in the short run (0.375 and 0.059) despite the negative (though very small) effect in the long run. Finally, in the case of Austria, Belgium, France and the Netherlands our results suggest that public debt has a negative impact on economic activity in both the short and the long run.

All in all, it should be noted that we do not find a positive long-run relationship between public debt and output in any country, although the short-run link is positive in four EA countries. Interestingly, in two peripheral countries, Spain and Portugal, while debt exerts an important negative effect on the long run, its impact, although small, is positive in the short run. These results are in line with some recent literature which has investigated how different country characteristics (e.g., the state of the public finances, the health of the financial sector or the degree of openness to trade) might influence the size of fiscal multipliers. In particular, Corsetti *et al.* (2012) and Ilzetzki *et al*. (2013) find that negative multipliers can be observed in high-debt countries (i.e., with debt-to-GDP ratios above 60%), but they could be much larger in countries under sound public finances. Furthermore, Eberhart and Presbitero (2015) stress that one of the reasons that explains the differences in the relationships between public debt and growth across countries is the dependence of vulnerability to public debt on current debt levels. Among peripheral EA countries, only Portugal and Spain registered an average debt ratio below the 60% threshold during the 1961-2013 period (37% and 35% respectively), while the debt ratio was also moderate in Finland and Germany (28% and 40% on average). Therefore, our results confirm that in countries with low or moderate indebtedness levels (i.e., in a sustainable public debt context, see Dreger and Reiners, 2013), an additional increase in public debt might exert a short-run positive effect on GDP. These findings are highly relevant since these two peripheral countries have been hit especially hard by both the economic and sovereign debt crises. And, amid the crisis, they received rescue packages (in the Spanish case, to save its banking sector) which were conditional on the implementation of structural reforms to improve competitiveness and highly controversial fiscal austerity measures (whose positive effects are nevertheless typically related to the long run).

Although our results must be regarded with caution since they present the average effects over the 50 year estimated period, they do not seem to favour the same austerity argument in all EA countries. In particular, they indicate that, in the short term, expansionary fiscal policies may not have a negative effect on output – but a marginal positive one – in some countries such as Spain and Portugal, regardless of its large negative impact in the long run. Then, although our findings support the view that the unprecedented sovereign debt levels reached in EA countries might have adverse consequences for their economies in the long run, they also suggest that the pace of adjustment may differ across these countries. In particular, within peripheral EA countries, policymakers should bear in mind that while the short-run impact of debt on economic performance is negative in Greece, Ireland and Italy, it is slightly positive in Spain and Portugal.

Regarding the estimated coefficients for the error correction terms (ECM_{t-1}) representing the speed of adjustment needed to restore equilibrium in the dynamic model following a disturbance, Table 2 shows that they range from -0.301 to -0.543 for the central countries (suggesting that, with the exception of Belgium and the Netherlands, more than half of the disequilibrium is corrected within one year), while ranging from -0.129 to -0.262 for the peripheral EA countries (suggesting relatively slow reactions to deviations from equilibrium and implying that short-term effects may dominate at longer horizons), corroborating the above results. Besides, the highly significant estimated error correction terms provide further support for the existence of stable long-run relationships such as those reported in Table 1 (Banerjee *et al.,* 1998).

Finally, as Table 2 indicates, the short-run analysis seems to pass diagnostic tests such as normality of error term, second-order residual autocorrelation and heteroskedasticity (χ^2_N, χ^2_{SC} and χ^2_H respectively). The regressions fit reasonably well, with R^2 values ranging from 0.625 for France to 0.895 for Finland.

5.3. Empirical results from the stability analysis

The estimated parameters presented in Table 2 are average values for the entire sample period (1961-2013) and do not take into account the possibility that they could change over time if a structural break occurred. Therefore, we also explore the possibility of multiple structural changes in the parameter relating the public debt variable to the real growth rate (ψ_t) in equation (6) by using the Bai and Perron (1998) test[16]. The results (not shown here to save space, but available from the authors upon request) seem to suggest strongly that there are two structural breaks in each of the estimated models. The detected break dates and the associated levels of public debt-to-GDP ratio are displayed in Table 3.

Table 3: Results of the structural changes test in the coefficient of the public debt

	AT	BE	FI	FR	GE	GR	IE	IT	NL	PT	SP
Structural break 1	1987 (58%)	1977 (60%)	1991 (22%)	1986 (31%)	1983 (39%)	1979 (23%)	1988 (107%)	1976 (56%)	1978 (41%)	1986 (57%)	1993 (52%)
Structural break 2	2007 (60%)	2005 (92%)	2007 (35%)	2005 (67%)	2008 (67%)	2008 (113%)	2007 (25%)	2007 (106%)	2008 (58%)	2003 (56%)	2009 (54%)

Notes: AT, BE, FI, FR, GE, GR, IE, IT, NL, PT and SP stand for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain respectively.
In the ordinary brackets, the associated levels of public debt-to-GDP ratio are given.

As can be seen, in all the countries under study, the first break point occurred before 1999 (i.e., before the beginning of the EA). It is located in the seventies in four countries: (1) Belgium ,– with the starting of an interest snowball from 1977 that led to one of the largest increases in debt-to-GDP ratios in advanced economies (Mauro and Zilinsky, 2016), (2) Greece, when this country entered a period of stagflation, caused by the second oil shock of 1979 (Alogoskoufis, 2012), (3) Italy, after a currency crisis in a period of severe political instability (Lubitz, 1978), and (4) the Netherlands, following a major change in economic policy (OECD, 1979). It occurred in the eighties in five economies: (1) Austria, around the

16 Bai and Perron (1998) consider the estimation of multiple structural shifts in a linear model estimated by least squares. They propose some tests for structural changes and a selection procedure based on a sequence of tests to estimate consistently both the number of breaks and the induced structural regimes in a linear model. We follow their recommendation and use a trimming region of 15%. We allow the system to search for a maximum of five breaks, which is the largest permissible number according to the Bai and Perron procedure.

introduction of measures to deal with serious structural problems in public finances (Katterl and Köhler-Töglhofer, 2005), (2) France, after a period of fiscal consolidation that resulted in a stabilization of the debt-to-GDP ratio (Corsetti and Roubini, 1991), (3) Germany, in the aftermath of the recession of 1983-1985 which introduced stagflation (Siebert, 2005), (4) Ireland, in a context of sustained real GDP expansion that lulled policymakers into a false sense of security regarding the sustainability of the revenues from cyclically sensitive taxes (Honohan, 2009), and (5) Portugal, marked by a second IMF-supported stabilization program, 1983–1985. Finally, it took place in the nineties in the other two EA countries in our sample: (1) Finland, after experiencing a banking crisis in 1991 that worsened the fiscal balance (Reinhart, 2009), and (2) Spain, coinciding with a severe economic crisis in 1993. Moreover, it is noticeable that the public debt-to-GDP ratio associated to the first break point surpasses the level of 60% only in Ireland (107%).

Regarding the second break point, in all cases it took place after the implementation of the common currency and in eight out of the 11 cases under study it occurred in 2007 or later, coinciding with the global financial and economic crisis. Specifically, it took place in 2007 (coinciding with the subprime crisis in the United States) in Austria, Finland, Ireland and Italy; in 2008 (when Lehman Brothers collapsed) in Germany, Greece and the Netherlands; and in 2009 (coinciding with the beginning of the EA sovereign crisis) in Spain[17]. However, in all countries but Spain, the second break date occurred before the economic recession reached its trough during the third regime, which pushed public debt up to unprecedented levels. Therefore, it can be observed that the associated debt-to-GDP ratio clearly increases in the second break point compared with the first one, presenting values of above 60% in 6 out of the 11 countries under study. Specifically, it occurs at ratios marginally above that value in Austria, Germany and France; slightly above 90% in Belgium and above 100% in Italy and Greece.

If we focus on peripheral EA countries, it can be observed that whilst in Spain and Portugal the public debt-to-GDP ratios associated with the two break dates are very similar (55% on average), in the other three countries they diverge significantly. As can be seen, in Greece the public debt-to-GDP ratio increases from 23% in the first break point (1979) to 113% in the second one (2008). A similar pattern is found in Italy, where it rises from 56% in 1976 to 106% in 2007. Nonetheless, the behaviour in Ireland is completely different: the ratio was 107% at the first break point (1988) and decreased to 25% at the second one (2007), indicating that the substantial debt accumulation in 2007-2008 was preceded by a huge deleverage period in that country.

Next, we utilize this information and form three regimes for each country. The idea is to re-estimate the regression model including a dummy variable that incorporates the detected breakpoints and gauge whether structural breaks have disturbed the effect of public debt

$$\Delta y_t = \sum_{i=1}^{p} \theta_i \Delta y_{t-1} + \sum_{i=1}^{q_1} \varpi_i \Delta k_{t-1} + \sum_{i=1}^{q_2} \pi_i \Delta l_{t-1} + \sum_{i=1}^{q_3} \tau_i \Delta h_{t-1} + \\ + \sum_{i=1}^{q_4} \psi_i^1 \Delta d_{t-1} + \sum_{i=1}^{q_4} \psi_i^2 \Delta d_{t-1} D1_t + \sum_{i=1}^{q_4} \psi_i^3 \Delta d_{t-1} D2_t + \eta ECM_{t-1}$$

(8)

where $D1_t$ is a dummy variable taking value 0 from 1961 until T_1-1 and 1 between T_1 and T_2-1 and $D2_t$ is a dummy variable taking value 0 from 1961 until T_2-1 and 1 between T_2 -and T, being T_1 and T_2 the detected break dates.

From the significant coefficients estimated using equation (8), we can compute for every country the short-term impact of debt on economic performance during each of the three regimes as:

$$\text{short-term effects in regime } j = \sum_{i=1}^{q_4} \psi_i^j / (1 - \sum_{i=1}^{p} \theta_i), \; j=1,2,3 \qquad (9)$$

The full estimations results are reported in Appendix 2, while the estimated short-term effects are presented in Table 4. As can be seen,

17 In 2009 Spanish public deficit reached a historical peak of 11.0% of GDP.

Table 4: Short-run analysis with structural breaks

Central EA countries	*Short-term*	*Regime 1*	*Regime 2*	*Regime 3*
Austria	-0.331* (-2.994) [1961-2013]	-0.119* (-3.393) [1961-1986]	-0.158* (-3-011) [1987-2006]	-0.074* (-3.082) [2007-2013]
Belgium	-0.186* (-4.346) [1961-2013]	-0.295* (-3.945) [1961-1976]	-0.271** (-2.740) [1977-2004]	-0.376* (-3.842) [2005-2013]
Finland	0.059* (4.950) [1961-2013]	0.074* (3.6448) [1961-1990]	-0.036* (-3.067) [1991-2006]	-0.037* (-3.741) [2007-2013]
France	-0.054* (-3.252) [1961-2013]	-0.062* (-3.149) [1961-1985]	-0.030* (-2.951) [1986-2004]	-0.014* (-3.287) [2005-2013]
Germany	0.375* (3.882) [1961-2013]	0.308* (4.117) [1961-1982]	-0.106* (-3.696) [1983-2007]	-0.044* (-4.358) [2008-2013]
Netherlands	-0.031* (-3.936) [1961-2013]	-0.027* (-3.643) [1961-1977]	-0.008* (-3.200) [1978-2007]	-0.037* (-2.918) [2008-2013]
Peripheral EA countries	*Short-term*	*Regime 1*	*Regime 2*	*Regime 3*
Greece	-0.195* (-3.732) [1961-2013]	-0.017* (-3.874) [1961-1978]	-0.052* (-3.701) [1979-2007]	-0.255* (-2.933) [2008-2013]
Ireland	-0.077* (-3.902) [1961-2013]	-0.090** (-2.740) [1961-1987]	-0.137* (-3.624) [1988-2006]	0.031* (-2.870) [2007-2013]
Italy	-0.143* (-3.714) [1961-2013]	-0.143* (-3.526) [1961-1975]	-0.098* (-3-702) [1976-2006]	-0.391* (-3.689) [2007-2013]
Portugal	0.063* (3.187) [1961-2013]	-0.056* (3.160) [1961-1985]	0.097** (2.813) [1986-2002]	-0.174* (-2.971) [2003-2013]
Spain	0.067* (2.882) [1961-2013]	0.072* (2.997) [1961-1992]	-0.016** (-2.805) [1993-2008]	-0.029* (-2.945) [2009-2013]

Notes: AT, BE, FI, FR, GE, GR, IE, IT, NL, PT and SP stand for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain respectively.
In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown.
In the square brackets, the sample period for each regime is given.
The short-run effects of public debt on economic growth are calculated using equations (7) and (8)
* and ** denote statistical significance at the 1% and 5% level respectively.

we find very different results across central and peripheral countries.

Regarding central EA countries, with the exception of France, in countries where debt had a negative short-run effect on growth (Austria, Belgium, and the Netherlands), these inverse relationships between debt and growth seem to strengthen throughout the detected regimes. However, in Germany and Finland (where debt had a positive short-run effect on growth), we only detect a positive relationship between these two variables during the first regime (i.e., before the first break point). Subsequently, from 1983 and 1991 onwards, debt also exerts a negative effect on growth in Germany and Finland respectively.

Interestingly, in peripheral EA countries, although we found that the short-run effect was positive in Portugal and Spain, a positive relationship between debt and the real growth rate during the first regime is only found in the Spanish case. However, it is noticeable that in this economy, although the relationship changes to negative from 1993 until the end of the sample, its magnitude is very small (-0.016 and -0.029 in the second and third regime, respectively). In the case of Portugal, we find a temporary positive coefficient after the first detected break (during the 1986-2002 period), followed by a further negative

Figure 1a: Debt-growth relationship in peripheral EA countries

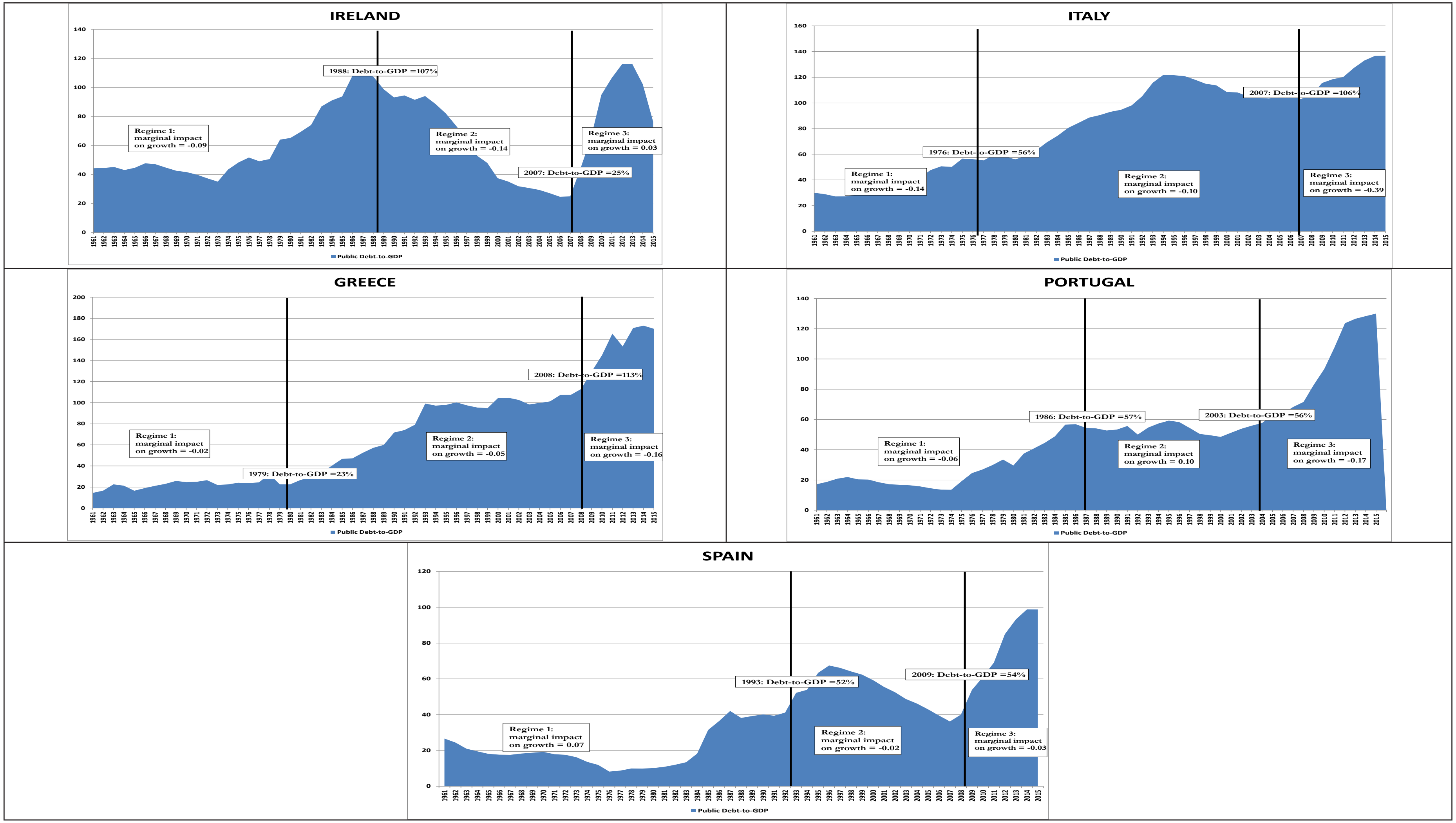
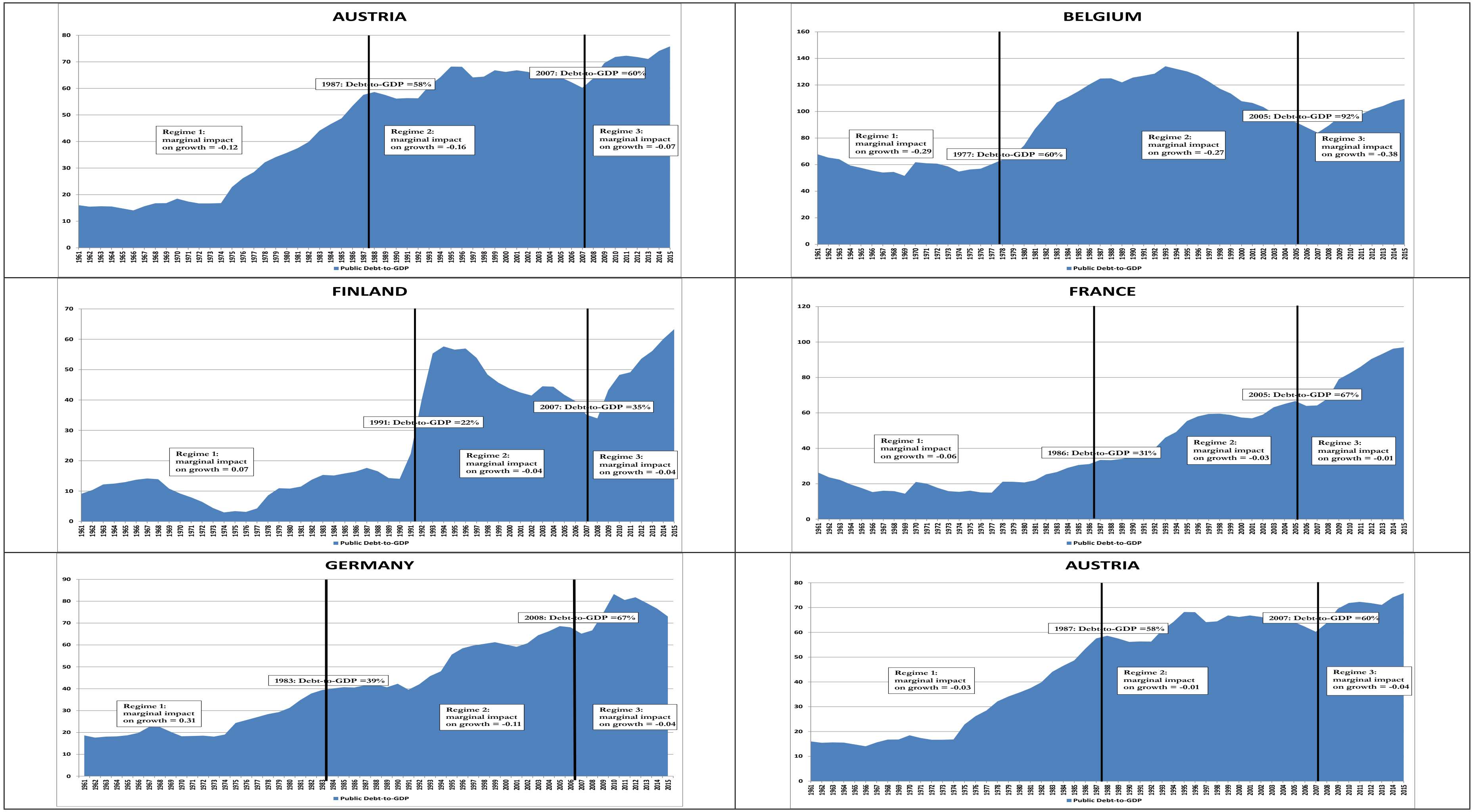


Figure 1b: Debt-growth relationship in central EA countries



Source: AMECO, IMF and own estimates.

coefficient after the second break, reinforcing the inverse association between the variables under study from then on. Moreover, a small positive relationship (0.031) between debt and growth is also found in Ireland during the third regime (2007-2013) where, after an important deleveraging process, the debt-to-GDP ratio reached a value of 25% in 2007. Finally, in the other two peripheral EA countries (Italy and Greece), we find a negative relationship between the two examined variables not only in the short-term, but throughout the three examined regimes as well. This behaviour could be related to the fact that these two countries present the highest average debt-to-GDP ratio during the 1961-2013 period (75% and 69% respectively).

Figures 1a and 1b summarize the main results for peripheral and central EA countries respectively. Specifically they present for each EA country: (1) the two break points with the associated debt-to-GDP ratio and (2) the evolution of the marginal impact of sovereign debt ratio on economic growth in the three regimes into which the sample period is split.

Figure 1a shows the existence of a positive relationship between the public debt-to-GDP ratio and economic growth in some sub-periods in three peripheral EA countries: Spain (from 1961 until 1992), Portugal (from 1986 until 2002), and Ireland (between 2007 and 2013). Therefore, with the exception of Ireland, in the other two peripheral EA countries (which also registered a positive short-run effect), the relationship between public debt and economic growth only becomes negative from a debt-to-GDP ratio between 50% and 60%. Moreover, again with the exception of Ireland, the highest detrimental marginal impact of public debt on peripheral countries' economic performance takes place after the second break point (mainly from 2007 to 2009, coinciding with the global financial crisis), with debt-to-GDP ratios that range from 55% (Spain and Portugal) to slightly above 100% (Italy and Greece), being Spain the peripheral country where the negative impact is lower during the crisis episode.

The highest negative marginal impact also takes place after the second break date in three out of the six central EA countries (see Figure 1b). In Finland and the Netherlands, it occurs from 2007-2008 (with a debt-to-GDP level that ranges from 35% to 58%), while in Belgium it takes place from 2005 with debt-to-GDP levels above 90%.

Therefore, our results seem to suggest that the debt-to-GDP ratio at which public debt exerts the strongest negative impact on economic growth changes over time and across EA countries. In seven out of eleven countries, the negative impact is especially high in times of distress, but the associated debt ratio clearly differs across countries. Whilst in some countries it takes place at low ratios (e.g., at 35% in Finland), in others it occurs at very high values (90% in Belgium and above 100% in Italy and Greece). In addition, the highest negative marginal impact also differs across EA countries. The maximum negative values are observed in Italy and Belgium (-0.391 and -0.376), whilst the minimum is registered in Spain (-0.029).

6. Concluding remarks

Despite the severe sovereign debt crisis in the EA, few papers have examined the relationship between debt and growth for member states. The limited body of literature available lends support to the presence of a common debt threshold across EA countries and does not distinguish between short and long-run effects. To our knowledge, no strong case has yet been made for analysing the incidence of debt accumulation on economic growth taking into account the particular characteristics of each EA economy and examining whether the effects differ depending on the time horizon, even though this potential heterogeneity has been stressed by the literature.

This paper aims to fill this gap. Unlike previous studies in the EA, we do not make use of panel techniques but study cross-country differences in the debt-growth nexus both across EA countries and across time horizons using time series analyses. To this end, our empirical examination of 11 member states (both central and peripheral) during the 1961-2013 period is based on the estimation, for each country, of a log-linearized Cobb–Douglas production function augmented with a debt stock term, by means of the ARDL testing approach to cointegration.

As in every empirical analysis, the results must be regarded with caution since they are based on a set of countries over a certain period and a given econometric methodology. This is particularly true of the comparison of the results with those of previous papers, since we adopt a time series analysis instead of a panel data approach, and since we use an analytical framework based on a production function augmented with public debt instead of growth regressions augmented by public debt. Nonetheless, our findings are in concordance with the predominant view that the positive effect of debt on output is more likely to be felt in the short rather than in the long run. In particular, our empirical evidence suggests a negative effect of public debt on output in the long run. Thus, our results support previous reports indicating that high public debt tends to hamper growth by increasing uncertainty over future taxation, crowding out private investment, and weakening a country's resilience to shocks (see, e.g., Krugman, 1988). However, they detect the possibility that a public debt increase may have a positive effect in the short run by raising the economy's productive capacity and improving efficiency depending on the characteristics of the country and the final allocation of public debt. Specifically, this short-run positive effect is found in Finland, Germany, Portugal and Spain, suggesting that in a context of low rates of economic growth, the path of fiscal consolidation may differ across the different EA countries. When in the short run stability analysis we allow the coefficient estimates on the public debt variable to differ before and after two endogenously (data-based) identified structural breaks, our results also indicate that debt exerts a positive effect on growth in the first regime in Finland, Germany and Spain (from 1961 until 1990, 1982 and 1992 respectively); whilst a positive relationship is found in the second regime in the case of Portugal (between 1986 and 2002). In all cases, the positive relationship between a debt increase and economic growth is found when the indebtedness level is either low or moderate (i.e., in sustainable debt periods). Moreover, within EA peripheral countries, Spain is the one that presents the lowest negative relationship between debt and growth during the distress episode (-0.029).

This issue is particularly relevant to policymakers because of its implications for the effectiveness of a common fiscal policy, in view of the pronounced differences in the responsiveness of output in the long and short run and across countries. These findings seem to corroborate the idea that there is no "one size fits all" definition of fiscal space but that, conversely, debt limits and fiscal space may be country-specific and depend on each country's track record of adjustment (see, e. g., Ostry *et al.*, 2010).

Extensions from the present research might take a number of directions. First, it would be interesting to examine possible non-linear effects (smooth or sudden structural changes) using the time-series approach applied in this paper to detect further potential heterogeneities among EA countries, complementing the evidence from existing literature using panel data techniques. A second natural extension to the analysis presented in this paper would be to further explore the main determinants of the detected differences in the relationships between public debt and economic growth across countries, with special emphasis on the economic and institutional factors suggested in Kourtellos *et al.* (2013) and in Eberhardt and Presbitero (2015). Both items are on our future research agenda. In view of the encouraging results presented in this paper, some optimism about the benefits of implementing these extensions seems justified.

References

Abbas S.M.A. – Christesen, J. E. (2007): The role of domestic debt markets in economic growth: An empirical investigation for low–income countries and emerging markets. Working Paper 07/127. Washington, DC: International Monetary Fund.

Alesina, A., Barbiero, O. – Favero, C. – Giavazzi, F. – Paradisi, M. (2015): Austerity in 2009-2013. Working Paper 20827, Cambridge, MA: National Bureau of Economic Research.

Alogoskoufis, G. (2012): Greece's sovereign debt crisis: retrospect and prospect. GreeSE Paper 54. London: Hellenic Observatory, London School of Economics and Political Science.

Ahiborn, M. – Schweickert, R. (2016): Public debt and economic growth: Economic systems matter, Discussion Paper 281, Göttingen: Center for European Governance and Economic Development Research.

Aizenman, J. – Kletzer, K. – Pinto, B. (2007): Economic growth with constraints on tax revenues and public debt: Implications for fiscal policy and cross-country differences. Working Paper 12750, Cambridge, MA: National Bureau of Economic Research.

Antonakakis, N. (2014): Sovereign debt and economic growth revisited: The role of (non-) sustainable debt thresholds. Working Paper 187, Vienna: Department of Economics, Vienna University.

Aschauer, D. A. (1989): Is public expenditure productive? *Journal of Monetary Economics*, 23: 177–200.

Bai, J. – Perron, P. (1998): Estimating and testing linear models with multiple structural changes. *Econometrica*, 66: 47–78.

Baier, S. L. – Glomm, G (2001): Long-run growth and welfare effects of public policies with distortionary taxation. *Journal of Economic Dynamics and Control*, 25: 2007–2042.

Banerjee, A. – Dolado, J. – Mestre, R. (1998): Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of Time Series Analysis*, 19: 267–283.

Barro, R. J. (1979): On the determination of the public debt. *Journal of Political Economy*, 87: 940–971.

Barro, R. J. (1990): Government spending in a simple model of endogenous growth. *Journal of Political Economy*, 98: S103–S125.

Barro, R. – Lee, J. W. (2013): A new data set of educational attainment in the world, 1950-2010. *Journal of Development Economics*, 104: 184-198.

Baum, A. – Checherita-Westphal, C. – Rother, P. (2013): Debt and growth: New evidence for the euro area. *Journal of International Money and Finance*, 32: 809–821.

Becker, G. S. (1962): Investment in Human Capital: A theoretical analysis. *Journal of Political Economy*, 70: 9–49.

Becker, G. S. (2007): Health as human capital: Synthesis and extensions. *Oxford Economic Papers*, 59: 379–410.

Belke, A. – Domnick, C- – Gros, D. (2017): Business cycle synchronization in the EMU: Core vs.

periphery. Discussion Paper 38. Global Labor Organization.

Berg, A. G. – Ostry, J. D. (2011): Inequality and unsustainable growth: Two sides of the same coin. Staff Discussion Note 11/08. Washington DC: International Monetary Fund.

Castro, G. – Félix, R. M. – Júlio, P. – Maria, J. R. (2015): Unpleasant debt dynamics: Can fiscal consolidations raise debt ratios? *Journal of Macroeconomics*, 44: 276–294.

Cecchetti, S. – Mohanty, M. S. – Zampolli, F. (2011): Achieving growth amid fiscal imbalances: The real effects of debt. In *Achieving Maximum Long-Run Growth* (pp. 145-196). Jackson Hole: Federal Reserve Bank of Kansas City.

Cerra, V. – Saxena, S. C. (2008): Growth Dynamics: The myth of economic recovery. *American Economic Review*, 98: 439–57.

Checherita-Westphal, C. – Rother, P. (2012): The impact of high government debt on economic growth and its channels: An empirical investigation for the Euro Area. *European Economic Review*, 56: 1392–1405.

Cheung, Y.-W. – Chinn, M. D. (1997): Further investigation of the uncertain unit root in GNP. *Journal of Business and Economic Statistics*, 15: 68–73.

Cochrane, J. H. (2011): Understanding policy in the Great Recession: Some unpleasant fiscal arithmetic. *European Economic Review*, 55: 2–30.

Corsetti, G. – Roubini, N. (1991): Fiscal deficits, public debt and government solvency: evidence from OECD countries. *Journal of the Japanese and International Economies*, 5: 354-380.

Corsetti, G. – Meier, A. – Muller, G. (2012): What Determines Government Spending Multipliers? *Economic Policy*, 27: 521-565.

Cottarelli, C. – Jaramillo, L. (2013): Walking hand in hand: Fiscal policy and growth in advanced economies. *Review of Economics and Institutions*, 4:1–25.

De Hek, P. A. (2006): On taxation in a two-sector endogenous growth model with endogenous labor supply. *Journal of Economic Dynamics and Control*, 30: 655–685.

Delong, J. B. – Summers, L. H. (2012): Fiscal policy in a depressed economy, Brookings Papers on Economic Activity (Spring), 233–274.

Devarajan, S. – Swaroop, V. – Zou, H. G. (1996): The composition of public expenditure and economic growth. *Journal of Monetary Economics*, 37: 313–344.

Donayre, L. – Taivan, A. (2017): Causality between Public Debt and Real Growth in the OECD: A Country-by-Country Analysis. *Forthcoming in Economic Papers*.

Dreger, C. – Reimers, H.-E. (2013): Does euro area membership affect the relation between GDP growth and public debt? *Journal of Macroeconomics*, 38: 481–486.

Eberhardt, M. – Presbitero, A F. (2015): Public debt and growth: Heterogeneity and non-linearity. *Journal of International Economics*, 97: 45–58.

Égert, B. (2015): The 90% public debt threshold: The rise and fall of a stylised fact. *Applied Economics*, 47: 3756–3770.

Elmendorf, D. W. – Mankiw, N. G. (1999): Government debt. In J. B. Taylor – M. Woodford (Eds), *Handbook of Macroeconomics*, Vol. 1C (pp. 1615–1669). Amsterdam: North-Holland.

Elliott, G. – Rothenberg, T. J. – Stock, J. H. (1996): Efficient tests for an autoregressive unit root, *Econometrica*, 64: 813–836.

Engle, R. F. – Granger, C. W. J. (1987): Co-integration and error correction: Representation, estimation and testing. *Econometrica*, 55: 251–276.

European Commission (1995): The impact of exchange-rate movements on trade within the Single Market. *European Econ*omy, 4: 1–94.

Feenstra, R. C. – Inklaar, R. – Timmer, M. P. (2013): The Next Generation of the Penn World Table. Available for download at www.ggdc.net/pwt

Frankel, M. (1962): The production function in allocation and growth: A synthesis. *American Economic Review*, 52: 996–1022.

Gómez-Puig, M. (2013): Crisis de la deuda soberana y apalancamiento en la Zona Euro: Un intento de cuantificación. *Spanish Journal of Economics and Finance*, 36: 67–83.

Gómez-Puig, M. – Sosvilla-Rivero, S. (2015): The causal relationship between public debt and economic growth in EMU countries. *Journal of Policy Modeling*, 37: 974–989.

Ghosh, A. R. – Kim, J. I. – Mendoza, E. G. – Ostry, J. D. – Qureshi, M. S. (2013): Fiscal fatigue, fiscal space and debt sustainability in advanced economies. *The Economic Journal*, 123: F4–F30.

Glomm, G. – Ravikumar, B. (1997): Productive government expenditures and long-run growth. *Journal of Economic Dynamics and Control*, 21: 183–204.

Hakkio, C. S. – Rush, M. (1991): Cointegration: how short is the long run? *Journal of International Money and Finance*, 10: 571–581.

Honohan, P. (2009): What went wrong in Ireland? Paper prepared for the World Bank.

Ilzetzki, E. – Mendoza, E.G. – Vegh, C. (2013): How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, 60: 239–254.

Jacquemin, A. – Sapir, A. (1996): Is a European hard core credible? A statistical analysis. *Kyklos*, 49: 105– 117.

Jayachandran, S. – Lleras-Muney, A. (2009): Life expectancy and human capital investments: Evidence from maternal mortality declines. *Quarterly Journal of Economics*, 124: 349–397.

Johansen, S. (1991): Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica*, 59: 1551–1580.

Johansen, S. (1995): *Likelihood-based Inference in Cointegrated Vector Autoregressive Models*. Oxford: Oxford University Press.

Katterl, A. – Köhler-Töglhofer, W. (2005): The Impact of EU accession on Austria's budget policy. *Monetary Policy and the Economy*, 2: 101-116.

Kourtellos, A. – Stengos, T. – Tan, C. H. (2013): The effect of public debt on growth in multiple regimes. *Journal of Macroeconomics*, 38A: 35–43.

Krugman, P. (1988): Financing vs. forgiving a debt overhang. *Journal of Development Economics*, 29: 253–268.

Krugman, P. (2011): Self-defeating Austerity, New York Times, July 7.

Kwiatkowski, D. – Phillips, P. C. B. – Schmidt, P. – Shin, Y. (1992): Testing the null hypothesis of stationary against the alternative of a unit root. *Journal of Econometrics*, 54: 159–178.

Ledesma-Rodríguez, F. – Navarro-Ibáñez, M. – Pérez-Rodríguez, J. – Sosvilla-Rivero, S. (2005): Assessing the credibility of a target zone: Evidence from the EMS. *Applied Economics*, 37: 2265–2287.

Loazya, N. (1996): The Economics of the informal sector: A simple mode and some empirical evidence from Latin America. *Carnegie-Rochester Conference Series on Public Policy*, 45: 129-162.

Lof, M. – Malinen, T. (2014): Does sovereign debt weaken economic growth? A panel VAR analysis. *Economics Letters*, 122: 403–407.

Lubitz, R. (1978): The Italian economic crises of the 1970's. International Finance Discussion Paper 120. Washington, DC: Board of Governors of the Federal Reserve System.

Mankiw, N. G. – Romer, D. – Weil, D. N. (1992): A contribution to the empirics of economic growth. *Quarterly Journal of Economics*, 107: 407–437.

Mauro, P. – Zilinsky, J. (2016): Reducing government debt ratios in an era of low growth. Policy Brief 16-10. Washington, DC: Peterson Institute for International Economics.

Morrisson, C. – Murtin, F. (2007): Education inequalities and the Kuznets curves: A global perspective since 1870. Working Paper 2007-12. Paris School of Economics, Paris.

Ng, S. – Perron, P. (2001): Lag length selection and the construction of unit root tests with good size and power. *Econometrica*, 69: 1519–1554.

OECD (1979): *OECD Economic Surveys: Netherlands*. Paris: Organisation for Economic Co-operation and Development.

Ostry, J. D. – Ghosh, A. R. – Kim. J. I – Quresh, M. S. (2010): Fiscal space. IMF Staff Position Note 10/11, Washington DC: International Monetary Fund.

Panizza, U. – Presbitero, A. F. (2013): Public debt and economic growth in advanced economies: A survey. *Swiss Journal of Economics and Statistics*, 149: 175–204.

Pattillo, C. – Poirson, H. – Ricci, L. (2011): External debt and growth. *Review of Economics and Institutions*, 2: 1–30.

Perotti, R. (2012): The "austerity myth" gain without pain? In: *Fiscal Policy after the Financial Crisis*. Cambridge, MA: National Bureau of Economic Research.

Pesaran, M. H. – Shin, Y. (1999): An autoregressive distributed lag modelling approach to cointegration analysis. In S. Strom (Ed.), *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*: 371–413. Cambridge: Cambridge University Press.

Pesaran, M. H. – Shin, Y. – Smith, R. J (2001): Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16: 289–326.

Phillips, P. C. B. – Perron, P. (1988): Testing for a unit root in times series regression. *Biometrika*, 75: 335–346.

Psacharopoulos, G. (1994): Returns to investment in education: A global update. *World Development*, 22: 1325–1343.

Reinhart, C. M. (2009): The economic and fiscal consequences of financial crises. North and south. *Development Outreach*: 11, 8-12.

Reinhart, C.M. – Rogoff, K. S. (2010): Growth in a time of debt. *American Economic Review*, 100: 573–578.

Sachs, J. D. – Warner, A. M. (1997): Fundamental sources of long-run growth. *American Economic Review*, 87: 184–188.

Savvide, A. – Stengos, T. (2009): Human Capital and Economic Growth. Stanford, CA: Stanford University Press.

Salotti, S. – Trecroci, C. (2016): The impact of government debt, expenditure and taxes on aggregate investment and productivity growth. *Economica*, 83: 356–384.

Shambaugh, J. C (2012): The euro's three crises. Brookings Papers on Economic Activity, 44: 157–211.

Siebert, H. (2005): *The German economy: Beyond the social market*. Princeton, NJ: Princeton University Press.

Solow, R. M. (1956): A contribution to the theory of economic growth. *Quarterly Journal of Economics*, 70: 65–94.

Sosvilla-Rivero, S. – Morales-Zumaquero, A. (2012): Volatility in EMU sovereign bond yields: Permanent and transitory components. *Applied Financial Economics*, 22: 1453–1464.

Tanzi, V. – Zee, H. H. (1997): Fiscal policy and long-run growth. IMF Staff Papers 44, 179–209. Washington, DC: International Monetary Fund.

Teles. V. K. – Mussolini, C. C. (2014): Public debt and the limits of fiscal policy to increase economic growth. *European Economic Review*, 66: 1–15.

Woo, J. – Kumar, M. S. (2015): Public debt and growth. *Economica*, 82: 705–739.

Appendix 1: Definition of the explanatory variables and data sources

Variable	Description	Source
Level of Output (Y_t)	Gross domestic product at 2010 market prices	Annual Macroeconomic Database-European Commission (AMECO)
Capital Stock (K_t)	Net capital stock at 2010 market prices, total economy	AMECO
Accumulated public debt (D_t)	General government consolidated gross debt at 2010 market prices	AMECO and International Monetary Fund
Labour input (L_t)	Civilian employment	AMECO
Human capital (H_t)	Life expectancy at birth, total (years)	World Development Indicators, World Bank

Appendix 2: Short-run estimations results with structural breaks

	AT	BE	FI	FR	GE	GR	IE	IT	NL	PT	SP
Δy_{t-1}	0.336* (2.955)				0.134* (3.510)			0.301 (4.016)			
Δyt_{-2}	0.263** (2.714)							0.191 (3.828)			
Δk_t	3.296* (6.242)	2.769* (6.349)	3.987* (5.979)	0.538* (4.613)	4.673* (6.649)	3.948* (4.990)		5.324 (7.021)	3.335 (6.786)	1.788* (5.511)	3.159* (7.199)
Δk_{t-1}	1.432* (2. 870)	1.923* (4.486)	4.308* (6.226)		3.409* (4.082)	2.159* (4.332)	1.688* (4.550)	3.388* (6.658)	2.154* (4.833)	1.474* (3.458)	1.129* (5.377)
Δk_{t-2}			2.113* (3.787)						0.918* (3.167)	0.928* (3.625)	0.699* (3.064)
Δl_t	0.575* (4.211)	0.592* (3.787)	0.697* (4.256)	2.706* (6.613)	0.619* (3.741)	0.379* (3.762)	0.557* (4.890)	0.083* (3.578)		0.448* (3.256)	0.200* (3.018)
Δl_{t-1}									0.105* (3.572)		0.226* (3.367)
Δl_{t-2}			0.103* (3.002)	1.330* (3.047)						0.507* (3.240)	
Δh_t			1.299* (3.349)		0.270* (3.741)					0.293* (3.621)	0.990* (3.317)
Δh_{t-1}	1.843** (2.834)	1.681* (2.998)		2.701* (3.286)			4.783* (3.758				
Δh_{t-2}		1.426** (2.672)							0.186* (3.808)		
Δh_{t-3}		0.822** (2.655)						0.779* (3.580)	1.730* (3.715)		
Δd_t	-0.131* (-3.634)	-0.295* (-3.945)					-0.090* (-3.740)	-0.077* (-3.431)			0.023* (3.317)
$\Delta d_t D1_t$	0.0450* (2.964)	-0.271* (-3.892)					-0.137* (-3.627)	-0.052* (-3.524)			0.031* (2.867)
$\Delta d_t D2_t$	-0.078* (-3.182)	-0.376* (-3.892)					0.031* (2.870)	-0.210* (-2.991)			-0.019* (-3.159)
Δd_{t-1}	0.148* (3.695)		0.074* (3.648)	-0.062* (-3.148)	-0.093* (-3.359)	-0.017* (-3.874)			-0.090* (-4.751)	-0.056* (-3.160)	
$\Delta d_{t-1}D1_t$	-0.090* (-3.124)		-0.036* (-3.067)	-0.030* (-2.951)	-0.039* (-3.960)	-0.052* (-3.701)			-0.022* (-3.777)	0.097** (2.813)	
$\Delta d_{t-1}D2_t$	-0.021* (-2.903)		-0.0365* (-3.741)	-0.014* (-3.287)	-0.044* (-3.665)	-0.255* (-2.933)			-0.014* (-2.999)	-0.174* (-2.971)	
Δd_{t-2}									0.048* (3.176)		0.048* (2.862)
$\Delta d_{t-2}D1_t$									-0.009* (-2.945)		-0.047** (2.744)
$\Delta d_{t-2}D2_t$									-0.022** (2.831)		-0.011** (-2.731)
Δd_{t-3}	-0.065* (-2.849)								0.015* (3.004)		
$\Delta d_{t-3}D1_t$	-0.023* (-2.944)								0.024* (2.878)		
$\Delta d_{t-3}D2_t$	0.069* (3.161)								-0.001* (-2.925)		
ECM_{t-1}	-0.529* (-6.984)	-0.391* (-4.461)	-0.563* (-4.915)	-0.611* (-4.886)	-0.548* (-5.892)	-0.176* (-5.219)	-0.281* (-6.973)	-0.255* (-8.182)	-0.364* (-5.589)	-0.139* (-6.988)	-0.279* (-3.638)
Adjusted R^2	0.837	0.734	0.897	0.650	0.868	0.841	0.673	0.904	0.892	0.746	0.849
DW Test	2.291	2.143	2.151	2.110	2.029	2.011	2.018	2.121	2.205	2.119	2.132
χ^2_N	0.816 [0.665]	0.734 [0.641]	1.466 [0.480]	1.058 [0.589]	1.199 [0.430]	1.844 [0.398]	0.483 [0.786]	1.146 [0.564]	3.036 [0.219]	1.513 [0.469]	1.381 [0.471]
χ^2_{SC}	1.048 [0.368]	1.173 [0.415]	0.847 [0.439]	1.400 [0.258]	2.080 [0.137]	0.493 [0.671]	1.946 [0.155]	1.998 [0.150]	4.400 [0.145]	0.050 [0.9512]	0.028 [0.973]
χ^2_H	14.485 [0.563]	13.785 [0.183]	9.255 [0.351]	12.832 [0.145]	8.419 [0.394]	6.783 [0.452]	9.004 [0.252]	10.261 [0.418]	20.247 [0.209]	8.338 [0.569]	10.122 [0.684

Notes: AT, BE, FI, FR, GE, GR, IE, IT, NL, PT and SP stand for Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain respectively.

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown.

The short-run effects of public debt are calculated using equation (7)

* and ** denote statistical significance at the 1% and 5% level, respectively.

χ^2_N, χ^2_{SC} and χ^2_H are the Jarque-Bera test for normality, the Breusch-Godfrey LM test for second-order serial correlation and the Breusch-Pagan-Godfrey test for heteroskedasticity.

In the square brackets, the associated probability values are given.

Últimos títulos publicados

WORKING PAPERS

WP07/17 Hussain, Imran, y Sosvilla-Rivero, Simón: *Seeking price and macroeconomic stabilisation in the euro area: the role of house prices and stock prices*

WP06/17 Echevarria-Icazaa, Victor y Sosvilla-Rivero, Simón: *Systemic banks, capital composition and CoCo bonds issuance: The effects on bank risk.*

WP05/17 Álvarez, Ignacio; Uxó, Jorge y Febrero Eladio: *Internal devaluation in a wage-led economy. The case of Spain.*

WP04/17 Albis, Nadia y Álvarez Isabel.: *Estimating technological spillover effects in presence of knowledge heterogeneous foreign subsidiaries: Evidence from Colombia.*

WP03/17 Echevarria-Icazaa, Victor. y Sosvilla-Rivero, Simón: *Yields on sovereign debt, fragmentation and monetary policy transmission in the euro area: A GVAR approach.*

WP02/17 Morales-Zumaquero, Amalia.; Sosvilla-Rivero, Simón.: *Volatility spillovers between foreing-exchange and stock markets.*

WP01/17 Alonso, Miren.: *I open a bank account, you pay your mortgage, he/she gets a credit card, we buy health insurance, you invest safely, they… enjoy a bailout. A critical analysis of financial education in Spain.*

WP04/16 Fernández-Rodríguez Fernando y Sosvilla Rivero, Simón: *Volatility transmission between stock and exchange-rate markets: A connectedness analysis.*

WP03/16 García Sánchez, Antonio; Molero, José; Rama, Ruth: *Patterns of local R&D cooperation of foreign subsidiaries in an intermediate country: innovative and structural factors.*

WP02/16 Gómez-Puig, Marta; Sosvilla-Rivero, Simón: *Debt-growth linkages in EMU across countries and time horizon.*

WP01/16 Rodríguez, Carlos; Ramos, Javier: El sistema español de Garantía Juvenil y Formación Profesional Dual en el contexto de la Estrategia Europea de Empleo.

Desempleo Juvenil en España. Vol 2. Ruiz-Gálvez Juzgado, María Eugenia; Rodríguez Crespo, Carlos.

Desempleo Juvenil en España. Vol 1. Ramos, Javier; Vicent Valverde, Lucía; Recuenco-Vegas, Luis: *Desempleo Juvenil en España.*

WP05/15 Pérez Pineda, Jorge Antonio; Alañón Pardo, Ángel: *Mediciones alternativas de la cooperación internacional para el desarrollo en el contexto de la agenda post 2015.*

WP04/15 Fernández-Rodríguez, Fernando; Gómez-Puig, Marta; Sosvilla-Rivero, Simón: *Volatility spillovers in EMU sovereign bond markets.*

WP03/15 Stupariu, Patricia; Ruiz, Juan Rafael; Vilariño, Angel: *Reformas regulatorias y crisis de los modelos VaR.*

WP02/15 Sosvilla, Simón; Ramos, María del Carmen: *De facto exchange-rate regimes in Central and Eastern European Countries*

WP01/15 Fernández, Fernando; Gómez, Marta; Sosvilla, Simón: *Financial stress transmission in EMU sovereign bond market volatility: A connectedness analysis.*

WP08/14 Albis, Nadia; Álvarez, Isabel: *Desempeño innovador de las subsidiarias de empresas multinacionales en la industria manufacturera de Colombia*

WP07/14 Pérez, Luis; Hernández, Julio; Berumen, Sergio: *La motivación extrínseca del profesorado universitario en Alemania y en España: un análisis empírico.*

WP06/14 Donoso, Vicente; Martín, Víctor; Minondo, Asier: *Exposure to Chinese imports and local labor market outcomes. An Analysis for Spanish provinces*

WP05/14 Donoso, Vicente; Martín, Victor; Minondo, Asier: *Import competition from China and un employment. An analysis using Spanish workers'micro-data.*

WP04/14 Stupariu, Patricia; Vilariño, Ángel: *Retos y carencias de la regulación financiera internacional.*

WP03/14 García, Antonio; Molero, José; Rama, Ruth: *Foreign MNEs and domestic innovative capabilities: are there conditions for reverse spillovers in the spanish industry*

WP 02/14 Sosvilla Rivero, Simón; Ramos Herrera, María del Carmen: *On the forecast accuracy and consistency of exchange rate expectations: The Spanish PwC Survey*

WP01/14 Kropacheva, Anna; Molero, José: *Russian technological specialization in terms of world's innovation changes during 1994-2008. Comparison with countries of BRIC and European Innovation-driven economies.*

WP 07/13 Sanchís, Raúl G.: *Extended theory about the allocation of the time. Description and application to the increase in the retirement age policies.*

WP 06/13 Morales-Zumaquero, Amalia; Sosvilla-Rivero, Simón: *Real exchange rate volatility, financial crises and nominal exchange regimes.*

WP 05/13 Álvarez, Isabel; Labra, Romilio: *Identifying the role of natural resources in knowledge-based strategies of development.*

WP 04/13 Alonso Gallo, Nuria; Trillo del Pozo, David: *La respuesta de la regulación prudencial a la 29 crisis: Basilea II.*

WP 05/13 Sosvilla-Rivero, Simón; Ramos-Herrera, María del Carmen: *On the forecast and consistency of exchange rate expectations: The Spanish PwC Survey.*

WP 04/12 Sosvilla-Rivero, Simón; Morales-Zumaquero, Amalia: *Real exchange rate volatility, financial crises and nominal exchange regimes.*

WP 03/13 Revuelta, Julio; Alonso, Fernando: *Presencia de las multilatinas en Europa. Tipología y estrategia empresarial.*

WP 02/13 Nicolau Ibarra, Ignacio: *Evolución de la cooperación española en El Salvador.*

WP 01/13 Monedero, Juan Carlos; Jerez, Ariel; Ramos, Alfredo; Fernández, Jose Luis: *Participación ciudadana y Democracia. Una revisión de las mejores experiencias Iberoamericanas.*

WP 05/12 Sanchís, Raúl G.: *Trying to escape the Malaise State in the future. A macroecnomic design to hinder another Great Recession which risks the Welfare State.*

WP 04/12 Basave Kunhardt, J., *Flujos de IED mexicana hacia Europa y presencia de grandes multinacionales mexicanas en España. Evidencia empírica y reflexiones teóricas.*

WP 03/12 Luengo Escalonilla, F., Gracia Santos, M., Vicent Valverde, L., *Productividad y Posicionamiento Esctructural en la industria de bienes de equipo española.*

WP 02/12 Alonso (dir.), José A.; Castillo, Alberto; García, Héctor; Ospina, Shirley; Aguirre, Pablo; Millán, Natalia; Santander, Guillermo: *Estimación de la ayuda española a la infancia: una propuesta metodológica.*

WP 01/12 Alonso (dir.), José A.; Aguirre, Pablo; Castillo, Alberto: *La cooperación al desarrollo y la infancia. Apuntes estratégicos para el caso de España*.

WP 09/11 Torrecillas, Celia; Fischer, Bruno B.: *Technological Attraction of FDI flows in Knowledge-Intensive Services: a Regional Innovation System Perspective for Spain.*

WP 08/11 Gómez-Puig, Marta; Sosvilla-Rivero, Simón: *Causality and contagion in peripheral emu public debt markets: a dynamic approach.*

WP 07/11 Sosvilla-Rivero, Simón; Ramos-Herrera, María del Carmen: *The US Dollar-Euro exchange rate and US-EMU bond yield differentials: A Causality Analysis.*

WP 06/11 Sosvilla-Rivero, Simón; Morales-Zumaquero, Amalia: *Volatility in EMU sovereign bond yields: Permanent and transitory components .*

WP 05/11 Castellacci, Fulvio; Natera, José Miguel: *A new panel dataset for cross-country analyses of national systems, growth and development (CANA).*

WP 04/11 Álvarez, Isabel; Marín, Raquel; Santos-Arteaga, Franciso J.: *FDI entry modes, development and technological spillovers.*

WP 03/11 Luengo Escalonilla, Fernando: *Industria de bienes de equipo: Inserción comercial y cambio estructural.*

WP 02/11 Álvarez Peralta, Ignacio; Luengo Escalonilla, Fernando: *Competitividad y costes laborales en la UE: más allá de las apariencias.*

WP 01/11 Fischer, Bruno B; Molero, José: *Towards a Taxonomy of Firms Engaged in International R&D Cooperation Programs: The Case of Spain in Eureka.*

WP 09/10 Éltető, Andrea: *Foreign direct investment in Central and East European Countries and Spain – a short overview.*

WP 08/10 Alonso, José Antonio; Garcimartín, Carlos: *El impacto de la ayuda internacional en la calidad de las instituciones.*

WP 07/10 Vázquez, Guillermo: *Convergencia real en Centroamérica: evidencia empírica para el período 1990-2005.*

WP 06/10 P. Jože; Kostevc, Damijan, Črt; Rojec, Matija: *Does a foreign subsidiary's network status affect its innovation activity? Evidence from post-socialist economies.*

WP 05/10 Garcimartín, Carlos; Rivas Luis; García Martínez, Pilar: O*n the role of relative prices and capital flows in balance-of-payments constrained growth: the experiences of Portugal and Spain in the euro area.*

WP 04/10 Álvarez, Ignacio; Luengo, Fernando*: Financiarización, empleo y salario en la UE: el impacto de las nuevas estrategias empresariales.*

WP 03/10 Sass, Magdolna: *Foreign direct investments and relocations in business services – what are the locational factors? The case of Hungary.*

WP 02/10 Santos-Arteaga, Francisco J.: *Bank Runs Without Sunspots*.

WP 01/10 Donoso, Vicente; Martín, Víctor: *La sostenibilidad del déficit exterior de España.*

WP 14/09 Dobado, Rafael; García, Héctor: *Neither so low nor so short! Wages and heights in eighteenth and early nineteenth centuries colonial Hispanic America.*

WP 13/09 Alonso, José Antonio: *Colonisation, formal and informal institutions, and development.*

WP 12/09 Álvarez, Francisco: *Opportunity cost of CO2 emission reductions: developing vs. developed* economies.

WP 11/09 J. André, Francisco: *Los Biocombustibles. El Estado de la cuestión.*

WP 10/09 Luengo, Fernando: *Las deslocalizaciones internacionales. Una visión desde la economía crítica.*

WP 09/09 Dobado, Rafael; Guerrero, David: *The Integration of Western Hemisphere Grain Markets in the Eighteenth Century: Early Progress and Decline of Globalization.*

WP 08/09 Álvarez, Isabel; Marín, Raquel; Maldonado, Georgina: *Internal and external factors of competitiveness in the middle-income countries.*

WP 07/09 Minondo, Asier: *Especialización productiva y crecimiento en los países de renta media.*

WP 06/09 Martín, Víctor; Donoso, Vicente**:** *Selección de mercados prioritarios para los Países de Renta Media.*

WP 05/09 Donoso, Vicente; Martín, Víctor: *Exportaciones y crecimiento económico: estudios empíricos.*

WP 04/09 Minondo, Asier; Requena, Francisco: *¿Qué explica las diferencias en el crecimiento de las exportaciones entre los países de renta media?*

WP 03/09 Alonso, José Antonio; Garcimartín, Carlos: *The Determinants of Institutional Quality. More on the Debate.*

WP 02/09 Granda, Inés; Fonfría, Antonio: *Technology and economic inequality effects on international trade.*

WP 01/09 Molero, José; Portela, Javier y Álvarez Isabel**:** *Innovative MNEs' Subsidiaries in different domestic environments.*

WP 08/08 Boege, Volker; Brown, Anne; Clements, Kevin y Nolan Anna: *¿Qué es lo "fallido"? ¿Los Estados del Sur,o la investigación y las políticas de Occidente? Un estudio sobre órdenes políticos híbridos y los Estados emergentes.*

WP 07/08 Medialdea García, Bibiana; Álvarez Peralta, Nacho: *Liberalización financiera internacional, inversores institucionales y gobierno corporativo de la empresa.*

WP 06/08 Álvarez, Isabel; Marín, Raquel: *FDI and world heterogeneities: The role of absorptive capacities.*

WP 05/08 Molero, José; García, Antonio: *Factors affecting innovation revisited.*

WP 04/08 Tezanos Vázquez, Sergio: *The Spanish pattern of aid giving.*

WP 03/08 Fernández, Esther; Pérez, Rafaela; Ruiz, Jesús: *Double Dividend in an Endogenous Growth Model with Pollution and Abatement.*

WP 02/08 Álvarez, Francisco; Camiña, Ester: *Moral hazard and tradeable pollution emission permits*.

WP 01/08 Cerdá Tena, Emilio; Quiroga Gómez, Sonia: *Cost-loss decision models with risk aversion*.

WP 05/07 Palazuelos, Enrique; García, *Clara: La transición energética en China.*

WP 04/07 Palazuelos, Enrique: *Dinámica macroeconómica de Estados Unidos: ¿Transición entre dos recesiones?*

WP 03/07 Angulo, Gloria: *Opinión pública, participación ciudadana y política de cooperación en España.*

WP 02/07 Luengo, Fernando; Álvarez, Ignacio: *Integración comercial y dinámica económica: España ante el reto de la ampliación.*

WP 01/07 Álvarez, Isabel; Magaña, Gerardo: *ICT and Cross-Country Comparisons: A proposal of a new composite index.*

WP 05/06 Schünemann, Julia: *Cooperación interregional e interregionalismo: una aproximación social-constructivista.*

WP 04/06 Kruijt, Dirk: *América Latina. Democracia, pobreza y violencia: Viejos y nuevos actores.*

WP 03/06 Donoso, Vicente; Martín, Víctor: *Exportaciones y crecimiento en España (1980-2004): Cointegración y simulación de Montecarlo*.

WP 02/06 García Sánchez, Antonio; Molero, José: *Innovación en servicios en la UE: Una aproximación a la densidad de innovación y la importancia económica de los innovadores a partir de los datos agregados de la CIS3.*

WP 01/06 Briscoe, Ivan*: Debt crises, political change and the state in the developing world*.

WP 06/05 Palazuelos, Enrique: *Fases del crecimiento económico de los países de la Unión Europea–15.*

WP 05/05 Leyra, Begoña: *Trabajo infantil femenino: Las niñas en las calles de la Ciudad de México.*

WP 04/05 Álvarez, Isabel; Fonfría, Antonio; Marín Raquel: *The role of networking in the competitiveness profile of Spanish firms.*

WP 03/05 Kausch, Kristina; Barreñada, Isaías: *Alliance of Civilizations. International Security and Cosmopolitan Democracy.*

WP 02/05 Sastre, Luis: *An alternative model for the trade balance of countries with open economies: the Spanish case.*

WP 01/05 Díaz de la Guardia, Carlos; Molero, José; Valadez, Patricia: *International competitiveness in services in some European countries: Basic facts and a preliminary attempt of interpretation.*

WP 03/04 Angulo, Gloria: *La opinión pública española y la ayuda al desarrollo*.

WP 02/04 Freres, Christian; Mold, Andrew: *European Union trade policy and the poor. Towards improving the poverty impact of the GSP in Latin America.*

WP 01/04 Álvarez, Isabel; Molero, José: *Technology and the generation of international knowledge spillovers. An application to Spanish manufacturing firms*.

OCCASIONAL PAPERS

OP 02/17 Braña, Francisco J.; Molero, José: *The economic role of the State on the Spanish democratization and "development" process. A case of success?*

OP 01/16 Borrell, Josep; Mella, José María; Melle, Mónica; Nieto, José Antonio. *"¿Es posible otra Europa? Debate abierto."*

POLICY PAPERS

PP 01/15 De la Cruz, C.: *Cambio, Poder y Justicia de Género en la Agenda 2030: Reflexiones para no perdernos en el camino.*

PP 01/14 Luego F.; Vicent L.: *Encrucijadas de la moneda única. Algunas claves para una reflexión desde la periferia.*

PP 01/11 Monedero J.C., Democracia y Estado en Améríca Latina: *Por una imprudente reinvención de la política.*

PP 02/10 Alonso, José Antonio; Garcimartín, Carlos; Ruiz Huerta, Jesús; Díaz Sarralde, Santiago: *Strengthening the fiscal capacity of developing countries and supporting the international fight against tax evasión.*

PP 02/10 Alonso, José Antonio; Garcimartín, Carlos; Ruiz Huerta, Jesús; Díaz Sarralde, Santiago: *Fortalecimiento de la capacidad fiscal de los países en desarrollo y apoyo a la lucha internacional contra la evasión fiscal.*

PP 01/10 Molero, José: *Factores críticos de la innovación tecnológica en la economía española.*

PP 03/09 Ferguson, Lucy: *Analysing the Gender Dimensions of Tourism as a Development Strategy.*

PP 02/09 Carrasco Gallego ,José Antonio: *La Ronda de Doha y los países de renta media.*

PP 01/09 Rodríguez Blanco, Eugenia: *Género, Cultura y Desarrollo: Límites y oportunidades para el cambio cultural pro-igualdad de género en Mozambique*.

PP 04/08 Tezanos, Sergio: *Políticas públicas de apoyo a la investigación para el desarrollo. Los casos de Canadá, Holanda y Reino Unido.*

PP 03/08 Mattioli, Natalia *Including Disability into Development Cooperation. Analysis of Initiatives by National and International Donors.*

PP 02/08 Elizondo, Luis: *Espacio para Respirar: El humanitarismo en Afganistán (2001-2008).*

PP 01/08 Caramés Boada, Albert: *Desarme como vínculo entre seguridad y desarrollo. La reintegración comunitaria en los programas de Desarme, desmovilización y reintegración (DDR) de combatientes en Haití.*

PP 03/07 Guimón, José: *Government strategies to attract R&D-intensive FDI*.

PP 02/07 Czaplińska, Agata: *Building public support for development cooperation.*

PP 01/07 Martínez, Ignacio: *La cooperación de las ONGD españolas en Perú: hacia una acción más estratégica.*

PP 02/06 Ruiz Sandoval, Erika: *Latinoamericanos con destino a Europa: Migración, remesas y codesarrollo como temas emergentes en la relación UE-AL.*

PP 01/06 Freres, Christian; Sanahuja, José Antonio: *Hacia una nueva estrategia en las relaciones Unión Europea – América Latina.*

PP 04/05 Manalo, Rosario; Reyes, Melanie: *The MDGs: Boon or bane for gender equality and wo-men's rights?*

PP 03/05 Fernández, Rafael: *Irlanda y Finlandia: dos modelos de especialización en tecnologías avanzadas.*

PP 02/05 Alonso, José Antonio; Garcimartín, Carlos: *Apertura comercial y estrategia de desarrollo.*

PP 01/05 Lorente, Maite: *Diálogos entre culturas: una reflexión sobre feminismo, género, desarrollo y mujeres indígenas kichwuas.*

PP 02/04 Álvarez, Isabel: *La política europea de I+D: Situación actual y perspectivas*.

PP 01/04 Alonso, José Antonio; Lozano, Liliana; Prialé, María Ángela: *La cooperación cultural española: Más allá de la promoción exterior.*

DOCUMENTOS DE TRABAJO "EL VALOR ECONÓMICO DEL ESPAÑOL"

DT 16/11 Fernández Vítores, David: *El papel del español en las relaciones y foros internacionales: Los casos de la Unión Europea y las Naciones Unidas.*

DT 15/11 Rupérez Javier: *El Español en las Relaciones Internacionales*.

DT 14/10 Antonio Alonso, José; Gutiérrez, Rodolfo: *Lengua y emigración: España y el español en las migraciones internacionales.*

DT 13/08 de Diego Álvarez, Dorotea; Rodrigues-Silveira, Rodrigo; Carrera Troyano Miguel: *Estrategias para el Desarrollo del Cluster de Enseñanza de Español en Salamanca.*

DT 12/08 Quirós Romero, Cipriano: *Lengua e internacionalización: El papel de la lengua en la internacionalización de las operadoras de telecomunicaciones.*

DT 11/08 Girón, Francisco Javier; Cañada, Agustín: *La contribución de la lengua española al PIB y al empleo: una aproximación macroeconómica.*

DT 10/08 Jiménez, Juan Carlos; Narbona, Aranzazu: *El español en el comercio internacional.*

DT 09/07 Carrera, Miguel; Ogonowski, Michał: *El valor económico del español: España ante el espejo de Polonia.*

DT 08/07 Rojo, Guillermo: *El español en la red.*

DT 07/07 Carrera, Miguel; Bonete, Rafael; Muñoz de Bustillo, Rafael: *El programa ERASMUS en el marco del valor económico de la Enseñanza del Español como Lengua Extranjera.*

DT 06/07 Criado, María Jesús: *Inmigración y población latina en los Estados Unidos: un perfil socio-demográfico.*

DT 05/07 Gutiérrez, Rodolfo: *Lengua, migraciones y mercado de trabajo.*

DT 04/07 Quirós Romero, Cipriano; Crespo Galán, Jorge: *Sociedad de la Información y presencia del español en Internet.*

DT 03/06 Moreno Fernández, Francisco; Otero Roth, Jaime: *Demografía de la lengua española.*

DT 02/06 Alonso, José Antonio: *Naturaleza económica de la lengua.*

DT 01/06 Jiménez, Juan Carlos: *La Economía de la lengua: una visión de conjunto.*