"Nonfinancial debt and economic growth in euro-area countries"

Marta Gómez-Puig, Simón Sosvilla-Rivero

Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics
Universitat de Barcelona
Av. Diagonal, 690 • 08034 Barcelona

WEBSITE: www.ub.edu/irea/ • CONTACT: irea@ub.edu

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Abstract

In this paper we analyse the effects of all sources of the accumulation of nonfinancial debt (household, corporate as well as government) on economic growth in ten euro-area countries during the 1980-2015 period. To this end, we make use of three models (a baseline, an asymmetric and a threshold model) based on the empirical growth literature augmented by debt to assess whether a debt change has an impact on growth over and above other determinants, treating the different types of borrowers separately. By exploring the time series dimension in order to properly account for the historical experience of each country in the sample, we aim to detect potential heterogeneities in the relationship across euro area countries. Our results with both the baseline and the asymmetric models suggest that although the effects on nonfinancial debt accumulation clearly differ across countries, on average, the highest marginal impact of a rise in debt corresponds to the household and public sector, with an increase in private debt being more harmful in peripheral than in central countries; in contrast, the average effect of a rise in public debt does not differ between these two groups of countries. As for the effects of a debt increase beyond the turning point estimated in the threshold model, our findings indicate that the highest marginal impact corresponds to the household sector.

JEL classification: C22, D12, F33, H63, O16, O40, O52

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Marta Gómez-Puig: Department of Economics and Riskcenter, Universitat de Barcelona. 08034 Barcelona, Spain. E-mail: marta.gomezpuig@ub.edu
Simón Sosvilla-Rivero: Complutense Institute for International Studies, Universidad Complutense de Madrid. 28223 Madrid, Spain. E-mail: sosvilla@ccee.ucm.es

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1. Introduction

The perspective provided by the period of more than seven years since the start of the European Economic and Monetary Union (EMU) sovereign debt crisis in late 2009 highlights the fact that its origin goes beyond fiscal imbalances in euro-area countries. Indeed, the main causes of the debt crisis in Europe vary according to country; they reflect an important interconnection between public and private debt and thus, between banking and sovereign risk (see Singh *et al.*, 2016). Yet one of the lessons of the recent sovereign crisis in the euro-area is that in some countries such as Ireland or Spain there was next to nothing in the key indicators of public debt that suggested the imminent catastrophe; the build-up of financial fragility occurred in private sector balance sheets[1].

The increase recorded by total nonfinancial debt in euro-area countries during the past three decades has been very significant, not only in the public sector (governments), but in the private sector (households and nonfinancial corporations) as well. However, while the unprecedented increase in public debt across EMU countries has raised serious concerns among economists about both its sustainability and its impact on economic growth[2], they have taken a more nuanced position on the risks of private debt accumulation, despite its magnitude. Schularick (2013) points out that this attitude can be attributed to the incentive problems that may arise when governments, as opposed to private households and companies, borrow; as private sector borrowers act in their informed self-interest, they are assumed to bear the consequences of their actions. Nevertheless, all forms of nonfinancial debt, when they are high and moving upwards, are sources of justifiable concern. In particular, the negative implications of excessive private debt (a "debt overhang"[3]) for growth and financial stability are well documented in the literature, underscoring the need for private sector deleveraging in some countries.

In a series of recent papers, some authors [see, e.g. Schularick and Taylor (2012) and Jordà *et al.* (2016a)] demonstrate that high debt levels in the private sector are not only a good predictor of financial crises, but also a key determinant of the intensity of the ensuing recession. Moreover, high private debt levels can also hamper growth even in the absence of a financial crisis, since the accumulation of debt involves risk (International Monetary

[1] The important role played by private debt in euro-area sovereign debt crisis in some countries was already stressed by Gómez-Puig and Sosvilla-Rivero (2013).
[2] On average, public debt reached levels about 100% of Gross Domestic Product (GDP)– its highest level in 50 years – by the end of 2013.
[3] A situation in which a borrower's debt service exceeds its future repayment capacity.

Fund, 2016a). As debt levels increase, borrowers' ability to repay becomes progressively more sensitive to falls in income and sales as well as to increases in interest rates. In fact, high private debt can have a substantial adverse impact on macroeconomic performance and stability, as it hinders the ability of households to smooth their consumption and affects corporations' investments. In addition, elevated debt levels can create vulnerabilities or amplify and transmit macroeconomic and asset price shocks throughout the economy [see, e.g., Sutherland and Hoeller (2012) or Fisher (1931) whose theory of business cycles stressed that private over-indebtedness played a key role in generating severe recessions (and even depressions)]. Finally, spillovers from private balance sheets to the public sector due to government interventions (either direct in the form of targeted programs for debt restructuring, or indirect through the banking sector), may weaken the fiscal position or increase interest rates. All the above factors may compromise public debt sustainability (see Jarmuzek and Rozenov, 2017)[4].

Despite the relevance of this issue, the literature examining the effects of high private debt levels on euro-area countries' economic growth is very limited; the papers available do not focus exclusively on EMU countries but analyse the impact of private debt on economic growth in a broader group of economies, including some euro-area members. In particular, Cecchetti *et al.* (2011) analysed the impact of both private and public debt on 18 OECD countries' growth (10 belonging to the EMU), and Lombardi *et al.* (2017) examined the effects of households' debt on economic growth in 54 economies (11 euro-area countries). Conversely, more research has focused on the impact of government debt on EMU countries' growth [Baum *et al.* (2013), Checherita-Westphal and Rother (2012), Dreger and Reimers (2013), or Gómez-Puig and Sosvilla-Rivero (2017) to name just a few].

Hence, this paper aims to fill the gap in the literature by assessing the effect of nonfinancial debt (households, nonfinancial corporations and governments) on economic growth in ten euro-area countries. To this end, we use a methodology that builds on Gómez-Puig and Sosvilla-Rivero (2017) and explicitly takes into account the possible heterogeneity (see, e.g., Erberhart and Presbitero, 2015 or Chudick *et al.*, 2017)[5] in the relationship between all forms of nonfinancial debt and growth across euro-area countries. We apply this

[4] These authors also provide a quantitative assessment of the gaps between current and sustainable levels of private debt, identifying the key factors that drive excessive borrowing.

[5] Erberhart and Presbitero (2015) find some support for a negative relationship between public debt and long-run growth across countries, but no evidence for a similar (let alone common) debt threshold within countries. Similarly, Chudick *et al.* (2017) find no evidence for a universally applicable threshold effect in the relationship between public debt and economic growth.

methodology to an examination of whether the impact of a debt increase on economic growth might differ not only depending on the source of debt, but also on the idiosyncrasies of each EMU country.

The rest of the paper is organized as follows. Section 2 explains the rationale for our analysis on the basis of the results of some preliminary descriptive analyses of the evolution of public and private indebtedness in euro-area countries. Section 3 provides a literature review. Section 4 introduces the analytical framework. Section 5 presents the data used in the analysis and its time series properties. Section 6 offers our empirical models. Empirical results are presented in Section 7. Finally, some concluding remarks and policy implications are provided in Section 8.

2. Private and public indebtedness evolution in EMU countries

As stated above, the past three decades have witnessed a remarkable rise in the total nonfinancial debt in euro-area economies. Therefore, in what follows, we provide some descriptive analyses of the behaviour of nonfinancial debt during the 1980-2015 period in EMU countries: specifically, the evolution of private (households and nonfinancial corporations), public and total nonfinancial debt-to-GDP during this period in 10 euro-area countries[6] (both central –Austria, Belgium, Finland, France, Germany and the Netherlands – and peripheral – Greece, Italy, Portugal and Spain) [7] jointly with its average value is shown in Figure 1.

[Insert Figure 1 around here]

Figure 1 contains some revealing data. Total nonfinancial debt as a percentage of GDP, as well as its components, rose steadily for much of the 1980-2015 period. Starting at a relatively modest 147 percent of GDP in 1980, 36 years later this figure had reached 304

[6] Ireland is not included in this analysis because the Central Bank of Ireland's Quarterly Financial Accounts only provide data from the first quarter of 2002.

[7] This distinction between European central and peripheral countries has been extensively used in the empirical literature. The two groups we consider roughly correspond to the distinction made by the European Commission (1995) between 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 in order 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 the permanent and transitory volatilities of EMU sovereign yields. More recently, Belke *et al.* (2017) used the same division of core and peripheral countries to examine business cycle synchronization in the euro-area.

percent of GDP in euro-area countries. In this increase (270%), public debt accounts for 160 percentage points and private debt for 90 percentage points. However, the average ratio of indebtedness in the private sector (146%) is much higher (it represents around two thirds of the total debt ratio) than that in the public sector (77%) throughout the period. The evolution of the two components of private debt considered (households and nonfinancial corporations) is presented in Figure 2.

[Insert Figure 2 around here]

Figure 2 suggests that it is nonfinancial corporations rather than households that cause the high debt levels registered by the private sector during the period examined (companies' average debt ratio, 98%, is more than double that of families, 48%). Nonetheless, the growth rate of the debt during the period is higher for households (159%) than for nonfinancial corporations (65%).

Therefore, the rate of increase of the debt-to-GDP ratio during the 1980-2015 period is very high not only for the public sector but also for households[8] (close to 160% in both cases). Moreover, although nonfinancial corporations' debt records a lower rate of growth throughout the period, it represents around 44% of total nonfinancial debt, followed by the public sector (35%) and households (21%).

Tables 1a and 1b present the evolution of debt-to-GDP ratios for households, firms and governments during the 1980-2015 period for the EMU central and peripheral countries included in our sample.

[Insert Tables 1a and 1b around here]

Table 1a indicates that, in central countries, the highest increase in public debt took place in the 1980s and 1990s (before the launch of the euro), while during the decade preceding the onset of the crisis (from 1999 until 2009) the highest rate of growth was recorded by private debt (both households and nonfinancial corporations) rather than public debt.

A similar pattern is observed in most peripheral countries (see Table 1b), where public debt presents a noticeable upward trend during the two decades preceding the introduction of

[8] Household debt growth has normally been explained in the literature as a rational response of forward looking agents to hump-shaped time earning profiles or to temporary deviations of income from its long-run trend. So, mainstream theories can encompass the concept of excessive indebtedness only supposing that agents' maximizing behaviour results from a less than perfect rationality and foresight (see, e.g., Barnes and Young, 2003)

the common currency. This led to the high values registered by the sovereign debt-to-GDP ratio in 2009 coinciding with the outbreak of the crisis (120%, 106% and 80% in Greece, Italy and Portugal respectively)[9]. However, during the first ten years of monetary union, the rate of increase of private debt also overtook that of the public sector in peripheral countries. In particular, households' debt registered a rate of increase that ranges from 54% in Portugal to 223% in Greece, while nonfinancial corporations' debt recorded its highest rate of increase in Spain (83%), followed by Greece, Portugal and Italy.

Therefore, during the 2000s, on the eve of the recent sovereign debt crisis caused by the globalization of banking, rapid financial liberalization and a period of easy access to credit, nonfinancial private debt increased substantially in EMU Member States (both central and peripheral). The situation had become clearly unsustainable by the onset of the financial crisis. It is noticeable that during the first ten years of the euro, not only did exchange risk disappeare, but credit risk also fell progressively as markets perceived sovereign markets as a single unit, dismissing macroeconomic imbalances within euro-area countries and the possibility that governments might default[10]. As a result, along with the downward trend registered by sovereign bond yields, long-term interest rates also converged to very low values, fostering a credit expansion in the nonfinancial private sector[11]. So, in 2015 about two-thirds of total euro-area countries' nonfinancial debt had its origin in the private sector[12].

In addition, Table 1b also indicates that private debt also recorded an important surge in some EMU peripheral countries, not only during the 2000s but also during the two decades before the start of the monetary union. In particular, during the 1980s the rate of growth of households' debt was 225% in Italy and 65% in Spain, while it increased notably in Portugal and Greece (193% and 85% respectively) during the 1990s. In that decade, firms'

[9] It is noticeable that in other EMU peripheral countries such as Spain, with a debt-to-GDP ratio in 2009 close to 50%, considerably below the Stability and Growth Pact (SGP) ceiling, it seems that it was private rather than public debt that triggered the crisis.

[10] Nevertheless, with the financial crisis the picture changed completely and sovereign long term interest rates rose sharply. Indeed, the crisis put the spotlight on the macroeconomic and fiscal imbalances within EMU countries which had largely been ignored during the 1999-2009 period (see Gómez-Puig *et al.*, 2014).

[11]Alves and Pereira (2017) examine the dramatic indebtedness increase among households in Portugal, detecting a structural break around 1992, which may correspond to the signing of the Maastricht Treaty which ultimately led to this decline in interest rates and consequently the increase in indebtedness.

[12]A similar pattern has been registered by non-EMU countries. According to the International Monetary Fund (2016a), the global gross debt of the nonfinancial sector — comprising the general government, households, and nonfinancial firms — has more than doubled in nominal terms since the turn of the century, reaching $152 trillion in 2015 – i.e., which 225 per cent of world GDP. About two-thirds of this debt consists of liabilities of the private sector.

debt also registered notable rises in Portugal and Italy (104% and 45% respectively). Finally, of course, *ex post*, the severe financial crisis and economic recession would damage public finances via crashing revenues and rising cyclical expenditures, and consequently fuelling the public debt increase. Hence, during the 2009-2012 period, the public sector registered the highest rise in debt levels in all peripheral countries, with especially high increases in Spain (66%) and in Portugal (56%), while private debt began a deleveraging trend.

All in all, some interesting insights can be drawn from Figures 1 and 2 and Tables 1a and 1b, and they in fact motivate the analysis presented in this paper. First, during the last three decades debt evolution was significant not only in the public sector but in the private sector as well, providing one reason why economists and policy makers should take private sector indebtedness as seriously as public indebtedness. Second, private sector credit growth, not public debt accumulation, provides the key to understanding the build-up of the sovereign debt crisis in some euro-area countries. Third, the tendency to socialize the losses from private sector financial crisis has grown; they have become a key risk factor for public finances and have fostered the tight link between the private credit cycle and the fiscal cycle. Fourth, since high debt levels in the private sector are a determining element of the strength of the following recession (see Jordà *et al.*, 2016a), examining their nexus with economic growth emerges as a key topic that deserves economists' attention (especially in euro-area countries with their fierce banking, sovereign and economic crisis). Finally, today's unprecedented indebtedness levels (in both the public and the private sector) in EMU countries should be a matter of concern as long as the expected normalization in the future European Central Bank's monetary policy could push up long-term interest rates. In that case, interest expenses on the debt would start to increase borrowers' risk and eventually lead to a debt overhang, with the subsequent adverse effect on economic growth.

We should stress that Ireland's debt evolution is not included in Figures 1 and 2 and Tables 1a and 1b because private debt data are only available in this country from the first quarter of 2002 onwards. So, despite the relevance of private debt in the Irish economy (see Lydon and McIndoe-Calder, 2017), due to these data restrictions, in this paper we analyse the impact of nonfinancial debt (households, nonfinancial corporations and governments) on economic growth in ten EMU countries (excluding Ireland from the analysis) during the 1980-2015 period.

3. Literature review

Until the recent crisis, economists worried mainly about public debt, not about private debt. The warning signs of increased private leverage in the run-up to the crisis of 2008 were largely ignored. However, as shown in Figures 1 and 2, the increase in euro-area debt levels during the last 36 years was due to the behaviour not only of the public sector, but of the private sector as well, in particular of households. Moreover, firms' debt, which shows the highest share of total debt throughout the period, represents an important potential burden for the recovery of the economies. As it turns out, in 2015 only about one third of total debt in EMU countries corresponds to public debt accumulation. In other words, the overwhelming share of the debt increase has been due to higher borrowing by households and nonfinancial companies.

Therefore, economists should not disregard private sector leveraging; in fact they should pay as much attention to it as they do to public debt. The literature on this topic is still scarce, but not non-existent. One strand of the literature has focused on the relationship between the different forms of debt. Angeletos *et al.* (2016) highlighted that government debt expansions significantly influence households' financial condition; investigating the impact of government debt on corporate financing decisions, Demirci *et al.* (2017) found a negative relation between government debt and corporate leverage using data on 40 countries during the 1990-2014 period; and Uusküla (2016) examined the relationship between more than 30 macroeconomic variables and debt-to-GDP ratios for household, nonfinancial corporation and aggregate debt in a panel of European Union countries.

Another strand of literature examines the effects that the generalized and necessary deleveraging process currently taking place in the private sector may have on economic activity [see Crowe *et al.* (2011), Ruscher and Wolff (2013), Cuerpo *et al.* (2015) or Kuvshinov *et al.* (2016)]. Other authors (see, e. g., Bernardini and Peersman, 2015; Klein, 2016) have shown that the effects of fiscal consolidations crucially depend on the level of private indebtedness (mostly household leveraging), whereas the state of the business cycle and the level of public debt play only a minor role in the effectiveness of fiscal policy[13].

[13] Additionally, Klein and Winkler (2017) provide empirical evidence supporting the view that fiscal consolidations lead to a strong and persistent increase in income inequality during periods of private debt overhang.

[14] For example, it is well documented that in the U.S. during the financial crisis, the households that took subprime loans were much more prone to foreclosure and bankruptcy (Li and White, 2009).

Finally, some recent contributions have pointed to the important role of private debt for the propagation and amplification of shocks, since a high level of indebtedness may render the economy more vulnerable to negative shocks than otherwise. Mian and Sufi (2017) showed that an increase in the household debt to GDP predicts lower subsequent GDP growth and higher unemployment; Jordà *et al.* (2016b) found that more mortgage-intensive credit expansions tend to be followed by deeper recessions and slower recoveries, but that this effect is not present for non-mortgage credit booms[14]; using data for 31 OECD and 20 emerging market countries Randveer *et al.* (2011) found that a higher level of private debt before a recession is correlated with lower economic growth after the economic slowdown has finished; using microeconomic data for the United States Garriga *et al.* (2017) reported that most forms of private debt (mortgages, credit card debt, and auto loans) had significant boom-bust cycles; and Guerini *et al.* (2017) investigated the causal effects of public and private debts on U.S. output dynamics.

Nonetheless, the literature that has centred on the effects of high private debt levels on euro-area countries' economic growth is very limited and only includes papers that, instead of focusing on EMU countries, analyse the impact in a broader group that includes some euro-area members [Cecchetti *et al.* (2011) or Lombardi *et al.* (2017)]. Therefore, this paper aims to fill the gap existing in the literature by examining the effect of all sources of nonfinancial debt (private and public) on economic growth in a sample of ten EMU countries which have recently endured a severe financial and economic crisis. Our objective is to analyse whether the effect of debt accumulation depends on the source of debt (households, companies or governments) and on the idiosyncrasies of the different countries.

4. Analytical framework

Econometrics is concerned with drawing inferences about economic relationships from observed data using economic models that are inevitably incomplete characterizations of the complicated reality of economic life. Therefore, the crucial decision in all empirical studies concerns the set of variables for which observations should be collected and then analysed in order to describe the salient features of the economic world. Following both the relevant economic theory and the previous empirical knowledge, our analytical strategy incorporates the specification and estimation of a growth equation based on the empirical growth literature (e.g., Barro and Sala-i-Martin, 2004) augmented by debt to assess whether the latter has an impact on growth over and above other determinants.

The initial empirical specification is derived from the neoclassical growth model, stating that the growth rate of real *per capita* GDP (g_t) for a given country is given by:

$$g_t = \alpha + \gamma y_{t-1} + \sum_{i=1}^{n} \delta_i X_{it} + \beta d_t + \varepsilon_t \qquad (1)$$

where y_{t-1} is the logarithm of initial real *per capita* GDP (to capture the "catch-up effect" or conditional convergence of the economy to its steady state), X_{it} (i=1, …, n) is a set of explanatory regressors and d_t is the debt-to-GDP ratio. Following Cecchetti *et al.* (2011), household (hd_t), corporate (cd_t) and public (pd_t) debt are treated separately.

Regarding X_t, we consider a set of explanatory variables that have been shown to be consistently associated with growth in the literature: population growth rate ($POPGR_t$); the ratio of gross savings to GDP (GS_t); life expectancy at birth, a proxy for the level of human capital (HK_t)[15]; openness to trade, measured by the absolute sum of exports and imports over GDP ($OPEN_t$); and CPI inflation, a measure of macroeconomic instability and uncertainty (INF_t).

In the economic growth literature, the rate of growth of labour used in the production process is a key determinant of growth (Solow, 1956 or Frankel, 1962). So $POPGR_t$ is used to proxy country size and the rate of labour growth. The empirical evidence suggests that the relationship between population and economic growth is mixed and varies between countries. Some empirical studies suggest that the relationship is negative and insignificant (Levine and Renelt, 1992); others find a negative and significant association (Mankiw *et al.*, 1992), while still others present evidence of a positive relationship (Sachs and Warner, 1997). The population growth rate, then, has been found to exhibit either a positive or a negative relationship with economic growth.

As for the relationship between economic growth and savings, according to many literature reports a positive and statistically significant impact of GS_t on economic growth is

[15] This proxy is also used by Sachs and Warner (1997). Other proxies commonly used for human capital such as years of secondary education and school enrollment in secondary were only available 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 education are complementary with longer life expectancy (Becker, 2007). Indeed, life expectancy at birth correlates strongly with 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).

expected, since increased savings may stimulate economic growth through increased investment (Keynes, 1936). This approach is supported by the growth models proposed by Harrod (1939), Domar (1946) and Solow (1956).

HK_t is included to reflect the notion that countries with an abundance of human capital are more likely to be able to attract investors, absorb ideas from the rest of the world, and engage in innovation activities (Grossman and Helpman, 1991). While some studies have found a positive relationship between human capital and economic growth (Radelet *et al.*, 2001), others have found a negative relationship (Barro, 2003). Consequently, the effect of human capital on economic growth is expected to be either positive or negative. $OPEN_t$ is posited to boost productivity through transfers of knowledge and efficiency gains (Seghezza and Baldwin, 2008). Since most of the empirical literature [Romer (1992), Barro and Sala-i-Martin (1995), or Edwards (1998), among others] provides evidence of the positive impact of openness on growth, a positive sign is expected for this variable. Finally, with regard to INF_t, it has been argued that inflation is a good macroeconomic indicator of how the government manages the economy [see Fischer (1993) or Barro (2003), just to name a few] and that low inflation brings about economic efficiency because, through the price mechanism, economies are able to allocate scarce resources to their best economic use (World Bank, 1990). Nonetheless, the *a priori* expectation may be either a positive or negative association between inflation and economic growth. This presumable uncertain effect is supported by the different arguments presented in the literature regarding the relationship between these two variables. While some authors defend a negative relationship, others support a positive one. The former group includes De Gregorio (1993), who suggests that inflation can increase the cost of capital, reducing capital accumulation and lowering its productivity, and thus inhibiting long-run growth; Friedman (1977), who conjectures that inflation uncertainty would reduce the effectiveness of the price mechanism to coordinate economic activities, decreasing the output growth rate; and Fischer (1993) or Bruno and Easterly (1998), who stress the negative relationship between inflation and growth especially via their impact on the efficiency of physical capital. On the other hand, the latter group includes Tobin (1965), who argues that higher anticipated inflation can increase capital per head as households shift their (portfolio) assets away from real money balances (non-interest-bearing money) toward real capital (more productive forms), and Dotsey and Sarte (2000), who contend that inflation makes the return to money balances uncertain and reduces the demand for real money balances and consumption; this increases precautionary savings and, in response to higher anticipated inflation, the investment pool enhances economic growth.

5. Data and time series properties

5.1. Data

As mentioned above, we use annual data for ten EMU countries: both central (Austria, Belgium, Finland, France, Germany and the Netherlands) and peripheral countries (Greece, Italy, Portugal and Spain). We use long spans of data covering the period 1980-2015 (i.e., a total of 36 annual observations) to explore the dimension of historical specificity and to capture the underlying relationship between the variables under study.

To maintain as much homogeneity as possible for a sample of ten countries over the course of five decades, we use the World Bank's World Development Indicators[16] as our primary source, supplemented with data from Cecchetti *et al.* (2011), the European Commission's AMECO database and the International Monetary Fund (International Financial Statistics 2016b). As stated above, we use *per capita* GDP at 2010 market prices, population growth rate, the ratio of gross savings to GDP, an index of human capital, openness to trade and consumer price inflation. The precise definitions and sources of the variables are presented in Appendix 1.

5.2. Time series properties

Our approach focuses on time series analyses of yearly data for individual countries which can help us to document the possible differences in their experiences. This approach is likely to provide an accurate empirical estimate of the underlying debt-growth nexus in EMU countries.

Since the appropriate econometric treatment of a model depends crucially on the pattern of stationarity and non-stationarity of the variables under study, before carrying out the estimation we test for the order of integration of the variables by means of the Augmented Dickey-Fuller (ADF) tests. This step is necessary to ensure that all our variables in the regression equation have the same order of integration, given the non-stationarity that most macroeconomic data exhibit. The results decisively reject the null hypothesis of a unit root at conventional significance levels for g_t, INF_t, $POPGR_t$ and GS_t (indicating that they are stationary in levels, i.e., I(0)), while we do not reject the null for y_t, hd_t, cd_t, pd_t, $OPEN_t$ and

[16] http://data.worldbank.org/data-catalog/world-development-indicators

HK_t (suggesting that these variables can be treated as first-difference stationary, i.e., I(1))[17]. Then, following Cheung and Chinn's (1997) suggestion, we confirm these results using the KPSS tests (Kwiatkowski *et al.* 1992), where the null is a stationary process against the alternative of a unit root[18].

6. Empirical models

6.1. Baseline empirical model

Given that our dependent variable is stationary (i.e., its statistical properties such as mean, variance, autocorrelation, etc., remain constant over time), we cannot explain it with non-stationary variables (whose statistical properties change over time). Additionally, if the variables in the regression model are not stationary, then the standard assumptions for asymptotic analysis will not be valid and we cannot undertake hypothesis tests about the regression parameters. Therefore, by differencing the non-stationary variables we transform them into stationary variables[19].

As a result of the time series properties of our data, the baseline empirical model is modified as follows:

$$g_t = \phi g_{t-1} + \delta_1 INF_t + \delta_2 \Delta HK_t + \delta_3 \Delta OPEN_t + \delta_4 POPGR_t + \delta_5 GS_t + \beta \Delta d_t + \varepsilon_t \quad (2)$$

where Δ denotes the first difference operator.

Note that model (2) is quite different from model (1), which is commonly used in the literature, especially regarding the variables y_{t-1}, *HK*, *OPEN* and *d*, since we find that they are non-stationary and therefore enter our model in first differences. As argued in Asimakopoulos and Karavias (2016), by rewriting equation (1) as (3)

$$g_t = \alpha + \gamma y_{t-1} + \sum_{i=1}^{l} \delta_i^s X_{it}^s + \sum_{i=1}^{l} \delta_i^{ns} X_{it}^{ns} + \beta d_t + \varepsilon_t \quad (3)$$

(where X_{it}^s and X_{it}^{ns} denote the stationary and non-stationary explanatory variables respectively), we can compare (3) with our equation (2), which has $g_{t-1} = \Delta y_{t-1}$ instead of y_{t-1}, Δd_t instead of d_t and ΔX_{it}^{ns} instead of X_{it}^{ns} as explanatory variables due to non-

[17] These results (which are not shown here in order to save space, but are 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.

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

[19] Note that if the public debt-to-GDP ratio series contains a unit root, that would imply that the results of many previous studies (some of which had been used as a basis for policy recommendations) are spurious.

stationarity. The interpretation of the estimated parameters is the same in both models, but that of ϕ, δ_2, δ_3 and β changes.

6.2. Asymmetric model

We proceed further by exploring the possibility of an asymmetric effect on positive and negative debt variation on economic growth for each country[20]. We use the following alternative empirical specification to capture this possibility:

$$\begin{aligned} g_t &= \phi g_{t-1} + \delta_1 INF_t + \delta_2 \Delta HK_t + \delta_3 \Delta OPEN_t + \delta_4 POPGR_t + \delta_5 GS_t \\ &+ \beta_1 \Delta d_t I(\Delta d_t > 0) + \beta_2 \Delta d_t I(\Delta d_t < 0) + \varepsilon_t \end{aligned} \tag{4}$$

where I is an indicator function that takes the value 1 if the condition is fulfilled (i.e., if Δ is positive or negative) and zero otherwise. The indicator variable has the effect of splitting the variation of debt variable into two, allowing for an asymmetric response of growth to debt accumulation and relief.

6.3. Threshold model

Identifying a threshold effect for each economy under study would inform policy makers of the presence of a country-specific tipping point, which would be useful information for guiding macroeconomic policies and fiscal adjustments[21]. To this end, we use the following alternative specification:

$$\begin{aligned} g_t &= \phi g_{t-1} + \delta_1 INF_t + \delta_2 \Delta HK_t + \delta_3 \Delta OPEN_t + \delta_4 POPGR_t + \delta_5 GS_t \\ &+ \beta_1 \Delta d_t I(d_t \leq d^*) + \beta_2 \Delta d_t I(d_t > d^*) + \varepsilon_t \end{aligned} \tag{5}$$

where I is an indicator function that takes the value 1 if the condition is fulfilled (i.e., if d_t is either below or above a specific threshold value d^*) and zero otherwise. In this case, the indicator variable has the effect of splitting the variation of debt variable into two, allowing for the impact to differ above and below the threshold. Following the common practice in the empirical literature, the assignment to one or the other regime is determined by the

[20] For example, Eberhardt and Presbitero (2015) assess asymmetry in the long- and/or short-run relationship between public debt and growth in a large panel of countries in order to reflect the conclusions of the well-established literature on the asymmetric effects of fiscal policy in advanced economies (see, Sutherland, 1997; and Perotti, 1999). Nevertheless, their methodological approach is different from the one implemented in this paper, since we adopt a times series analysis instead of a panel data approach and we deal appropriately with the different order of integration of the relevant variables, using changes in debt-to-GDP ratio as the primary variable of interest.

[21] Baum *et al.* (2013), Checherita-Westphal and Rother (2012), Dreger and Reimers (2013), Antonakakis (2014) and Gómez-Puig and Sosvilla-Rivero (2017) have found that, for the euro-area, the relationship between public debt and growth is characterized by the presence of a threshold above which debt starts to have a negative effect on economic growth. Caution should be taken when comparing results with those presented in Baum *et al.* (2013), Checherita-Westphal and Rother (2012), Dreger and Reimers (2013) or Antonakakis (2014) due to the fact that these papers adopt a panel data analysis and use the debt-to-GDP ratio as the primary variable of interest.

debt-to-GDP ratio, allowing us to compare our results with previous papers which have adopted this ratio as the primary variable of interest. We evaluate all possible values for d^*, selecting for each country the value that minimizes the sum of squared residuals from the regression as the relevant one.

7. Empirical results[22]

In order to assess whether the proposed models are tentatively admissible (i.e., consistent with the data and with economic theory), we use a data-based method for obtaining a parsimony representation of the data-generating process: the general-to-specific approach (Hendry, 1995). In this approach, the modeller simplifies an initially general model that adequately characterizes the empirical evidence within his or her theoretical framework. Starting from a general unrestricted model that contains all the variables likely to be relevant, and lags long enough to be able to capture a constant parameter representation, standard testing procedures eliminate statistically insignificant variables. Diagnostic tests check the validity of the reductions, ensuring a consistent final selection which produces a parsimonious and interpretable econometric model that is data- admissible, presents well-behaved residuals and uses conditioning variables that are weakly exogenous (see Faust and Whiteman, 1997)[23]. This method has proved useful in practice for selecting empirical economic models (see Hendry, 2000).

Given the potential for endogeneity of the explanatory variables, we use two-stage least squares (2SLS) instrumental variable techniques to estimate the finally selected model. In the case of the threshold model, we use the 2SLS estimator proposed by Caner and Hansen (2004). Following common practice with macroeconomic data, we use lagged terms of regressors as instruments.

Recall that, in order to assess the differences between types of borrowers, household, corporate and government debt (hd_t, cd_t and pd_t, respectively) are treated separately.

[22] In each model, we focus our comments on the variation in debt to investigate its effect on growth, summarizing the results by pointing out the main regularities. The reader is asked to browse through Tables 2 to 4 to find evidence for particular country of her/his interest and for a detailed account of the impact of other explanatory variables on the growth rate.

[23] Phillips (1988) contends that the general-to-specific methodology performs a set of corrections that make it an optimal procedure under weak exogeneity.

7.1. Empirical results from the baseline empirical model

Panel A in Tables 2a and 2b reports the results for peripheral and central countries respectively. All explanatory variables turn out to be significant and their signs are in concordance with the literature. The degree of country's openness to trade, the proxy used to measure human capital, population growth and the ratio of gross savings to GDP have a positive impact on real GDP *per capita* growth, while the inflation rate and the ratio of debt over GDP exert a negative effect[24].

[Insert Table 2a and 2b around here]

Some interesting insights emerge from the results presented in Tables 2 when analysing the effect of a debt increase in the three different sectors on *per capita* GDP growth. We observe that, on average in the ten countries under study, the highest marginal impact of a debt rise corresponds to the household and public sector (-0.2), the marginal effect of an increase in nonfinancial corporations' debt being much lower (-0.1). However, there are important differences across countries. If there is an increase in households' debt, the estimated marginal effect on growth ranges from -0.54 in Greece to -0.03 in the Netherlands, and the response is higher in peripheral (-0.27) than in central countries (-0.17). A similar pattern is found when analysing the effect of an increase in nonfinancial firms' debt, since the marginal impact ranges from -0.34 in Greece to -0.003 in Germany and, on average, the influence is also higher in peripheral (-0.19) than in central countries (-0.09). However, even though the reaction to a public debt increase also differs across EMU countries (it ranges from -0.46 in Finland to -0.002 in Austria), the average value is very similar (close to -0.2) in central and peripheral countries.

Summing up, the results from the baseline model suggest that although the effects on nonfinancial debt accumulation clearly differ across countries, on average, the highest marginal impact of a debt rise corresponds to the household and public sector. Furthermore, an increase in private debt (both households and companies) is more harmful in peripheral than in central countries, while the average effect of a rise in public debt does not differ between these two groups of countries.

Finally, as can be seen in Panel B in Tables 2a and 2b, the estimated models seem to pass diagnostic tests such as normality of error term, second-order residual autocorrelation and

[24] As pointed out in Section 4, a positive effect was expected for the variable measuring openness to trade and the ratio of gross savings to GDP, while a negative effect was expected for the ratio of debt to GDP. However, according to the literature the expected effect of human capital, population growth and inflation rate might be either positive or negative.

heteroskedasticity (χ^2_N, $\chi 2_{SC}$ and χ^2_H respectively). The overall regression fit is satisfactory, as measured by the adjusted R^2 value (ranging from 0.5404 to 0.7575 for central EMU countries and from 0.5700 to 0.6979 for peripheral EMU countries). Therefore, our econometric modelling seems to have identified sensible and interpretable relationships between the economic variables under study.

7.2 Empirical results from the asymmetric model

As explained above, the introduction of an indicator variable in the asymmetric model has the effect of splitting the variation of debt variable into two, allowing for an asymmetric response of growth to debt accumulation and relief.

[Insert Tables 3a and 3b around here]

The results reported in Panel A in Tables 3 suggest that, on average, this asymmetric effect exists for households and governments. However, while in the households' sector the positive effect of a debt relief on growth (-0.3) is higher than the negative effect of a debt increase (-0.2), in the governments' sector the negative effect of a debt increase on growth (-0.2) is higher than the positive impact of a debt reduction (-0.1). Conversely, for companies, the average marginal impact of a debt increase is the same as that of a debt reduction (-0.1).

Regarding the effects of debt accumulation, the marginal effect of a debt increase also differs across countries regardless of the type of debt, and similar patterns to those resulting from the baseline model are found. The marginal response of an increase of household debt ranges from -0.51 in Greece to -0.04 in the Netherlands and, on average, the marginal influence is higher in peripheral (-0.31) than in central countries (-0.16). If companies' debt rises, the estimated marginal impact ranges from -0.39 in Greece to -0.04 in the Netherlands and, on average, it is higher in peripheral (-0.19) than in central countries (-0.11). In the case of a positive change in public debt, the marginal reaction ranges from -0.46 in Finland to -0.02 in Austria but, as in the baseline model, the average response does not differ between central and peripheral economies (-0.2 in both groups of countries).

Therefore, the effects of debt accumulation on growth resulting from the asymmetric model also stress the fact that an increase in private debt has a higher detrimental effect on economic growth in peripheral than in central countries, while the effect is very similar in the two groups of countries if there is a rise in public debt. It is noticeable that in both the baseline and the asymmetric models an increase in private debt is especially harmful in Greece, while the effect of a public debt increase on Greek economic growth seems to be much lower.

Tables 3 present some very important data regarding the effects of debt reduction on growth. On average, for the ten countries under study, a debt reduction has estimated marginal impacts of -0.3, -0.1 and -0.1 in the case of the household, government, and firm sectors respectively, indicating that while a reduction in nonfinancial corporations' and public debt has a negligible effect on growth[25], the response is relevant in the case of households.

Nevertheless, this significant positive reaction clearly differs across countries, the average impact being higher in peripheral than in central countries. Specifically, the marginal impact of debt deleveraging in the household sector presents values of -0.74, -0.48, -0.41 and -0.19 in Spain, Greece, Portugal and Italy respectively.

Consequently, in view of these results and considering that households' final consumption expenditure is the most important component of GDP (around 50%) in the countries under study, it is essential to point out that the huge increase in households' indebtedness (close to 160% over the last 36 years, mainly due to mortgage loans) has represented a significant impediment for economic growth, since it has crowded out consumption. Therefore, a reduction in households' debt (especially in EMU peripheral countries) may be crucial to stimulate consumption and growth; as the literature has stressed, households' debt plays a very important role in shaping the business cycle. Jordà *et al.* (2013) show that the presence of a high level of household debt leads to deeper recessions, while Mian *et al.* (2013) report the channel through which this might happen. Specifically, the latter authors highlight the role of household debt in explaining the large decline in U.S. consumption during the 2006-2009 period. In particular, since they find that the marginal propensity to consume is much higher for poorer households or those with higher leverage, their results suggest that the consequences of housing wealth decline on aggregate consumption will be more severe the higher the level of leverage in the housing sector.

[25] Gómez-Puig and Sosvilla Rivero (2017) also find the impact of public debt deleverage on EMU countries' economic growth to be insignificant.

As stated above, the effects of households' debt relief in central EMU countries (Table 3a) are lower than in peripheral economies. In fact, a debt reduction only presents a positive relevant effect in Finland and Austria.

Finally, notice that we have conducted diagnostic tests in order to see whether our results are free from problems of serial autocorrelation, heteroskedasticity and nonlinearity of residuals. As can be seen in Panel B of Tables 3, we found that none of these problems are present in our estimates. Additionally, the estimated adjusted R^2 statistics seem to suggest that a considerable fraction of the variance of the dependent variable is explained by the independent variables used in the regressions.

7.3. Empirical results from the threshold model

Panels A in Tables 4a and 4b show[26] the results from the threshold model. As in the asymmetric model, an indicator variable has been introduced which splits the effect of the debt change into two, thus allowing for the impact to differ below and above the threshold detected.

[Insert Tables 4a and 4b around here]

Some interesting observations can also be drawn from Tables 4. First, it is noticeable that above the estimated threshold, on average, the estimated negative effect of an increase in public debt on growth (-0.2) is similar to the one found using the baseline or the asymmetric model. However, the average negative reaction to an increase in private debt (both households and companies) is higher above the detected tipping point in the threshold model than in the two previous models. In the case of households, the average marginal impact increases from -0.2 to -0.3, while in the case of nonfinancial corporations it rises from -0.1 up to -0.2.

Second, on average, the highest thresholds are found for corporations' debt (87%), followed by public debt (59%) and households' debt (39%). Our findings reflect the fact that firms' debt is, on average, twice as high as households' debt and around one third higher than that of the public sector during the 1980-2015 period (see Figure 2 and Table 1). According to our results, firms have greater room for manoeuvre to increase the level of indebtedness than the other sectors, and the public sector has a greater margin than households.

[26] As can be seen in Panel B in Tables 4, the regressions fit reasonably well in terms of adjusted R^2 and they pass the diagnostic tests against non-normal errors, autocorrelation and heteroskedasticity.

Third, focusing on the private sector, not only are debt thresholds lower for households' debt rather than for firms' debt, but also the average marginal effect (-0.3) of a household debt increase on growth beyond the tipping point is higher than that of companies (-0.2). Moreover, in the two private sectors, thresholds are lower in peripheral than in central EMU countries (households' debt thresholds present average values of 31% and 44% in peripheral and central countries respectively, while the average values of firms' debt thresholds are 72% in peripheral and 96% in central countries) and the marginal impacts above them are very high in some of these peripheral economies (e.g., Greece presents a marginal impact of -0.76 and -0.55 beyond the 32% and 52% turning point for households' and firms' debt respectively). Therefore, these results suggest that an increase in households' debt (especially in peripheral countries) exerts a higher detrimental effect on growth than a rise in nonfinancial corporations' debt. Mian and Sufi (2017) show that an increase in the household debt-to-GDP predicts lower subsequent GDP growth and higher unemployment, while Jordà *et al.* (2016b) find that more mortgage-intensive credit expansions tend to be followed by deeper recessions and slower recoveries.

Fourth, analysing the results of the threshold model for the public sector, we find that while the tipping point is lower in central (55%) than in peripheral (65%) countries, the marginal impact beyond that point is similar in the two group of countries (around -0.2). Focusing on peripheral countries (Table 4b), thresholds are 90%, 71%, 50% and 50% in Italy, Greece, Portugal and Spain, while marginal impacts range from -0.3 in Spain and Italy to -0.2 in Portugal and -0.1 in Greece.

All in all, Tables 4 indicate that while public debt thresholds are higher in peripheral than in central countries, private debt thresholds are higher in core EMU countries. These results suggest that while peripheral countries might have a higher capacity to increase public indebtedness than central ones, in the case of private indebtedness central countries are in a better position to increase it. Consequently, public debt accumulation might exert a more harmful effect on central euro-area countries' economic growth, but the detrimental effect of an increase in private debt seems to be higher in peripheral countries. These results suggest that peripheral countries especially should be aware of the adverse consequences of private debt accumulation. Rather than disregarding private sector leveraging, they should pay it as much attention as they already do to public debt.

8. Concluding remarks

Total nonfinancial debt as a percentage of GDP, as well as its components, rose steadily for much of the 1980-2015 period. Starting at a relatively modest 147 percent of GDP in 1980, 36 years later total nonfinancial debt had reached 304 per cent of GDP in euro-area countries and, of this percentage, only one third corresponds to the public sector. In 2015 about two-thirds of total euro-area countries' nonfinancial debt has its origin in the private sector (both households and companies). However, while the unprecedented increase in public debt across EMU countries has raised serious concerns among economists about both its sustainability and its impact on economic growth, they have taken a more nuanced position regarding the risks of private debt accumulation, despite its magnitude. Nevertheless, all forms of nonfinancial debt should be sources of concern when they are high and register an upward trend.

This paper aimed to fill the existing gap in the literature by assessing the effect of all forms of nonfinancial debt (households, nonfinancial corporations and governments) on economic growth in euro-area countries. To do so, we used a methodology that explicitly takes into account the possible heterogeneity (see, e.g., Erberhart and Presbitero, 2015 or Chudick *et al.*, 2017) in the relationship between each source of nonfinancial debt and growth across euro-area countries. In particular, our analytical strategy has rested on the estimation of an equation based on the empirical growth literature augmented by debt to assess whether the latter has an impact on growth over and above other determinants. So, after ensuring that all the variables in the model have the same order of integration, and to provide a broad view of the debt-growth nexus, we successively estimated three models (a baseline, an asymmetric and a threshold model) for each of the ten countries in our sample and, following Cecchetti *et al.* (2011), we treated the different types of borrowers – households, corporations and governments – separately.

Summing up, the results from both the baseline and the asymmetric model suggest that although the effects on nonfinancial debt accumulation clearly differ across countries, on average the highest marginal impact of a debt rise corresponds to the household and public sector. Furthermore, an increase in private debt is more harmful in peripheral than in central EMU countries, while the average effect of a rise in public debt does not differ between these two groups of countries. Focusing on the effects of a debt increase beyond the turning point estimated in the threshold model, it is noticeable that above the estimated threshold, on average the negative effect of an increase in public debt on growth is similar to the one found using the baseline or the asymmetric model. However, the average negative reaction to an increase in private debt is higher above the detected tipping point in the threshold model than in the two previous ones. As a result, in the threshold model the highest marginal impact of a debt increase beyond the turning point corresponds to the household sector.

Our results also suggest that there exists an asymmetric effect for the household and government sectors. However, while in the households' sector the positive effect of a debt reduction on growth is higher than the negative effects of a debt increase, in the public sector the negative effect of a debt increase on growth is higher than the positive impact of a debt reduction. Furthermore, our findings indicate that while a reduction in nonfinancial corporations' or governments' debt has a negligible effect on growth, the response is relevant in the case of households. Nevertheless, the significant positive reaction of households' debt deleverage clearly differs across countries, the average impact being higher in peripheral countries (especially in Spain) than in their central counterparts.

Finally, it is noticeable that the highest thresholds are found for corporate debt (87%), followed by public debt (59%) and household debt (39%). Focusing on the private sector, not only are debt thresholds lower for households rather than for firms, but also, beyond the detected tipping point, the average marginal effect of a household debt increase on growth is higher than that of companies' debt. Moreover, in the two private sectors, thresholds are lower in peripheral than in central EMU countries and the marginal impact above them is very high in some of these peripheral economies. Conversely, in the public sector we find lower thresholds in central than in peripheral countries.

Therefore, our findings seem to suggest that EMU central countries are more tolerant of a private debt increase than peripheral economies, and that the negative potential effect is higher in peripheral Member States than in core countries. Yet, although the warning signs of increased private leverage in the run-up to the crisis of 2008 were largely ignored (especially in peripheral countries), euro-area economies should now be aware of the adverse consequences of private debt accumulation (in particular, in the household sector) and should be as concerned by private sector leveraging as they are by public debt.

Our results have significant policy implications. Empirical evidence on the impact of nonfinancial debt on economic growth helps to inform policy and stresses the importance of monitoring both private and public debt to stimulate economic growth. Additionally, the heterogeneous relationships detected in the debt-growth nexus suggest that the pace of leveraging should be adapted to the differences in debt tolerance and impact in each EMU country; therefore, rigid and uniform criteria are not advisable when addressing the necessary adjustments.

Our contribution also provides guidance for theoretical models that seek to study the consequences of debt on economic growth. We show that private debt matters as well as public debt. Thus, the growing macroeconomic literature should focus more closely on private indebtedness when studying the capacity of an economy to produce goods and services over time in order to increase the validity and viability of these models and their ability to offer a systematic structural interpretation of economic reality.

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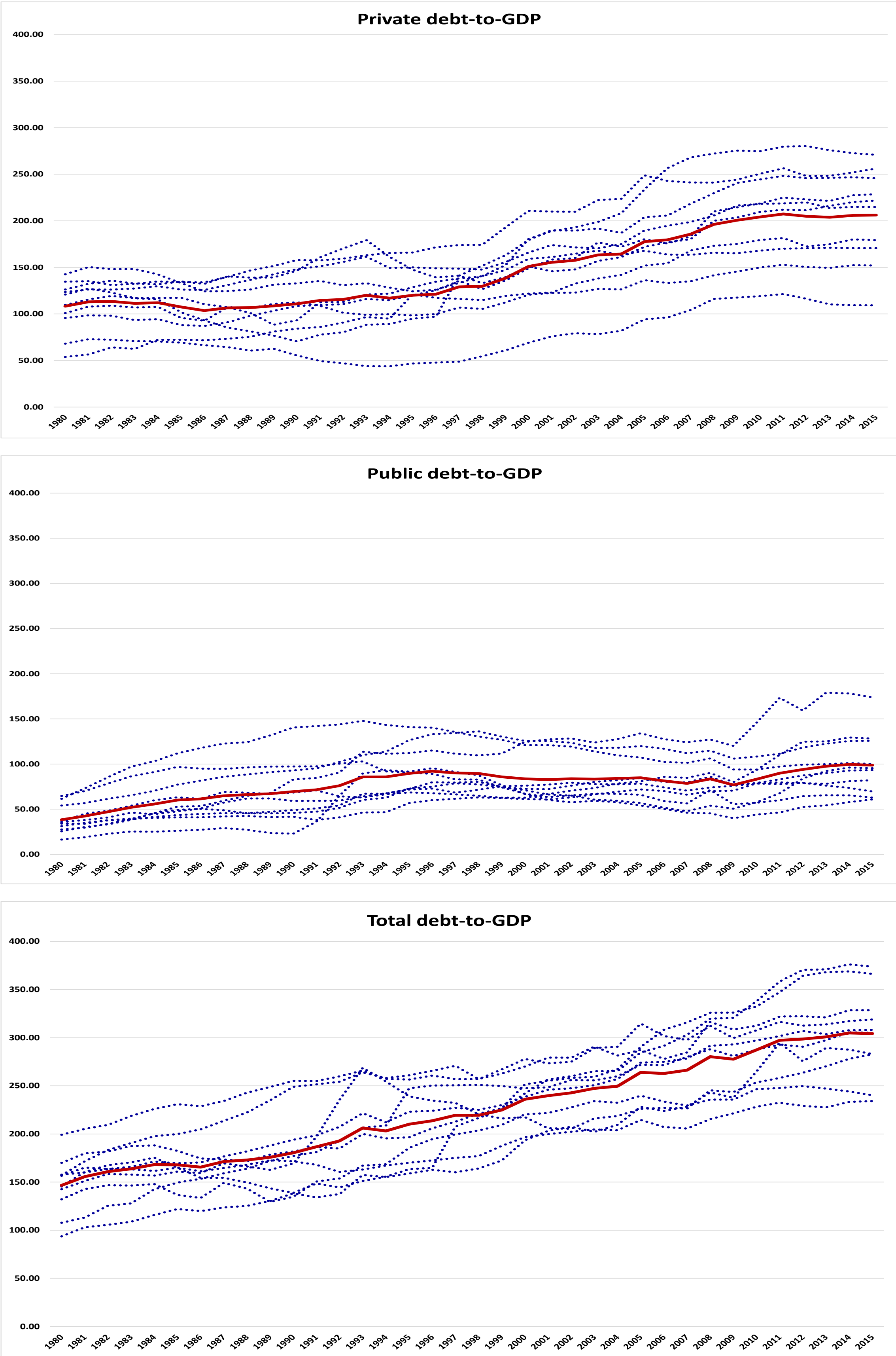
Appendix 1: Definition of the explanatory variables and data sources

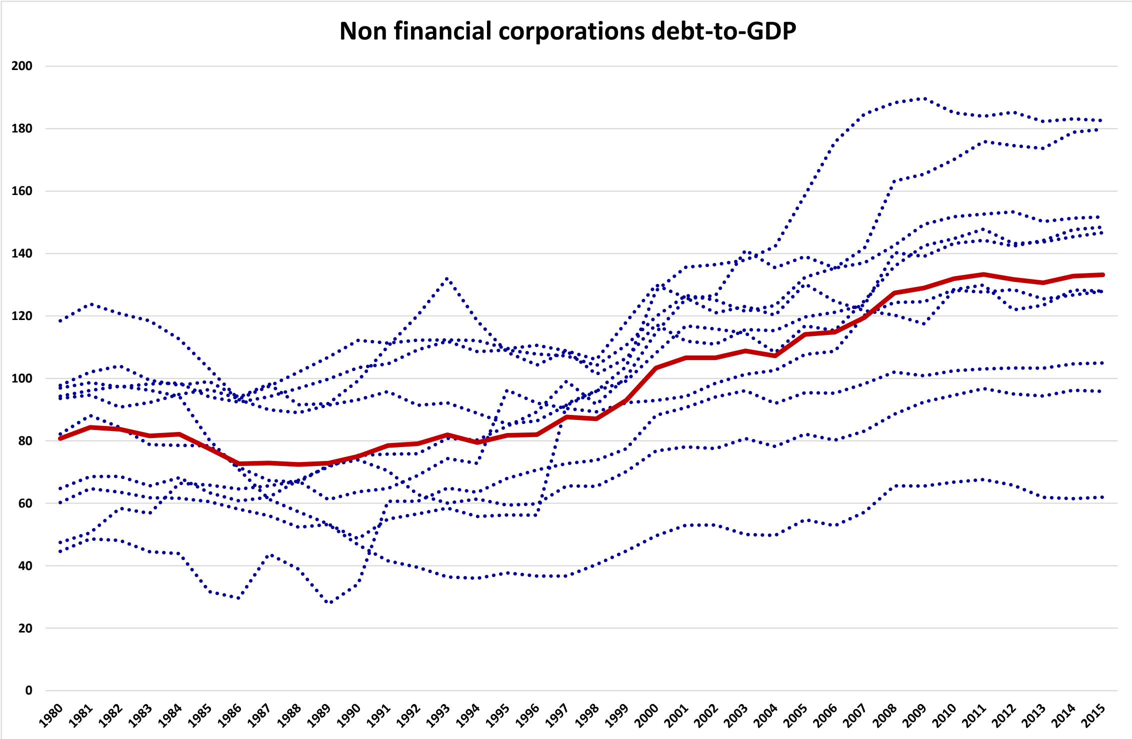
Variable	Description	Source
Real growth rate (g_t)	Growth rate of real *per capita* GDP (annual %)	World Development Indicators (World Bank)
Level of Output (y_t)	*Per capita* Gross domestic product at 2010 market prices	AMECO, extended to 2015 using International Monetary Fund (2016b)
Household debt-to-GDP ratio (hd_t)	Household and non-profit institutions serving households debt (all liabilities) as percentage of GDP	Cecchetti *et al.* (2011) extended to 2015 using AMECO http://www.bis.org/publ/work352_data.xls
Nonfinancial corporate debt-to-GDP ratio (cd_t)	Nonfinancial corporate debt (all liabilities less shares and other equity) as percentage of GDP	Cecchetti *et al.* (2011) extended to 2015 using AMECO http://www.bis.org/publ/work352_data.xls
Public debt-to-GDP ratio (pd_t)	Ratio of public debt to GDP	AMECO and International Monetary Fund (2016b)
Population growth ($POPGR_t$)	Population growth (annual %)	World Development Indicators (World Bank)
GS-to-GDP ratio (GS_t)	Ratio of gross savings to GDP (%)	World Development Indicators (World Bank)
Human capital (HK_t)	Life expectancy at birth, total (years)	World Development Indicators (World Bank)
Openess ($OPEN_t$)	Absolute sum of exports and imports over GDP	World Development Indicators (World Bank)
Inflation (INF_t)	Inflation as measured by the consumer price index (annual %)	World Development Indicators (World Bank),

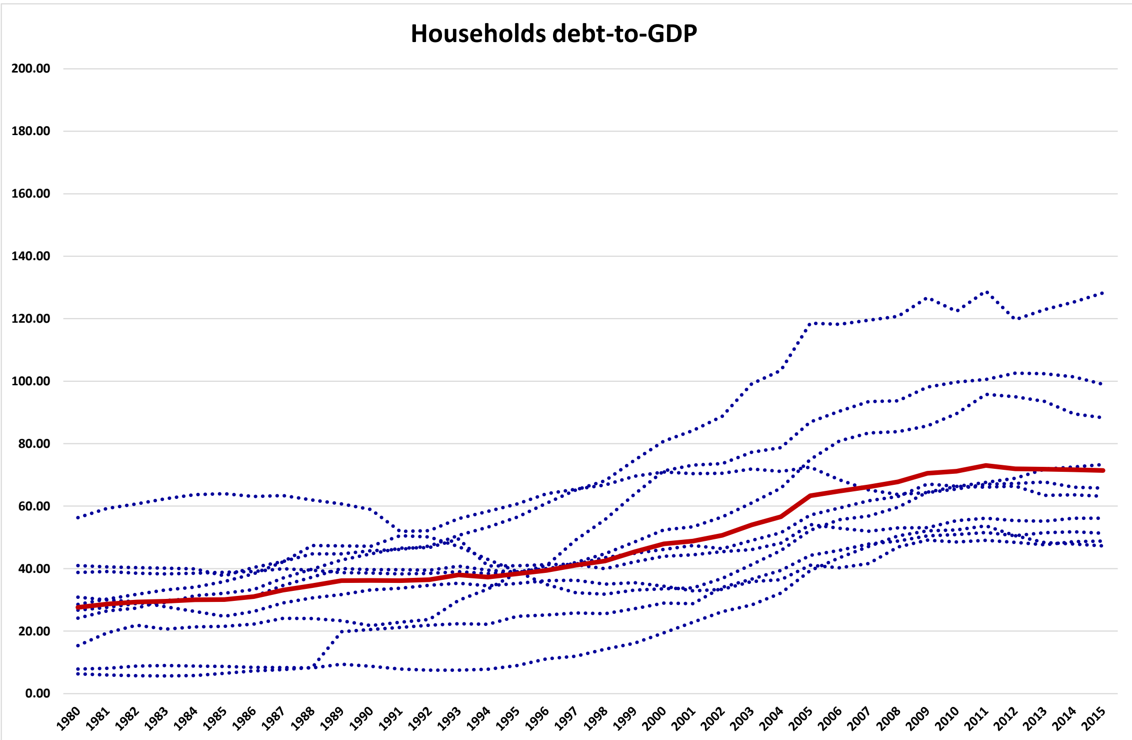
Figure 1. Debt-to-GDP by sector in EMU countries: 1980-2015



Source: Cecchetti *et al.* (2011) extended to 2015 using AMECO and International Monetary Fund.
Red lines correspond to the average values.

Figure 2. Private debt-to-GDP by sector in EMU countries: 1980-2015





Source: Cecchetti *et al.* (2011) extended to 2015 using AMECO; http://www.bis.org/publ/work352_data.xls
Red lines correspond to the average values.

Table 1a. EMU central countries sectoral debt as a percentage of GDP

	Levels						Changes				
AUSTRIA	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	38.8	38.6	42.1	53.1	55.4	56.2	-0.4%	9.1%	26.0%	4.3%	1.4%
Nonfinancial corporations	82.2	73.9	70.2	92.4	95.0	95.9	-10.1%	-5.0%	31.7%	2.8%	0.9%
General Government	35.7	59.1	75.4	75.8	78.8	82.1	65.6%	27.5%	0.6%	3.9%	4.2%
BELGIUM	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	30.9	33.2	35.5	49.1	48.4	48.8	7.5%	6.9%	38.5%	-1.4%	0.8%
Nonfinancial corporations	64.8	75.3	100.4	165.4	174.6	179.8	16.3%	33.3%	64.7%	5.6%	3.0%
General Government	61.5	140.5	126.8	93.9	99.3	100.0	128.5%	-9.7%	-25.9%	5.8%	0.7%
FINLAND	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	28.5	47.2	33.1	64.5	68.9	73.3	65.2%	-29.8%	94.8%	6.9%	6.4%
Nonfinancial corporations	97.8	99.3	106.5	139.1	142.4	148.5	1.6%	7.2%	30.6%	2.4%	4.3%
General Government	16.3	22.8	76.5	40.0	52.3	60.8	40.5%	234.9%	-47.7%	30.9%	16.3%
FRANCE	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	26.7	44.7	44.9	67.1	66.4	63.1	67.5%	0.5%	49.4%	-1.0%	-5.0%
Nonfinancial corporations	96.9	103.4	110.7	149.4	153.3	151.7	6.7%	7.0%	35.0%	2.7%	-1.0%
General Government	34.1	45.8	74.3	76.6	87.3	93.2	34.6%	62.2%	3.0%	14.0%	6.8%
GERMANY	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	56.3	59.0	69.6	64.3	67.3	65.8	4.73%	18.05%	-7.54%	4.55%	-2.25%
Nonfinancial corporations	44.6	34.2	77.5	100.8	103.3	104.9	-23.32%	126.58%	30.16%	2.49%	1.54%
General Government	31.2	41.6	62.3	70.6	79.2	69.5	33.38%	49.50%	13.34%	12.21%	-12.17%
NETHERLANDS	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	41.0	45.7	74.7	126.8	119.7	128.2	11.6%	63.3%	69.7%	-5.6%	7.1%
Nonfinancial corporations	93.6	112.2	118.1	117.5	128.5	127.9	19.8%	5.3%	-0.5%	9.3%	-0.5%
General Government	64.6	97.3	74.2	55.4	64.3	62.8	50.7%	-23.7%	-25.4%	16.1%	-2.4%

Table 1b. EMU peripheral countries sectoral debt as a percentage of GDP

	Levels						Changes				
GREECE	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	7.8	8.7	16.1	52.1	50.5	47.3	11.6%	84.9%	222.6%	-2.9%	-6.5%
Nonfinancial corporations	60.2	46.7	44.7	65.5	65.8	62.0	-22.5%	-4.2%	46.5%	0.4%	-5.8%
General Government	25.5	82.9	111.6	120.1	159.2	173.8	224.7%	34.7%	7.6%	32.6%	9.2%
ITALY	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	6.3	20.5	27.2	50.5	50.5	51.3	224.8%	32.3%	86.0%	0.0%	1.6%
Nonfinancial corporations	47.4	63.7	92.2	124.6	121.9	128.0	34.2%	44.8%	35.1%	-2.1%	5.0%
General Government	54.0	92.8	130.4	105.9	118.2	125.7	72.0%	40.4%	-18.8%	11.6%	6.3%
PORTUGAL	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	15.4	21.8	63.8	98.1	102.6	99.0	41.7%	193.1%	53.8%	4.5%	-3.4%
Nonfinancial corporations	94.3	48.7	99.2	142.5	143.2	146.7	-48.4%	103.7%	43.7%	0.4%	2.5%
General Government	35.8	68.4	62.7	80.0	124.7	128.2	91.3%	-8.3%	27.5%	55.9%	2.8%
SPAIN	**1980**	**1990**	**1999**	**2009**	**2012**	**2015**	**1980-1990**	**1990-1999**	**1999-2009**	**2009-2012**	**2012-2015**
Households	24.1	39.7	48.5	85.7	95.0	88.3	64.5%	22.2%	76.7%	10.9%	-7.1%
Nonfinancial corporations	118.5	93.2	103.8	189.7	185.2	182.6	-21.4%	11.5%	82.7%	-2.4%	-1.4%
General Government	27.5	49.0	74.3	50.6	83.9	95.3	78.1%	51.8%	-31.9%	65.9%	13.6%

Source: Cecchetti *et al.* (2011) extended to 2015 using AMECO; http://www.bis.org/publ/work352_data.xls

Table 2a. Baseline empirical model. Central countries

Panel A: Estimation results																		
	AT			BE			FI			FR			GE			NL		
	hd	*cd*	*pd*	*hd*	*cd*	*pd*	*hd*	*cd*	*pd*	*hd*	*cd*	*pd*	*hd*	*cd*	*pd*	*hd*	*cd*	*pd*
g_{t-1}	0.3738	0.4390	0.3825	0.0758	0.1168	0.0597	0.0171	0.0376	0.3010	0.4555	0.4886	0.1457	0.1694	0.2811	0.1596	0.5363	0.5509	0.4737
	(2.7455)	(3.4691)	(2.9431)	(2.9536)	(2.9368)	(2.7498)	(2.9744)	(3.2888)	(2.9865)	(2.9320)	(3.3858)	(2.9316)	(3.1397)	(3.1121)	(2.9443)	(3.7445)	(3.8854)	(3.3240)
INF_t	-0.1081	-0.1472	-0.0803	-0.2507	-0.2676	-0.0559	-0.2528	-0.2941	-0.2053	-0.0040	-0.0335	-0.0029	-0.2054	-0.1510	-0.1951	-0.4289	-0.4152	-0.3693
	(-3.1421)	(-3.1321)	(-2.9393)	(-2.8713)	(-3.1538)	(-2.9565)	(-2.8492)	(-2.9429)	(-2.9846)	(-2.8654)	(-2.8915)	(-2.7982)	(-2.9596)	(-2.9126)	(-2.9772)	(-2.9385)	(-3.1020)	(-2.9176)
ΔHK_t	0.0420	1.0005	0.2335	1.7608	1.5789	1.9230	1.0024	1.0714	0.2321	1.6952	1.5914	0.8473	1.8120	1.5990	1.3715	0.5682	0.3034	0.7281
	(2.6325)	(2.8281)	(2.8713)	(2.8764)	(2.8581)	(2.8369)	(2.8759)	(2.7942)	(2.9166)	(2.7952)	(2.8629)	(2.9903)	(2.8708)	(2.9422)	(2.8306)	(2.8409)	(2.9219)	(2.9562)
$\Delta OPEN_t$	0.2346	0.2832	0.2128	0.1292	0.1373	0.0925	0.2616	0.4124	0.2762	0.2255	0.2831	0.1514	0.3976	0.4254	0.3925	0.1266	0.1152	0.1126
	(4.3356)	(5.5322)	(3.1009)	(4.7738)	(4.9634)	(4.1412)	(3.2038)	(3.2587)	(3.3701)	(3.0763)	(3.7864)	(3.1191)	(5.8877)	(5.5711)	(5.3482)	(3.1494)	(2.9384)	(2.9783)
$POPGRO_t$	0.0718	0.3350	0.0112	1.990	1.8297	1.5474	13.0941	10.8246	4.8721	1.4546	1.8213	0.4563	0.8033	1.0290	0.9958	0.9221	0.7040	0.6100
	(2.8345)	(2.7299)	(2.9144)	(2.7953)	(2.7613)	(2.9185)	(3.2038)	(3.0170)	(2.7637)	(2.8461)	(2.8325)	(2.8311)	(2.8701)	(2.9256)	(2.9860)	(2.9549)	(2.7812)	(2.7723)
GS_t	0.0541	0.0670	0.0457	0.1051	0.1087	0.0826	0.2712	0.2233	0.1804	0.0096	0.0126	0.0753	0.0005	0.0050	0.0110	0.0460	0.0490	0.0586
	(2.7691)	(2.8477)	(2.8635)	(3.4975)	(3.6877)	(3.2412)	(4.8230)	(4.1510)	(4.1991)	(2.9401)	(2.8811)	(2.9437)	(2.9215)	(2.9211)	(2.8454)	(3.3748)	(2.9466)	(2.8070)
Δd_t	-0.2487	-0.1880	-0.0023	-0.0463	-0.0381	-0.1116	-0.3332	-0.1106	-0.4605	-0.0930	-0.1209	-0.2839	-0.2857	-0.0028	-0.1565	-0.0301	-0.0677	-0.1084
	(-2.9506)	(-3.1881)	(-2.8425)	(-2.9636)	(-2.9102)	(-2.8738)	(-2.9411)	(-2.9870)	(-2.9791)	(-2.9394)	(-2.9864)	(-2.9559)	(-2.9670)	(-2.8697)	(-2.9738)	(-2.9583)	(-2.9786)	(-2.8638)
Panel B: Model Diagnostics																		
Adjusted R^2	0.6054	0.6247	0.5565	0.6154	0.6247	0.6507	0.6335	0.6953	0.7575	0.5828	0.5404	0.5618	0.6574	0.6099	0.6327	0.5808	0.5926	0.5968
DW Test	2.1267	2.1809	2.1792	2.2069	2.1715	2.1661	2.2949	2.2082	2.2488	2.1181	2.1911	2.2147	2.2893	2.2847	2.2231	2.2156	2.1636	2.2076
χ^2_N	0.3646	0.3913	0.3634	0.7268	0.3995	0.8038	2.2910	0.4366	2.5958	1.0438	2.6440	1.6846	0.5578	0.9015	1.4372	1.1960	1.3359	1.1500
	[0.8334]	[0.8223]	[0.8338]	[0.6953]	[0.8190]	[0.6690]	[0.5244]	[0.8034]	[0.2731]	[0.5934]	[0.2671]	[0.4307]	[0.7566]	[0.6372]	[0.4874]	[0.5499]	[0.5312]	[0.5627]
χ^2_{SC}	0.6832	0.7820	0.5616	1.5286	2.1435	1.0074	0.6935	0.8074	0.6065	1.3346	0.9962	2.0913	0.40403	1.2670	1.2341	0.8292	0.6592	0.3355
	[0.5138]	[0.4680]	[0.5771]	[0.2357]	[0.1375]	[0.3801]	[0.7070]	[0.4569]	[0.5561]	[0.2807]	[0.3829]	[0.1438]	[0.7824]	[0.2985]	[0.3089]	[0.4476]	[0.5257]	[0.7189]
χ^2_H	11.4297	5.7638	11.3543	3.9147	4.1806	5.6342	5.8134	3.1477	1.5026	6.3093	4.2422	1.2822	6.3893	4.1034	5.3348	3.8458	8.5920	11.5745
	[0.1209]	[0.5676]	[0.1239]	[0.7896]	[0.7588]	[0.5831]	[0.5617]	[0.8710]	[0.9822]	[0.5041]	[0.7515]	[0.9889]	[0.4973]	[0.7678]	[0.6192]	[0.7974]	[0.2833]	[0.1154]

Notes: AT, BE, FI, FR, GE and NL stand for Austria, Belgium, Finland, France, Germany and the Netherlands respectively, while *hd, cd and pd* stand for household, corporate and public debt respectively.

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors proposed by Newey and West (1987).

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. The associated probability values are given in square brackets.

Table 2b. Baseline empirical model. Peripheral countries.

Panel A: Estimation results	GR			IT			PT			SP		
	hd	*cd*	*pd*	*hd*	*cd*	*pd*	*hd*	*cd*	*pd*	*hd*	*cd*	*pd*
g_{t-1}	0.6952	0.6638	0.4374	0.2579	0.2969	0.1781	0.4654	0.5313	0.2934	0.7765	0.8557	0.4335
	(3.9309)	(4.1203)	(2.9916)	(2.8508)	(2.9651)	(2.9111)	(2.9918)	(3.4383)	(2.9513)	(3.1404)	(3.3086)	(2.9349)
INF_t	-0.3243	-0.2594	-0.2198	-0.0011	-0.0105	-0.0471	-0.1321	-0.1062	-0.0528	-0.0481	-0.0767	-0.0219
	(-2.9755)	(-2.8716)	(-2.7857)	(-2.8693)	(2.9160)	(-2.8709)	(-2.8727)	(-2.7673)	(-2.8067)	(-2.9797)	(-2.9282)	(-2.8386)
ΔHK_t	0.5144	0.6712	0.4085	1.1121	1.1180	1.2429	0.9624	0.9480	0.0836	0.7728	0.5498	1.1984
	(2.7254)	(2.7652)	(2.8206)	(2.9447)	(2.9433)	(2.8123)	(2.8303)	(2.8171)	(2.7761)	(2.7630)	(2.8453)	(2.8201)
$\Delta OPEN_t$	0.0137	0.0625	0.0114	0.2369	0.2395	0.1891	0.1428	0.1463	0.1210	0.2294	0.2754	0.1218
	(2.7124)	(2.7536)	(2.7110)	(2.7934)	(2.8679)	(2.8270)	(2.7510)	(2.7542)	(2.7586)	(2.7387)	(2.7215)	(2.7513)
$POPGRO_t$	1.7489	1.1643	1.8628	2.3133	2.1702	2.0588	1.4095	0.5896	0.0080	0.3932	0.1454	0.7608
	(2.9646)	(2.6804)	(2.7968)	(2.7567)	(2.8721)	(2.8929)	(2.9681)	(2.8535)	(2.7622)	(2.7684)	(2.8304)	(2.8312)
GS_t	0.1952	0.1448	0.1434	0.0430	0.0451	0.0545	0.1306	0.0980	0.1167	0.0436	0.0371	0.1205
	(3.1206)	(2.6441)	(2.8193)	(2.7352)	(2.7419)	(2.8175)	(2.9616)	(2.9185)	(3.3047)	(2.8451)	(2.7623)	(2.7473)
Δd_t	-0.5350	-0.3390	-0.1434	-0.1768	-0.0767	-0.1502	-0.2175	-0.1593	-0.2279	-0.1444	-0.1826	-0.2050
	(-2.9417)	(-2.8192)	(-2.8576)	(-2.8635)	(-2.9115)	(-2.8552)	(-2.9244)	(-2.9221)	(-3.1441)	(-2.9745)	(-2.8794)	(-2.7208)
Panel B: Model Diagnostics												
Adjusted R^2	0.5700	0.6180	0.6321	0.5939	0.6028	0.6134	0.5928	0.6289	0.6377	0.6293	0.6365	0.6979
DW Test	2.2119	2.1480	2.1987	2.3144	2.2578	2.3077	2.2578	2.2229	2.2791	2.1571	2.1446	2.2499
χ^2_N	0.7694	0.1594	0.4905	0.2095	0.3395	0.1880	0.3395	0.7712	0.3485	1.7129	0.7618	1.7816
	[0.6809]	[0.9234]	[0.7825]	[0.9006]	[0.8438]	[0.9131]	[0.8438]	[0.6801]	[0.8401]	[0.4249]	[0.6833]	[0.4144]
χ^2_{SC}	0.3660	0.7903	0.7345	1.9360	3.2863	1.4282	3.2863	0.1957	0.9953	1.0187	1.2034	2.3961
	[0.6970]	[0.4643]	[0.4894]	[0.1645]	[0.2212]	[0.2594]	[0.2212]	[0.8235]	[0.3833]	[0.3750]	[0.3163]	[0.1109]
χ^2_H	3.8231	4.8579	7.6662	6.6320	6.0811	6.4324	6.0811	3.8070	6.9531	9.6066	7.1328	9.3144
	[0.7999]	[0.6773]	[0.3629]	[0.4682]	[0.5303]	[0.4903]	[0.5303]	[0.8017]	[0.4338]	[0.2120]	[0.4152]	[0.2309]

Notes: GR, IT, PT and SP stand Greece, Italy, Portugal and Spain respectively, while *hd, cd and pd* stand for household, corporate and public debt respectively.

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors proposed by Newey and West (1987).

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. The associated probability values are given in square brackets.

Table 3a. Asymmetric model. Central countries

Panel A: Estimation results																		
	AT			**BE**			**FI**			**FR**			**GE**			**NL**		
	hd	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***
g_{t-1}	0.3657	0.4021	0.3816	0.0798	0.1125	0.0797	0.0123	0.0640	0.3064	0.4595	0.4925	0.1418	0.1679	0.2163	0.1602	0.4459	0.5417	0.4607
	(2.9490)	(2.8320)	(2.8808)	(2.9606)	(2.8786)	(2.8711)	(2.9758)	(2.8652)	(2.9479)	(3.2191)	(3.3180)	(2.9150)	(3.1979)	(2.9536)	(2.9114)	(3.6746)	(3.7397)	(2.9083)
INF_t	-0.1129	-0.1749	-0.0832	-0.2622	-0.2688	-0.0731	-0.2736	-0.2725	-0.2136	-0.0011	-0.0279	-0.0228	-0.2029	-0.1306	-0.1963	-0.4915	-0.4246	-0.3775
	(-2.7564)	(-3.3050)	(-2.8521)	(-2.8887)	(-3.1129)	(-2.7508)	(-2.8753)	(-2.9319)	(-2.8671)	(-2.9168)	(-2.9490)	(-2.8448)	(-2.9464)	(-2.8881)	(-2.9298)	(-3.2724)	(-2.9111)	(-2.9265)
ΔHK_t	0.0249	0.9138	0.2830	1.7427	1.5681	2.0416	1.0187	0.8453	0.1954	1.6862	1.6824	1.1022	1.8118	1.8302	1.3782	1.8799	0.3647	0.7315
	(2.8883)	(2.8515)	(2.9659)	(2.8282)	(2.8927)	(2.7687)	(2.7954)	(2.8230)	(2.8136)	(2.7948)	(2.8608)	(2.8332)	(2.8499)	(2.8554)	(2.8755)	(2.8559)	(2.8585)	(2.8555)
$\Delta OPEN_t$	0.2370	0.2905	0.2094	0.1263	0.1370	0.0798	0.2592	0.4393	0.2733	0.2569	0.2869	0.1643	0.3957	0.4000	0.3928	0.1584	0.1194	0.1106
	(4.2480)	(4.1407)	(4.1428)	(3.5361)	(3.3407)	(2.8043)	(3.1049)	(4.2010)	(4.1131)	(3.0501)	(3.7587)	(2.7756)	(5.5781)	(5.1659)	(5.2092)	(4.5974)	(2.8403)	(2.8568)
$POPGRO_t$	0.0586	0.2698	0.0508	1.9072	1.8289	2.0102	13.3649	9.9146	4.9146	1.3537	1.6559	0.9861	0.7954	0.8660	0.9966	0.2058	0.9105	0.6852
	(2.8163)	(2.8423)	(2.8598)	(2.9628)	(2.8571)	(2.9043)	(3.8480)	(3.5380)	(2.7617)	(2.9017)	(2.8811)	(2.8522)	(2.8617)	(2.8606)	(2.8490)	(2.8463)	(2.7752)	(2.7641)
GS_t	0.0563	0.0602	0.0481	0.1046	0.1095	0.1073	0.2679	0.2232	0.1786	0.0118	0.0157	0.0732	0.0024	0.0099	0.0104	0.1018	0.0408	0.0567
	(2.7303)	(2.7432)	(2.9130)	(4.4203)	(4.6189)	(4.0988)	(4.5984)	(4.3908)	(3.9671)	(2.8753)	(2.8413)	(2.9790)	(2.9148)	(2.8916)	(2.9307)	(3.2200)	(2.8749)	(2.8662)
$\Delta d_t I(\Delta d_t I>0)$	-0.4313	-0.1025	-0.0207	-0.0859	-0.0835	-0.2812	-0.2821	-0.2843	-0.4551	-0.0448	-0.0891	-0.3447	-0.0832	-0.0503	-0.1537	-0.0412	-0.0419	-0.0459
	(-2.9481)	(-2.8574)	(-2.9107)	(-2.9808)	(-2.9022)	(-2.9342)	(-2.9440)	(-3.5385)	(-3.4399)	(-2.9695)	(-2.9471)	(-3.0785)	(-2.9225)	(-2.9150)	(-2.8596)	(-2.9726)	(-2.8362)	(-2.9155)
$\Delta d_t I(\Delta d_t I<0)$	-0.2222	-0.0577	-0.0362	-0.0545	-0.0501	-0.1272	-0.4203	-0.1168	-0.4298	-0.1304	-0.1945	-0.0985	-0.0516	-0.1067	-0.0471	-0.0521	-0.0371	-0.0220
	(-2.8372)	(-2.9824)	(-2.8111)	(-2.8248)	(-2.8581)	(-2.8114)	(-2.8666)	(-2.9214)	(-2.9103)	(-2.9077)	(-2.8404)	(-2.9057)	(-2.8766)	(-2.9253)	(-2.8609)	(-3.6277)	(-2.8378)	(-2.8683)
Panel B: Model Diagnostics																		
Adjusted R^2	0.6446	0.6486	0.6597	0.5807	0.5930	0.6256	0.6760	0.7009	0.7452	0.6248	0.6353	0.6455	0.6747	0.6524	0.6633	0.6272	0.6242	0.6470
DW Test	2.3823	2.2169	2.1792	2.3471	2.2247	2.1669	2.3435	2.2827	2.2405	2.2702	2.2114	2.2114	2.4112	2.2875	2.2636	2.2143	2.2186	2.2155
χ^2_N	2.4205	0.3067	0.3595	2.6114	2.5000	0.1005	1.2791	0.0517	2.5186	0.9232	2.9845	2.3810	0.5704	0.7583	1.4306	1.5059	1.7202	1.8202
	[0.2908]	[0.8578]	[0.8355]	[0.2663]	[0.2864]	[0.9948]	[05275]	[0.9745]	[0.2639]	[0.6393]	[0.2248]	[0.3041]	[0.7519]	[0.6845]	[0.4890]	[0.4710]	[0.5149]	[0.5011]
χ^2_{SC}	0.2994	0.8219	0.5716	0.6508	0.6783	1.5696	0.6458	0.7515	1.0305	0.9862	0.7671	1.2462	0.6531	0.0075	1.2583	0.1453	1.3659	0.3256
	[0.7439]	[0.4511]	[0.5719]	[0.5852]	[0.5811]	[0.2279]	[0.6557]	[0.4775]	[0.3759]	[0.3867]	[0.4750]	[0.3049]	[0.6209]	[0.9926]	[0.3047]	[0.8654]	[0.2735]	[0.7251]
χ^2_H	9.3411	10.7826	10.5837	4.8270	5.3436	5.3384	5.7081	3.1780	1.4742	6.4897	4.9780	2.3561	6.0860	3.9572	4.9919	11.0725	8.7312	12.6654
	[0.2366]	[0.2143]	[0.2264]	[0.7759]	[0.7203]	[0.7209]	[0.6799]	[0.9227]	[0.9931]	[0.5926]	[0.7599]	[0.9681]	[0.6376]	[0.8610]	[0.7584]	[0.1976]	[0.3655]	[0.1239]

Notes: AT, BE, FI, FR, GE and NL stand for Austria, Belgium, Finland, France, Germany and the Netherlands respectively; while *hd, cd and pd* stand for household, corporate and public debt respectively.

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors proposed by Newey and West (1987).

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.

The associated probability values are given in square brackets.

Table 3b. Asymmetric model. Peripheral countries.

Panel A: Estimation results

	GR			IT			PT			SP		
	hd	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***
g_{t-1}	0.5992	0.6534	0.1392	0.2557	0.2899	0.1323	0.4766	0.5790	0.3119	0.8802	0.8926	0.4381
	(2.9723)	(2.9536)	(2.9325)	(2.8257)	(2.8777)	(2.8218)	(3.0387)	(2.9794)	(2.9110)	(3.0305)	(3.0503)	(2.8850)
INF_t	-0.3849	-0.2755	-0.3450	-0.0104	-0.0158	-0.0346	-0.1370	-0.1109	-0.0674	-0.0114	-0.1419	-0.0285
	(-3.1451)	(-2.7661)	(-2.9123)	(-2.7827)	(-2.8912)	(-2.7526)	(-2.9267)	(-2.9698)	(-2.7836)	(-2.9152)	(-2.9268)	(-2.8435)
ΔHK_t	0.3057	0.1226	0.1514	0.7764	1.5046	0.9579	1.0638	0.8110	0.2826	0.7905	0.9224	1.2093
	(2.7545)	(2.8327)	(2.8514)	(2.7573)	(2.7722)	(2.8658)	(2.9088)	(2.7454)	(2.7427)	(2.7667)	(2.8269)	(2.9189)
$\Delta OPEN_t$	0.0108	0.1139	0.0120	0.2613	0.2313	0.1879	0.1517	0.1628	0.1237	0.1974	0.2847	0.1221
	(2.7099)	(2.9499)	(2.7406)	(3.5372)	(2.8518)	(2.9468)	(2.7659)	(2.8269)	(2.8510)	(2.8723)	(3.0860)	(2.7902)
$POPGRO_t$	1.4382	1.6757	1.8957	2.3696	2.2084	2.2395	1.2213	0.6516	0.0031	0.3964	0.1359	0.7131
	(2.8082)	(2.9766)	(2.8381)	(2.7549)	(2.8053)	(2.8313)	(2.8256)	(2.7632)	(2.7428)	(2.7170)	(2.8776)	(2.8489)
GS_t	0.2585	0.1714	0.2795	0.0642	0.0366	0.0873	0.1462	0.0577	0.1376	0.0050	0.0191	0.1240
	(3.1210)	(2.8916)	(2.9548)	(2.7266)	(2.9189)	(2.8239)	(2.7403)	(2.8405)	(3.8611)	(2.8124)	(2.7189)	(3.3650)
$\Delta d_t I(\Delta d_t I>0)$	-0.5137	-0.3900	-0.2763	-0.2561	-0.1737	-0.2400	-0.2666	-0.0870	-0.2828	-0.1924	-0.0981	-0.1129
	(-2.8232)	(-2.9150)	(-2.9596)	(-2.9234)	(-2.8325)	(-2.9501)	(-2.9443)	(-2.7413)	(-3.5280)	(-2.9296)	(-2.7754)	(-3.1691)
$\Delta d_t I(\Delta d_t I<0)$	-0.4800	-0.0033	-0.0526	-0.1878	-0.0751	-0.1760	-0.4112	-0.0706	-0.1343	-0.7396	-0.0728	-0.0376
	(-2.7953)	(-2.8117)	(-2.8463)	(-3.2643)	(-2.8960)	(-2.8649)	(-2.8545)	(-2.8561)	(-2.8546)	(-2.8585)	(-2.9720)	(-2.9599)

Panel B: Model Diagnostics

	GR *hd*	GR *cd*	GR *pd*	IT *hd*	IT *cd*	IT *pd*	PT *hd*	PT *cd*	PT *pd*	SP *hd*	SP *cd*	SP *pd*
Adjusted R^2	0.5824	0.6550	0.7370	0.6628	0.6021	0.6201	0.6121	0.6543	0.6647	0.6136	0.6395	0.6873
DW Test	2.3108	2.2684	2.2910	2.2083	2.2837	2.3025	2.2117	2.1382	2.1709	2.3208	2.1564	2.2221
χ^2_N	0.7340	0.1803	1.3648	0.2160	0.9752	0.5109	0.5135	1.4850	2.4805	0.1092	1.4116	1.4624
	[0.6928]	[0.9138]	[0.5054]	[0.8976]	[0.6138]	[0.7746]	[0.7736]	[0.4759]	[0.2893]	[0.9469]	[0.4937]	[0.5637]
χ^2_{SC}	0.3257	0.5302	1.6182	1.7222	1.6267	1.0837	0.4286	0.3776	0.5417	0.0938	1.2985	0.9362
	[0.7251]	[0.7203]	[0.2183]	[0.1992]	[0.2167]	[0.3550]	[0.6561]	[0.8312]	[0.5941]	[0.9108]	[0.2907]	[0.4086]
χ^2_H	4.5151	4.9322	0.6884	6.7924	5.9522	4.4272	5.0263	4.2221	8.6515	7.4995	2.9953	8.8562
	[0.8070]	[0.7648]	[0.9996]	[0.5592]	[0.6526]	[0.8167]	[0.7548]	[0.8365]	[0.2725]	[0.4838]	[0.9347]	[0.3546]

Notes: GR, IT, PT and SP stand Greece, Italy, Portugal and Spain respectively; while *hd, cd and pd* stand for household, corporate and public debt respectively.
In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors
In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors proposed by Newey and West (1987).
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.
The associated probability values are given in square brackets.

Table 4a. Threshold model. Central countries.

Panel A: Estimation results

	AT			BE			FI			FR			GE			NL		
	hd	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***
g_{t-1}	0.3812	0.4619	0.3980	0.0826	0.1164	0.1468	0.0060	0.0349	0.2867	0.4901	0.3768	0.1592	0.1382	0.2537	0.0676	0.5486	0.5662	0.4578
	(2.9578)	(3.5729)	(2.8935)	(2.9650)	(2.9329)	(2.9207)	(2.9711)	(2.9264)	(2.8979)	(3.3965)	(2.9565)	(2.9171)	(3.1128)	(2.8757)	(2.9189)	(3.7974)	(3.9266)	(3.3624)
INFt	-0.1579	-0.1228	-0.1701	-0.2059	-0.2556	-0.1151	-0.3094	-0.3033	-0.2321	-0.0713	-0.0368	-0.1219	-0.2243	-0.1509	-0.2085	-0.3287	-0.4401	-0.4506
	(-2.9175)	(-2.9232)	(-2.8547)	(-2.8615)	(-2.9776)	(-2.8376)	(-2.8842)	(-2.9407)	(-2.8635)	(-2.8191)	(-2.8378)	(-2.8480)	(-2.9366)	(-2.9003)	(-2.9701)	(-2.9541)	(-2.9183)	(-2.9487)
ΔHKt	1.0575	1.1273	0.6369	1.5200	1.4224	1.7559	0.8464	1.0339	0.0700	1.7175	1.6387	0.9103	2.0515	1.7604	1.6316	0.7420	0.0409	0.8853
	(2.8491)	(2.8247)	(2.9444)	(2.8730)	(2.8646)	(2.7655)	(2.7860)	(2.8702)	(2.8496)	(2.8853)	(2.8510)	(2.8106)	(2.9170)	(2.9799)	(2.9344)	(2.7527)	(2.8476)	(2.8715)
ΔOPENt	0.2201	0.2860	0.2524	0.1326	0.1350	0.1005	0.2582	0.4096	0.2632	0.2517	0.2409	0.1602	0.3854	0.4122	0.3980	0.1377	0.1223	0.1179
	(4.4324)	(4.5622)	(3.5412)	(2.9958)	(3.8539)	(3.2246)	(3.1223)	(4.2784)	(4.1254)	(3.5592)	(3.1871)	(2.8723)	(5.6486)	(5.1063)	(3.9811)	(3.2575)	(2.8468)	(3.2622)
POPGROt	0.0386	0.0774	0.7719	1.7896	1.6550	1.5868	13.3835	10.9080	4.9110	1.0355	1.6401	0.0882	0.8180	0.9903	0.8069	0.2997	0.8598	0.7978
	(2.8646)	(2.7838)	(2.8561)	(2.8434)	(2.7783)	(2.8359)	(3.9879)	(3.9674)	(2.7667)	(2.7924)	(2.8374)	(2.7586)	(2.8716)	(2.8696)	(2.7638)	(2.8640)	(2.9459)	(2.7516)
GSt	0.0411	0.0622	0.0431	0.0990	0.1059	0.0829	0.2690	0.2224	0.1733	0.0018	0.0033	0.0889	0.0006	0.0060	0.0022	0.0469	0.0454	0.0642
	(2.8945)	(2.7524)	(2.8156)	(4.2681)	(4.5304)	(3.4266)	(4.7280)	(5.0413)	(4.0169)	(2.8179)	(2.8937)	(2.8341)	(2.9287)	(2.8250)	(2.9583)	(2.8394)	(2.8733)	(2.8695)
ΔdtI(dt>d*)	-0.2771	-0.2113	-0.0524	-0.2635	-0.0549	-0.0341	-0.3172	-0.5295	-0.4311	-0.2782	-0.2908	-0.2864	-0.1355	-0.0211	-0.1770	-0.0337	-0.0748	-0.2592
	(-2.9968)	(-3.2864)	(-2.9410)	(-2.9614)	(-2.8420)	(-2.8473)	(-2.8879)	(-3.7953)	(-3.3641)	(-2.8735)	(-2.9307)	(-3.6270)	(-2.8793)	(-2.9365)	(-2.9165)	(-2.9461)	(-2.8782)	(-2.9513)
ΔdtI(dt<d*)	0.1290	0.0542	0.0398	0.0965	0.0066	0.0061	0.7080	0.2433	0.2408	0.1466	0.0570	0.0487	0.0936	0.0280	0.0571	0.3754	0.0230	0.0218
	(2.8791)	(2.8612)	(2.8345)	(2.8711)	(2.8115)	(2.7638)	(2.8324)	(2.8659)	(3.1271)	(2.9690)	(2.8345)	(2.8674)	(2.8779)	(2.9707)	(3.1712)	(2.9511)	(2.8325)	(2.8203)
d*	39%	65%	60%	40%	110%	96%	34%	105%	40%	40%	135%	35%	65%	60%	40%	47%	102%	60%

Panel B: Model Diagnostics

	AT *hd*	AT *cd*	AT *pd*	BE *hd*	BE *cd*	BE *pd*	FI *hd*	FI *cd*	FI *pd*	FR *hd*	FR *cd*	FR *pd*	GE *hd*	GE *cd*	GE *pd*	NL *hd*	NL *cd*	NL *pd*
Adjusted R^2	0.6733	0.6641	0.6816	0.6662	0.5728	0.6678	0.6778	0.7411	0.7571	0.6767	0.5873	0.6786	0.6979	0.6632	0.6773	0.6588	0.6239	0.6454
DW Test	2.2078	2.1265	2.1861	2.3727	2.1528	2.1871	2.4117	2.2471	2.2131	2.2754	2.2233	2.1881	2.3312	2.2093	2.2112	2.2363	2.2180	2.2164
χ^2_N	0.9964	1.4591	0.2813	0.6388	0.7440	0.9011	0.7667	0.0397	2.2067	1.2756	1.7358	2.0208	0.7933	0.9080	1.0586	0.6652	0.7351	0.7813
	[0.6076]	[0.4821]	[0.8688]	[0.7283]	[0.6833]	[0.6373]	[0.6867]	[0.9804]	[0.3318]	[0.5285]	[0.4198]	[0.3841]	[0.6726]	[0.6351]	[0.5890]	[0.6357]	[0.6517]	[0.64111]
χ^2_{SC}	0.6195	0.4473	0.4990	1.1391	2.2545	1.8948	0.6297	0.5488	1.5578	1.4275	0.9418	1.0884	1.0565	1.1253	0.7799	1.1263	1.2661	1.0447
	[0.5463]	[0.6444]	[0.6130]	[0.3362]	[0.2287]	[0.1713]	[0.6924]	[0.5844]	[0.2392]	[0.2588]	[0.4033]	[0.3522]	[0.3534]	[0.3404]	[0.4693]	[0.3401]	[0.3009]	[0.3667]
χ^2_H	4.7135	9.0544	7.7119	4.4394	5.8618	3.2244	7.6402	3.0921	1.6446	6.3419	4.8857	0.9549	6.8825	4.1841	3.3197	10.5322	7.9127	11.9384
	[0.7650]	[0.3377]	[0.4614]	[0.8155]	[0.6627]	[0.9195]	[0.4694]	[0.9284]	[0.9900]	[0.6090]	[0.7697]	[0.9985]	[0.5494]	[0.8401]	[0.9127]	[0.2296]	[0.4420]	[0.2168]

Notes: AT, BE, FI, FR, GE and NL stand for Austria, Belgium, Finland, France, Germany and the Netherlands respectively; while *hd, cd and pd* stand for household, corporate and public debt respectively.

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors

*d** indicates the estimated threshold in the debt/GDP ratio.

In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors proposed by Newey and West (1987). 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. The associated probability values are given in square brackets.

Table 4b. Threshold model. Peripheral countries.

Panel A: Estimation results												
	GR			IT			PT			SP		
	hd	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***	***hd***	***cd***	***pd***
g_{t-1}	0.6956	0.7073	0.4205	0.1655	0.2471	0.2426	0.4581	0.4709	0.3036	0.8802	0.8533	0.3218
	(3.8584)	(4.4791)	(2.7976)	(2.8455)	(2.9131)	(2.8477)	(2.9148)	(2.9488)	(2.9465)	(3.0305)	(3.1630)	(2.8527)
INF_t	-0.3282	-0.2385	-0.3245	-0.0572	-0.0292	-0.0900	-0.1163	-0.0950	-0.0120	-0.0114	-0.0890	-0.1132
	(-2.7342)	(-2.7425)	(-2.9230)	(-2.7762)	(-2.8405)	(-2.8888)	(-2.8568	(-2.8398)	(-2.7699)	(-2.9152)	(-2.9202)	(-2.7810)
ΔHK_t	0.5166	0.4972	0.1976	1.0427	1.3297	1.0141	0.8297	1.0094	0.0863	0.7905	0.7258	1.2688
	(2.7251)	(2.7249)	(2.8103)	(2.7648)	(2.9124)	(2.7499)	(2.7768)	(2.7957)	(2.8133)	(2.7667)	(2.8614)	(2.7901)
$\Delta OPEN_t$	0.0133	0.0462	0.0044	0.3049	0.2144	0.2509	0.1279	0.1281	0.1374	0.1974	0.3062	0.1490
	(2.8119)	(2.7408)	(2.7847)	(4.1812)	(2.8369)	(3.1804)	(2.7312)	(2.7735)	2.7649)	(2.8723)	(3.0701)	(2.0466)
$POPGRO_t$	1.7723	1.8452	2.7994	1.8146	2.2311	1.5816	1.2847	0.6516	0.3953	0.3964	0.1754	0.4447
	(2.9354)	(2.8378)	(2.7619)	(2.7612)	(2.8268)	(2.7537)	(2.8695)	(2.7598)	(2.7449)	(2.7170)	(2.7349)	(2.7594)
GS_t	0.1976	0.1094	0.1529	0.0168	0.0358	0.0596	0.1256	0.0911	0.0949	0.0050	0.0355	0.1465
	(2.7586)	(2.9228)	(2.9539)	(2.7613)	(2.8988)	(2.9162)	(2.9472)	(2.8323)	(2.8475)	(2.8124)	(2.8211)	(2.9624)
$\Delta d_t I(\Delta d_t I>0)$	-0.7607	-0.5550	-0.1440	-0.1172	-0.1842	-0.2821	-0.1764	-0.1738	-0.2074	-0.1924	-0.1846	-0.2970
	(-2.9171)	(-2.8235)	(-2.9542)	(-2.9741)	(-2.9172)	(-2.9449)	(-2.9543)	(-2.8508)	(-2.9400)	(-2.9296)	(-2.9342)	(-2.9764)
$\Delta d_t I(\Delta d_t I<0)$	0.5346	0.0580	0.0464	0.7293	0.1301	0.1097	0.3889	0.2181	0.0296	-0.7396	0.2248	0.0313
	(2.8994)	(2.7648)	(2.8711)	(3.7289)	(2.8578)	(2.8614)	(2.8335)	(2.7654)	(2.8110)	(-2.8585)	(2.8698)	(2.8763)
d^*	32%	52%	71%	19%	61%	90%	33%	80%	50%	40%	95%	50%
Panel B: Model Diagnostics												
Adjusted R²	0.6316	0.6824	0.7103	0.6112	0.6404	0.6714	0.6415	0.6762	0.6762	0.6568	0.6607	0.7887
DW Test	2.3005	2.1822	2.1493	2.2567	2.2311	2.2381	2.3691	2.2233	2.2191	2.3149	2.2845	2.2153
χ^2_N	2.2877	0.7561	0.0312	2.5389	0.3742	1.1246	0.7757	0.0647	0.1476	0.7465	1.1876	1.0470
	[0.3186]	[0.6852]	[0.9845]	[0.2810]	[0.8294]	[0.5448]	[0.6785]	[0.9682]	[0.9289]	[0.6996]	[0.5612]	[0.5925]
χ^2_{SC}	0.8302	1.6307	0.4180	1.6747	0.8491	1.5284	0.3948	1.0446	1.0446	0.7698	0.7427	0.7515
	[0.4476]	[0.2159]	[0.6629]	[0.2077]	[0.4398]	[0.2365]	[0.6779]	[0.3667]	[0.3667]	[0.4738]	[0.4861]	[0.4833]
χ^2_H	6.2949	3.1782	7.6419	3.7351	5.8636	6.8805	7.5708	3.0960	3.0960	6.4329	3.4514	3.8619
	[0.6142]	[0.9227]	[0.4692]	[0.8802]	[0.6625]	[0.5496]	[0.4765]	[0.9282]	[0.9282]	[0.5989]	[0.9029]	[0.8694]

Notes: GR, IT, PT and SP stand for Greece, Italy, Portugal and Spain respectively, while *hd, cd and pd* stand for household, corporate and public debt respectively.
In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors
*d** indicates the estimated threshold in the debt/GDP ratio.
In the ordinary brackets below the parameter estimates, the corresponding *t*-statistics are shown, based on the heteroskedasticity and autocorrelation consistent standard errors proposed by Newey and West (1987). 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. The associated probability values are given in square brackets.

UB IREA

Institut de Recerca en Economia Aplicada Regional i Pública
Research Institute of Applied Economics

Universitat de Barcelona
Av. Diagonal, 690 • 08034 Barcelona

WEBSITE: www.ub.edu/irea/ • **CONTACT:** irea@ub.edu