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Membership in the Euro area and fiscal sustainability.

Analysis through panel fiscal reaction functions

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Abstract

We estimate various panel fiscal reaction functions, including those of the main categories of general government revenue and expenditure for the 12 Euro area member states over the 1970-2013 period. We find that in the peripheral countries where sovereign bond yields decreased sharply in the years 1996-2007, fiscal stance ceased to respond to sovereign debt accumulation. This was due to the lack of sufficient adjustment in the government non-investment expenditure and direct taxes. In contrast, in the core member states, which did not benefit from the yields' convergence related to the Euro area establishment, responsiveness of fiscal stance to sovereign debt increased between 1996 and 2007. This was achieved mainly through pronounced adjustments in the government non-investment expenditure. Our findings are in accordance with the predictions of the theoretical model by Aguiar et al. (2014) and are robust to various changes in the modelling approach.

JEL classification: C23, E62, F34, H63

Keywords: fiscal reaction function, sovereign bond yields' convergence, fiscal adjustment composition

1. Introduction

Although the European sovereign debt crisis burst five years ago[1], its' causes still remain unclear. There are three explanations of the crisis which differ with respect to the assessment of pre-crisis fiscal policy in the peripheral countries of the Euro area (i.e. in Greece, Ireland, Italy, Portugal, and Spain).

According to the first narrative, the debt crisis was closely linked to the global financial crisis, which pushed the peripheral member states into a particularly deep recession resulting in a huge fiscal deficit and exploding sovereign debt. This narrative emphasizes that before the outburst of the global financial crisis, fiscal deficits in the peripheral member states were low and sovereign debt levels rather stable (see, e.g. Bronner et al., 2014).

The second narrative links the sovereign debt crisis to unsustainable fiscal policy which the peripheral member states were running after joining the Euro area. According to this narrative, these countries could anticipate a bailout by the remaining member states for either political reasons or due to the fear of financial contagion (see, e.g. Baskaran and Hessami, 2013).

The third explanation (see, e.g. Aguiar et al., 2014) points to the following mechanism. The prospects of joining the Euro area allowed the peripheral countries to benefit from higher credibility of the remaining member states. This opportunity weakened the incentive of their governments to spend less in order to borrow cheaply, while leaving their impatience unchanged.[2] Thus, they loosened their fiscal policy. Nevertheless, this policy change was not driven by the anticipation of a bailout by the remaining countries (as suggested by the second narrative), but by a windfall of lower interest payments. However, when the global financial crisis spawned fears of Euro area disintegration[3] and the windfall disappeared, fiscal policy run by peripheral countries turned out to be unsustainable.

[1] The crisis is described in details, e.g. by Lane (2012) and Shambaugh (2012).
[2] By the same token, if credibility of the remaining countries was somewhat weakened by a currency union, the incentive of their governments to spend less in order to borrow cheaply should have been strengthened.
[3] In November 2011 the probability (implied from prices on the online betting market Intrade) that at least one country would leave the Euro area peaked at over 65% (Shambaugh, 2012).

Empirical literature on pre-crisis fiscal sustainability in the Euro area has been growing fast in recent years. Nevertheless, it does not provide evidence unambiguous enough to confirm one explanation and reject others. For example, Baldi and Staehr (2013) do not find different fiscal reaction functions for the pre-crisis period in the countries which eventually experienced serious sovereign debt problems, compared to the ones less affected. In contrast, Baskaran and Hessami (2013) find some evidence that introduction of the Euro and, in particular, suspension of the Stability and Growth Pact in the late 2003 encouraged borrowing in countries which had traditionally run large fiscal deficits. In turn, Weichenrieder and Zimmer (2013) find that the Euro area membership has weakened the responsiveness of fiscal policy to the level of sovereign debt compared to the period prior to the Euro adoption. However, they view their results as not robust enough to draw firm conclusions. Thus, further research is needed. We provide empirical evidence in favor of the third narrative, which provides at least three testable hypotheses. First, the perspective of joining and then membership in the Euro area subdued the importance of domestic factors in sovereign bond yields of the peripheral countries. These factors regained their importance only after the fears of Euro area disintegration had spread. Second, the peripheral countries had been running unsustainable fiscal policies before the global financial crisis. Their policies ceased to be sustainable not after adopting the Euro, but when their governments started to gain the windfall of low interest burden. Third, during the period, when peripheral countries were gaining the windfall of low interest burden, the remaining countries strengthened their fiscal sustainability.

There is ample evidence supporting the first hypothesis[4], therefore, we focus on the remaining two. Our approach to study fiscal sustainability builds on the framework of fiscal reaction functions proposed by Bohn (1998) and developed by many others, in particular de Mello (2005) and Mendoza and Ostry (2008). We use it in a form which controls for the possibility of spurious correlation, much like, *inter alia*, Afonso (2008), Afonso and Jalles (2011), or Medeiros (2012) have done. Following Favero and Marcellino (2005) and, in particular, Burger and Marinkov

[4] See, e.g. Afonso et al., 2012; Afonso et al., 2013; Arghyrou and Kontonikas, 2011; Aßmann and Boysen-Hogrefe, 2012; Attinasi et al., 2009; Bernoth and Erdogan, 2012; Borgy et al., 2012; De Grauwe and Ji, 2012a and 2012b; De Santis, 2012; Gibson et al., 2012; Gerlach et al., 2010; von Hagen et al., 2011; or Haugh et al., 2009.

(2012), we apply such a function not only to the fiscal stance indicators, but also to major categories of government revenue and expenditure.

We estimate fiscal reaction functions on a sample of 12 early member states of the Euro Area in the period of 1970-2013. We divide the sample into two groups based on the scale of benefits from the sovereign bond yields' convergence related to the establishment of the Euro area[5]. This benefits also form the split of the analyzed period into two sub-periods: the baseline (covering the years of 1970-1995 and 2008-2013) and the time of the windfall for the peripheral member states (covering the years 1996-2007).

Our main findings are as follows. First, in the countries where sovereign bond yields decreased sharply in the years 1996-2007, fiscal stance ceased to respond to sovereign debt accumulation. This was due to the lack of sufficient adjustment in government non-investment expenditure and direct taxes. By contrast, in the member states which did not benefit from the yields' convergence related to the Euro area establishment, responsiveness of the fiscal stance to sovereign debt increased during 1996-2007. It was achieved mainly through the pronounced adjustments of government non-investment expenditure. This findings are robust to the changes in the estimation method, measure of fiscal stance, composition of the sample and definition of the windfall.

The paper makes three main contributions to the literature.

First, while studying fiscal sustainability in the Euro area, the paper focuses on effects of the windfall gains from the sovereign bond yields' convergence in the peripheral countries. To the best of our knowledge, none of the previous studies on fiscal reaction functions in the Euro area pay as much attention as this paper does to the role of windfall.

Second, due to such a focus, the paper contributes to the relatively underdeveloped literature on the effects of windfall gains in advanced economies. Although the literature on windfall gains is broad and diverse, it is centered on the developing countries. It has been focusing on natural resources (see, e.g. Mehlum et al., 2006), foreign aid (see, e.g. Svensson, 2000), or foreign borrowing (see, e.g.

[5] Other reasons for such a division are specified in the section 1.

Vamvakidis, 2007). These sources of windfall are of no importance to the vast majority of advanced economies. Exceptions include e.g. resource abundant countries like Norway, which have made good use of such kind of windfall (see, e.g. Gylafson, 2011). Obviously, the paper is not the first one to deal with the effects of windfall on the peripheral countries of the Euro area. It follows, e.g. Fernández-Villaverde et al. (2013), however only in very general terms. These authors, on the one hand, associate the windfall with the global financial bubble, rather than with sovereign bond yields' convergence related to the Euro area establishment. On the other hand, they study the general reform process in the peripheral economies rather than fiscal policy.

Third, the paper studies links between fiscal adjustment composition and fiscal sustainability through the lens of fiscal reaction functions[6]. The main advantage of this approach is being able to avoid discretion in defining the notion of fiscal sustainability. The paper extends analyses by Favero and Marcellino (2005) and Burger and Marinkov (2012). The former studies reactions of total revenue and expenditure only, whereas the latter analyses South Africa rather than the Euro area.

The remainder of the paper is organized in five sections and an appendix. Section 1 provides a bird's eye view of the windfall in the peripheral economies resulting from the sovereign bond yields' convergence related to the establishment of the Euro area and how it was used. Section 2 presents our estimation strategy. Section 3 provides estimation results of various fiscal reaction functions. Section 4 verifies the results' robustness. Section 5 discusses policy implications. Section 6 concludes. The appendix including figures and tables follows.

[6] Research on these links has intensified following the sovereign debt crisis in the Euro area (see, e.g. Afonso and Jalles, 2012; Alesina and Ardagna, 2013; or Heylen et al., 2013). However, most papers generally approached the issue from different angles than the one which fiscal reaction functions allow for.

2. A bird's eye view of the effects of windfall from the sovereign bond yields' convergence in the Euro area

When the establishment of the Euro area was formally decided in the Maastricht Treaty in 1992, there was a clear division across the EU with regard to the sovereign bond yields. While in most EU countries they were very close to each other, spread against 10 year German bunds was ranging from 4 to 6 percentage points in Italy, Portugal and Spain. In Greece it was even exceeding 16 percentage points.

We label these 4 countries as peripheral. Ireland, with the spread in excess of 1 percentage point, hardly fits this group, however taking into account the yield path in the aftermath of the crisis, we included it among the peripheral countries (as most other studies do – see, e.g. Corsetti at al., 2014, Lane, 2012 or Shambaugh, 2012)[7, 8].

The spreads in the peripheral countries started to narrow after December 1995, when details of Euro adoption were agreed upon. During the subsequent 3 years, spreads dropped to about 20 basis points, except for Greece, where the yields' convergence took 2 years longer. Therefore, financial markets treated the peripheral countries like the most economically stable core countries. The changes in spreads are shown in Figure 1.

Yields' convergence contributed to a deep decline of interest payments on sovereign debt in the peripheral countries. In 1996-1999 the decline ranged from 1.7% of GDP in Spain to 4.9% of GDP in Italy. By comparison, in the core countries it ranged from 0.1% of GDP in Luxembourg to 1.6% of GDP in Belgium. Gains in terms of lower interest payments due to yields' convergence were magnified in the peripheral countries by larger sovereign debt levels compared to the core countries. Although in 1996 the country with the largest net debt was Belgium, the next five most indebted EU states belonged to the peripheral countries.

[7] The first study applies sovereign CDS spread above 150 basis points as a formal criterion for delineation between the peripheral and core countries. The remaining two studies do not specify criteria, but they also seem to base their division of the Euro area on the yield paths in the aftermath of the crisis.

[8] In the econometric analysis developed in Section 4 we check robustness of the results to the exclusion of Ireland from the peripheral economies.

In 1999-2007 interest payments declined further. In both groups of countries the decline was similar and ranged from 0.1% to 3.0% of GDP. While in the peripheral countries it was primarily due to the rollover of maturing debt at lower yields, in the majority of core economies it was caused largely by a fall in the sovereign debt level.

Described yields' convergence in the peripheral countries resulted in a negative interest rate growth differential (IRGD), which is the difference between the interest rate paid to service sovereign debt and the growth rate of the economy. While IRGD in the core countries became clearly negative only in 2006-2007, i.e. at the peak of the pre-crisis boom and during the early phase of subsequent flight-from-risk and flight-to-quality[9], yields in the peripheral countries fell below the nominal GDP growth rate in 1996 and remained clearly below that rate until 2007 (see Figure 2)[10].

Negative IRGD implies that larger spending today does not require lower future spending (see, e.g. Fischer and Easterly, 1990). In the case of fiscal policy, this means that, in theory, permanently negative IRGD prevents sovereign debt to GDP ratio from exploding notwithstanding the primary deficit. Even if government incurs debt to repay the whole interest on debt previously incurred, the sovereign debt grows slower than the economy (cf. equation 2 in section 3) [11]. There where at least two reasons why negative IRGD in the peripheral countries should be considered a windfall rather than a permanent phenomenon. First, one might expect interest rates to stay permanently below the growth rate of an economy if the economy over-saved, i.e. kept savings above capital remuneration. However this had not been the case with respect to the peripheral economies, as their domestic saving rates remained much lower than the capital share of GDP. Second, there is plenty of empirical evidence confirming that country-specific credit and liquidity risk factors

[9] Flight-from-risk and flight-to-quality are provided as an explanation of the negative IRGD in the core countries by, e.g. Caporale and Girardi (2011).

[10] In this group only Italy which was struggling with slow GDP growth, did not benefit from negative IRGD. Lack of large external imbalances was another Italian peculiarity. Due to this peculiarity Italy is not included in peripheral countries in some studies (see, e.g. Kang and Shambaugh, 2014). In the econometric analysis we check robustness of our results to the change of Italy's classification (i.e. shifting from peripheral to core countries).

[11] However, Ball et al. (1998) argue that attempt to roll over sovereign debt forever would fail in the case of negative shock to output growth. Such a shock would force government to impose higher taxation on generations already burdened by slow output growth. This is what apparently happened in the peripheral countries in the aftermath of the global financial crisis.

in the yields of the peripheral countries were dominated by the international factor. Therefore, the former factors were mispriced in the years preceding the global financial crisis[12]. After its' outburst, when these factors started regaining their importance, the yields of the peripheral countries soared[13].

Despite the arguments mentioned above, fiscal policy in the peripheral countries had been run as if IRGD was to be permanently negative. We present a justification of this thesis in the following paragraphs.

The period prior to introducing the Euro is commonly hailed as one of successful fiscal consolidations, which even resulted in a "consolidation fatigue" after the Euro area establishment (see, e.g. Briotti, 2004 or Fernández-Villaverde et al., 2013). In 1996-1999 fiscal balance indeed improved considerably. However, in the peripheral countries almost 80% of this improvement was due to a decline in interest payments[14] and the remaining part due to cyclical factors. It was accompanied by increases in non-interest spending (sometimes very large, e.g. Greece and Portugal), but their impact on fiscal stance was muted or even offset by tax increases. In the core countries in 1996-1999 fiscal balance improved much less than in the peripheral countries. In contrast to the one in the peripheral countries, its' improvement did not result exclusively from the decline of interest payments, nor from cyclical factors, but also from cuts in the non-interest spending. Changes of the main fiscal categories in the peripheral and core countries in 1996-1999 are compared in Figure 3.

In 1999-2007 fiscal policy was expansionary in the peripheral, as well as core countries. However, both groups of countries substantially differed in terms of the size and composition of fiscal expansion. In the peripheral countries the fiscal balance worsened in spite of the decline in interest payments and booming economy. This worsening resulted from the very large increases in non-interest spending. In

[12] See, e.g. Afonso et al., 2012; Barrios et al., 2009; Bernoth and Erdogan, 2012; De Grauwe and Ji, 2012a, 2012b; Haugh et al., 2009; or Laubach, 2011.
[13] See, e.g. Afonso et al., 2012; Afonso et al., 2013; Arghyrou and Kontonikas, 2012; Aßmann and Boysen-Hogrefe, 2012; Attinasi et al., 2009; Bernoth and Erdogan, 2012; Borgy et al., 2012; De Grauwe and Ji, 2012a, 2012b; De Santis, 2012; Gerlach et al., 2010; Gibson et al., 2012; von Hagen et al., 2011; or Haugh et al., 2009.
[14] This is probably why e.g. Briotti (2004) finds that the more indebted the country was, the deeper fiscal consolidation it undertook before Euro adoption.

every peripheral country they exceeded 2% of GDP in cyclically adjusted terms (and in Greece and Ireland – even 5% of GDP). Unlike in 1996-1999, their impact on the fiscal stance was not seriously alleviated by tax increases, except in Portugal and Spain. In the core countries the worsening of cyclically adjusted primary balance was not large enough to outweigh the decline of interest payments and the positive effects of automatic stabilizers on the fiscal balance. Besides, it resulted from tax reductions (sometimes very large, in particular in Austria, Germany and Luxembourg), while non-interest spending was usually cut. It is also worth noting that the worsening reflected the introduction of a countercyclical fiscal stimulus after the burst of the dotcom bubble, which was largely withdrawn in the subsequent years. That said, fiscal profligacy in the large core economies early after the Euro area establishment, led to the suspension of the Stability and Growth Pact in 2003 and its' watering-down in 2005. Changes in the main fiscal categories in the peripheral and core countries between 1999-2007 are shown in Figure 4.

As the majority of the peripheral countries increased their non-interest spending in 1996-2007 by more than they saved on interest payments, they entered the global financial crisis with cyclically adjusted primary balance in the red. Italy was the only exception to that rule. By comparison, among the core countries only France ran a cyclically adjusted primary balance deficit at the time[15]. Still worse, although the peripheral countries lacked fiscal space, most of them introduced large fiscal stimuli in response to the outburst of the crisis. As a result, when the yields diverged in 2010-2012, all the peripheral countries experienced solvency problems. They either accepted assistance from the EU bailout mechanisms: European Financial Stability Facility (EFSF) or European Stability Mechanism (ESM) (Ireland, Greece, Portugal and Spain), or were major beneficiaries of unconventional monetary policy measures undertaken by the European Central Bank (ECB), which included bond purchase programs (Italy and Spain). These problems forced the peripheral countries to introduce large fiscal consolidations in 2010-2013.

[15] That picture changes if cyclical adjustment of primary balance is based on trend GDP instead of potential output. According to this alternative measure of cyclically adjusted primary balance, Austria and Netherlands were also in the red.

Nevertheless, their cyclically adjusted primary balance had remained worse than in the core countries, even though due to higher yields they would need better primary balance (or faster growth) than the core countries to achieve fiscal sustainability.

The July 2012 declaration by Mario Draghi, the President of the ECB, to do "whatever it takes to preserve the euro" and the announcement of Outright Monetary Transactions (OMT) in September 2012 was followed by yields' re-convergence[16] (even though the OMT framework has not been used so far to make any bond purchase). The effects of this re-convergence on fiscal sustainability in the peripheral countries remains to be seen.

[16] Although many observers credit these events for the falling sovereign spreads in peripheral countries (see, e.g. Corsetti et al., 2014), other researchers argue that it was rather related to the reduction in external imbalances of the countries in question (see, e.g. Gros, 2013). Some other observers (in particular, Steikamp and Westermann, 2014) go even further in their skepticism, as the ECB has the status of senior lender and they find evidence that the share of senior lenders in the total sovereign debt increases sovereign bond yields.

3. Estimation strategy

The narrative analysis from the previous section suggests three hypotheses concerning the differences in the effects of yields' convergence on fiscal sustainability across the Euro area countries:

Hypothesis A: the peripheral countries were running unsustainable fiscal policies, when they were receiving the windfall from the yields' convergence;

Hypothesis B: at that time, the core countries have strengthened their fiscal sustainability;

Hypothesis C: this distinction has been mirrored primarily in the differences between the core and peripheral countries in terms of non-interest expenditure changes during the windfall period.

The hypotheses are in line with the explanation of the European sovereign debt crisis by Aguiar et al. (2014) presented in the introduction to the paper. In the next two sections we verify the hypotheses econometrically, using heterogeneous fiscal reaction functions.

Note that it remains questionable, whether testing sustainability in the hard sense is at all possible, as it would seem to require perfect knowledge of the future distribution of sovereign debt across different states of nature (Bohn, 1995). Therefore when testing sustainability with fiscal reaction functions, we define it in a weak sense, i.e. as a policy which responds to surges in sovereign debt with increases in primary balance. This approach leaves out the unfortunate case when government's response is too weak to avoid sovereign debt accumulating up to the level, where there is a serious risk of default.

The literature on fiscal reaction functions has been fast growing in the recent years. On the theoretical ground, the new impulse to its' development was given, in particular, by Bohn (2007), who argued against the reliability of unit root and cointegration tests in evaluating fiscal sustainability.[17] On empirical ground, this impulse was given by the global financial crisis, followed by serious fiscal tensions

[17] Bohn (2007) has shown cointegration tests to be incapable of rejecting the consistency of data with the intertemporal budget constraint. If any finite number of differencing operations is sufficient to turn the debt variable stationary, then the budget identity is satisfied.

in various parts of the world, especially in the Euro area (see, e.g. Baldi and Staehr, 2013; Baskaran and Hessami, 2013; European Commission, 2011; Medeiros, 2012; or Weichenrieder and Zimmer, 2013).

Fiscal reaction functions are derived from the budget identity (see in particular the seminal paper by Bohn, 1998):

$$D_t = (1 + i_t) \cdot D_{t-1} - PB_t \tag{1}$$

where D stands for the sovereign debt, i for the nominal interest rate on sovereign debt and PB for the primary balance.

After shifting to GDP ratios, the budget identity implies that a change in public debt yields:

$$\Delta\left(\frac{D}{Y}\right)_t = \left(\frac{r - g}{1 + g}\right)_t \cdot \left(\frac{D}{Y}\right)_{t-1} - \left(\frac{PB}{Y}\right)_t \tag{2}$$

where Y stands for the GDP, r for the real interest rate on sovereign debt and g for the real growth rate of GDP.

Setting a stable debt-to-GDP ratio $\Delta\left(\frac{D}{Y}\right)_t = 0$ and defining $\alpha_t = \left(\frac{r-g}{1+g}\right)_t$, one gets:

$$\left(\frac{PB}{Y}\right)_t = \left(\frac{r - g}{1 + g}\right)_t \cdot \left(\frac{D}{Y}\right)_{t-1} = \alpha_t \cdot \left(\frac{D}{Y}\right)_{t-1} \tag{3}$$

Equation (3) allows the estimation of the simplest fiscal reaction function:

$$\left(\overline{\frac{PB}{Y}}\right)_t = \alpha \cdot \left(\frac{D}{Y}\right)_{t-1} + \varepsilon_t \tag{4}$$

Given that inequality: $r > g$ should hold in the long run[18], fiscal sustainability in the weak sense, we referred to previously, requires a statistically significant and positiveα.

Empirical fiscal reaction functions usually include also output gap and government expenditure gap to control for the effects of cyclical fluctuations (see, e.g. Bohn, 1998), lag of primary balance to allow for policy inertia (see, e.g. de

[18] At least in the long term, to which the notion of fiscal sustainability applies. Nevertheless, as already mentioned, Ball et al. (1998) provide some reservations to this claim with regard to sovereign bond yields.

Mello, 2005), or current account balance to control for the "twin deficits" effect (Mendoza and Ostry, 2008 or European Commission, 2011). Current account balance in our case is particularly useful, as the cost competitiveness of the peripheral countries had been deteriorating after their accession to the Eurozone. In the first step of econometric analysis we start with the same specification as European Commission (2011):

$$pbalance_{it} = \alpha_i + \alpha_1 \cdot pbalance_{it-1} + \alpha_2 \cdot debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_4 \cdot cab_{it} + \varepsilon_{it} \quad (5)$$

where α_i is the country effect, $pbalance$ is the primary balance, $debt$ is the sovereign debt, $ogap$ is the output gap, $ggap$ is the cyclical component of government final consumption expenditure, cab is the current account balance[19]. We modify the specification in order to take into account nonstationarity of the variables: according to Maddala and Wu (1999) and Pesaran (2007) stationarity tests (results are presented in Table 1) only $ogap$ and $ggap$ variables are stationary[20]. The final specification of the fiscal reaction function (hereafter: Model 1) is therefore:

$$\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_4 \cdot \Delta cab_{it} + \varepsilon_{it} \quad (6)$$

We estimate equation (6) for 9 subsamples as specified in Table 2. As indicated in the previous sections, the subsamples are created based on the scale of benefits from the sovereign bond yields' convergence related to the establishment of the Euro area. Given that these definitions require some discretion, as part of robustness analysis, we re-estimate the model under alternative composition of both groups of countries, and different splits of the analyzed period (for more on the robustness analysis, see section four).

[19] Unlike Bohn (1998) and like European Commission (2011) and Mendoza and Ostry (2008) equation (5) does not include quadratic and the cubic sovereign debt to control for possible non-linearity in the responsiveness of primary balance. It is worth noting that their inclusion in other studies gave results which are hardly robust. On the one hand, Bohn (1998) found that in the United States larger sovereign debt led to stronger responsiveness of primary balance. IMF (2003), using debt-threshold dummies, confirms this result for industrialized countries. Afonso (2008) finds an increasing responsiveness of primary balance to sovereign debt in the EU-15. On the other hand, the opposite effect is found by Calasun et al. (2007) and the IMF (2003) for the developing countries and by Ghosh et al. (2013) and Medeiros (2012) for the industrialized economies and EU-15 respectively.

[20] We are aware that the results of both tests may be biased. Maddala and Wu test assumes lack of cross-section dependence, which is actually the case for all analysed variables, but is most suitable for short and fixed time dimension as in our sample (Hoang and McNown, 2006). On the other hand, Pesaran test assumes cross-section dependence, but T tending to infinity. Unfortunately, to the best of our knowledge there is no test which addresses both of these shortcomings simultaneously.

In order to verify **Hypotheses A and B,** we compare the lagged debt estimates (α_2) between the windfall and baseline period for the peripheral and core countries. If the estimate for the peripheral countries, based on the windfall subsample, is statistically non-significant or negative, it will support **Hypothesis A**. By the same token for the core countries, statistically significant positive α_2 for the windfall subsample higher than the baseline subsample would support **Hypothesis B**.

In the second step we estimate responsiveness of the major categories of government revenue and expenditure to the changes in sovereign debt. Recall that as indicated in **Hypothesis C** the divergence in fiscal sustainability between the peripheral and core countries was mostly driven by the different paths of government non-interest spending. We estimate separate fiscal reaction functions for (i) direct tax revenue ($dirtax$), (ii) indirect tax revenue ($indtax$), (iii) investment expenditure ($invexp$) and (iv) non-investment expenditure ($consexp$)[21]. For each of these variables we use the specification presented in (6), e.g.

$$\Delta dirtax_{it} = \alpha_i + \alpha_1 \cdot \Delta dirtax_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_4 \cdot \Delta cab_{it} + \varepsilon_{it} \qquad (7)$$

and each equation (hereafter: Model 2 – 5, respectively) has been estimated for 9 subsamples, which gives us 36 estimates of α_2. Direct comparison of $\alpha_2$values for the different subsamples and revenue or expenditure categories allows us to verify **Hypothesis C**.

Definitions of all variables used in the estimates and their data sources are presented in Table 3. Most of the data is sourced from the AMECO database. Data on the primary balance for Ireland and Spain is supplemented by IMF WEO and the data on the sovereign bond yields is obtained from the Eurostat. Descriptive statistics follow in Table 4.

[21] This part of the econometric analysis follows Favero and Marcellino (2005) and Burger and Marinkov (2012). The former paper uses the fiscal reaction function framework for the government revenue and expenditure, while the latter applies it to the specific categories of taxes and government expenditure.

We estimate the above equations using a set of panel data estimators. We begin with fixed effects (FE) and random effects (RE) estimators, which assume homogeneous coefficients of the explanatory variables, but allow for a different constant term for the particular countries. Results based on the mentioned estimators, may be biased due to several methodological problems. The first one is a possible cross-section dependence (or spatial correlation) of error terms. In the analyzed model, this is equivalent to the assumption that there are unobserved time-varying omitted variables common for all the countries, which impact individual states. Actually, the results of the Pesaran's test for cross-section dependence indicate that this is a characteristic of the data set used (but not necessarily of the particular subsamples). If these unobservable common factors are uncorrelated with the independent variables, the coefficient estimates based on FE and RE regressions are consistent, but standard errors estimates are biased. Therefore, we use the Driscoll and Kraay (1998) nonparametric covariance matrix estimator (DK) which corrects for the error structure spatial dependence. This estimator also addresses the second problem, namely standard errors bias due to potential heteroskedasticity and autocorrelation of the error terms. The third problem results from the fact that the estimated equations are dynamic, so standard panel data estimators, such as fixed effects (FE) and random effects (RE) are biased. One approach to addressing this problem is to apply an instrumental variable estimator, such as the one proposed by Arellano and Bond (1991) or Arellano and Bover (1995). These estimators are asymptotically consistent, but their properties are unsatisfactory in the case of short samples. As Kiviet (1995) notes, it is possible to correct the bias of the standard estimators without affecting their efficiency. In this article, we apply a corrected least square dummy variable estimator (LSDVC) proposed by Bun and Kiviet (2002) and modified for the analysis of the unbalanced panels by Bruno (2005).

Taking into account all of the above restrictions, we use four types of panel data estimators: fixed effects (FE), random effects (RE), Driscoll-Kraay (DK) and corrected least square dummy variable estimator (LSDVC). That said, we are fully aware that our results ought to be viewed with caution – at the very least due to the estimation problems typical for panel datasets with such a short time dimension as in some of our subsamples.

4. Estimation results

We start the econometric analysis with verification of **Hypotheses A and B** put forward in section two, on the basis of the theoretical model by Aguiar et al. (2014). To this aim we estimate Model 1 for each of nine subsamples defined in Table 2 using four different estimators. Table 5 provides results for the whole EU-12 sample with estimators and time periods grouped in the particular columns. These models cover the largest data panel with up to 402 observations, however they also conceal any heterogeneity within the EU-12. Lagged public debt coefficients for all periods and estimators are positive and statistically significant indicating that governments area-wide reduce fiscal deficits when faced with increases in debt levels. In FE, DK and LSDVC estimators, reaction appears actually stronger during the windfall period than the baseline. As the core country group dominates the EU-12 sample, this may be attributed to its' fiscal consolidations during the pre-accession period, which were indicated by the descriptive investigation in section 2.

Tables 6 and 7 show estimates for the core and peripheral country groups respectively. Results yield the primary support for **Hypotheses A and B**:

(i) Estimates of $\Delta debt_{t-1}$ are positive and statistically significant in all cases except for the windfall period in the peripheral country group, where it loses statistical significance for the FE, RE and LSDVC estimators[22]. It thus appears, that fiscal policy in the peripheral countries ceases to react to the changes in sovereign debt during the windfall years in accordance with **Hypothesis A**.

(ii) As further indicated by the coefficients of the $\Delta debt_{t-1}$ variable, fiscal positions of the core member states react much more strongly to the levels of debt in the windfall period than the baseline, with respective coefficients, amounting to 0.260-0.438 for the former and 0.132-0.138 for the latter period (depending on the estimator used). The results support **Hypothesis B,**

[22] 5% significance of the estimate obtained using the DK estimator for the windfall period in the peripheral countries is rather spurious: the results of Pesaran's and Frees' tests shown in the table indicate cross-section **independence** in this particular subsample. Utilizing the DK estimator in this case may yield biased estimates, as the idea of the estimator is to correct standard errors for the presence of cross-section **dependence**.

which indicates that during the windfall period the core countries, as opposed to the peripheral ones, have strengthened their fiscal sustainability.

The result, which demands further elaboration, is the stronger reaction of the fiscal balance to sovereign debt in the peripheral than the core countries during the baseline period (estimates of 0.172-0.178 compared to 0.132-0.138). We see two plausible and non-exclusive explanations for such results. First, the European sovereign debt crisis is part of the baseline period. This may be unfortunate, but we cannot afford to leave it out, considering the limited size of our sample. The peripheral member states, due to their dire fiscal positions, were required to conduct stronger fiscal consolidations during this period than the core countries. Second, Afonso (2008) found stronger responsiveness of fiscal policy at higher debt levels in the EU-15 data during the 1970-2003 period. Mean consolidated gross debt in our sample is greater for the peripheral than core country group in every single year, perhaps explaining the different responsiveness during the baseline period.

In the next step we estimate Model 2 – Model 5, i.e. fiscal reaction functions for tax and spending categories, which allow to verify **Hypothesis C**. Results are presented in Table 8 in panels A-D respectively.[23]

First, in panel A (Model 2), we estimate a reaction function for direct taxes. Results indicate that direct taxes were an adjustment instrument only during the baseline period in the peripheral countries, which responded with tax increases to higher debt levels. In the remaining subsamples the estimates are not significant.

Second, in panel B (Model 3), the reaction function is based on indirect taxes. In general, it appears that the peripheral countries were increasing the indirect taxes in response to rising debt in both periods, with stronger and more statistically significant estimates for the windfall years. In the core member states rising debt coincided with opposite response of the indirect taxes, however the estimates are statistically significant only for the whole sample.

[23] For the sake of brevity we restrict presentation of the results to lagged debt estimates only. Remaining estimates are available upon request.

Third, in panel C (Model 4), an expenditure reaction function with investment expenditure is estimated. It follows from the results that both, core and periphery groups, used investment spending as an adjustment mechanism to the changing debt levels during the baseline timespan. The adjustment has been significantly stronger for the periphery than core group (estimates of -0.28 and -0.22 respectively). Both groups of countries did not use investment expenditure to adjust to debt level during the windfall years.

Fourth, in panel D (Model 5), non-investment expenditure reaction function is estimated. In this case, the results signal that non-investment expenditure had been an adjustment mechanism in the baseline period for both core and peripheral member states, with stronger and more statistically significant results for the core group. However, during the windfall timespan, the results indicate even more substantial changes in the reaction to debt fluctuations than during the baseline years in the core group, while lack of statistically significant relationship for the peripheral countries.

Recoupling the results gives strong support to **Hypothesis C**:

(i) During the baseline period, the peripheral countries reacted to the rising levels of debt with cuts in both non-investment and investment expenditure. However, in the windfall years, the fiscal stances of the peripheral member states ceased to react to growing debt with expenditure cuts and increases in direct taxes, but instead moved to rise the indirect taxes. As tax-based fiscal consolidations are typically less likely to reduce debt-to-GDP ratios (Alesina and Ardagna, 2013), our results give further credence to **Hypothesis A**.

(ii) The core member states in the baseline years responded to deteriorations in fiscal position with non-investment spending cuts and much smaller decreases in investment expenditure. In the windfall period, the core countries moved to strengthen their fiscal stances with much stronger non-investment expenditure consolidations than during the baseline period. This finding lends further support to **Hypothesis B**.

5. Robustness analysis

In this section we examine whether the results are robust to various changes in the modelling approach. All regressions presented in this section are carried out with the fixed effects estimator, as previously there were no major differences between the various estimation methods[24].

In part I and II of the analysis we check if the results are sensitive to the way, in which cyclical factors are controlled for in the model. To this end, in Model 1 the primary balance is exchanged for the cyclically adjusted primary balance as the dependent variable and lagged explanatory variable, while the output gap is removed from explanatory variables. In part I, we utilize the cyclically adjusted primary balance based on trend GDP[25] and show results in Table 9. As in our primary results, the $\Delta debt_{t-1}$ coefficient is positive and statistically significant across all timespans and country groups, except for the windfall period in the peripheral member states, where it lacks statistical significance. The strength of responsiveness is similar to previous results. Subsequently, in part II, we utilize the cyclically adjusted primary balance based on potential GDP[26] instead of trend GDP. Results are presented in Table 10. As previously, the $\Delta debt_{t-1}$ coefficient is positive and significant, except the periphery sample during the windfall period.

In part III we check whether our results are robust to excluding any single country from our sample. Debt coefficients with their standard errors and significance levels from this procedure are summarized in Table 11. Results for other estimators are available on demand and they do not change our conclusions. When Belgium or Finland are excluded from the core sample, the statistical significance of fiscal responses during the baseline period is lost for the core countries. However, the strength of the response remains similar and increased during the windfall years and whole sample in the core country group. On the other hand, exclusion of Greece from the periphery sample alters the results in terms of both the response strength and statistical significance during all years and baseline periods in the periphery. There is not much change in the all years EU-12 sample.

[24] Results for the other estimators are available on demand and they do not change our conclusions.
[25] Trend GDP is calculated using the Hodrick-Prescott filter (European Commission, 2014; European Commission, 2000).
[26] Potential GDP is calculated based on a TFP adjusted Cobb-Douglas production function approach (European Commission, 2014; Denis et al., 2002).

Subsequently, in part IV we alter the composition of the core and periphery groups. The aim is to investigate the results when the periphery group is defined as the countries with negative interest rate-growth differentials during the windfall period. This results in moving Italy from the periphery to core country group. The outcome is presented in Table 12 and does not alter our previous conclusions.

Finally, in part V we change the composition of the baseline and windfall timespans. The windfall period is now defined as the pre-crisis Euro area membership years[27]. Estimates are presented in Table 13 and remain similar as previously, however the lagged debt coefficient loses statistical significance during the baseline period in the core countries. It is difficult to account for this, nevertheless the result of a statistically insignificant response during the windfall period in the periphery remains valid (**Hypothesis A**) along with the high fiscal policy responsiveness in the core countries during the windfall years (**Hypothesis B**).

In conclusion, the results are robust not only to the choice of different estimators (as shown in the previous section), but also to the changes of the dependent variable (parts I and II), exclusions of countries from the sample (part III), changes in the country groups definitions (part IV) and alternative time periods definitions (part V). Relatively small deviations are present in the robustness analysis, however they are to be expected due to the small size of our sample.

[27] 2001-2007 for Greece and 1999-2007 for all other countries.

6. Discussion and policy implications

As mentioned in the introduction to the paper, studies analyzing fiscal sustainability in the Euro area through the lens of fiscal reaction functions are hardly conclusive (cf. Baldi and Staehr, 2013; Baskaran and Hessami, 2013; European Commission, 2011; Medeiros, 2012; Weichenrieder and Zimmer, 2013). Our results are in line with these studies, which find different reaction functions, for the pre-crisis period, in the peripheral countries, compared to the core ones. We find the evidence that many similar studies fail to establish (see, e.g. Baldi and Staehr, 2013 or Weichenrieder and Zimmer, 2013), possibly because we put stress on the windfall gained by the peripheral countries from the yields' convergence, while these studies usually focus either on the establishment of the Euro area or on Euro adoption by the peripheral countries. It is worth noting that studies of fiscal reaction functions for Japan, which since the 1990's has been gaining a windfall of low interest burden due to the unconventional monetary policy measures, reach similar conclusions to ours (see, e.g. Doi et al., 2011; Ito et al., 2011; Mauro et al., 2013; or Sakuragawa and Hosono, 2011).

Another main finding appears to be much less controversial. There is ample evidence that the composition of fiscal adjustments matters for fiscal sustainability (see, e.g. Afonso et al., 2005; Afonso and Jalles, 2012; Alesina and Ardagna, 2013, 2010 or 1998; Alesina and Perotti, 1996; Alesina et al., 1998; Baldacci et al., 2010; von Hagen et al., 2002; von Hagen and Strauch, 2001; Heylen et al., 2013; McDermott and Wescott, 1996; Purfield, 2003; or Tsibouris et al., 2006). Our results suggest that this evidence also holds when one avoids discretion in defining the notion of fiscal sustainability and instead refers to the budget identity.

If these findings were correct, then they would have far reaching implications for the appropriate policy. They suggest that any actions which suppress the significance of country specific credit risk in sovereign bonds' prices, sow the seeds of a new crisis, given the inherent government's temptation not to save a windfall of low interest burden. Paradoxically, the more reason there is in the claims that the Euro area members are susceptible to similar risk to the one faced by countries

forced to issue debt in foreign currency (see, e.g. De Grauwe and Ji, 2012a or 2012b), the greater threat such actions cause. They widen the ranges of deficit and debt levels, within which market does not act as a deterrent against unsustainable fiscal policy. There is little chance that a government would not fully exploit this broader opportunity to run unsustainable fiscal policy. The longer the market reactions are muted, the more seriously the market may overreact (cf. Manganelli and Wolswijk, 2009). Our findings would also contribute to the on-going debate on "austerity"[28]. Namely, they suggest that the peripheral countries have largely exhausted fiscal space during the pre-crisis period and have had no choice but to struggle for restoring it thereafter. They suggest also that to make public finances sustainable these countries should have adjusted mainly non-investment government spending, rather than relied on tax increases or cuts in investment outlays.

[28] It is surveyed, e.g. by Balcerowicz et al. (2013).

7. Concluding remarks

We estimate various fiscal reaction functions for the 12 Euro area member states during the 1970-2013 period.

This allows us, first, to test two hypotheses which are implied by the explanation of the European sovereign debt crisis provided by the theoretical model by Aguiar et al. (2014). We find that the peripheral countries, in which sovereign bond yields fell deeply in the years 1996-2007, were running unsustainable fiscal policies. In contrast, in the core countries which did not benefit from the yields' convergence related to the Euro area establishment, fiscal sustainability was strengthened during 1996-2007. These findings are robust to various changes in the modelling approach. They suggest that windfall gains are perilous not only for the developing countries, but are likely to cause severe fiscal tensions even in advanced economies.

Second, the estimated fiscal reaction functions provide a new type of evidence that the composition of fiscal innovations matters for fiscal sustainability. We find that unsustainable fiscal policy in the peripheral countries during 1996-2007 resulted from the lack of sufficient adjustment in the government non-investment expenditure and direct taxes. In contrast, the strengthened fiscal sustainability in the core countries at the time was mainly related to pronounced adjustments of the government non-investment expenditure.

We find our contributions both timely and policy relevant. That said, we are fully aware that our results ought to be viewed with caution – at the very least due to the estimation problems typical for panel datasets with a short time dimension.

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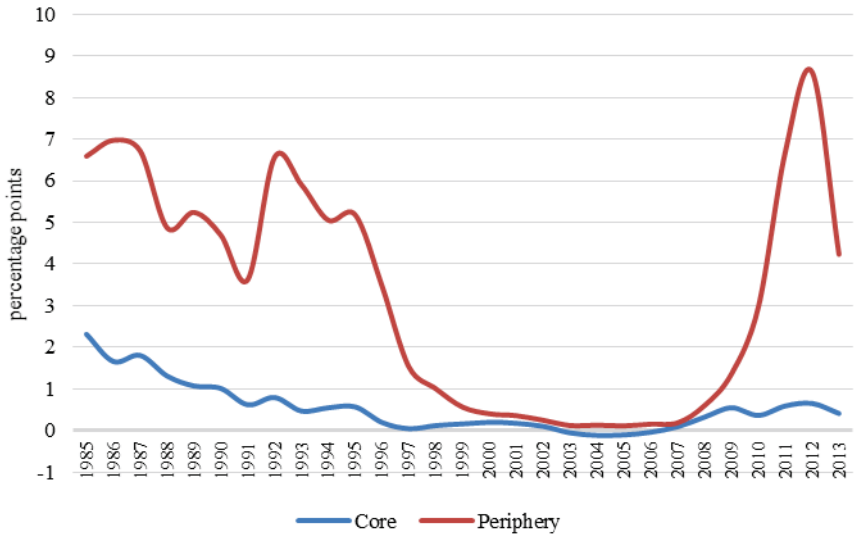
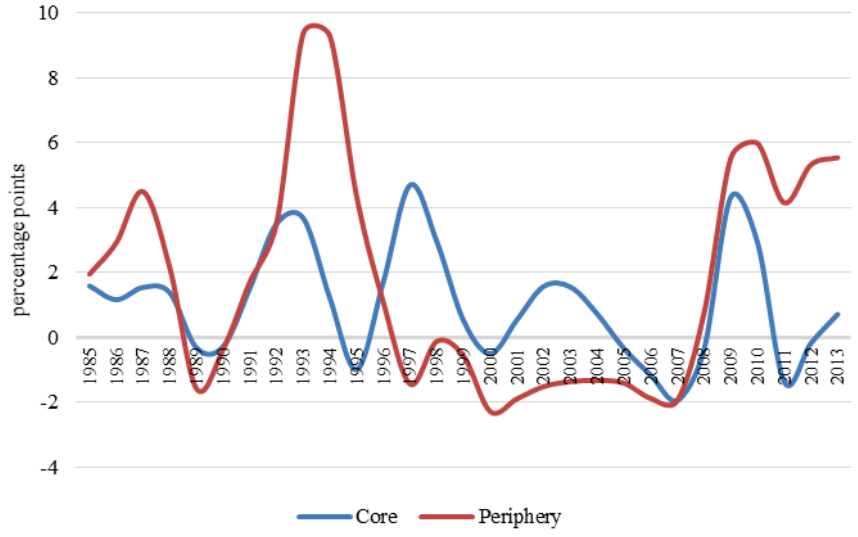
Appendix

FIGURE 1. Government bond spreads against Germany (percentage points)



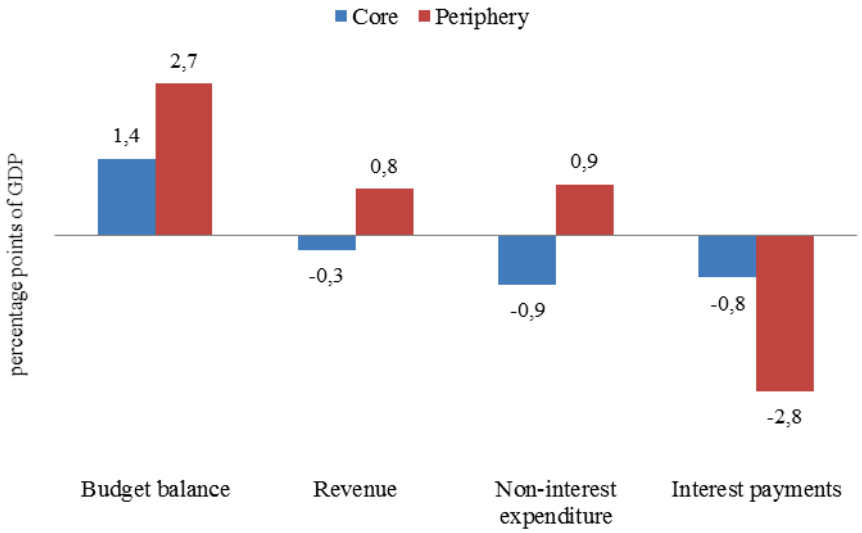
Note: German long-term government bond yields have been subtracted from values for every single country (including Germany) and then averaged. Further information on the source and computation method are given in Table 3.

FIGURE 2. Interest rate-growth differential (percentage points)



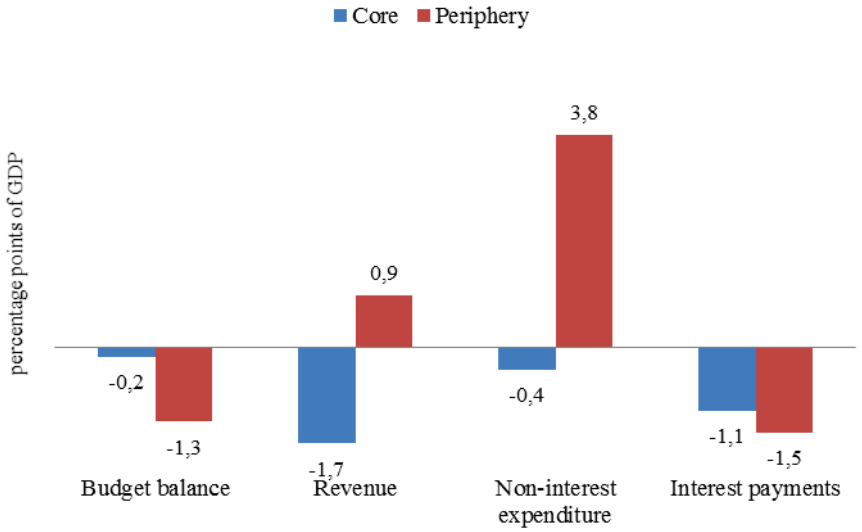
Note: Interest rate growth differential is defined as the differential between the cost of debt and growth rate of nominal GDP. Effective interest rate on sovereign debt is approximated by the ratio of government interest payments to sovereign debt. The same approximation is used, e.g. by Favero and Monacelli (2005). Further information on the source and computation method are given in Table 3.

FIGURE 3. Change in main fiscal categories. EU-12 core and peripherial countries from 1996 to 1999 (percentage points of GDP)



Note: 1996 values have been subtracted from 1999. All variables are cyclically adjusted based on potential GDP. Appraisal of fiscal policy in the EU-12 core and periphery does not change when analysis is based on values cyclically adjusted with trend GDP or without any cyclical adjustment.

FIGURE 4. Change in main fiscal categories. EU-12 core and peripherial countries from 1999 to 2007 (percentage points of GDP)



Note: 1999 values have been subtracted from 2007. All variables are cyclically adjusted based on potential GDP. Appraisal of fiscal policy in the EU-12 core and periphery does not change when analysis is based on values cyclically adjusted with trend GDP or without any cyclical adjustment.

TABLE 1. Panel unit root tests

Test	Lvls./frst diff.	Trend	Lags	pbalance	debt	ogap	ggap	cab	dirtax	indtax	invexp	consexp	capb_p	capb_t
Maddala and Wu 1999	Levels	No	0	59.921***	59.922	59.923***	59.924***	59.925*	59.93***	59.931	59.928*	59.929*	59.926***	59.927***
	Levels	No	1	65.777***	13.37	122.474***	238.083***	40.287**	51.167***	50.148***	38.875**	37.148**	56.211***	48.528***
	Levels	No	2	44.054***	16.209	80.265***	152.563***	36.782**	41.184**	37.676**	28.354	26.586	37.199**	33.115
	Levels	No	3	37.749**	20.535	88.567***	136.497***	32.39	32.524	31.759	21.196	31.281	33.535*	34.464*
	Levels	Yes	0	41.555**	4.701	52.117***	98.104***	30.297	40.368**	29.155	26.751	30.123	51.964***	42.279**
	Levels	Yes	1	49.048***	25.6	96.433***	181.411***	40.257**	47.951***	45.909***	24.51	43.655***	43.509***	35.698*
	Levels	Yes	2	31.906	22.097	57.482***	106.593***	46.461***	44.174***	32.092	11.463	24.527	28.828	25.27
	Levels	Yes	3	27.608	29.546	65.579***	94.899***	41.744**	30.386	36.064*	10.133	26.652	24.103	23.475
	Dif.	No	0	366.968***	142.495***	366.065***	406.849***	443.984***	320.868***	326.985***	329.609***	316.286***	430.71***	413.737***
	Dif.	No	1	234.341***	96.154***	323.642***	393.783***	233.938***	182.921***	208.067***	214.295***	196.024***	235.124***	213.741***
	Dif.	No	2	149.736***	68.287***	198.492***	290.253***	145.134***	135.126***	143.485***	129.157***	127.054***	147.906***	130.172***
	Dif.	No	3	106.919***	66.546***	196.633***	219.695***	152.133***	108.106***	122.929***	89.3***	83.483***	97.506***	82.099***
	Dif.	Yes	0	306.723***	126.428***	301.847***	333.403***	377.686***	258.77***	274.634***	281.44***	262.52***	354.767***	341.076***
	Dif.	Yes	1	190.585***	72.525***	261.715***	322.512***	189.42***	133.273***	167.65***	180.794***	154.237***	179.872***	160.69***
	Dif.	Yes	2	116.551***	51.05***	148.548***	228.114***	110.224***	91.043***	109.89***	104.227***	103.558***	108.147***	92.256***
	Dif.	Yes	3	83.811***	51.692***	156.09***	162.463***	111.482***	71.532***	90.938***	72.309***	70.117***	69.912***	55.038***
Pesaran (2007)	Levels	No	0	-3.087***	3.449	-4.275***	-6.837***	-0.385	-2.496***	-1.162	-0.67	-0.581	-3.748***	-3.345***
	Levels	No	1	-2.322**	1.321	-4.342***	-7.279***	-0.501	-1.825**	-1.169	0.13	0.348	-2.334**	-2.221**
	Levels	No	2	-1.382*	0.865	-2.676***	-6.241***	-0.006	0.078	-0.202	0.917	1.502	-0.966	-0.601
	Levels	No	3	-0.645	0.44	-2.785***	-4.673***	0.303	-0.285	-0.467	1.351	1.764	-0.525	-0.311
	Levels	Yes	0	-2.102**	6.128	-3.057***	-4.883***	0.364	-2.151**	-0.501	0.232	-0.049	-3.079***	-2.704***
	Levels	Yes	1	-0.868	3.204	-3.202***	-5.364***	-0.132	-1.992**	-0.804	1.577	1.122	-0.907	-0.602
	Levels	Yes	2	0.016	3.642	-1.515*	-4.345***	-0.326	-0.583	0.744	2.459	1.659	0.681	1.279
	Levels	Yes	3	0.042	4.015	-1.895**	-2.435***	0.104	-1.171	0.749	3.041	1.358	1.01	1.515
	Dif.	No	0	-13.352***	-8.722***	-13.624***	-14.336***	-14.917***	-13.388***	-13.252***	-12.679***	-13.302***	-14.147***	-13.903***
	Dif.	No	1	-9.263***	-4.037***	-11.648***	-11.788***	-10.16***	-9.022***	-9.676***	-7.088***	-7.66***	-10.012***	-9.945***
	Dif.	No	2	-5.831***	-1.908**	-8.004***	-8.747***	-6.588***	-5.983***	-5.292***	-3.786***	-4.017***	-5.633***	-5.477***
	Dif.	No	3	-3.113***	-0.879	-8.162***	-7.659***	-4.826***	-4.801***	-3.695***	-1.355*	-1.633*	-2.914***	-2.481***
	Dif.	Yes	0	-12.672***	-8.056***	-12.788***	-13.297***	-14.119***	-12.101***	-12.123***	-11.549***	-13.166***	-13.071***	-12.906***
	Dif.	Yes	1	-8.547***	-3.704***	-10.198***	-10.251***	-8.703***	-7.245***	-8.255***	-5.719***	-6.418***	-8.344***	-8.131***
	Dif.	Yes	2	-5.021***	-1.595*	-6.431***	-6.866***	-5.012***	-4.378***	-3.661***	-2.425***	-2.891***	-4.095***	-3.753***
	Dif.	Yes	3	-2.064**	-1.111	-7.182***	-5.596***	-3.066***	-3.523***	-1.418*	0.096	-0.86	-1.496*	-1.003

Notes: The first test is Maddala and Wu (1999) panel unit root test. Results shown are chi-square statistics. The second test is a Pesaran (2007) Panel Unit Root Test (CIPS). Results are Zt-bars. Stars denote stationarity at 1% (***), 5% (**), 10% (*) levels.

TABLE 2. Number of observations by country group and period

Group of countries	All years 1970-2013	Baseline 1970-1995 & 2008-2013	Windfall 1996-2007
Core (Austria, Belgium, Finland, France, Germany, Luxembourg, Netherlands)	250	166	84
Periphery (Greece, Ireland, Italy, Portugal, Spain)	152	92	60
EU-12 (all of the above)	402	258	144

TABLE 3. Variable definitions

Variable	Name in models	Unit	Definition	Source
Primary balance	pbalance	% GDP	Primary balance of general government. Note that data is sourced from AMECO, however gaps for Ireland (1980-1984) and Spain (1980-1994) are completed with WEO data.	EC AMECO, IMF WEO
Debt	debt	% GDP	Consolidated gross debt of general government.	EC AMECO
Output gap	ogap	% GDP	Gap between actual GDP and potential GDP.	EC AMECO
Cyclical component of government final consumption expenditure	ggap	% GDP	Cyclical component of final consumption expenditure of general government, constructed by detrending the final government consumption expenditure as a share of GDP with the Hodrick-Prescott filter (smoothing parameter set at 100).	Authors' calculations based on EC AMECO
Current account balance	cab	% GDP	Current account balance.	EC AMECO
Cyclically adjusted primary balance (trend GDP)	capb_p	% GDP	Cyclically adjusted primary balance based on potential GDP.	EC AMECO
Cyclically adjusted primary balance (potential GDP)	capb_t	% GDP	Cyclically adjusted primary balance based on trend GDP.	EC AMECO
Indirect taxes	indtax	% GDP	Taxes linked to imports and production.	EC AMECO
Direct taxes	dirtax	% GDP	Current taxes on income and wealth.	EC AMECO
Investment expenditure	invexp	% GDP	Gross fixed capital formation of general government.	EC AMECO
Non-investment expenditure	consexp	% GDP	Total expenditure of general government excluding interest and gross fixed capital formation.	Authors' calculations based on EC AMECO
Cyclically adjusted budget balance	NA	% GDP	Cyclically adjusted budget balance of general government based on potential GDP.	EC AMECO
Cyclically adjusted revenue	NA	% GDP	Cyclically adjusted revenue of general government based on potential GDP.	EC AMECO
Cyclically adjusted non-interest expenditure	NA	% GDP	Cyclically adjusted non-interest expenditure of general government based on potential GDP.	EC AMECO
Cyclically adjusted interest payments	NA	% GDP	Cyclically adjusted interest payments of general government based on potential GDP.	Authors' calculations based on EC AMECO
Interest-rate-growth differential	NA	Percentage points	Differential between the cost of debt (computed by dividing interest payments in ECU/EUR by consolidated gross debt of general government in ECU/EUR) and growth rate of nominal GDP.	Authors' calculations based on EC AMECO
Bond spreads against Germany	NA	Percentage points	Long-term government bond spreads against Germany based on EMU convergence criterion bond yields. German bond yields have been subtracted from values for every single country (including Germany) and then averaged. Yearly values have been aggregated from monthly data.	Authors' calculations based on Eurostat

TABLE 4. Descriptive statistics

	Name in models	Unit	All years 1970-2013					Baseline 1970-1995 & 2008-2013					Windfall 1996-2007				
			Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max
Primary balance	pbalance	% GDP	433	0.55	3.19	-11.6	9.81	289	-0.29	3.16	-11.64	8.33	144	2.25	2.50	-3.97	9.81
Debt	debt	% GDP	513	56.51	33.76	4.05	175.05	369	53.73	34.95	4.05	175.05	144	63.65	29.43	6.07	127.15
Output gap	ogap	% potential GDP	515	-0.01	2.51	-12.58	8.13	371	-0.35	2.69	-12.58	8.13	144	0.87	1.70	-3.57	5.61
Cyclical component of government final consumption expenditure	ggap	% GDP	528	-0.00	0.63	-2.27	2.52	384	0.06	0.66	-2.27	2.52	144	-0.16	0.52	-1.50	1.51
Current account balance	cab	% GDP	528	0.27	5.77	-17.96	25.09	384	0.14	5.63	-17.	25.09	144	0.61	6.15	-17.63	13.22
Cyclically adjusted primary balance (potential GDP)	capb_p	% GDP	414	0.67	3.16	-25.41	9.05	270	0.04	3.33	-25.41	9.05	144	1.86	2.42	-3.68	8.79
Cyclically adjusted primary balance (trend GDP)	capb_t	% GDP	414	0.57	3.40	-25.12	8.61	270	-0.14	3.54	-25.12	8.43	144	1.91	2.66	-6.69	8.61
Indirect taxes	indtax	% GDP	414	12.61	1.78	7.68	15.94	270	12.40	1.91	7.68	15.94	144	13.01	1.42	9.91	15.89
Direct taxes	dirtax	% GDP	414	12.40	3.17	4.53	21.09	270	12.24	3.25	4.53	18.83	144	12.69	3.01	6.40	21.09
Investment expenditure	invexp	% GDP	414	3.05	0.91	1.00	5.46	270	3.13	0.88	1.00	5.46	144	2.88	0.95	1.07	5.26
Non-investment expenditure	consexp	% GDP	414	40.64	6.28	24.37	58.93	270	41.28	6.46	24.37	58.93	144	39.45	5.75	25.68	53.15

TABLE 5. Estimation results. Fiscal reaction function, EU-12, dependent variable: primary balance

	FE			RE			DK			LSDVC		
	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall
$\Delta pbalance_{t-1}$	-0.163**	-0.125	-0.251***	-0.161**	-0.111	-0.239***	-0.163**	-0.125*	-0.251	-0.139***	-0.088	-0.186**
	(0.069)	(0.074)	(0.059)	(0.070)	(0.079)	(0.065)	(0.060)	(0.058)	(0.151)	(0.042)	(0.062)	(0.085)
$\Delta debt_{t-1}$	0.143***	0.157***	0.216*	0.138***	0.158***	0.157**	0.143***	0.157***	0.216***	0.143***	0.158***	0.213***
	(0.027)	(0.041)	(0.105)	(0.024)	(0.038)	(0.069)	(0.024)	(0.024)	(0.057)	(0.029)	(0.051)	(0.050)
$ogap_t$	0.072	0.113*	-0.070	0.080	0.131**	-0.155**	0.072	0.113*	-0.070	0.070*	0.111	-0.074
	(0.060)	(0.062)	(0.084)	(0.059)	(0.059)	(0.060)	(0.059)	(0.056)	(0.118)	(0.041)	(0.109)	(0.101)
$ggap_t$	-1.604***	-1.651***	-1.408***	-1.576***	-1.599***	-1.537***	-1.604***	-1.651***	-1.408***	-1.590***	-1.627***	-1.398***
	(0.159)	(0.158)	(0.345)	(0.162)	(0.162)	(0.350)	(0.406)	(0.488)	(0.279)	(0.157)	(0.248)	(0.264)
Δcab_t	-0.018	0.004	-0.050	-0.008	0.014	0.001	-0.018	0.004	-0.050	-0.017	0.004	-0.051
	(0.070)	(0.092)	(0.074)	(0.066)	(0.094)	(0.060)	(0.059)	(0.064)	(0.111)	(0.058)	(0.073)	(0.094)
constant	-0.225***	-0.365***	0.234***	-0.216***	-0.361***	0.244**	-0.225	-0.365	0.234	NA	NA	NA
	(0.032)	(0.096)	(0.051)	(0.064)	(0.137)	(0.110)	(0.194)	(0.219)	(0.374)			
N	402	258	144	402	258	144	402	258	144	402	258	132
Within R^2	0.2807	0.3394	0.2239	0.2805	0.3390	0.2127	0.2807	0.3394	0.2239	NA	NA	NA
Between R^2	0.0267	0.2636	0.0520	0.0308	0.2890	0.2302	NA	NA	NA	NA	NA	NA
Overall R^2	0.2755	0.3373	0.1963	0.2757	0.3378	0.2105	NA	NA	NA	NA	NA	NA
Pesaran's test (p-val)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	NA	NA	NA	NA	NA	NA
Frees' test (statistic)	1.397***	1.102***	1.194***	1.455***	1.047***	1.206***	NA	NA	NA	NA	NA	NA
Breush-Pagan's test (p-val)	NA	NA	NA	1.0000	1.0000	1.0000	NA	NA	NA	NA	NA	NA

Notes: The dependent variable is primary balance and the estimated model is given by $\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. The first row of the table lists the estimators used in the subsequent regressions, while the second row indicates time dimension of the sample. We use four types of panel data estimators: fixed effects (FE), random effects (RE), Driscoll–Kraay with corrected standard errors (DK) and a bias-corrected least squares dummy variables (LSDVC). For Breush-Pagan's and Pesaran's (2004) cross-section dependence test results shown are p-values. For Frees' (2004) cross-section dependence test results shown are Q-statistics. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 6. Estimation results. Fiscal reaction function, EU-12 core, dependent variable: primary balance

	FE			RE			DK			LSDVC		
	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall
$\Delta pbalance_{t-1}$	-0.217**	-0.178**	-0.216**	-0.214***	-0.161**	-0.244***	-0.217**	-0.178*	-0.216	-0.195***	-0.147*	-0.157
	(0.078)	(0.071)	(0.062)	(0.079)	(0.076)	(0.076)	(0.087)	(0.085)	(0.138)	(0.052)	(0.086)	(0.101)
$\Delta debt_{t-1}$	0.121***	0.132**	0.438**	0.120***	0.138***	0.260***	0.121**	0.132**	0.438***	0.121***	0.135***	0.428***
	(0.032)	(0.049)	(0.136)	(0.031)	(0.049)	(0.092)	(0.037)	(0.041)	(0.112)	(0.036)	(0.050)	(0.097)
$ogap_t$	-0.025	-0.024	0.023	-0.013	0.014	-0.103	-0.025	-0.024	0.023	-0.027	-0.026	0.022
	(0.052)	(0.081)	(0.105)	(0.057)	(0.074)	(0.106)	(0.067)	(0.069)	(0.111)	(0.068)	(0.078)	(0.149)
$ggap_t$	-1.922***	-2.038***	-1.652***	-1.890***	-1.968***	-1.750***	-1.922***	-2.038***	-1.652***	-1.908***	-2.022***	-1.620***
	(0.149)	(0.215)	(0.394)	(0.144)	(0.198)	(0.440)	(0.301)	(0.376)	(0.421)	(0.256)	(0.312)	(0.557)
Δcab_t	0.058	0.106	-0.083	0.061	0.113	-0.052	0.058	0.106	-0.083	0.061	0.109	-0.085
	(0.057)	(0.099)	(0.126)	(0.059)	(0.098)	(0.116)	(0.086)	(0.104)	(0.119)	(0.077)	(0.119)	(0.131)
constant	-0.181***	-0.396***	0.472***	-0.180***	-0.397***	0.408***	-0.181	-0.396*	0.472	NA	NA	NA
	(0.037)	(0.101)	(0.058)	(0.064)	(0.152)	(0.123)	(0.209)	(0.169)	(0.461)			
N	250	166	84	250	166	84	250	166	84	250	166	77
Within R^2	0.2775	0.3555	0.2842	0.2774	0.3546	0.2592	0.2775	0.3555	0.2842	NA	NA	NA
Between R^2	0.2374	0.1237	0.1629	0.2046	0.1908	0.3655	NA	NA	NA	NA	NA	NA
Overall R^2	0.2743	0.3516	0.2144	0.2744	0.3526	0.2402	NA	NA	NA	NA	NA	NA
Pesaran's test (p-val)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	NA	NA	NA	NA	NA	NA
Frees' test (statistic)	1.222***	0.804***	1.162***	1.251***	0.737***	1.470***	NA	NA	NA	NA	NA	NA
Breush-Pagan's test (p-val)	NA	NA	NA	1.0000	1.0000	1.0000	NA	NA	NA	NA	NA	NA

Notes: The dependent variable is primary balance and the estimated model is given by $\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. The first row of the table lists the estimators used in the subsequent regressions, while the second row indicates time dimension of the sample. We use four types of panel data estimators: fixed effects (FE), random effects (RE), Driscoll–Kraay with corrected standard errors (DK) and a bias-corrected least squares dummy variables (LSDVC). For Breush-Pagan's and Pesaran's (2004) cross-section dependence test results shown are p-values. For Frees' (2004) cross-section dependence test results shown are Q-statistics. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 7. Estimation results. Fiscal reaction function, EU-12 periphery, dependent variable: primary balance

	FE			RE			DK			LSDVC		
	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall
$\Delta pbalance_{t-1}$	-0.089	-0.076	-0.273***	-0.084	-0.064	-0.220***	-0.089	-0.076	-0.273	-0.054	-0.016	-0.184*
	(0.132)	(0.165)	(0.059)	(0.134)	(0.172)	(0.053)	(0.084)	(0.105)	(0.150)	(0.090)	(0.160)	(0.096)
$\Delta debt_{t-1}$	0.164**	0.177**	0.106	0.155***	0.172***	0.083	0.164***	0.177***	0.106**	0.163***	0.178**	0.106
	(0.042)	(0.060)	(0.088)	(0.040)	(0.058)	(0.075)	(0.025)	(0.030)	(0.037)	(0.035)	(0.069)	(0.066)
$ogap_t$	0.100	0.146	-0.195	0.106	0.161**	-0.208	0.100	0.146*	-0.195	0.098	0.141	-0.194
	(0.082)	(0.086)	(0.165)	(0.083)	(0.081)	(0.155)	(0.065)	(0.062)	(0.106)	(0.065)	(0.154)	(0.149)
$ggap_t$	-1.404***	-1.513***	-1.299**	-1.375***	-1.452***	-1.359***	-1.404**	-1.513**	-1.299**	-1.382***	-1.471**	-1.280***
	(0.194)	(0.319)	(0.309)	(0.200)	(0.308)	(0.369)	(0.465)	(0.504)	(0.293)	(0.219)	(0.575)	(0.391)
Δcab_t	-0.099	-0.102	-0.089	-0.076	-0.095	-0.053	-0.099	-0.102	-0.089	-0.099	-0.106	-0.082
	(0.137)	(0.166)	(0.158)	(0.128)	(0.161)	(0.127)	(0.119)	(0.130)	(0.157)	(0.105)	(0.168)	(0.102)
constant	-0.289***	-0.242	0.019	-0.272*	-0.214	0.023	-0.289	-0.242	0.019	NA	NA	NA
	(0.061)	(0.169)	(0.101)	(0.148)	(0.266)	(0.226)	(0.244)	(0.364)	(0.249)			
N	152	92	60	152	92	60	152	92	60	152	92	55
Within R^2	0.3120	0.3569	0.2466	0.3115	0.3563	0.2389	0.3120	0.3569	0.2466	NA	NA	NA
Between R^2	0.0564	0.2963	0.0364	0.0614	0.3359	0.0034	NA	NA	NA	NA	NA	NA
Overall R^2	0.3019	0.3510	0.2172	0.3023	0.3516	0.2267	NA	NA	NA	NA	NA	NA
Pesaran's test (p-val)	0.0000	0.0000	0.6304	0.0000	0.0000	0.5360	NA	NA	NA	NA	NA	NA
Frees' test (statistic)	0.224**	0.271	-0.008	0.195**	0.279	0.066	NA	NA	NA	NA	NA	NA
Breush-Pagan's test (p-val)	NA	NA	NA	1.0000	1.0000	1.0000	NA	NA	NA	NA	NA	NA

Notes: The dependent variable is primary balance and the estimated model is given by $\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. The first row of the table lists the estimators used in the subsequent regressions, while the second row indicates time dimension of the sample. We use four types of panel data estimators: fixed effects (FE), random effects (RE), Driscoll–Kraay with corrected standard errors (DK) and a bias-corrected least squares dummy variables (LSDVC). For Breush-Pagan's and Pesaran's (2004) cross-section dependence test results shown are p-values. For Frees' (2004) cross-section dependence test results shown are Q-statistics. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 8. Estimation results. Coefficients of $\Delta debt_{t-1}$ from revenue and expenditure reaction functions, EU-12 core, EU-12 periphery and EU-12, dependent variable: direct taxes (panel A), indirect taxes

(panel B), investment expenditure (panel C), non-investment expenditure (panel D)

		FE			RE			DK			LSDVC		
Dependent variable	Group of countries	1970-2013 All years	1970-1995 & 2008-2013 Baseline	1996-2007 Windfall	1970-2013 All years	1970-1995 & 2008-2013 Baseline	1996-2007 Windfall	1970-2013 All years	1970-1995 & 2008-2013 Baseline	1996-2007 Windfall	1970-2013 All years	1970-1995 & 2008-2013 Baseline	1996-2007 Windfall
A. Direct taxes	EU-12	0.024***	0.029***	0.004	0.027***	0.031***	0.016	0.024***	0.029***	0.004	0.024***	0.029	0.005
		(0.006)	(0.009)	(0.032)	(0.007)	(0.008)	(0.024)	(0.007)	(0.009)	(0.010)	(0.007)	(0.018)	(0.023)
	Core	0.021	0.023	0.039	0.023	0.023	0.041	0.021	0.023	0.039*	0.021	0.024	0.038
		(0.013)	(0.028)	(0.028)	(0.014)	(0.024)	(0.027)	(0.014)	(0.019)	(0.019)	(0.016)	(0.025)	(0.046)
	Periphery	0.023**	0.030**	-0.012	0.026***	0.031***	0.003	0.023**	0.030**	-0.012	0.022*	0.028	-0.011
		(0.007)	(0.008)	(0.051)	(0.007)	(0.009)	(0.044)	(0.008)	(0.010)	(0.015)	(0.013)	(0.028)	(0.036)
B. Indirect taxes	EU-12	0.007	0.013	0.025*	0.009	0.013	0.015*	0.007	0.013*	0.025	0.006	0.013	0.024
		(0.007)	(0.009)	(0.013)	(0.007)	(0.009)	(0.009)	(0.004)	(0.006)	(0.014)	(0.005)	(0.011)	(0.016)
	Core	-0.013**	-0.009	-0.008	-0.013***	-0.011	-0.011	-0.013	-0.009	-0.008	-0.013	-0.010	-0.008
		(0.004)	(0.009)	(0.016)	(0.005)	(0.009)	(0.008)	(0.008)	(0.013)	(0.012)	(0.008)	(0.013)	(0.022)
	Periphery	0.020*	0.023	0.038*	0.022***	0.023*	0.031**	0.020*	0.023	0.038*	0.020**	0.022	0.037
		(0.009)	(0.014)	(0.017)	(0.008)	(0.014)	(0.015)	(0.009)	(0.011)	(0.015)	(0.010)	(0.019)	(0.031)
C. Investment expenditure	EU-12	-0.025***	-0.026***	-0.010	-0.024***	-0.025***	-0.017	-0.025***	-0.026***	-0.010*	-0.025***	-0.026***	-0.010
		(0.006)	(0.005)	(0.010)	(0.006)	(0.006)	(0.011)	(0.003)	(0.004)	(0.005)	(0.003)	(0.006)	(0.010)
	Core	-0.018***	-0.022**	-0.002	-0.017***	-0.022***	-0.006	-0.018**	-0.022**	-0.002	-0.018***	-0.022***	-0.002
		(0.003)	(0.006)	(0.008)	(0.003)	(0.006)	(0.007)	(0.006)	(0.006)	(0.016)	(0.006)	(0.007)	(0.019)
	Periphery	-0.026**	-0.028***	-0.010	-0.024***	-0.027***	-0.019	-0.026***	-0.028***	-0.010	-0.025***	-0.028**	-0.009
		(0.007)	(0.006)	(0.016)	(0.007)	(0.006)	(0.014)	(0.005)	(0.006)	(0.014)	(0.006)	(0.013)	(0.017)
D. Non-investment expenditure	EU-12	-0.097***	-0.120***	-0.115	-0.087***	-0.122***	-0.070	-0.097*	-0.120*	-0.115*	-0.096***	-0.122**	-0.115***
		(0.021)	(0.035)	(0.076)	(0.018)	(0.027)	(0.053)	(0.051)	(0.056)	(0.057)	(0.019)	(0.052)	(0.039)
	Core	-0.099**	-0.145**	-0.321**	-0.100**	-0.161***	-0.205***	-0.099**	-0.145***	-0.321**	-0.099***	-0.148***	-0.315***
		(0.038)	(0.053)	(0.103)	(0.039)	(0.047)	(0.069)	(0.027)	(0.038)	(0.112)	(0.035)	(0.046)	(0.079)
	Periphery	-0.115***	-0.123**	-0.023	-0.104***	-0.122***	0.020	-0.115	-0.123	-0.023	-0.114***	-0.124	-0.024
		(0.023)	(0.039)	(0.050)	(0.020)	(0.035)	(0.037)	(0.068)	(0.070)	(0.041)	(0.041)	(0.119)	(0.052)

Notes: In panel A the dependent variable are direct taxes and the estimated model is given by $\Delta dirtax_{it} = \alpha_i + \alpha_1 \cdot \Delta dirtax_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$, in panel B the dependent variable are indirect taxes and the estimated model is given by $\Delta indtax_{it} = \alpha_i + \alpha_1 \cdot \Delta indtax_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$, in panel C the dependent variable is investment expenditure and the estimated model is given by $\Delta invexp_{it} = \alpha_i + \alpha_1 \cdot \Delta invexp_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$, in panel D the dependent variable is investment expenditure and the estimated model is given by $\Delta consexp_{it} = \alpha_i + \alpha_1 \cdot \Delta consexp_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. The first row of the table lists the estimators used in the subsequent regressions, while the second row indicates time dimension of the sample. We use four types of panel data estimators: fixed effects (FE), random effects (RE), Driscoll–Kraay with corrected standard errors (DK) and a bias-corrected least squares dummy variables (LSDVC). For Breush-Pagan's and Pesaran's (2004) cross-section dependence test results shown are p-values. For Frees' (2004) cross-section dependence test results shown are Q-statistics. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 9. Robustness analysis part I. Change in the dependent variable: cyclically adjusted primary balance based on trend GDP

	EU-12			Core			Periphery		
	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall
$\Delta capb\_t_{t-1}$	-0.158***	-0.132***	-0.302***	-0.221***	-0.120*	-0.295***	-0.145*	-0.165**	-0.186***
	(0.039)	(0.039)	(0.046)	(0.059)	(0.049)	(0.043)	(0.053)	(0.055)	(0.027)
$\Delta debt_{t-1}$	0.162***	0.163***	0.228**	0.101**	0.079**	0.411**	0.192***	0.196**	0.126
	(0.025)	(0.040)	(0.098)	(0.029)	(0.022)	(0.138)	(0.030)	(0.059)	(0.088)
$ggap_t$	-1.076***	-1.177***	-0.589**	-0.686***	-0.740***	-0.825**	-1.412**	-1.628**	-0.547
	(0.201)	(0.262)	(0.228)	(0.131)	(0.108)	(0.241)	(0.327)	(0.437)	(0.334)
Δcab_t	0.013	0.017	-0.023	0.100	0.193**	-0.121	-0.087	-0.167	0.122
	(0.060)	(0.092)	(0.086)	(0.064)	(0.073)	(0.116)	(0.098)	(0.154)	(0.154)
constant	-0.246***	-0.313**	-0.009	-0.145***	-0.197***	0.306**	-0.369***	-0.171	-0.278
	(0.036)	(0.108)	(0.057)	(0.037)	(0.053)	(0.086)	(0.052)	(0.259)	(0.166)
N	388	244	144	251	167	84	137	77	60
Within R^2	0.1827	0.1936	0.2143	0.1107	0.1036	0.3245	0.2525	0.2755	0.1270
Between R^2	0.0431	0.1924	0.0117	0.0272	0.0379	0.1374	0.0052	0.0383	0.0012
Overall R^2	0.1790	0.1976	0.1649	0.1087	0.1004	0.2463	0.2467	0.2720	0.1052
Pesaran's test (p-val)	0.0000	0.0046	0.0000	0.0000	0.0071	0.0000	0.0231	0.0947	0.1230
Frees' test (statistic)	0.933***	0.235	0.758***	0.811***	0.237*	0.772***	0.238**	0.274	-0.035

Notes: The estimated model is given by $\Delta capb\_t_{it} = \alpha_i + \alpha_1 \cdot \Delta capb\_t_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ggap_{it} + \alpha_4 \cdot \Delta cab_{it} + \varepsilon_{it}$. Only $debt_{t-1}$ coefficients are presented, remaining estimates are available upon request. Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. Presented regressions were carried out using fixed effects estimator. Results for other estimators are available on demand and they do not change our conclusions. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 10. Robustness analysis part II. Change in the dependent variable: cyclically adjusted primary balance based on potential GDP

	EU-12			Core			Periphery		
	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall
$\Delta capb\_p_{t-1}$	-0.188***	-0.147***	-0.345***	-0.240***	-0.133**	-0.319***	-0.174**	-0.171**	-0.293***
	(0.036)	(0.034)	(0.041)	(0.058)	(0.045)	(0.037)	(0.048)	(0.052)	(0.059)
$\Delta debt_{t-1}$	0.138***	0.145***	0.199*	0.084**	0.064**	0.389**	0.165***	0.178**	0.098
	(0.026)	(0.042)	(0.096)	(0.031)	(0.022)	(0.133)	(0.034)	(0.062)	(0.077)
$ggap_t$	-1.179***	-1.253***	-0.742***	-0.857***	-0.882***	-1.002***	-1.448**	-1.591**	-0.707*
	(0.197)	(0.249)	(0.236)	(0.105)	(0.088)	(0.224)	(0.368)	(0.459)	(0.302)
Δcab_t	-0.010	-0.017	-0.017	0.065	0.129	-0.101	-0.098	-0.174	0.087
	(0.071)	(0.098)	(0.083)	(0.085)	(0.092)	(0.115)	(0.122)	(0.186)	(0.163)
constant	-0.180***	-0.262**	0.062	-0.100**	-0.154**	0.332***	-0.277***	-0.158	-0.212
	(0.037)	(0.110)	(0.059)	(0.038)	(0.053)	(0.084)	(0.059)	(0.267)	(0.165)
N	385	242	143	250	166	84	135	76	59
Within R^2	0.1851	0.1963	0.2335	0.1328	0.1214	0.3310	0.2372	0.2593	0.1569
Between R^2	0.0425	0.1507	0.0186	0.4074	0.0148	0.1075	0.0244	0.0750	0.0189
Overall R^2	0.1825	0.1981	0.1947	0.1297	0.1182	0.2544	0.2338	0.2560	0.1403
Pesaran's test (p-val)	0.0000	0.0060	0.0000	0.0000	0.0061	0.0000	0.0504	0.1298	0.5128
Frees' test (statistic)	0.606***	-0.002	0.319**	0.766***	0.312*	0.412**	0.048	-0.320	-0.257

Notes: The estimated model is given by $\Delta capb\_p_{it} = \alpha_i + \alpha_1 \cdot \Delta capb\_p_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ggap_{it} + \alpha_4 \cdot \Delta cab_{it} + \varepsilon_{it}$. Only $debt_{t-1}$ coefficients are presented, remaining estimates are available upon request. Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. Presented regressions were carried out using fixed effects estimator. Results for other estimators are available on demand and they do not change our conclusions. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 11. Robustness analysis part III. Exclusion of a country from the sample

	EU-12			Core			Periphery		
Excluded country	1970-2011	1970-1995 & 2008-2011	1996-2007	1970-2011	1970-1995 & 2008-2011	1996-2007	1970-2011	1970-1995 & 2008-2011	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall	All years	Baseline	Windfall
Austria	0.141***	0.156***	0.206*	0.112**	0.125*	0.446**	NA	NA	NA
	(0.028)	(0.043)	(0.107)	(0.031)	(0.051)	(0.160)			
Belgium	0.148***	0.155***	0.217*	0.133**	0.123	0.462**	NA	NA	NA
	(0.029)	(0.044)	(0.109)	(0.049)	(0.074)	(0.149)			
Finland	0.146***	0.154***	0.230*	0.124**	0.105	0.529***	NA	NA	NA
	(0.030)	(0.047)	(0.114)	(0.040)	(0.063)	(0.113)			
France	0.143***	0.156***	0.209*	0.117**	0.132**	0.443**	NA	NA	NA
	(0.027)	(0.042)	(0.108)	(0.031)	(0.049)	(0.164)			
Germany	0.138***	0.158***	0.174*	0.099***	0.119*	0.341**	NA	NA	NA
	(0.028)	(0.044)	(0.090)	(0.022)	(0.056)	(0.126)			
Luxembourg	0.146***	0.160***	0.209*	0.126**	0.139**	0.449**	NA	NA	NA
	(0.027)	(0.042)	(0.107)	(0.034)	(0.051)	(0.173)			
Netherlands	0.154***	0.174***	0.183*	0.145**	0.182***	0.380*	NA	NA	NA
	(0.027)	(0.040)	(0.098)	(0.037)	(0.020)	(0.157)			
Greece	0.123***	0.120**	0.339***	NA	NA	NA	0.136	0.124	0.250
	(0.030)	(0.043)	(0.100)				(0.073)	(0.081)	(0.117)
Ireland	0.160***	0.181***	0.243*	NA	NA	NA	0.203***	0.223**	0.121
	(0.023)	(0.036)	(0.132)				(0.023)	(0.050)	(0.125)
Italy	0.140***	0.161***	0.194*	NA	NA	NA	0.162**	0.186*	0.057
	(0.029)	(0.044)	(0.103)				(0.049)	(0.066)	(0.055)
Portugal	0.143***	0.163***	0.210*	NA	NA	NA	0.164*	0.191*	0.086
	(0.029)	(0.045)	(0.109)				(0.054)	(0.077)	(0.088)
Spain	0.132***	0.138***	0.212*	NA	NA	NA	0.144**	0.143*	0.097
	(0.025)	(0.040)	(0.110)				(0.042)	(0.059)	(0.091)

Notes: The estimated model is given by $\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Only $debt_{t-1}$ coefficients are presented, remaining estimates are available upon request. The sample of the countries consists of EU-12, core or periphery, respectively, without a country mentioned in the column named "excluded country". Variables definitions are reported in Table 3. All regressions were carried out with the fixed effects estimator as previously, there were no major differences between the various methods. Results for other estimators are available on demand and they do not change our conclusions. Results shown are coefficients, while standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 12. Robustness analysis part IV. Change in definition of countries included in periphery group

	Core group with Italy			Periphery group without Italy		
	1970-2013	1970-1995 & 2008-2013	1996-2007	1970-2013	1970-1995 & 2008-2013	1996-2007
	All years	Baseline	Windfall	All years	Baseline	Windfall
$\Delta pbalance_{t-1}$	-0.190**	-0.152*	-0.207**	-0.125	-0.116	-0.310***
	(0.078)	(0.065)	(0.062)	(0.145)	(0.184)	(0.041)
$\Delta debt_{t-1}$	0.129***	0.124**	0.456***	0.162**	0.186*	0.057
	(0.029)	(0.045)	(0.115)	(0.049)	(0.066)	(0.055)
$ogap_t$	0.054	0.086	0.039	0.071	0.131	-0.316
	(0.084)	(0.106)	(0.085)	(0.092)	(0.099)	(0.134)
$ggap_t$	-1.633***	-1.641***	-1.638***	-1.567***	-1.710**	-1.412**
	(0.309)	(0.393)	(0.337)	(0.119)	(0.314)	(0.306)
Δcab_t	0.073	0.133	-0.078	-0.131	-0.140	-0.144
	(0.062)	(0.094)	(0.115)	(0.156)	(0.192)	(0.180)
constant	-0.163***	-0.301**	0.429***	-0.354***	-0.322	0.032
	(0.040)	(0.100)	(0.049)	(0.059)	(0.171)	(0.082)
N	282	186	96	120	72	48
Within R^2	0.2526	0.3098	0.3095	0.3412	0.4007	0.2866
Between R^2	0.0708	0.3988	0.1295	0.0978	0.3830	0.0840
Overall R^2	0.2514	0.3107	0.2336	0.3293	0.3894	0.2569
Pesaran's test (p-val)	0.0000	0.0000	0.0000	0.0000	0.0000	0.9925
Frees' test (statistic)	1.143***	0.609***	0.832***	0.082	0.421**	-0.123

Notes: The estimated model is given by $\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Periphery definition is changed to negative interest rate-growth differential during the windfall period, which results in moving Italy from periphery to core. Core consists of Austria, Belgium, Finland, France, Germany, Italy, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. Presented regressions were carried out using fixed effects estimator. Results for other estimators are available on demand and they do not change our conclusions. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

TABLE 13. Robustness analysis part V. Change in definition of windfall period

	EU-12		Core		Periphery	
	1970-1998 & 2008-2013	1999-2007	1970-1998 & 2008-2013	1999-2007	1970-1998 & 2008-2013	1999-2007
	Baseline	Windfall	Baseline	Windfall	Baseline	Windfall
$\Delta pbalance_{t-1}$	-0.157*	-0.312***	-0.230*	-0.325***	-0.088	-0.334**
	(0.083)	(0.065)	(0.111)	(0.073)	(0.142)	(0.119)
$\Delta debt_{t-1}$	0.132**	0.219*	0.082	0.375**	0.167*	0.163
	(0.046)	(0.107)	(0.054)	(0.135)	(0.063)	(0.117)
$ogap_t$	0.090	0.069	-0.059	0.253**	0.136	-0.117
	(0.072)	(0.120)	(0.088)	(0.080)	(0.086)	(0.188)
$ggap_t$	-1.599***	-1.918***	-1.958***	-2.063***	-1.486***	-1.718
	(0.181)	(0.432)	(0.196)	(0.207)	(0.259)	(0.820)
Δcab_t	-0.018	0.020	0.111	-0.067	-0.129	0.040
	(0.101)	(0.076)	(0.096)	(0.105)	(0.177)	(0.151)
constant	-0.129	-0.380**	-0.075	-0.334*	-0.143	-0.216
	(0.088)	(0.134)	(0.096)	(0.144)	(0.140)	(0.188)
N	296	106	187	63	109	43
Within R^2	0.2763	0.3550	0.2687	0.4169	0.3317	0.3640
Between R^2	0.2622	0.0443	0.0007	0.3887	0.3145	0.3379
Overall R^2	0.2734	0.3259	0.2652	0.3370	0.3208	0.2937
Pesaran's test (p-val)	0.0000	0.0010	0.0000	0.0087	0.0000	1.1244
Frees' test (statistic)	2.047***	0.387*	1.541***	0.472**	0.506***	-0.276

Notes: The estimated model is given $\Delta pbalance_{it} = \alpha_i + \alpha_1 \cdot \Delta pbalance_{it-1} + \alpha_2 \cdot \Delta debt_{it-1} + \alpha_3 \cdot ogap_{it} + \alpha_4 \cdot ggap_{it} + \alpha_5 \cdot \Delta cab_{it} + \varepsilon_{it}$. Windfall period definition is changed to beginning with accession to the Euro area, which results in a timespan 1999-2007 (2001-2007 for Greece). Core consists of Austria, Belgium, Finland, France, Germany, Luxembourg and the Netherlands. Periphery encompasses Greece, Ireland, Italy, Portugal and Spain. EU-12 is the sum of core and periphery. Variables definitions are reported in Table 3. Presented regressions were carried out using fixed effects estimator. Results for other estimators are available on demand and they do not change our conclusions. Standard errors are given in parentheses. Stars denote estimates significance at 1% (***), 5% (**), 10% (*) levels.

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