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# Evidence on Fiscal Consolidations and the Evolution of Public Debt in Europe

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## Abstract

The objective of this paper is to gain insights into the relationship between deficit-reducing policies and the evolution of the debt/GDP ratio. We consider past events of fiscal consolidation in a selected group of EU countries, by using the new data set recently made available by Devries et al. (2011), and check what is the associated change of the debt/GDP ratio both from a short and medium-term perspective. Our results show that a favourable short-term response emerges in the majority of the countries considered, while the medium-term one is adverse for all. The analysis provides information to assess the convenience of deficit-reducing policies to contain or invert the evolution of the debt/GDP ratio.

JEL-Code: H630, E630.

Keywords: fiscal consolidation, debt/GDP ratio, European Union.

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**Main Abbreviations**

| | |
|---|---|
| DGR | debt/GDP ratio |
| ΔDGR | variation (first-difference) of the debt/GDP ratio |
| FC | Fiscal Consolidation |
| yes-FC | used to mark years when a FC is implemented |
| no-FC | used to mark years when a FC does not occur |
| BEFC | Budgetary Effect of a Fiscal Consolidation |

**Variables**

| | |
|---|---|
| *B (b)* | Debt level (debt level / GDP ratio) |
| *BEC* | Variable describing the budget effect of FC as a percentage of GDP |
| *OD* (*od*) | Overall public deficit (overall public deficit / GDP ratio) |
| *PD* | Primary deficit |
| *Y* | *GDP* |
| *Dbt* | deviation of current DGR variation ($\Delta b_t$) w.r.t. to the average $\Delta DGR$ in the previous two periods |
| $\Delta_2 b_{it+1}$ | $\Delta_2 b_{it+1} = \Delta b_{it} + \Delta b_{it+1} = b_{it+1} - b_{it-1}$ |

This paper includes 8 Tables and 3 Figures in the Appendix.

# Evidence on Fiscal Consolidations and the Evolution of Public Debt in Europe

## 1 Introduction

In recent time, a wide debate has developed concerning the effects of restrictive fiscal policies on the dynamics of the ratio of public debt/GDP ratio (DGR). The debate is nourished by the current experience of EU countries, where fiscal consolidation policies are implemented with the objective of reducing their DGR. An objective which is now made mandatory by the new Six-pack and Fiscal Compact agreements which impose a precise reduction path for the countries exceeding the 60% Maastricht limit.

The object of this paper is the study of how the DGR dynamics changed when a fiscal consolidation was implemented. From an economic-policy perspective, building on past episodes, we aim to provide information helping to assess whether fiscal authorities' effort to contain the DGR through fiscal consolidations is effective or not in general terms. Indeed, the restrictive effect of a fiscal consolidation on the GDP might well offset the deficit reduction and cause an undesired DGR increase. As a matter of fact, this is a self-defeating outcome which one cannot exclude a-priori (Gros 2011, Krugman 2011, Southerland et al. 2012) and which has a clear theoretical reference in the fiscal multiplier literature (see, among the others, Cwik & Wieland 2011 for their focus on the Euro Area).

Our analysis covers a selected group of EU countries, observed over the period 1980-2009. We consider fiscal-consolidation events as recently recorded in Devries et al. (2011) and check (i) the associated contemporaneous variation in the DGR with respect to its past evolution, and (ii) the associated ex-post DGR cumulated change; results are drawn from the comparison of the DGR distribution under different policy stances. This work flows into a research stream devoted to the understanding of how fiscal policy affects macroeconomic variables (Alesina et al. 1995) and which explicitely considers differnent policy optionions in the presence of public debt (Corsetti et al. 2011). It is also particularly relevant in the context of the actions taken to tackle the Euro Area debt crisis started in 2010 (Cafiso 2012).

The paper is structured as follows. Section 2 introduces to the budget relations which are object of our empirical investigation. Section 3 describes the data set of fiscal-consolidation events used, which is the edge of our analysis. Section 4 outlines the analysis. In sections 5 and 6 we discuss respectively the short and medium-term results of the analysis. A discussion of whether the Euro's introduction has altered the association between fiscal consolidations and the dynamics of the debt/GDP ratio is in section 7. Section 8 provides the concluding remarks.

## 2 Budget relations: a simple algebra of deficit and debt dynamics

The budget relations at the basis of our empirical investigation can be easily derived from national budget accounting (Escolano 2010). The way in which we present them in this section is inspired from Gros (2011). We start with the difference equation which describes the debt evolution:

$$B_t = OD_t + B_{t-1} \tag{1}$$

where $B_t$ is the debt level and $OD_t$ is the overall deficit, such that $OD_t = PD_t + i_t B_{t-1}$; $PD_t$ is the primary deficit and $i_t B_{t-1}$ is the interest bill.[1] Since $OD_t$ is the overall deficit (and not the balance), $\Delta OD_t > 0$ means a deficit increase. Dividing (1) for the nominal GDP $(Y_t)$ and considering that $Y_{t-1}/Y_t = 1/(1+g_t)$, we get:

$$\frac{B_t}{Y_t} = \frac{OD_t}{Y_t} + \frac{B_{t-1}}{Y_{t-1}} \frac{1}{(1+g_t)}. \tag{2}$$

Using small letters for GDP ratios and re-expressing the equation in terms of first differences, we obtain:

$$\Delta b_t \overset{def}{=} b_t - b_{t-1} = od_t + \frac{b_{t-1}}{1+g_t} - b_{t-1}. \tag{3}$$

At this point, we draw from the fiscal multiplier literature (e.g., Corsetti et al. 2011) and illustrate the possible effect of a deficit reduction on the DGR variation both in the short-term and over a longer period. The following discussion develops considering the DGR variation, not the DGR level. Indeed, as it will be made clear in section 4.3, we are interested in its average change in fiscal-consolidation years with respect to years of no fiscal-consolidation.[2]

### 2.1 Short-term effect of a deficit reduction on the DGR

Gros (2011) defines the short-term effect of a deficit reduction on the DGR as the contemporaneous DGR variation caused by such deficit reduction; in symbols, the short-term effect evaluation consists in assessing the link $\Delta od_t < 0 \rightarrow \Delta b_t$. Considering equation (3) and assuming that $g_t = g(od_t)$, this effect can be quantified by the derivative $\partial \Delta b_t / \partial od_t$:

[1] The analysis here considers the overall deficit; for a discussion of how differently the primary balance and the interest bill determine the debt evolution, refer to Cafiso (2011).

[2] For this reason, the derivatives derived in section 2.1 and 2.2 are defined for the DGR variation. However, they are formally equal to those for the DGR level.

$$\frac{\partial \Delta b_t}{\partial od_t} = 1 - \frac{b_{t-1}}{(1+g_t)^2} \cdot \frac{\partial g_t}{\partial od_t} \tag{4}$$

Notice that $\partial \Delta b_t / \partial od_t > 0$ means that a higher (lower) deficit will cause a higher (lower) debt variation. Then, a lower deficit will not affect positively the same-year DGR when the opposite holds true, that is $\partial \Delta b_t / \partial od_t < 0$ (self-defeating outcome):

$$\frac{\partial \Delta b_t}{\partial od_t} < 0 \Rightarrow 1 < \frac{\partial g_t}{\partial od_t} \cdot \left[ b_{t-1} \cdot (1+g_t)^{-2} \right]. \tag{5}$$

Gros (2011) labels $\partial g / \partial od$ as fiscal multiplier. He argues that if it is equal to +1, and furthermore $(1+g_t)^{-2} \cong 1$, condition (5) may happen to hold for a country with a DGR larger than one; for e.g. Italy, where the DGR is approximately 1.2.[3]

## 2.2 Longer-term effect of a deficit reduction on the DGR

The longer-term effect of a deficit reduction is defined as the cumulated *m*-periods DGR variation caused by a year *t* deficit reduction; in symbols, $\Delta od_t < 0 \rightarrow \Delta_m b_{t+m-1}$ where $\Delta_m b_{t+m-1} = b_{t+m-1} - b_{t-1}$. Gros (2011) considers the longer-term effect of a deficit reduction in two alternative cases, namely under a temporary or definitive deficit reduction.

*I) Temporary Deficit Reduction*: $\Delta od_t < 0$ and $\Delta od_{t+1} > 0$ such that $od_{t-1} = od_{t+1}$.
Here we can imagine further sub-cases: *1a*) no output drop, $Y_{t-1} = Y_t = Y_{t+1}$; *1b*) temporary output drop, $\Delta Y_t < 0$, $\Delta Y_{t+1} > 0$ and $Y_{t-1} = Y_{t+1}$; *1c*) permanent output drop, $\Delta Y_t < 0$ and $Y_{t-1} > Y_t = Y_{t+1}$.

Case (1c) is unlikely to happen since the deficit reduction under scrutiny is temporary. As for case (1b), the longer-term effect (from *t*+1) is positive and limited to less debt-creation in *t* if and only if the output drop in *t* does not offset completely the deficit reduction. In case (1a) the maximum longer-term effect of a temporary deficit reduction emerges because less debt has been added through less deficit in *t* at a constant output level.

[3] Even in this simple framework, conclusions about the effectiveness of the policy depend on the size of the fiscal multiplier. The size of the multiplier is a debated issue in the literature because, among other things, it determines whether or not fiscal stimuli are worth to invert a recession. For a recent discussion of this issue referring to the policy answer to the 2008-2009 crisis, see Cwick & Wieland (2011).

II) *Definitive Deficit Reduction*: $\Delta od_t < 0$ and $od_t = ... = od_{t+m-1}$.

Also in this case, it is possible to consider some sub-cases: *2a*) contemporaneous but temporary output drop, $Y_{t-1} > Y_t$ and $Y_t < Y_{t+1}$ such that $Y_{t-1} = Y_{t+1}$; *2b*) contemporaneous and prolonged output drop, $Y_{t-1} > Y_t = Y_{t+1} = ... = Y_{t+m-1}$ but $Y_{t-1} = Y_{t+m}$; *2c*) permanent output drop, $Y_{t-1} > Y_t = Y_{t+1} = ... = Y_{t+\infty}$; *2d*) no output drop, $Y_{t-1} = Y_t = Y_{t+1} = ... = Y_{t+\infty}$.

We imagine case (2c) not to be likely because the output tends to return to its growth path in the long-run, even in case of a permanent deficit reduction. In case (2d) the cumulative beneficial effect is to take for-given, because less debt has been added through comparatively less deficit in each year at a constant GDP level. As for case (2a), a beneficial effect in terms of DGR evolution is assumed from t+1 onwards.

Case (2b) needs more consideration. We develop the discussion by considering a 2-year time horizon ($m$=2). Since we apply such 2-year horizon in our subsequent empirical investigation, we will talk of *medium-term* effect of a fiscal consolidation in the analysis in section 6.

If we imagine that the deficit reduction is such to keep down the GDP level for $m$=2, we need to evaluate the link: $od_{t-1} > od_t = od_{t+1} \rightarrow \Delta_2 b_{t+1}$ under the hypothesis $Y_{t-1} > Y_t = Y_{t+1}$. Starting from eq. (1) translated in *t+1,* after simple manipulations we obtain:

$$\frac{B_{t+1}}{Y_{t+1}} = \frac{OD_{t+1}}{Y_{t+1}} + \left[ \frac{OD_t}{Y_t} \frac{1_t}{(1+g_{t+1})} + \frac{B_{t-1}}{Y_{t-1}} \frac{Y_{t-1}}{Y_t} \frac{Y_t}{Y_{t+1}} \right] \qquad (6)$$

By considering the conditions defining the case (2b), namely, $Y_{t-1} > Y_t = Y_{t+1}$, equation (6) becomes:

$$\frac{B_{t+1}}{Y_{t+1}} = \frac{OD_{t+1}}{Y_{t+1}} + \left[ \frac{OD_t}{Y_t} + \frac{B_{t-1}}{Y_{t-1}} \frac{Y_{t-1}}{Y_t} \right] \qquad (7)$$

or, equivalently,

$$b_{t+1} = od_{t+1} + \left[ od_t + \frac{b_{t-1}}{1+g_t} \right] \qquad (8)$$

and in terms of 2-year cumulated change:

$$\Delta_2 b_{t+1} \overset{def}{=} b_{t+1} - b_{t-1} = od_{t+1} + \left[ od_t + \frac{b_{t-1}}{1+g_t} \right] - b_{t-1} \qquad (9)$$

In the manner of Gros (2011), and taking into account that $od_t = od_{t+1}$ under case (2b), the effect of a permanent deficit reduction may be expressed as the first derivative of eq. (9) $\partial \Delta_2 b_{t+1} / \partial od_t$ :

$$\left.\frac{\partial \Delta_2 b_{t+1}}{\partial od_t}\right|_{od_t = od_{t+1}} = 1 + 1 - b_{t-1} \cdot (1 + g_t)^{-2} \cdot \frac{\partial g_t}{\partial od_t} \cong 2 - b_{t-1} \cdot \frac{\partial g_t}{\partial od_t} \tag{10}$$

From equation (10), the condition for having a self-defeating outcome from a fiscal consolidation policy is:

$$\left.\frac{\partial \Delta_2 b_{t+1}}{\partial od_t}\right|_{od_t = od_{t+1}} < 0 \Rightarrow 2 < b_{t-1} \cdot \frac{\partial g_t}{\partial od_t} \tag{11}$$

Condition (11) is more difficult to meet than condition (5) because the product of the fiscal multiplier and the starting debt/GDP ratio must now exceed 2.

Before moving to the empirical analysis, we point out that there is no theoretical reason for which the short and longer-term effect of a fiscal consolidation on the DGR should be of the same sing. As recently explained by Clinton et al. (2011), other factors may come into place and alter the overall outcome. To wit, the GDP variation is likely not to be constant between the short and medium term (Conen et al. 2008).

In the empirical analysis that follows, we study the short-term effect through a variable which quantifies the deviation of the DGR trend (section 5). Indeed, debt and deficit data do not allow studying the intra-year effect, and we therefore compare the DGR variation contemporaneous to a fiscal adjustment with the variation registered in the two previous years. As for the so-called longer-term effect, we use the 2-year cumulated change (section 6) and therefore talk of *medium-term* effect.

## 3 A new data set of Fiscal Consolidation events

For the scope of our analysis we use the recent data set provided by Devries et al. (2011): they compile a data set of the Budgetary Effect of Fiscal Consolidation measures (BEFC) following the so-called *narrative approach* first developed by Romer & Romer (2010). The edge of this data set is that it records the BEFC using contemporaneous estimates in official government documents. The data set reports the BEFC only of deficit-reducing measures. Namely, it quantifies the deficit reduction in terms of GDP as an outcome of the fiscal authorities' discretionary action to reduce such deficit. Hence, there is no record if in a certain

year the deficit has decreased because of an output increase, or other events different from discretionary policy.

We consider observations for thirteen EU countries available in the data set, which are: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom, with a yearly frequency over the 1980-2009 time span.

The same data set of Devries et al. (2011) is used by Guajardo et al. (2011) to test the *expansionary austerity hypothesis* as documented in several contributions (Alesina & Ardagna 2010, Giavazzi & Pagano 1990). According to the expansionary austerity hypothesis, a fiscal consolidation causes a GDP increase under certain circumstances (for a detailed and clarifying discussion for the Euro Area countries when the goal is a DGR reduction, see Coenen et al. 2007). With a specific reference to Alesina & Ardagna (2010), the objective of Guajardo et al. (2011) is to prove that the expansionary austerity hypothesis emerges as a bias of using significant variation of the Cyclical-Adjusted Primary Balance to account for changes in the fiscal stance. They provide evidence that this is the case, by showing that fiscal consolidations cause real GDP contractions. Furthermore, they show that tax-increase-based fiscal consolidations are more negative on the GDP than expenditure-cuts-based ones, as already pointed out in several contributions (e.g., Perotti 1996). The result by Guajardo et al. (2011) is relevant for our analysis because the negative effect of fiscal consolidations on the GDP affects the association between fiscal consolidations and the DGR, as discussed in section 2.

# 4 Outline of the Analysis

We have two research objectives. First, we aim to assess whether a discontinuity in the DGR evolution (with respect to its recent past) emerges at the time of a significant fiscal consolidation (short-term response). Second, we want to quantify the DGR cumulated change following a fiscal consolidation in order to assess if the DGR increases or diminishes and by which amount (medium-term response).

We start by describing the series used in the analysis (section 4.1) and through a first insight into the budget relations studied using pairwise correlations (section 4.2). Afterwards, we explain how we split the sample of countries into two groups, using cluster analysis, to have a finer investigation (4.3).

## 4.1 The BEC and the DGR series

Based on Devries et al. (2011)'s data set, we generate the variable *BEC* which consists of 390 observations (balanced panel, with 13 countries observed over a 30 year period). For every country *i,* year *t* may be a fiscal consolidation year (yes-FC) or not (no-FC). In the case of no-FC, variable *BEC* is set equal to zero; in the case of yes-FC, the value of *BEC* is equal to the budget amount of the adjustment (in terms of GDP) as reported in the BEFC data set by Devries et al. (2011). Formally:

$$BEC = \begin{cases} BEFC \text{ if } t \text{ is a yes-FC year} \\ 0 \text{ if } t \text{ is a no-FC year} \end{cases}$$

In case of yes-FC, the distribution of variable *BEC* is very heterogeneous among countries, as shown in Table 1-Panel X. The largest *BEC* values pertain to the cases of Ireland in 2009 (4.74%), Italy in 1993 (4.49%), Italy in 1995 (4.20%), and Finland in 1993 (3.71%).[4]

The distribution of the variable describing the DGR variations ($\Delta DGR$) is reported in Table 1 under different conditions. In Panel A we report the distribution of the whole sample: it emerges that positive variations are more than the negative (50th percentile is positive), and the bulk of values lies to the left of the mean (positive skewness). Then, DGR increases have been more frequent than decreases. Figure 1 in Appendix A provides the graphs of the historical DGR evolution in our sample.

In our analysis we compare the $\Delta DGR$ distribution in different policy stances. If one considers years of yes-FC (panel C in Table 1) against years of no-FC (panel B in Table 1), it emerges that in periods of no-FC there are more negative variations (the DGR decreases), while there are more positive $\Delta DGR$ in case of yes-FC. Furthermore, the larger the BEC (above 50th percentile), the larger the portion of positive $\Delta DGR$ (as it is clear from the comparison between panels D and E).

[4] Negative *BEC* values are inserted by Devries et al. (2011) in the year that follows a fiscal consolidation which has only a temporary nature. By doing so, the negative value corrects the previous year correction.

**Table 1: Distribution of BEC and $\Delta DGR$ of in different cases**

| Panel X: BEC distr. in case of yes-FC (obs 120) | | Panel A: $\Delta DGR$, whole sample (Obs 367) | |
|---|---|---|---|
| Descriptive statistics | Percentiles | Descriptive statistics | Percentiles |
| Mean 1.210 | 10%: .120 | Mean .907 | 10%: -4.345 |
| Std. Dev. 1.031 | 25%: .500 | Std. Dev. 4.798 | 25%: -2.233 |
| Variance 1.064 | 50%: 1.025 | Variance 23.021 | 50%: .400 |
| Skewness 1.060 | 75%: 1.655 | Skewness .835 | 75%: 3.299 |
| Kurtosis 4.461 | 90%: 2.635 | Kurtosis 4.691 | 90%: 6.929 |
| Panel B: $\Delta DGR$, no-FC (Obs 257) | | Panel C: $\Delta DGR$, yes-FC (Obs 110) | |
| Descriptive statistics | Percentiles | Descriptive statistics | Percentiles |
| Mean .376 | 10%: -5.005 | Mean 2.147 | 10%: -2.942 |
| Std. Dev. 4.792 | 25%: -2.698 | Std. Dev. 4.596 | 25%: -.651 |
| Variance 22.971 | 50%: .100 | Variance 21.132 | 50%: 1.254 |
| Skewness .717 | 75%: 2.703 | Skewness 1.345 | 75%: 3.770 |
| Kurtosis 4.163 | 90%: 6.300 | Kurtosis 5.981 | 90%: 10.800 |
| Panel D: $\Delta DGR$, yes-FC & *BEC*>0 (Obs 102) | | Panel E: $\Delta DGR$, yes-FC & *BEC*>p50th (Obs 53) | |
| Descriptive statistics | Percentiles | Descriptive statistics | Percentiles |
| Mean 2.334 | 10%: -2.899 | Mean 3.359 | 10%: -2.763 |
| Std. Dev. 4.635 | 25%: -.651 | Std. Dev. 5.095 | 25%: .300 |
| Variance 21.484 | 50%: 1.350 | Variance 25.968 | 50%: 2.516 |
| Skewness 1.402 | 75%: 4.100 | Skewness 1.073 | 75%: 6.100 |
| Kurtosis 5.786 | 90%: 9.000 | Kurtosis 4.916 | 90%: 10.200 |

Note: The DGR data are from the ECFIN Ameco database.

## 4.2 Correlation Analysis and related considerations

In this section we explore correlations between some variables of interest in order to gain basic information useful for the following analysis. Moreover, drawing from the correlation values, we raise some issues which motivate the analytical approach taken. Pairwise correlations under different restrictions are in Table 2 in separate panels.

The contemporaneous correlation between *BEC* and $\Delta DGR$ is positive: FC events are associated with higher contemporaneous $\Delta DGR$; the correlation remains quite high also between $BEC_t$ and $\Delta DGR_{t+1}$, but it is neglectable between $BEC_t$ and $\Delta DGR_{t+2}$ (see panels A and C). The association therefore seems to last only 1-period ahead. Given this result, our subsequent analysis on the DGR evolution is limited to a 2-year horizon.

The contemporaneous correlation between *BEC* and *rg* is negative (panel C): the larger the fiscal consolidation, the smaller the real-GDP growth rate; a result coherent with the analysis in Guajardo et al. (2011).The correlation between real-GDP growth and $\Delta DGR$ is strongly negative too both in case of yes- and no-FC: the smaller the GDP growth, the larger the government's financing needs.

**Table 2: Pairwise correlations and average Real GDP growth rates in different cases**

*Pairwise correlations between variables of interest*

Panel A: whole sample

| | $BEC_t$ | $\Delta DGR_t$ | $\Delta DGR_{t+1}$ | $\Delta DGR_{t+2}$ | *rg* | *ng* | *Bg* |
|---|---|---|---|---|---|---|---|
| $BEC_t$ | 1.000 | | | | | | |
| $\Delta DGR_t$ | .316 | 1.000 | | | | | |
| $\Delta DGR_{t+1}$ | .126 | .609 | 1.000 | | | | |
| $\Delta DGR_{t+2}$ | -.022 | .301 | .608 | 1.000 | | | |
| *rg* | -.166 | -.590 | -.468 | -280 | 1.000 | | |
| *ng* | -.063 | -.044 | .019 | .058 | .423 | 1.000 | |
| *Bg* | .185 | .832 | .560 | .274 | -.373 | .365 | 1.000 |

Panel B : no-FC

| | $BEC_t$ | $\Delta DGR_t$ | $\Delta DGR_{t+1}$ | $\Delta DGR_{t+2}$ | *rg* | *ng* | *Bg* |
|---|---|---|---|---|---|---|---|
| $BEC_t$ | na | | | | | | |
| $\Delta DGR_t$ | na | 1.000 | | | | | |
| $\Delta DGR_{t+1}$ | na | .594 | 1.000 | | | | |
| $\Delta DGR_{t+2}$ | na | .335 | .619 | 1.000 | | | |
| *rg* | na | -.589 | -.507 | -.314 | 1.000 | | |
| *ng* | na | -.007 | -.010 | .011 | .404 | 1.000 | |
| *Bg* | na | .835 | .524 | .270 | -.371 | .408 | 1.000 |

Panel C: yes-FC

| | $BEC_t$ | $\Delta DGR_t$ | $\Delta DGR_{t+1}$ | $\Delta DGR_{t+2}$ | *rg* | *ng* | *Bg* |
|---|---|---|---|---|---|---|---|
| $BEC_t$ | 1.000 | | | | | | |
| $\Delta DGR_t$ | .363 | 1.000 | | | | | |
| $\Delta DGR_{t+1}$ | .162 | .643 | 1.000 | | | | |
| $\Delta DGR_{t+2}$ | -.034 | .266 | .593 | 1.000 | | | |
| *rg* | -.152 | -.548 | -.347 | -205 | 1.000 | | |
| *ng* | .162 | .014 | .167 | .202 | .418 | 1.000 | |
| *Bg* | .289 | .839 | .641 | .301 | -.340 | .348 | 1.000 |

*Real GDP growth rates under different cases*

| Case | Mean | Stad. Dev. | Freq |
|---|---|---|---|
| yes-FC | 2.073 | 2.171 | 259 |
| no-FC | 2.406 | 2.605 | 118 |
| whole | 2.301 | 2.480 | 377 |

Note: *rg* is the growth rate of real GDP; *ng* is the growth rate of nominal GDP; *Bg* is the rate of growth of the stock of debt. Apart for the BEC series, all the data are from the ECFIN Ameco database.

The negative correlation between *BEC* and real GDP growth raises a *sample-selection bias issue*: we consider FC events and DGR variations in years when real GDP growth is below its average. This emerges also by comparing the average real GDP growth rate in cases of no or yes-FC as reported in Table 2 (lower part). Lower GDP growth may be either the cause or the consequence of a fiscal consolidation (*reverse causality issue*): of course, deficit-reducing fiscal consolidations are likely during recessions, but a fiscal-tightening is also likely to cause lower demand and GDP as an outcome.[5]

[5] Likely, in more recent years and for the Euro Area countries under considerations, lower growth is the cause of deficit-reducing consolidations because of externally-imposed discipline such as the Stability and Growth pact (since 1999). However, further in the past, EU countries committed often to deficit-reducing measures for other reasons too. Just to provide an example here, in 1984 Belgium lunched a three year programme to reduce its deficit (1984-1987). The 1984 IMF Recent Economic Developments reports that it was motivated by "the awareness that the borrowing requirement was approaching a self-perpetuating level through the 'snowball effect' on interest payments". For a detailed discussion of the background of each FC event included in our sample, see Devries et al. (2011).

The issues of causality and selection bias discussed here, as well as obvious simultaneity between the *BEC* and Δ*DGR* series, are the motivation why we opt for non-econometric methods in developing our analysis. Indeed, we prefer an approach based on the comparison of distributions, an approach which we believe to be more reliable and robust to the mentioned issues.

## 4.3 Variables for the analysis and country grouping

In this section we introduce the two variables used respectively for the short-term analysis (section 5) and the medium-term analysis (section 6). We also explain the cluster analysis based on such variables and used to divide our sample into two groups for a comparison purpose.

### *4.3.1 A variable to capture the Break of Tendency*

We introduce a variable denoted as $DTb_{it}$ which accounts for the deviation of the current DGR variation ($\Delta b_t$) with respect to the average DGR variation in the previous two periods (*t-1* and *t-2*); formally:

$$DTb_{it} = \left( \frac{\Delta b_{it-1} + \Delta b_{it-2}}{2} \right) - \Delta b_{it} \qquad (12)$$

where $\Delta b_t = b_t - b_{t-1}$ and $b_t$ is the debt/GDP ratio (DGR). Note that:

- $DTb_{it} > 0$ signals a favourable evolution in year $t$ : the current increase in $b$ is smaller than the average increase registered in the two previous years, or even, the country records a current DGR decrease larger with respect to the previous 2-year average;
- $DTb_{it} < 0$ signals an adverse evolution in year $t$ : either the DGR increase is higher or its reduction smaller with respect to the previous 2-year average.

In the manner of Alesina & Ardagna (2010), we focus our analysis on non-marginal deviations, by considering only $DTb_{it}$ above the 25th percentile of each country absolute-value distribution, so that in what follows we consider $DTb_{it}^*$ :

$$DTb_{it}^* = \begin{cases} DTb_{it} \text{ if } DTb_{it} \geq 25^{th} \text{ percentile of abs}\left(DTb_{it}\right) \\ 0 \text{ if } DTb_{it} < 25^{th} \text{ percentile of abs}\left(DTb_{it}\right) \end{cases}$$

Clearly, in every year *t*, $DTb_{it}^*$ can be positive, negative or zero. We judge a fiscal consolidation favourable on the DGR short-term evolution, if we observe a positive $DTb_{it}^*$ value (desiderd outcome).

### *4.3.2 A variable to measure the Cumulated Change*

We study the medium-term response of a fiscal-consolidation on the DGR by considering the 2-year cumulated change:

$$\Delta_2 b_{it+1} = \Delta b_{it} + \Delta b_{it+1} = b_{it+1} - b_{it-1} \tag{13}$$

where $\Delta b_t = b_t - b_{t-1}$ and $b_t$ is the debt/GDP ratio (DGR). As already mentioned, we opt for a 2-year horizon because correlations in Table 2 signal a statistical significant effect up to the following year only.[6]

As for $DTb_{it}$, we focus on non-marginal cumulated changes, we therefore consider $\Delta_2 b_{it+1}$ above the 25th percentile of country *i*'s absolute-value distribution: $\Delta_2 b^*_{it+1}$.

$$\Delta_2 b^*_{it+1} = \begin{cases} \Delta_2 b_{it+1} \text{ if } \Delta_2 b_{it+1} \geq 25^{th} \text{ percentile of abs}\left(\Delta_2 b_{it+1}\right) \\ 0 \text{ if } \Delta_2 b_{it+1} < 25^{th} \text{ percentile of abs}\left(\Delta_2 b_{it+1}\right) \end{cases}$$

In every year *t*, $\Delta_2 b^*_{it+1}$ can be positive, negative or non-significant (equal to zero). We judge a fiscal consolidation favourable on the DGR medium-term evolution if we observe an associated negative $\Delta_2 b^*_{it+1}$ (desired outcome).

### *4.3.3 Country grouping*

We now consider the two variables explained above ($DTb_{it}$ and $\Delta_2 b_{it+1}$) to split our country sample into two groups by using cluster analysis. We generate two groups to compare their short and medium-term response to a FC event. If a statistically-significant difference emerges between such groups, we will conclude that they behave differently (sections 5 and 6).

Cluster analysis attempts to determine the natural groupings (or clusters) of observations (Everitt et al. 2001). It breaks the observations into *k* distinct number of non-overlapping groups; in our application *k*=2. We implement the "means" partition method.[7] The cluster analysis is based on the $DTb_{it}$ and $\Delta_2 b_{it+1}$ values only in yes-FC years because we want to cluster countries for their different response to a FC event.

The cluster analysis generates 2 clusters (A and B); we label as "cluster A" the one with the lower $\Delta_2 b_{it+1}$ mean value (smaller 2-year cumulated change) and the higher $DTb_{it}$ mean value (larger positive break of

[6] Other authors, like Alesina & Ardagna (2010), choose a 3-year period instead. We tested our conclusions also using such horizon, and they remain largely unchanged.

[7] In means-clustering, each observation is assigned to the group whose mean is closest, and then based on that categorization, new group means are determined. These steps continue until no observations change groups. The algorithm begins with k seed values, which act as the *k* group means. There are many ways to specify the beginning seed values. We specify that *k* partitions are formed randomly among the observations to be clustered, then the group means from the k groups defined by this partitioning are used as the starting group centres. As similarity measure we use the Euclidean distance.

tendency). Since we have multiple time observations per country, it happens that some observations of a country fall in cluster A, while others in the cluster B. We denote as *non-virtuous* the countries for which the portion of "cluster A" observations is below the 25th percentile of the all-countries distribution of "cluster A" portions. Based on this criterion, the *non-virtuous* group turns out to consist of Spain (ES), Ireland (IE) and Portugal (PT); all the other countries are in the *virtuous* group. Some details and the final result of the present cluster analysis are reported in Table 3.[8]

**Table 3: Cluster analysis output**

| Country | # of FC | # obs in cluster A | % obs in cluster A | Final group | | Country | # of FC | # obs in cluster A | % obs in cluster A | Final group |
|---|---|---|---|---|---|---|---|---|---|---|
| AT | 5 | 4 | .80 | V | | IE | 6 | 2 | .33 | NV |
| BE | 10 | 5 | .50 | V | | IT | 12 | 8 | .67 | V |
| DE | 15 | 9 | .60 | V | | NL | 3 | 3 | 1.00 | V |
| DK | 5 | 4 | .80 | V | | PT | 7 | 1 | .14 | NV |
| ES | 10 | 4 | .40 | NV | | SE | 7 | 6 | .86 | V |
| FI | 6 | 4 | .67 | V | | UK | 6 | 5 | .83 | V |
| FR | 9 | 6 | .67 | V | | | | | | |

Note: The Table reports the number of fiscal consolidation episodes for each country, the number of observations falling in cluster A and the portion over the total. In the "final group" column, V stays for "virtuous" and NV for "non-virtuous", as explained in text.

# 5 Short-term analysis: Break of Tendency

In this section we develop the first part of our analysis, our aim is to check if a discontinuity in the DGR evolution emerges (present with respect to past) when a fiscal consolidation is enforced. We start by studying $DTb_{it}$* for the whole sample of countries, then we compare $DTb_{it}$* between the virtuous and non-virtuous group of countries.

## 5.1 All-countries analysis

In the whole sample (266 observations, both yes-FC and no-FC years), the share of positive values of $DTb_{it}$* is 53.0% (id A in Table 5). Then, positive and negative deviations are almost equal in number. If we consider years of yes-FC against no-FC years, portions diverge: 64.8% positive in case of yes-FC (id C in Table 4), 47.2% positive in case of no-FC (id B in Table 4). We test whether such portions are statistically different from each other, through the Chi-squared Test (Conover, 1999) which checks association, and the Rank-sum Test (Wilcoxon 1945) which checks origin from the same distribution. Both tests reject the null hypothesis (p.B=p.C, in Table 4) and signal that the distribution of positive $DTb_{it}$* is statistically different under the two policy stances.

[8] The same countries are assigned to the non-virtuous group when the criterion chosen is that the percentage of observations in cluster A is below 50%.

The same point is supported by binomial tests which indicate that the share of positive $DTb_{it}^*$ in case of no-FC is statistically equal to half (p.B=0.5 in Table 4), while it is not in case of yes-FC (p.C=0.5 in Table 4). It is worth emphasising that the share of episodes with the desired outcome is 64.8%, largely far from 100% which is what one might like.

These results suggest that fiscal consolidations are associated with a larger portion of favourable outcomes than years in which no fiscal consolidations occur. This finding matches desired expectations concerning the effect of a fiscal consolidation intended to correct the debt evolution. In the following sub-section we test this finding for the virtuous/non-virtuous groups to check its robustness.

**Table 4: Break-of-Tendency analysis, all countries**

Distribution of observations

| | Total number of $DTb^*_{it}$ | Share of positive $DTb^*_{it}$ | ID code for tests |
|---|---|---|---|
| All obs | 266 | 53.0% | A |
| No-FC | 178 | 47.2% | B |
| Yes_FC | 88 | 64.8% | C |
| Yes_FC,>50pc | 42 | 61.9% | D |

Tests

| | Comparison concerning | H0 | Result – p statistics |
|---|---|---|---|
| Association test | B,C | p.B=p.C | P=.007 (H0 rejected) |
| Rank-sum test | B,C | p.B=p.C | P=.000 (H0 rejected) |
| Binomial probability | A | p.A=.5 | P=.358 (H0 not-rejected) |
| | B | p.B=.5 | P=.500 (H0 not-rejected) |
| | C | p.C=.5 | P=.007 (H0 rejected) |

Note: Association test is the Conover (1999) Chi-squared Test which checks association, the Rank-sum test is the Wilcoxon (1945) test which checks origin from the same distribution, the Binomial probability test (Stata 2009) checks the likelihood of a specified probability. H0: p.B=p.C means that the null hypothesis is the equality of portions in case B and in case C. The null hypothesis is rejected or not rejected at the 5% significance level.

## 5.2 Virtuous versus non-Virtuous countries

We now consider the portion of positive deviations for the group of virtuous against non-virtuous countries (Ireland, Portugal and Spain); results are in Table 5. The portion of positive deviations ($DTb_{it}^*$ >0) is similar between the two groups in case of no-FC (id B and E in Table 5); coherently, the tests do not reject $H_0$, and their difference is not statistically-significant (p.B=p.E in Table 5). On the contrary, in case of yes-FC (id C and F in Table 5) the portion of positive deviations is 36.4% for non-virtuous countries and 74.2% for virtuous countries with both tests rejecting $H_0$ at 10% (p.C=p.F in Table 5).

By-group results suggest that fiscal consolidations are largely associated to favourable outcomes, in terms of DGR evolution, only in virtuous countries. Differently, non-virtuous countries respond negatively. Figure 2 in Appendix A displays the break-of-tendency analysis in charts by country.

**Table 5: Break-of-Tendency analysis, virtuous vs. non-virtuous countries**

Distribution of Observations

| Countries | Event | Total $DTb_{it}$* | Share of positive $DTb_{it}$* | ID for Test |
|---|---|---|---|---|
| Virtuous | all obs | 203 | 54.7% | A |
| | No Fis Cons | 137 | 45.2% | B |
| | Yes Fis Cons | 66 | 74.2% | C |
| Non Virtuous | all obs | 63 | 47.6% | D |
| | No Fis Cons | 41 | 53.7% | E |
| | Yes Fis Cons | 22 | 36.4% | F |

Tests

| Test | Comparison concerning | Comparison concerning | H0 | Result – p statistics |
|---|---|---|---|---|
| Association test | Same stance, different groups | A,D | p.A=p.D | P=.327 (H0 not-rejected) |
| | | B,E | p.B=p.E | P=.344(H0 not-rejected) |
| | | C,F | p.C=p.F | P=.001(H0 rejected) |
| | Same group, Different stances | B,C | p.B=p.C | P=.000 (H0 rejected) |
| | | E,F | p.E=p.F | P=.190 (H0 not-rejected) |
| Rank-sum test | Same stance, different groups | A,D | p.A=p.D | P=.942 (H0 not-rejected) |
| | | B,E | p.B=p.E | P=.334 (H0 not-rejected) |
| | | C,F | p.C=p.F | P=.097 (H0 not-rejected) |
| | Same group, Different stances | B,C | p.B=p.C | P=.000 (H0 rejected) |
| | | E,F | p.E=p.F | P=.851 (H0 not-rejected) |

Note: Association test is the Conover (1999) Chi-squared Test which checks association; the Rank-sum test is the Wilcoxon (1945) test which checks origin from the same distribution; H0 is rejected or not rejected at the 5% significance level.

# 6 Medium-term analysis: Cumulated Change

In the previous section we discussed the association between fiscal consolidations and the contemporaneous DGR evolution considered with respect to its past change (interpreted as the short-term response to a fiscal consolidation). In this section we consider what is the 2-year cumulated DGR change after a fiscal consolidation. As Alesina & Ardagna (2010), we judge a fiscal consolidation as favourable on the DGR evolution if we observe a *negative* 2-year cumulated DGR change ($\Delta_2 b^*_{it+1} < 0$); this is the desired outcome. We therefore consider portions of negative $\Delta_2 b^*_{it+1}$ over the total number of $\Delta_2 b^*_{it+1}$.

## 6.1 All-countries analysis

When we consider the whole sample, the portion of negative $\Delta_2 b^*_{it+1}$ over the total number (266 obs) is 44.7% (id A in Table 6); negative 2-year cumulated changes are slightly less than positive ones. When we consider no-FC years against yes-FC years, portions diverge: the portion of negative $\Delta_2 b^*_{it}$ is 49.7% in case of no-FC and 32.4% in case of yes-FC (id B, C in Table 6) with their difference being statistically-significant both using the Chi-square and Rank-sum test (p.B=p.C in the second part of Table 6). Also in

this case, the results are supported by binomial distribution tests. Furthermore, the portion of negative $\Delta_2 b_{it}^*$ decreases further with the size of fiscal consolidation (id D versus id C in Table 6).

These pieces of evidence are bad news as to the effectiveness of fiscal consolidations: the pooled analysis suggests that FC events are mainly associated to an adverse DGR evolution in the current and following year.[9] Furthermore, the tighter the fiscal consolidation is, the less the portion of DGR decreases.

**Table 6: Cumulated-Change analysis, all countries**

Distribution of Observations

| | Total number of $\Delta_2 b_{it}^*$ | Share of negative $\Delta_2 b_{it}^*$ | ID code for tests |
|---|---|---|---|
| All obs | 266 | 44.7% | A |
| No-FC | 189 | 49.7% | B |
| Yes-FC | 77 | 32.5% | C |
| Yes-FC, >50$^{th}$ perc | 42 | 22.2% | D |

Tests

| | Comparison concerning | H0 | Result – p statistics |
|---|---|---|---|
| Association test | B,C | p.B=p.C | P=.010 (H0 rejected) |
| Rank-sum test | B,C | p.B=p.C | P=.004 (H0 rejected) |
| Binomial probability | A | p.A=.5 | P=.097 (H0 not-rejected) |
| | B | p.B=.5 | P=1.00 (H0 not-rejected) |
| | C | p.C=.5 | P=.002 (H0 rejected) |

Note: Association test is the Conover (1999) Chi-squared Test which checks association, the Rank-sum test is the Wilcoxon (1945) test which checks origin from the same distribution, the Binomial probability test (Stata 2009) checks the likelihood of a specified probability.$H_0$ is rejected or not rejected at the 5% significance level.

## 6.2 Virtuous versus non-Virtuous countries

We now consider the portion of negative $\Delta_2 b_{it+1}^*$ for the group of virtuous and non-virtuous countries separately; descriptive statistics and relative tests are provided in Table 7. We recall that the desired outcome of a fiscal consolidation on the cumulated DGR evolution corresponds to negative value of $\Delta_2 b_{it+1}^*$.

It turns out that virtuous and non-virtuous countries have a similar portion of negative $\Delta_2 b_{it+1}^*$ in general (A versus D, in Table 7; note that null hypothesis p.A=p.D is not rejected): the share of desired outcomes is smaller than the half in both groups. If we limit our consideration to the no-FC years, the portion of negative values increases to 63.6% in non-virtuous countries and to 45.5% in virtuous countries (B versus E); tests provide contradictory evidence about the relevance of their difference (p.B=p.E in Table 7). This

[9] We point out that these results are not in contrast with the theoretical predictions of section 2. Admittedly, we find a larger number of self-defeating outcomes on the DGR in the medium term as compared to the short term. Indeed, in the empirical analysis, we do not differentiate in which specific sub-case an observed fiscal consolidation fits, and hence the ranking of probability of fiscal consolidations with the desired outcome between the short and longer-term effect (as resulting from condition (11) versus (5)) has not to be necessarily verified.

result is not a surprise since the clustering is done considering only yes-FC years. Indeed, portions across groups reverse in the case of yes-FC episodes: negative cases drops to 10.5% in non-virtuous countries and to 39.7% in virtuous countries (C versus F) with their difference being statistically significant ( p.C=p.F in Table 7).

**Table 7: Cumulated-Change analysis, virtuous vs. non-virtuous countries**

Distribution of Observations

| Countries | Event | Total $\Delta_2 b^*_{it+1}$ | Share of negative $\Delta_2 b^*_{it+1}$ | ID for Test |
|---|---|---|---|---|
| Virtuous | all obs | 203 | 43.8% | A |
| | No- FC | 145 | 45.5% | B |
| | Yes- FC | 58 | 39.7% | C |
| Non Virtuous | all obs | 63 | 47.6% | D |
| | No-FC | 44 | 63.6% | E |
| | Yes-FC | 19 | 10.5% | F |

Tests

| Test | Comparison concerning | Comparison concerning | H0 | Result |
|---|---|---|---|---|
| Association test | Same stance, different groups | p.A=p.D | A,D | P=.598 (H0 not-rejected) |
| | | p.B=p.E | B,E | P=.035 (H0 rejected) |
| | | p.C=p.F | C,F | P=.019 (H0 rejected) |
| | Same group, Different stances | p.B=p.C | B,C | P=.447 (H0 not-rejected) |
| | | p.E=p.F | E,F | P=.000 (H0 rejected) |
| Rank-sum test | Same stance, different groups | p.A=p.D | A,D | P=.860 (H0 not-rejected) |
| | | p.B=p.E | B,E | P=.111 (H0 not-rejected) |
| | | p.C=p.F | C,F | P=.003 (H0 rejected) |
| | Same group, Different stances | p.B=p.C | B,C | P=.272 (H0 not-rejected) |
| | | p.E=p.F | E,F | P=.001 (H0 rejected) |

Note: Association test is the Conover (1999) Chi-squared Test which checks association; the Rank-sum test is the Wilcoxon (1945) test which checks origin from the same distribution; H0 is rejected or not rejected at the 5% significance level.

By-group analysis confirms results from the pooled sample: FC events are associated with a smaller portion of negative $\Delta_2 b^*_{it+1}$ in both groups, but the portion is much lower for non-virtuous countries. This means that in case of a FC both virtuous and non-virtuous countries' DGR evolution worsens. In Figure 3 of Appendix A we display the 2-year cumulated change ($\Delta_2 b^*_{it+1}$) in charts by country.

## 6.3 Size of the cumulated change: tax-based versus expenditures-based consolidations

Some researchers argue that fiscal consolidations based on expenditure cuts are more effective in stabilizing the DGR than those based on a tax increase (e.g., Alesina & Ardagna 2010). Their argument builds on the evidence that expenditure cuts appear less output-depressive than tax increases -as a matter of empirical evidence- (Gujarado et al. 2011). The issue is also of interest because expenditure reductions are generally seen as a necessary policy option given the limit to an ever-higher taxation when the DGR is

already high (Corsetti et al. 2011). Moreover, the anticipation of a spending cut enhances the expansionary effect of a fiscal stimulus (Corsetti et al. 2010).

Devries et al. (2011)'s data set allows us to check this claim with reference to the EU countries under scrutiny, because the amount of each fiscal consolidation which they record is decomposed in the portion due to a tax-increase and to an expenditures-cut. We therefore classify each FC event as "tax-based" or "expenditures-based" according to its main component: if the larger part of a FC derives from a tax-increase, we define it as a tax-based fiscal consolidation.[10] Then, we study the average 2-year cumulated change ($\Delta_2 b_{it+1}$) separately in tax-based and in expenditures-based FC events; results are in panels A and B of Table 8.

In cases of DGR increase ($\Delta_2 b_{it+1} > 0$) when yes-FC, which corresponds to a indesired outcome, there is limited difference between tax or expenditures-based FC; such difference is not statistically significant according to the appropriate mean equality test.[11] On the contrary, a large difference emerges in case of DGR decreases ($\Delta_2 b_{it+1} < 0$): in such cases, expenditures-based FC are associated to larger DGR decreases with this difference being statistically-significant.[12]

In line with previous research, we may conclude that a significant difference emerges concerning the effectiveness of fiscal consolidation options on the DGR evolution: when fiscal consolidations work, those based on expenditure cuts seem more effective.[13]

**Table 8: Cumulated-Change, under different consolidation options**

| Cases | Mean | Std Dev | Freq |
|---|---|---|---|
| Panel A: DGR increase – Tax-based FC vs. Spending-based FC | | | |
| tax-based | 7.510 | 4.694 | 27 |
| expenditures-based | 7.125 | 6.900 | 40 |
| both | 7.280 | 6.070 | 67 |
| Panel B: DGR decrease - Tax-based FC vs. Spending-based FC | | | |
| tax-based | -2.229 | 2.589 | 13 |
| expenditures-based | -4.149 | 3.333 | 27 |
| both | -3.525 | 3.210 | 40 |

[10] To wit, Belgium's 1984 fiscal consolidation amounts to 0.69% GDP, of which 0.28% comes from a tax increase and 0.41% from an expenditures cut. We therefore classify this FC event as expenditures-based.

[11] T-test for the equality of means considers as the null hypothesis, $H_0$:"mean(yes-FC/tax-based)=mean(yes-FC/expenditures-based) if $2\Delta b_{it+1} > 0$".

[12] T-test for the equality of means, $H_0$:"mean(yes-FC/tax-based)=mean(yes-FC/expenditures-based) if $2\Delta b_{it+1} < 0$".

[13] However, remember that in many cases fiscal consolidations turn out to be not associated to a DGR decrease in general, regardless whether they are based on a tax increase or expenditures cut.

# 7 Consequences of the Euro's introduction

The time span used for the analysis comprises the Euro's introduction in 1999. Then, we have checked whether it is possible to detect a change in the association between fiscal consolidations and the evolution of public debt after the Euro's introduction. We have done this by comparing the results regarding the short and medium-term response in the period 1999-2009 with those from 1980-1998; we have considered only the Euro area countries for this.[14]

As for the short-term response, both tests (Chi-square and Rank-sum) strongly reject any change in the association in case of yes-FC: the Euro has not altered the way in which the DGR is associated to a fiscal consolidation.

At lower statistical significance (p-values close to the 5% threshold: Chi-square test p=0.067, Rank-sum test p=0.051), the same conclusion applies to the medium-term response: no change in the behaviour of the cumulated DGR variation occurs after the Euro's introduction in case of yes-FC as compared to the pre-Euro period.[15]

Thus, the Euro's introduction does not appear to represent a structural break as to the effects of fiscal consolidation policies upon public debt dynamics.

# 8 Concluding Remarks

In this paper we have analysed the effect of fiscal consolidation policies in a set of EU countries, over the period 1980-2009. In our investigation we have used the data set made available by Devries et al. (2011), which is built following the so-called narrative approach. Such data represent a novelty, within a wide and lively body of literature on the effects of fiscal policy upon macroeconomic variables and public debt dynamics.

Our results can be summarised as follows. Fiscal consolidations appear to have a favourable contemporaneous effect on the debt/GDP ratio, when one considers the whole sample of EU countries under scrutiny. More precisely, fiscal consolidation policies appear to interrupt the growth tendency of the debt/GDP ratio in the larger part of cases. Nevertheless, by going deeper, we find that the favourable break of tendency pertains to a specific set of countries only (labelled as "virtuous countries"), while the break of tendency is generally adverse for some others ("non-virtuous" countries).

[14] With respect to the analysis in the other sections, we therefore rule out Denmark, Sweden and the UK from the sample. To ease the reading, we have not reported the results discussed in this section. Nonetheless, they are promptly available upon request.

[15] Not surprisingly, if we consider the whole sample regardless of fiscal consolidations (both yes- and no-FC years), the analysis shows that positive cumulated changes $(\Delta_2 b_{t+1})$ are more concentrated in the pre-Euro period, while negative cumulated changes are in the Euro period. We imagine that this is easily explained by the tighter budget behaviour required to each country once it has joined the Euro.

As far as the effects are concerned over a medium-term horizon (namely, the cumulative effect in the current and following year) they seem to be adverse (that is, self-defeating) in all countries. Indeed, fiscal consolidations are more likely associated to a 2-year cumulated DGR increase in general; this is especially true for non-virtuous countries. Furthermore, when fiscal consolidations work in reducing the DGR, the analysis shows that 2-year DGR *decreases* are larger on-average when fiscal consolidations are based more on expenditures-cut than on a tax-increase.

A difference between the short and medium-term response therefore emerges in our analysis: the former is favourable for the majority of countries (virtuous), while the latter is generally adverse for all countries. A plausible explanation can be found in Guajardo et al. (2011) where the authors show that the FC effect on real GDP achieves its peak within two years. Then, the different timing of the FC effect on the deficit (in level) and on the output may explain the difference between the short and medium-term. To wit, the deficit responds contemporaneously and this causes a positive short-term effect given that the GDP remains temporarily stable, but when the GDP starts declining the DGR worsens and this explains the adverse medium-term response. This explanation is in line with other studies (among the others, Clinton et al. 2011), which highlight a varying effect of fiscal consolidations on macroeconomic variables over time.

This explanation, however, does not fit the experience of a small group of countries (namely, the countries that we have labelled as "non virtuous") which record an adverse response also in the short-term. We imagine that these countries have idiosyncratic characteristics which make them different from the others as signalled by the cluster analysis itself. However, we postpone a results-founded explanation to further research on this topic.

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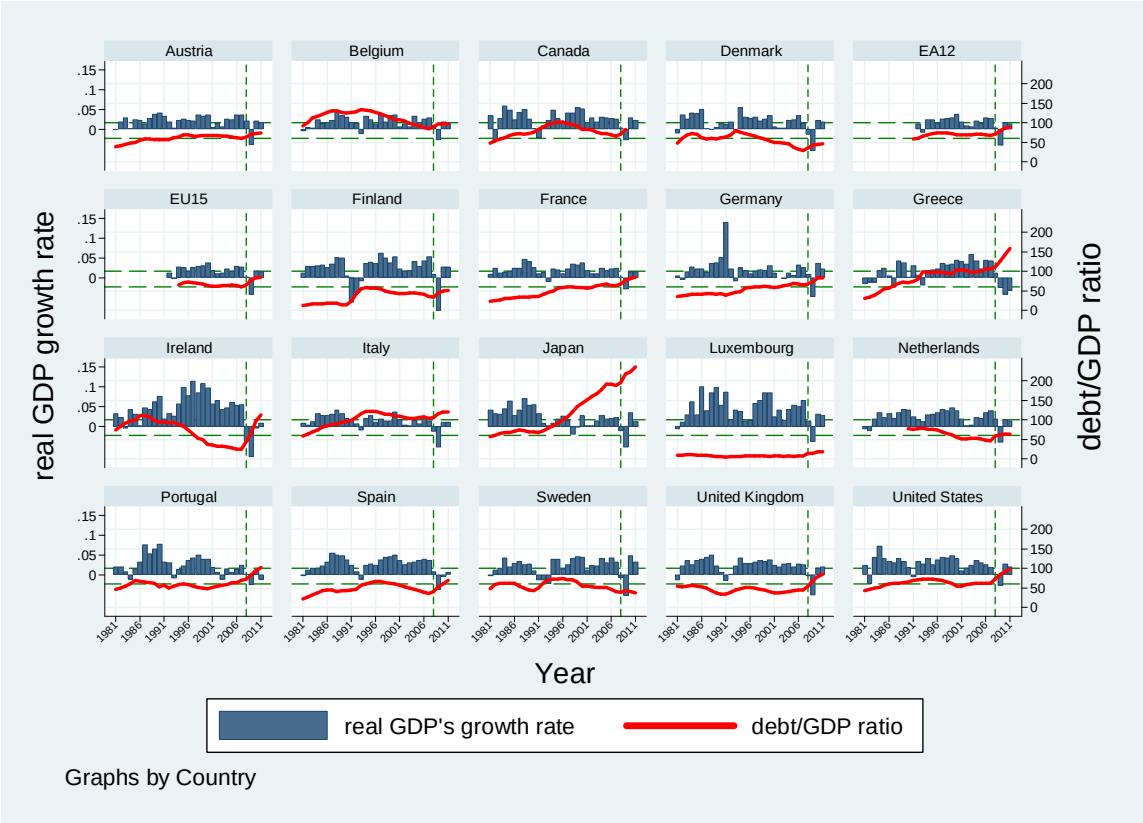
# Appendix A

**Figure 1: Debt/GDP ratio from 1981 to 2011**




Notes: •the DGR evolution is plotted against the real GDP growth rate to highlight its counter-cyclical dynamics. •Data from ECFIN Ameco database. •Green long-dash vertical lines mark year 2008, upper green long-dash lines mark 100% DGR level, lower green long-dash lines mark 60% DGR level. •DGR estimated values for 2011.

**Figure 2: Break-of-Tendency analysis by country**


Notes: •db1 is the DGR variation at time t, db1_y2 is the average DGR variation in t-1 and t-2, red "x" marks event of fiscal consolidations and their amount(BEC) •The vertical distance between the green bar and the red cross reflects the $DTb_{it}$* amount in case of yes-FC.

**Figure 3: Cumulated-Change analysis by country**


Notes: •Grey-bars report the amount of the 2-year DGR cumulated-change at time *t*, red "x" marks event of fiscal consolidations and their amount (BEC). •The vertical height of the red cross reflects the BEC amount in case of yes-FC.