Fiscal Policy as a Stabilization Tool

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Abstract: We analyze empirically the cyclical behavior of fiscal policy among a group of 23 OECD countries. We introduce a framework to capture the fiscal policy stance in a way that brings together automatic stabilizers and discretionary fiscal policy. We show that, for most countries, automatic changes in the budget balance play a stronger role in stabilizing output than discretionary fiscal policy. When compared across countries, changes in fiscal policy stance are predominantly linked to differences in government size. Tax revenues are close to being proportional to GDP and, combined with a relatively stable government spending, this leads to a countercyclical budget balance, which in turn helps stabilize aggregate demand. Furthermore, countries with less responsive automatic stabilizers, like the United States, tend to use countercyclical discretionary fiscal policy more aggressively. For all countries discretionary policy has become more aggressive in recent decades.

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1. Introduction

The 2008–2009 recession has shaken existing prior beliefs and frameworks concerning the role of fiscal policy in advanced economies, bringing this role to the forefront of economic policy discussions. Prior to the crisis, academic research and debate among policymakers focused almost exclusively on monetary policy, under the assumption that fiscal policy was not a good stabilizing tool and that the risks associated with debt sustainability were contained (at least in the Organisation for Economic Co-operation and Development [OECD] economies). The implicit consensus among academics and policymakers could be described in the following way:

1. Automatic stabilizers were seen as "doing their thing." No one questioned their role and there was little discussion as to how these stabilizers could be improved.
2. Discretionary fiscal policy as a stabilizing tool was shelved in favor of monetary policy because of lags existing in the decisionmaking process and political interference.
3. Although the issue of debt sustainability had been discussed in many advanced economies since the mid-1980s, the last economic boom and, more importantly, the expansion during the 1990s, reduced the urgency of addressing the issue.[1]

[1] "President Clinton on Monday proposed paying off the national debt by 2015 after issuing a new budget outlook that adds $1 trillion more to the overall budget surplus over the next 15 years." CNN, June 26, 1999. Available at http://money.cnn.com/1999/06/28/economy/clinton/.

Since 2007 this framework has given way to one of grave concern about the sustainability of public finances and even the fear of sovereign default, combined with a growing pressure for fiscal policy to become a key instrument in economic recovery.

There are many sides to the current debate on fiscal policy, not all of which can be dealt with in this paper. We focus on a small number of issues that would seem to be central to any proposal for a new and improved framework for fiscal policy: How do automatic stabilizers work? How do governments use discretionary fiscal policy to react to economic fluctuations? Is there a relationship between the use of discretion in reacting to the cycle and the level of automatic stabilization? These questions are addressed within the more general setting of the link between fiscal policy and business cycles. It is clear that causality works both ways: fiscal policy reacts to the business cycle and the business cycle is affected by fiscal policy. The relationship between the two is at the heart of understanding the three components listed above.

Clearly, the first two issues (the role of automatic stabilizers and discretionary fiscal policy) are all about the link between fiscal policy and the business cycle. But even the third issue, debt sustainability, cannot be resolved without a solid understanding of this relationship. The optimism of the expansion years is crucial to understanding the evolution of debt levels in advanced economies, especially in the United States. The failure of the Stability and Growth Pact in Europe was not about the long-term goals around which it was designed. The exact targets can be questioned but the idea of limiting deficits and debt has to be the starting point of any plan to ensure sustainability. The Pact's real failure was in its implementation at a business cycle frequency. The system failed to provide on an annual basis an objective reference for the conduct of

fiscal policy among such a diverse group of countries. Additionally, the fact that the discussion and enforcement were left to the politicians and the "potential sinners" did not help either.

We use a simple theoretical framework to understand the links between fiscal policy and the business cycle, with an emphasis on the similarities between automatic stabilizers and discretionary fiscal policy. The lack of a focus on and understanding of automatic stabilizers is a weakness in current thinking about fiscal policy. The current crisis has shown that even if there is some agreement on the need to use fiscal policy to stimulate the economy, the political process through which it is translated into concrete actions can distort or even paralyze its implementation. Our theoretical framework provides some simple but powerful insights that question existing notions in the academic literature about automatic stabilizers by clarifying the similarities between automatic and discretionary changes in fiscal policy. Using accounting identities and a relatively simple theoretical framework, we make explicit the crucial role that government size plays in the stabilization provided by the automatic reaction of the budget balance to economic fluctuations.

Essentially, our analysis shows that the size of government is the best indicator of how strong automatic stabilizers are in the OECD economies. Large governments stabilize the economy simply because they are large and thus control a higher percentage of total aggregate demand. While changes in spending or taxes could potentially play an automatic stabilization role, in many cases their actual response is not significant enough.

The paper is structured as follows. The following section provides a selective review of the academic literature. Section 3 presents both a set of accounting identities

and a theoretical framework to think about the stabilizing role of fiscal policy. Section 4 presents the empirical results from the OECD panel and individual country regressions. Section 5 presents our conclusions.

2. Literature Review

Much of the macroeconomic research on fiscal policy and the business cycle can be categorized in one of three areas: (1) analysis of fiscal policy from a normative point of view; (2) descriptive exposition of how fiscal authorities actually behave; and (3) theoretical and empirical analysis of the effects of fiscal policy on the business cycle.

The normative analysis is carried out within dynamic stochastic general equilibrium models, where issues of optimal taxation are key to the analysis. This line of research does not focus on the interaction between business cycles and fiscal policy, but the dynamic predictions of these models do pose some implications for these interactions. For example, Barro (1979) argues that tax rates should follow a random path and therefore should not react to the business cycle. Chari, Christiano, and Kehoe (1994), in a richer model, challenge Barro's (1979) conclusion, arguing that taxes on labor should follow the stochastic properties of the exogenous shocks driving business cycles.

There is, of course, a much closer connection between fiscal policy and the business cycle in the traditional Keynesian IS-LM model, which provides the intuition behind the standard prescription for using countercyclical fiscal and monetary policies to stabilize output. This intuition is the basis of most policy discussions on the need for countercyclical policy (IMF 2008).

New Keynesian models have been used to validate the IS-LM intuition in dynamic and optimizing environments. In addition to the richness that a fully specified dynamic model introduces, these models also enable explicit welfare considerations. In a static (IS-LM) model, the goal of stabilizing the business cycle is taken as a given, while in dynamic New Keynesian models stabilizing economic activity is an outcome of optimal economic policy.

Because price rigidity is the distinguishing factor of both these models, the analysis tends to be focused on monetary policy and concludes that stabilizing inflation is the best a central bank can do. And stabilization of inflation coincides with stabilization of output (or what Blanchard and Galí [2007] refer to as the "divine coincidence"). These models also allow for the analysis of optimal fiscal policy, but the welfare effects of fiscal policy are then closer to the analysis of optimal taxation of the traditional real business cycle models (Schmitt-Grohé and Uribe 2004, 2006).

In discussing output stabilization, there is a sense in which fiscal policy and monetary policy can be seen as substitutes in these models. If a choice is to be made, then monetary policy becomes the preferred policy tool because it is quicker and it is not subject to political interference (Taylor 2000). This logic underscores the belief that fiscal policy should not be used as a stabilizing tool. Interestingly, there is very little discussion on whether this logic also applies to automatic stabilizers. Potentially, if monetary policy is powerful enough to stabilize the business cycle, what is the benefit of having automatic stabilizers? Even those who criticize discretionary fiscal policy are more open to the role of automatic stabilizers because of their timing, but this conclusion is rarely linked to a particular model or welfare analysis (Taylor 2000).

There are, however, instances when monetary policy cannot achieve the first best result. In such cases, fiscal policy can be used as a tool to stabilize the business cycle. In particular, instances where monetary policy is constrained by the zero lower bound on interest rates have received much attention in recent years (see Eggertsson and Woodford 2003, 2004, 2006). More generally, in the presence of more than one distortion in the economy, not just price rigidity, monetary policy may not be enough to bring the economy to the first best outcome, and fiscal policy could play a role (Blanchard and Galí 2007).

The second strand of the literature looks at the cyclical behavior of fiscal policy from a descriptive (positive) point of view. While for the most part this work consists of purely empirical papers, these studies tend to be framed within two theoreticalapproaches: one, the standard Keynesian prescription in favor of countercyclical fiscal policy and two, the notion of sustainability and therefore the need for fiscal policy to react to debt levels. This literature has developed in part from the observation that fiscal policy in many countries is not countercyclical but procyclical. There is evidence of procyclical fiscal policy among Latin American economies, as documented by Gavin and Perotti (1997) and by Kaminsky, Reinhardt, and Vegh (2004). The evidence for OECD and European economies is somewhat mixed. While there are instances where fiscal policy is procyclical, typically we find that policy is either acyclical, slightly countercyclical, or countercyclical (Lane 2003; Wyplosz 2005; Fatás and Mihov 2009; or Egert 2010).

The observation that fiscal policy is procyclical led to a set of theoretical papers using political economy arguments to explain this behavior. Tornell and Lane (1999)

introduced the notion of a "voracity effect," where increases in revenues increase politicians' desire to spend more. Alesina, Campante, and Tabellini (2008) present alternative political economy theories of this behavior, in particular how voters seek to starve governments of resources in order to reduce political rents. This is a source of procyclical spending and the predication that it is more pronounced in countries with a higher degree of corruption is validated by the data.

While most of these papers attempt to understand and measure why fiscal policy is procyclical, they are less concerned about the actual impact that fiscal policy has on output. Woo (2009) and Aghion and Marinescu (2008) are two papers which do examine how fiscal policy affects output: both show that procyclical fiscal policy increases the volatility of output and may hurt long-term growth.

The third strand of literature analyzes the effects of fiscal policy on the business cycle. Unlike the second stream, this strand focuses on the reverse causality by asking how fiscal policy affects business cycle characteristics. This literature can be divided into two separate subfields, one dealing with discretionary policy and another focusing on automatic stabilizers.

Because of econometric considerations, the literature on the effects of discretionary policy on output at a business cycle frequency focuses on *exogenous* changes in fiscal policy. These are changes that, by definition, are independent of the business cycle. In this sense, the literature looks at changes in fiscal policy that are not relevant to the potential stabilizing role of government spending and taxes. There remains, however, a belief that the findings can still be informative about the potential stabilizing role of countercyclical fiscal policy under the assumption that exogenous

discretionary fiscal policy should have similar effects to endogenous discretionary policy. Earlier work includes Fatás and Mihov (2001), Blanchard and Perotti (2002), and Burnside, Eichenbaum, and Fisher (2004). More recent contributions can be found in Barro and Redlick (2009), Perotti (2011), and Ramey (2011).

Finally, a small number of papers investigate the effects of automatic stabilizers by focusing on the effects of budget changes that are automatically triggered by tax laws and spending rules. This strand of the literature is somewhat less developed than its peers.[2] Empirically, because of endogeneity considerations, it does not provide a dynamic analysis of the effects of fiscal policy; instead, it focuses more on the cross-country differences in business cycles, conditioning for different degrees of automatic stabilizers. This particular strand started with a seminal paper by Galí (1994), who observed that countries with large governments tended to have less volatile business cycles. Fatás and Mihov (2001) supplied broad support for the notion that this correlation could be seen as an estimate of the effectiveness of automatic stabilizers. More recently, Debrun and Kapoor (2010) have provided confirmation of these earlier estimates.

Interestingly, despite the favorable evidence on the effectiveness of automatic stabilizers, there is scant research on how this evidence relates to what we know about discretionary fiscal policy, or how to design better automatic stabilizers. This neglect partly stems from the dominant/prevailing belief that monetary policy is the right tool to stabilize aggregate demand. But, as mentioned earlier, even those who that argue that

[2] As an example of the shortage of academic papers in this area, here are two quotes from the literature considering the state of scholarship since 1990. Blanchard (2000) stated: "In the last 10 years automatic stabilizers have not been discussed much by academics." And six years later (and six years ago) the same author wrote "very little work has been done on automatic stabilization; JSTOR lists only 11 articles on automatic stabilizers in the last 20 years" (Blanchard 2006).

fiscal policy should not be used as a stabilizing tool (Taylor 2000) still support the idea that automatic stabilizers should still be allowed to do their work.[3]

3. Measuring Fiscal Policy over the Business Cycle

Our paper is related to the last two strands of literature discussed in the previous section—those describing the cyclical behavior of fiscal policy and dealing with its effectiveness as a stabilizing tool. One of the central challenges in both strands is the proper measurement of fiscal policy in relation to the business cycle. In this section we look at different indicators of fiscal policy's cyclicality, but we do so in the context of how it relates to economic models of stabilization. We are not simply interested in describing the cyclical behavior of fiscal policy but in producing an indicator of how this behavior helps us understand its stabilizing rolewhich we refer to here as the"fiscal policy stance."

The measurement of fiscal policy over the business cycle requires a good understanding of how each component of the budget reacts to the cycle. Taxes and spending, which are designed to react to changes in output are called "automatic stabilizers." When assessing whether fiscal policy is doing the right thing in a given year we normally want to understand the structural stance apart from the automatic changes that are the result of the tax code and spending laws. A second issue to be addressed is the need to find a benchmark: Do we compare the result to last year? Or should we compare it to a year where output is equal to potential?

[3] As an illustration of this, one of the earlier papers in this literature was about letting automatic stabilizers "do their thing" (Cohen and Follette 2000).

As will become clear in our analysis, the answers to these questions will depend on the reasons why we are looking for such an indicator. Some papers look at the construction of a fiscal policy indicator from a normative point of view, as these studies seek to compare fiscal policy with an optimal benchmark without the influence of the business cycle. Others take a more positive point of view, with the goal of describing how fiscal policy changes during the business cycle and how that behavior feeds back into the cycle itself. In fact, it could be argued that summarizing fiscal policy with just one variable is an impossible task; hence we should produce a set of measures of the fiscal policy stance that inform us about different aspects of fiscal policy and are relevant for different questions about both the positive and normative side of the analysis. This is the point made in Blanchard (1993), whose arguments we discuss next, beginning with a simple accounting exercise before introducing an economic model.

3.1 Fiscal Policy Accounting: Discretionary versus Automatic Changes

Fiscal policy can be thought of as a collection of tax and spending policies that are incorporated into the government budget. The balance summarizes these policies during the year as the difference between revenues and spending. Let's start with some basic accounting on budget balances and how to interpret changes over the cycle.

The budget balance (BB) is written as

$$BB_t = T_t - G_t$$

Taxes and government spending can be seen as functions of the business cycle. Methodologically, it is common to extract the response of taxes and spending, which is automatic (in other words, built into the tax code and spending rules), from the budget balance. We refer to this component as an automatic stabilizer (AS). What remains can be regarded as what the budget balance would have been if output was at a "normal" level (normally captured by potential output) and we refer to that component as the cyclically adjusted balance, or CAB . Changes in the CAB can also be seen as a measure of discretionary fiscal policy actions.

The calculation of the cyclically adjusted balance requires using the budget during a normal year as a reference and understanding how deviations from that normal state of the economy affect taxes and spending. It is common to use the output gap as an indicator of the business cycle.

Let's assume for the moment that taxes and spending can be expressed as functions of output and that the CAB is simply expressed as the budget balance that would exist if output were equal to potential:

$$CAB_t = T\left(Y_t^p\right) - G\left(Y_t^p\right)$$

where $T(\cdot)$ and $G(\cdot)$ represent how revenues and spending depend on the level of economic activity.

The CAB is not observed, and specifying the functions $T(\cdot)$ and $G(\cdot)$ and evaluating them at potential output is an impossible task, so the calculation of cyclically adjusted balances normally requires an indirect approach. We start with the values of

taxes and spending that can be observed and then assume a function of how taxes and government spending are automatically affected by the business cycle, as captured by deviations from potential output. In other words, we need a four-step approach:

1. Establish a measure of the business cycle that is relevant for the automatic changes in fiscal variables.
2. Calculate how current output deviates from the benchmark of that cyclical variable.
3. Measure the elasticity of different tax bases and spending components for such a measure of the business cycle.
4. Estimate the elasticities of revenues and spending to those tax bases.

Conceptually the four steps are clear but there are several technical difficulties in their implementation. The first problem is that no single measure of the cycle is responsible for movements in all sources of revenue and spending. While some cyclical measures might react to output, others react to output growth, or the output gap, or unemployment. Moreover, there could be composition effects as the empirical importance of different tax bases changes over time. Finally, the elasticities of taxes and revenues are normally assumed to be stable over time but these are likely to change as a result of changes in tax law or spending policies.

These calculations are done separately for several of the budget components. For simplicity we will look at just taxes and spending, and calculate the cyclically adjusted counterparts as:

$$T_t^{CAB} = T(Y_t^p) = T_t\left(\frac{Y_t^p}{Y_t}\right)^{\epsilon_T}$$

$$G_t^{CAB} = G(Y_t^p) = G_t\left(\frac{Y_t^p}{Y_t}\right)^{\epsilon_G}$$

where ϵ_T and ϵ_G are the elasticities of taxes and spending relative to potential output.[4] At this point it is important to highlight that these elasticities simply measure the automatic reaction of taxes and spending to the business cycle. These are normally part of what we call "automatic stabilizers," but so far the only behavior they are capturing is the *automatic* reaction of budget components to the cycle. There is nothing to indicate that these elasticities capture in any way the *stabilizing* effect of fiscal policy. In a sense, we are adhering to the U.S. Congressional Budget Office (CBO) definition of automatic stabilizers: "Automatic stabilizers broadly refer to elements of the budget that work to increase deficits during downturns and reduce them during times of strong economic growth" (CBO 2011).

But if we refer to these variables as stabilizers, it is also because we believe that they are designed to stabilize economic activity, a perspective dealt with in the next section.

[4] For the sake of simplicity we ignore interest payments from this equation. Hence we do not discuss the differences between overall and primary balance.

3.2 Fiscal Policy as a Measure of the Degree of Stabilization: The Fiscal Policy Stance

So far we have only looked at how fiscal policy reacts to the business cycle. But how does this response inform our understanding of the effects that fiscal policy has on economic outcomes in a given year? These effects are normally called the fiscal policy stance, and can mean both a contractionary or an expansionary stance depending on how fiscal policy contributes to economic growth. Measuring the stabilizing effect of fiscal policy is conceptually much more difficult because it requires us to have an economic model in mind. And depending on the economic model that we have in mind, we need to look at a different variable or indicator. Blanchard (1993) discusses this issue at length. His approach is to present a variety of models to understand how fiscal policy affects aggregate demand and how this can be translated into an indicator of the fiscal policy stance.

In a simple static IS-LM model, this effect will depend on how fiscal policy stabilizes aggregate demand (which in this model is identical to output). There are two forces:

1. Spending affects aggregate demand. A high level of government spending relative to private demand will provide a boost to aggregate demand. This boost will stabilize output if spending is high when private demand is low.
2. Taxes can help stabilize disposable income if they move in the opposite direction to income. The effect is not one-to-one because the marginal propensity to consume is lower than one.

The fact that the effect of taxes is felt not directly but through consumption means that a standard measure of the budget balance, weighting government spending and taxes with the same coefficient, does not accurately capture the aggregate demand effect of fiscal policy. Ideally, we want to adjust taxes by a coefficient that approximates to the marginal propensity to consume. But even without this adjustmentwe can see that, within the context of the IS-LM model, measuring expenditures and taxes in relationship to the level of output comes very close to capturing the effect of fiscal policy on economic activity. Based on this logic, Blanchard (1993) concludes that the inflation-adjusted budget balance as a ratio to GDP is a good proxy for the aggregate demand effect of fiscal policy in a given year. So keeping track of how the budget balance (as a percentage of GDP) changes in a given year is a good approximation of the stabilizing effects of fiscal policy.

Moving from a static model to a dynamic one, the relationship between fiscal policy and aggregate demand becomes more complicated. Now what matters for demand and output is not only current but also future fiscal policy. For example, to understand and measure the effects of a change in fiscal policy we need to assess how these changes translate into expected changes in spending and taxes, as well as how these affect other components of aggregate demand and potentially have an effect on the supply side of the economy. Blanchard (1993) shows that the previous result also applies to a simple intertemporal model that deviates from Ricardian equivalence, under the assumption of stable expectations regarding future taxes.

When looking at the change in the budget balance we can separate automatic and discretionary changes, but from the perspective of aggregate demand this is irrelevant—it is the overall balance that matters.

Hence we follow Blanchard's (1993) recommendation of looking at (the changein) the budget balance scaled by GDP as a proxy for the stabilizing effects of fiscal policy. The fiscal policy stance is simply the change oin

$$bb_t = \frac{BB_t}{Y_t} = \frac{T_t - G_t}{Y_t}$$

where noncapitalized letters refer to variables expressed as a ratio to economic activity. Changes in this ratio help us understand how fiscal policy stabilizes the business cycle.

To compare this with our previous analysis we now want to distinguish between changes in the fiscal policy stance that come from automatic changes and those that come from discretionary ones. We define discretionary changes in fiscal policy (from the perspective of this ratio) as changes to the cyclically adjusted balance as a ratio to potential output. This ratio is simply

$$cab_t = \frac{CAB_t}{Y^p}.$$

It is important to emphasize that this time the normalization is relative to potential output. The automatic component (automatic stabilizers) is defined as the difference between the two ratios given above:

$$as_t = bb_t - cab_t = \frac{BB_t}{Y_t} - \frac{CAB_t}{Y^p} =$$

$$= \frac{T_t - G_t}{Y_t} - \left[\frac{T_t\left(\frac{Y^p}{Y_t}\right)^{\epsilon_T} - G_t\left(\frac{Y^p}{Y_t}\right)^{\epsilon_G}}{Y^p}\right] =$$

$$= \frac{T_t}{Y_t}\left[1 - \left(\frac{Y^p}{Y_t}\right)^{\epsilon_T - \mathbf{1}}\right] - \frac{G_t}{Y_t}\left[1 - \left(\frac{Y^p}{Y_t}\right)^{\epsilon_G - \mathbf{1}}\right] .$$

Following Blanchard (1993), we now measure changes in the fiscal policy stance as changes in the budget balance from one year to the next, broken down into discretionary and automatic changes,

$$\boldsymbol{\Delta} bb_t = \boldsymbol{\Delta} cab_t + \boldsymbol{\Delta} as_t .$$

What is the connection between this expression and the cyclicality of different budget components? The change in the fiscal policy stance is a function of two forces. First, there is the obvious connection between this variable and the elasticities of spending and taxes. We want spending to be high and taxes to be low when income is low, so the budget balance worsens during a recession. But there is a second consideration that matters to the change in the budget balance: the size of government, which turns out to play a very important role in stabilizing economic fluctuations.

To illustrate this point, let's focus on a simple example where we assume that all the action comes from automatic stabilizers. The change in the fiscal policy stance is therefore equal to the automatic changes:

$$\Delta as_t = \frac{T_t}{Y_t}\left(1 - \left(\frac{Y^p}{Y_t}\right)^{\epsilon_T - 1}\right) - \frac{G_t}{Y_t}\left(1 - \left(\frac{Y^p}{Y_t}\right)^{\epsilon_G - 1}\right) -$$

$$- \frac{T_{t-1}}{Y_{t-1}}\left(1 - \left(\frac{Y^p}{Y_{t-1}}\right)^{\epsilon_T - 1}\right) + \frac{G_{t-1}}{Y_{t-1}}\left(1 - \left(\frac{Y^p}{Y_{t-1}}\right)^{\epsilon_G - 1}\right).$$

There are several parameters that matter in this equation: the output gap in each of the two periods, the elasticities of taxes and spending, and the size of tax revenues and spending relative to GDP.

We now look at a specific case that is often used in the literature and is not far from the tax and spending systems of many countries around the world. We assume a proportional tax system with a tax rate τ and a level of government spending that does not react to output. In this case we have $\epsilon_T = 1$ and $\epsilon_G = 0$. In this particular instance, the above expression simplifies to

$$\Delta as_t = \frac{G}{Y^p}\left(\frac{Y_t - Y_{t-1}}{Y_{t-1}}\right).$$

This expression is intuitive. It tells us that when taxes are proportional to income and government spending is constant, the change in the budget balance measured as a percentage of GDP is simply the product of GDP growth and the size of government as measured by government spending as a percentage of (potential) GDP.

The mechanics behind this expression are simple. Under proportional taxes, the ratio of taxes to GDP is constant. The fact that taxes move proportionally with output means that the volatility of disposable income is identical to the volatility of income. This

has no stabilizing effect on consumption under the assumption that consumption depends on disposable income.[5]

Why does government spending matter when it is acyclical? If spending does not change, the ratio of government spending to GDP increases during the recession. This is the only reason why we see a worsening of the budget balance. And the larger the government, the larger the change in the budget balance.

In the particular case where we assume that the economy was at potential in period $t-1$, the above expression is simply

$$\Delta as_t = \frac{G}{Y^p}\, gap$$

Of course, in a more general case the elasticities of taxes (if larger than 1) and spending (if larger than 0) will also matter for the fiscal policy stance, but what is useful about this example is that we see a dimension of fiscal policy that matters for stabilization *beyond the responsiveness of taxes and spending to the cycle*. This dimension is government size. And while the effect we are describing can be seen as simply a mechanical deterioration of the budget balance, from an economic point of view it means that larger governments provide stronger output stabilization.[6]

[5] The literature is not always clear on this point. Some papers refer to the stabilizing effect of proportional taxes, because a $1 decrease in income leads to an increase in disposable income of less than $1.00. But in most economic models what matters is the percentage change in these variables and not the absolute change. In a proportional tax system a 1 percent decline in income translates into a 1 percent decline in disposable income—in other words, there is no stabilization in percentage terms.

[6] To illustrate this logic, we can even think about a government that collects zero taxes. The budget balance is equal to $-\frac{G}{Y}$. If government spending is constant, a downturn will increase the deficit by a factor that is equal to the product of the size of the government and the growth rate of GDP.

The above expression is one illustration of how government spending (even if unresponsive to the cycle) matters to the fiscal policy stance. The exact expression depends on our initial assumption that looking at the change in the budget balance is the right way to measure fiscal policy's stabilizing effects. If we were to start with a different logic, we would end up with a different measure for the fiscal policy stance indicator and, therefore, a different calculation for automatic stabilizers.

Another interesting question is whether government size should be measured as spending or taxes. Fedelino, Ivanova, and Horton (2009) and Cottarelli and Fedelino (2010) reach a similar conclusion to ours but in both cases government size is captured by the ratio of taxes, and not spending, to GDP. These analyses start with a different logic: it is common practice to normalize the cyclically adjusted balance by potential output,

$$\frac{CAB}{Y^p}.$$

If we also use potential output as the scaling factor for the budget balance as our indicator of fiscal policy stance, we end up with the expression,

$$\frac{AS_t}{Y^p} - \frac{AS_{t-1}}{Y^p} = \frac{T_t}{Y^p}\left(1 - \left(\frac{Y^p}{Y_t}\right)^{\epsilon_T}\right) - \frac{G_t}{Y^p}\left(1 - \left(\frac{Y^p}{Y_t}\right)^{\epsilon_G}\right) -$$

$$- \frac{T_{t-1}}{Y^p}\left(1 - \left(\frac{Y^p}{Y_{t-1}}\right)^{\epsilon_T}\right) + \frac{G_{t-1}}{Y^p}\left(1 - \left(\frac{Y^p}{Y_{t-1}}\right)^{\epsilon_G}\right).$$

In the particular case where taxation is proportional to output so its elasticity is equal to 1, and government spending does not react to output so that $\epsilon_G = \mathbf{0}$, we have

$$\Delta\frac{AS}{Y^p} = \tau\left(\frac{Y - Y^p}{Y^p}\right) = \tau\ gap$$

,

where τ is the tax rate and gap is the output gap.

Therefore, in this instance we also find that the stabilizing contribution of automatic stabilizers is the product of the output gap and government size, but now it is the tax rate and not government spending that captures government size. Why is government size now measured by revenues and not spending? If we use potential output to rescale the budget balance, under the assumption that government spending is constant, the ratio of spending to potential output is constant and therefore does not contribute to changes in the budget balance. But because taxes change (proportionally) with output, these will generate a change in the revenue to potential output ratio that will be responsible for the change in the budget balance.

Which of the two equations is more informative depends on how we match their logic to an economic model. Blanchard's (1993) analysis is done within a class of models where what matters is the budget balance relative to current output. This makes sense because what matters is the level of taxes and spending relative to the actual level of demand or output. Cottarelli and Fedelino (2010) start their analysis by arguing that it is common to use potential output to analyze the cyclically adjusted balance. Hence, to be consistent they contend that the budget balance should be scaled by the same variable. This is correct, but it is not the right measure of stabilization within the context of an

economic model: this is one illustration of why a model is needed to produce a measure of the fiscal policy stance.

So far our analysis has focused on automatic stabilizers, but the logic also applies to discretionary changes in response to the business cycle. But in this case the analysis is straightforward. We are looking at discretionary changes in taxes and spending from an exogenous point of view. What matters here is the size of the shock and there is no need to measure it in relation to the business cycle.

Given the importance of relying on a model to produce an indicator of the fiscal policy stance, it is interesting to understand how the intuition in Blanchard (1993) applies to other models. In the next section we show that this intuition carries over to a dynamic model with "enough" Keynesian features. This model will also allow us to frame some of our empirical results.

3.3 A Model-Derived Analysis of the Fiscal Policy Stance and the Role of Government Size

We now analyze the effectiveness of fiscal policy as a stabilizing tool in the dynamic model developed by Mankiw and Weinzeri (2011). This is a highly stylized model that captures the aggregate demand effects of monetary and fiscal policy. We refer readers to their paper for a full analysis of the model. We will ignore their analysis of optimal monetary policy and simply use their settings and some of their basic results to illustrate the effectiveness of fiscal policy, paying special attention to the role of government size.

There are two time periods and the representative household maximizes its welfare/utility:

$$\max\{u(C_1) + \mathbf{v}(G_1) + \beta\,[u(C_2) + \mathbf{v}(G_2)]\},$$

where C_t is consumption and G_t is government spending.

From a welfare point of view, the inclusion of government spending in the utility function is important, but our analysis does do not consider welfare so this functional form will be irrelevant.

Firms only produce with capital, which in the first period is predetermined (K_1). The capital stock fully depreciates and the stock of capital in the second period is simply the investment done in period 1. Production in period t is given by the production function,

$Y_t = A_t\, K_t$.

As there is no labor, all household income comes from the profits of firms. So the private sector's budget constraint can be written as

$$P_1(\Pi_1 - T_1 - C_1) + \frac{P_2(\Pi_2 - T_2 - C_2)}{(1+i)} = 0,$$

where T_t are the taxes set by governments in each period and i is the nominal interest rate between the two periods.

The only shock to the economy is a change in the technology parameter, A_2. Although this is a technology shock, it implies a reduction in wealth and leads, under certain assumptions, to a decrease in aggregate demand in the first period.

Fiscal policy sets government spending and taxes on both periods to satisfy a budget constraint,

$$P_1 (T_1 - G_1) + \frac{P_2(T_2 - G_2)}{(1+i)} = 0$$

Because taxes are lump sum and there are no financial constraints, the timing of taxes will not matter in equilibrium (this is Ricardian equivalence). The only dimension of fiscal policy that matters is government spending.

Households are required to hold money to purchase the consumption good so that

$$M_t = P_t C_t .$$

The money supply is assumed to be perfectly elastic in the first period, while the central bank sets the nominal interest rate and the money supply in the second period.

Mankiw and Weinzeri (2011) first analyze the equilibrium with flexible prices. We refer to their analysis for the solution to this case. With flexible prices, money is neutral and optimal fiscal policy seeks to maximize consumer welfare by equating marginal utility of consumption and government services.

Since we are interested in a model with Keynesian features, we focus on the case of price rigidity. Following Mankiw and Weinzeri (2011), we introduce price rigidity by

fixing prices in the first period at a level that is too "high,"meaning that there will be a shortage of demand relative to the potential level of output, $A_1 K_1$.

Using an isoelastic utility function for private consumption,

$$u(C_t) = \frac{C_t^{\left(1-\frac{1}{\sigma}\right)} - 1}{1 - \frac{1}{\sigma}},$$

we will be assuming that $\sigma < 1$, so that a decrease in A_2 leads to a decrease in demand in the first period. This assumption ensures that income effects dominate substitution effects.

We obtain the following solution for output in period 1:

$$Y_1 = A_2^{(1-\sigma)} \beta^{-\sigma} \frac{M_2}{(1+i) P_1} + \frac{M_2}{(1+i) P_1} + \frac{G_2}{A_2} + G_1.$$

This equation looks like an aggregate demand curve and, as we can see from the first term, a decrease in A_2 reduces aggregate demand (under the assumption $\sigma < 1$). In this setting monetary policy can have a real effect on output. From the perspective of fiscal policy there are two potential scenarios:

1. The central bank can replicate the flexible price equilibrium with a combination of the right interest rate (i) and money supply in period 2 (M_2), so that output in the first period is equal to potential output $A_1 K_1$. In this case, optimal fiscal policy

is identical to the case of flexible prices. Fiscal policy plays no role in stabilizing output.

2. The central bank cannot replicate the flexible price equilibrium. This is the scenario that Mankiw and Weinzeri (2011) label "restricted monetary policy." In this case, optimal fiscal policy will play a stabilizing role. A higher level of G_1 will lead to output being closer to its efficient level.

The type of constraints that Mankiw and Weinzeri (2011) have in mind for monetary policy is when interest rates have reached the zero-lower bound and the government is unable to commit to a credible increase in the money supply in period 2 to restore the flexible-price equilibrium.[7] Our analysis does not look at monetary policy, so we do not need to be specific about where constraints come from; we simply assume that monetary policy is unable to bring output equal to its potential after setting a certain value for the interest rate and committing to a level of M_2. We take those two values as given in the above solution and ask how different fiscal policies contribute to stabilizing the economy.

As discussed earlier, taxes do not show up in this equation because we are using the Ricardian equivalence assumption. But government spending affects current output via two channels. First, G_2 has a positive effect on output through the effect it has on investment. In addition, it also affects the response of output to a shock. The cross derivative is equal to

$$\frac{\partial^2 Y}{\partial A_2 \, \partial G_2} = -\frac{1}{[(A]_2)^2}.$$

[7] In their model, the flexible price equilibrium can be achieved even if the nominal interest rate is zero by committing to a large enough money supply in period 2.

The interpretation of this cross derivative is that larger government spending mitigates the negative effect of a decline in second-period productivity. The intuition is that with higher G_2, a negative shock to A_2 leads to a smaller decline in first-period investment as firms still have to build their capital stock for producing in period 2 to satisfy demand from the government. If $G_1 = G_2$—in other words, government spending is kept constant—then we see that larger governments can stabilize economic fluctuations via the investment channel.

But this is not the effect that we are interested in. We want to focus on the contemporaneous effect that fiscal policy G_1 has on output Y_1. As we can see from the model's solution, there is a one-to-one connection between the two. In absolute terms a $1 increase in government spending raises output by $1. In other words, we have a multiplier of 1.

We can think about G_1 reacting to news about A_2, but also think simply about a larger government (a higher level of G_1). In this instance a larger government stabilizes aggregate demand and as a result stabilizes output, because output in this model is demand driven. The stabilization is one-to-one if calculated in absolute terms. But if we think in terms of the volatility of output growth, we then have the following expression (assuming $G_2 = 0$):

$$\frac{\partial \ln(Y_1)}{\partial \ln(A_2)} = (1-\sigma) - \frac{(1-\sigma)}{1 + A_2^{(1-\sigma)}\beta^{-\sigma}} - \frac{(1-\sigma)\,A_2^{(1-\sigma)}\beta^{-\sigma}}{1 + A_2^{(1-\sigma)}\beta^{-\sigma}}\,\frac{G_1}{Y_1}$$

$$\frac{\partial \ln(Y_1)}{\partial \ln(A_2)} = \frac{A_2^{(1-\sigma)}\beta^{-\sigma}}{\left(1 + A_2^{(1-\sigma)}\beta^{-\sigma}\right)\left(1 - (1-\sigma)\frac{G_1}{Y_1}\right)}.$$

So the volatility of output growth decreases with government size (under the assumption that $\sigma < 1$).

Mankiw and Weinzeri (2011) also consider the case where a portion of consumers is financially constrained and their consumption depends on disposable income. In this case we obtain two additional effects:

1. A larger multiplier for government spending, as the stabilization of income that G_1 provides also leads to more stable disposable income and therefore a more stable consumption. In this scenario, government size also helps stabilize private consumption.
2. Taxes matter for stabilization. In particular, a low value of T_1 helps keep disposable income stable and therefore consumption stable.

In summary, we end up with an intuitive model that is similar to the static IS-LM model. What matters for stabilization is how spending and taxes affect aggregate demand. High spending and low taxes relative to the current level of income raise aggregate demand and stabilize economic activity.

How general is this result? This analysis is certainly specific to a class of models, those where demand is relevant for determining output in the short run. Yet we are ignoring other potential fiscal policy effects on volatility. For example, government size

or distortionary taxation can affect steady-state levels of employment or investment and therefore affect the response of these variables to shocks. Indeed this is the analysis of Galí (1994), who looks at the effects of government size on the volatility of GDP in a standard RBC model with technology shocks. Government size measured by taxes is destabilizing because the more distortionary taxes are, the higher the elasticity of labor to productivity shocks (lower steady-state employment). When it comes to government spending, depending on how it behaves over the cycle, we can get a small stabilizing effect. Galí's (1994) model is an RBC model with optimizing agents who do not have financial constraints. Andrés, Domenech, and Fatás (2008) extend Galí's (1994) model to incorporate Keynesian effects via price rigidities and consumers who are financially constrained. In their analysis, if these effects are strong enough we can again generate results similar to those of Mankiw and Weinzeri (2011). Specifically, in that model government size stabilizes output (both total output and private demand).

3.4 From Theory to Empirics: Estimating Fiscal Policy Reaction Functions

A large body of empirical literature has analyzed the relationship between business cycles and fiscal policy. This relationship goes both ways: fiscal policy reacts to business cycles and, at the same time, fiscal policy has an effect on output and therefore an effect on the business cycle.

The empirical analysis of fiscal policy variables tends to be done in the context of fiscal policy reaction functions that capture the behavior of governments. To be more explicit, let's think about a standard fiscal policy reaction function such as,

$$FP_t = \alpha + \beta_1 Cycle_t + \beta_2 Z_t ,$$

where FP_t is an indicator of fiscal policy.

Of all the determinants of fiscal policy, we highlight one: the economic cycle itself ($Cycle_t$). The other determinants are included in the vector Z_t. Within this vector we normally include the debt level to incorporate sustainability. It is also possible to think about interactions between different variables where, for example, the reaction of fiscal policy to the business cycle is a function of the government debt level.

As argued in the previous section, these reaction functions are designed to understand government behavior and cannot simply be interpreted as a way of assessing the stabilizing effects of fiscal policy. In other words, the cyclicality of a certain fiscal policy variable does not capture the strength of that variable as a stabilizer.

To illustrate this point again—but now in the context of empirically estimated policy reaction functions—let's think about the stylized example discussed earlier: a government where there are no discretionary changes in fiscal policy and where all the action comes from automatic stabilizers. For simplicity, we will think about two components of the budget, taxes and spending, and ignore issues of different taxes or spending categories. We also ignore the issue of interest payments to keep the analysis as simple as possible.

Let's start by capturing the business cycle by output growth, and measure revenues and taxes as growth rates as well. We then have regressions of the type,

$$\Delta t_t = \alpha + \beta_1^T \Delta y_t + \beta_2^T Z_t + \varepsilon_t^T$$

$$\Delta g_t = \alpha + \beta_1^G \Delta y_t + \beta_2^G Z_t + \varepsilon_t^G ,$$

where noncapitalized letters denote natural logarithms and Y is output. The parameters β_1^G and β_1^T represent the elasticities of spending and taxes to output growth. These are the empirical counterparts of ϵ_G and ϵ_T in our theoretical analysis.

Let's think about the case where the elasticity of spending is zero (government spending is constant). If we were to run these regressions, we would get $\beta_1^G = 0$, and β_1^T would be positive and a function of the progressivity of the tax system. We would normally use the expression "government spending is acyclical" and taxes are "countercyclical," in the sense that revenues increase when output increases so that disposable income increases by less than output.

To measure of the fiscal policy stance we now move to the budget balance as a percentage of GDP. . This, again, is the empirical counterpart of our earlier analysis:

$$\Delta \frac{T_t - G_t}{Y_t} = \alpha + \beta_1^B \Delta y_t + \beta_2^B Z_t + \varepsilon_t^B .$$

Under the above assumptions, where spending is constant but taxes react to output, β_1^B will be positive. We will be referring to countercyclical fiscal policy. The parameter β_1^B is just the semi-elasticity of the budget balance relative to output, and it is this parameter that informs us of the fiscal policy stance. How does the value of β_1^B relate to the elasticities of each of the budget components?

In the case where spending is constant and the tax rate can be expressed as a function of income, $\tau(Y)$, it can be shown that

$$\beta_1^B = \tau'(Y)\, Y + \frac{G}{Y}.$$

In the case where taxes are simply proportional to output, $\tau'(Y) = 0$, the expression simplifies to

$$\beta_1^B = \frac{G}{Y}.$$

This is the same result discussed in the previous section. The stabilizing effects of fiscal policy in this particular case can be approximated by the size of the government measured by the ratio of spending to output. In other words, acyclical spending combined with proportional taxes helps stabilize output by a factor that is simply the size of government.

The confusion in the empirical literature comes from the fact that the coefficients β_1^G and β_1^T are sometimes interpreted as a measure of the strength of automatic stabilizers. Yet from an economic point of view what matters is β_1^B; though it does depend on these two other elasticities, this parameter also depends on the size of government. In the extreme case above, when $\beta_1^G = 0$ and $\beta_1^T = 1$ (a standard assumption in the literature), the only thing that matters is the ratio of government expenditures to GDP.

3.5 Fiscal Policy Reaction Functions: Behavior or Stabilization?

A different but related issue is the question of how comprehensive these policy reaction functions should be. Many other variables could be included in the estimation. We can think about these reaction functions as representing the government sector's response to economic and political variables. Of course, one of the variables to be included isa measure of the business cycle, but we can also include others if we want to understand all the determinants of fiscal policy including, in some cases, channels through which the business cycle might lead to movements in components of the budget.

For example, Beatrix and Lane (2010), when looking at the behavior of fiscal policy during the 2008–2009 period, run regressions of the type

$$\Delta \frac{T_t - G_t}{Y_t} = \alpha + \beta_1^B \Delta y_t + \beta_2^B U_t + \beta_3^B Debt_t + \beta_4^B Housing_t + \varepsilon_t^B,$$

where they include several variables that capture the business cycle (output growth and unemployment) because some components of the budget react to one variable, while some react to the other ones. They include debt because of sustainability concerns, and they include variables that capture the housing cycle (possibly prices or activity) because variation in taxes could be a function of this sector.

In our analysis we will focus on a simple reaction function that captures the cyclicality of policy. The disadvantage of a parsimonious specification is that we will not be able to identify the broad set of macroeconomic dynamics that affect fiscal policy decisions. The benefit, however, is that we will capture, *on average*, the automatic

reaction of fiscal policy to any developments in the economy that affect the business cycle.

4. Empirical Analysis

We now provide an analysis of fiscal policy in 23 OECD countries. The choice of these countries is partly due to data availability but also to have, as much as possible, a homogeneous sample so our analysis can concentrate on differences in fiscal policy. Details on the countries and data sources can be found in the appendix.

4.1 Fiscal policy Stance in a Panel of 23 Countries

Our baseline specification is

$$FP_t = \alpha + \beta_1 Cycle_t + \beta_2 Z_t + \varepsilon_t .$$

Our starting point is the framework developed earlier. We are interested in understanding how fiscal policy reacts to the business cycle and how this reaction is related to output stabilization. Our focus will be on the reaction of the budget balance, measured as a percentage of GDP, to the business cycle. We will also look at components of the budget to better understand the observed movements in the balance.

We expect the coefficients for each country to be different and will seek to explain these differences later in our analysis, but as a starting point we begin with a set

of panel regressions. The advantage of using panel regressions lies in the size of the sample, which allows a much more consistent description of the data and the average behavior of fiscal policy.

Table 1 provides the results of running eight different specifications for the budget balance (as a percentage of GDP). We keep the control variables to a minimum. In some of the specifications we include the lagged value of gross government debt. As indicated, our interest is not in fully describing the behavior of governments but in gaining an understanding of how fiscal policy moves in response to business cycles.

We will be agnostic about the econometric specification, and for this reason we include regressions in differences and levels with the lagged value of the endogenous variable on the right-hand side. We measure the business cycle in two ways: using output growth or the output gap. While the output gap is a more natural choice to measure the business cycle, it is not observed and there are always methodological questions on its measurement. In addition, for some countries output growth seems to provide a better description of the cycle from the perspective of fiscal policy (see Fatás and Mihov 2009).

The results across all eight columns of table 1 are consistent. The budget balance moves in a countercyclical manner, regardless of the measure of the cycle used or the econometric specification.[8] The coefficient is in the range 0.3–0.5. It tends to be higher when we control for the lagged value of debt. These results are consistent with previous results in the literature (see Egert 2010 for a recent survey).

Table 2 displays the results of running the same eight specifications, but we now use the primary balance as opposed to the general balance. The numbers are almost

[8] We use the term "countercyclical" to refer to fiscal policy, which is supposed to stabilize the business cycles. This means higher taxes, higher balances, and lower spending during expansions.

identical to those in table 1, as expected. The behavior of interest payments over the cycle does not make a large difference to the cyclicality of the budget balance. Because of this similarity, going forward we will limit our analysis to the overall balance instead of the primary balance.

The interpretation of the coefficients on tables 1 and 2 is straightforward. When output growth falls by 1 percent, the budget balance deteriorates by 0.3–0.5 percent as a ratio to GDP.

How much of that change is caused by automatic stabilizers and how much is due to discretionary changes in policy? Table 3 replicates the results in the previous two tables, but the dependent variable is now the cyclically adjusted balance. The coefficient on the cycle is much smaller, now in a range of 0.09–0.2. This is expected, as automatic stabilizers are larger in size than discretionary changes in policy. The size of automatic stabilizers can be read as the difference between the two coefficients, which is somewhere around 0.3. Because the cyclically adjusted balance is constructed from estimated elasticities of taxes and spending, this coefficient is simply an estimate of the elasticities used in that calculation. The elasticities provided by the OECD are indeed around that value for the OECD group (Girouard and André 2005).

Where is the cyclicality of the budget balance coming from? Is it about changes in taxes or about changes in spending?

We start with a specification where we look at the response of tax growth rates on the two measures of the cycle. Table 4 presents the results. The coefficient is very close to 1 when we use the GDP growth rate and about 0.9 when using the output gap. This result is consistent with previous results in the literature: where it has been shown that the

elasticity of taxes is around 1, taxes are close to being proportional to output. The last columns of table 4 present the results from running a specification where we regress the change in the revenues-to-GDP ratio on the business cycle. This specification is the closest to that run for the budget balance. The coefficient is close to zero and insignificant when using output growth, and significant but small when using the output gap. In other words, the ratio of revenues to GDP is close to being acyclical and does not contribute to the change in the budget balance (measured as a percentage of GDP). This is consistent with the fact that taxes move proportionally with output.

As a next step, we run the same regression using government expenditures as a dependent variable. Table 5 displays the results. When regressing the growth rate of expenditures on output growth, we find that spending is mildly countercyclical or is acyclical. When measuring the business cycle with the output gap, we find spending to be acyclical or procyclical but with a small coefficient. Even in cases where the coefficient is positive and significant, spending reacts less than one-to-one to changes in output. And because spending does not react much to output, the spending-to-GDP ratio is clearly countercyclical as it goes up when output decreases, as shown in the last columns. So during recessions, government spending is high relative to the other components of output. And this is the result of the not-very-strong response of spending to the business cycle.

Therefore, the result that the government balance worsens in recessions when measured as a percentage of GDP can be seen as the result of taxes moving one-to-one with GDP, spending remaining stable, and the spending ratio increasing during recessions. This reading of the data is not far from the theoretical example we have

contemplated several times in previous sections, where we assumed unit tax elasticity and a zero spending elasticity. In this particular scenario, the cyclical semi-elasticity of the budget balance (measured as a ratio to GDP) should be similar to the size of government. And indeed this is what we find. As shown in tables 1 through 3, the semi-elasticity of the budget balance as measured by the coefficient on the business cycle is close to the average government size for our sample (about 40 percent as measured by spending).

All the regressions we have run are descriptive and cannot be interpreted in terms of causality. Indeed, the very fact that we are discussing the stabilizing role of fiscal policy implies that fiscal policy has an effect on output, so we need to be careful of reverse causality. The literature has struggled with the issue of endogeneity and there is no consensus on how to completely avoid the problem. Many of the papers use ordinary least squares (OLS), and those that use instrumental variables tend to make use of either lags or measures of the cycle in the United States or the rest of the world. We check whether the use of instrumental variables affects our results by running some of our regressions and instrumenting the cycle with the weighted sum of either GDP growth or the output gap for all other countries (a method used in Galí and Perotti 2003and several other papers in the literature).

The results of these regressions are presented in table 6, and are not far from the OLS results presented in table 1. The budget balance reacts positively to the business cycle. The size of the coefficient is always higher than the one we obtained using OLS. A possible interpretation of this result is that if countercyclical policy (say, an increase in government spending during recessions) is helping to stabilize output, this would induce a negative correlation between the budget balance and output growth that would bias

downwards the OLS regressions of table 1. This potential explanation is partly confirmed by the results in table 7 that apply instrumental variables just to the cyclically adjusted balance. These coefficients are much larger than when using OLS, suggesting that the bias in the OLS estimates is coming from discretionary changes in fiscal policy and not automatic stabilizers, as expected.

We now check whether the above responses are different if we restrict our sample to more recent years, the post-1990 period. The reason for choosing this period is that its monetary policy regime is characterized by low and stable inflation for most economies. Between 1990 and 2010 most countries experienced three recessionary periods: the early 1990s, 2001–2003, and the most recent recession.

Tables 8–10 reproduce our first three tables for the post-1990 period. In this shorter sample we find that the budget balance is more responsive to changes in the cycle. Comparing table 1 and table 8, we find that regardless of the column, the coefficient on the business cycle is larger in the post-1990 period. When comparing table 2 and table 9 (for the primary balance) we find that the response is closer when comparing both samples. This is probably an indication that some of the increased countercyclicality that we observe in the post-1990 sample is due to interest rates being more countercyclical in that sample. When looking at the cyclically adjusted balance we also see that there is a small increase in countercyclicality in the post-1990 sample.

From this exercise we make the overall conclusion that fiscal policy is countercyclical in these countries and that the countercyclicality has increased in the last part of the sample. Tax elasticities are close to one, while spending is nearly acyclical. The empirical estimates are close to the theoretical exercise we have explored before of

proportional taxes and stable spending. In this environment the cyclical semi-elasticity of the budget balance is driven by government size. The panel regressions do not allow us to explore differences across countries in some of these parameters. This is done in the next section.

4.2. Response of Individual Countries

We now look at the behavior of fiscal policy for individual countries. The advantage of fitting a fiscal policy rule for each country is that we allow parameters to differ across countries. We expect these parameters to be different and we plan to explore these differences by analyzing the cross-country variability. The disadvantage of using country data is that the number of observations is smaller and therefore the analysis becomes noisier. In addition, in terms of presenting the results, , it is more difficult to summarize the large number of estimated parameters.

As in the panel regressions, we start with an analysis of the budget balance. In order to maximize the number of observations, we use the simplest specification where we run the budget balance against a measure of the cycle without using debt as a control. We do this for the overall budget balance, the cyclically adjusted one, and the one labeled "automatic stabilizers" (which is simply the difference between the previous two).

Table 11 displays the results. Given the number of regressions and specifications, we simply include the value and significance of the coefficient on the measure of the business cycle. The first six columns are a regression of the budget balance as a percentage of GDP on either output growth or the output gap. The last three columns

include a linear and quadratic trend, which makes a difference for countries with large swings in the fiscal balance (such as Japan).

Overall we find that fiscal policy is countercyclical in most countries and the coefficient is significant at the 10 percent level or better for all except five countries. When we focus on the two components of fiscal policy, automatic versus discretionary, we find that in the case of automatic stabilizers we consistently get a strong significance and countercyclical policy. This should not be a surprise given that the mechanisms behind automatic stabilizers, proportional or progressive taxes, and stable government spending are present in all these countries.

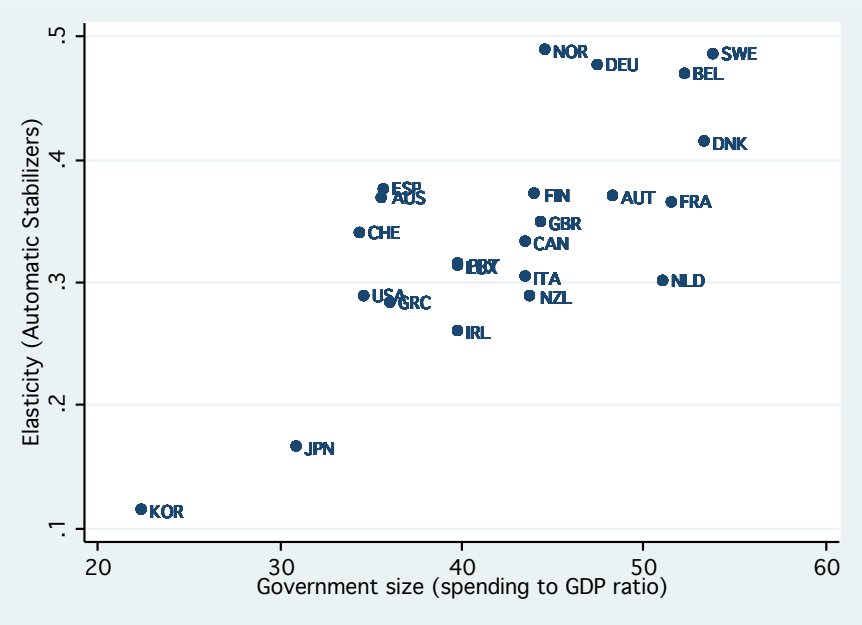
More specifically, we are looking at a regression coefficient such as

$$\Delta as_t = \alpha + \beta \Delta y_t + \varepsilon_t^B .$$

We know from the panel regressions that taxes are almost proportional to output and that spending is not that reactive. In this environment, β is just the size of government as measured by spending.

In figure 1 we plot this coefficient against government size (measured as total government spending as a ratio to GDP). As expected, the correlation is strong and not far from the 45-degree line. There is, of course, some noise around it because of the use of a regression and the fact that taxes and spending are not perfectly described by a proportional tax system and stable spending.

Figure 1: Government Size and the Cyclical Semi-Elasticity of Automatic Stabilizers



Source: Authors' calculations.

When it comes to discretionary fiscal policy there are large variations across countries. For most countries we cannot reject the hypothesis that the coefficient is zero—in other words, that discretionary fiscal policy is acyclical. There are, however, some countries where discretionary fiscal policy is clearly countercyclical. For example, for the United States, Norway, Ireland, Canada, and Australia the coefficient is significant at less than the 1 percent level. The coefficient is large for some of these countries.

In the United States, countercyclical discretionary policy is almost as large as automatic stabilizers. This is very different from a country like Germany where all the budget balance's countercyclical behavior is coming from automatic stabilizers and the

coefficient in discretionary fiscal policy is in fact negative, although close to zero and nonsignificant.

Table 12 checks whether we have seen significant changes in these individual country coefficients in the post-1990 sample. Confirming what we observed in the panel regressions, we see that in most countries fiscal policy has become more countercyclical in the post-1990 period. Most of the change is due to changes in discretionary fiscal policy.

In the case of the United States, the coefficient on the overall balance has increased from 0.54 to 0.84 and all this increase is due to a more responsive discretionary fiscal policy. We observe a very similar phenomenon for the United Kingdom and Canada, where discretionary fiscal policy has changed from being acyclical to being clearly countercyclical.

As before, we now check whether the use of instrumental variables changes our conclusions. We replicate the regressions for the three measures of the balance for the post-1990 period using the same instrument as in table 6, and we compare the results to the OLS coefficients. The results (table 13) show that the use of instrumental variables consistently leads to higher coefficients for all countries and that the difference comes from discretionary fiscal policy. Beyond this difference, the results look very similar to those in the OLS regressions. For example, the same list of countries appears to be more aggressive when it comes to the use of discretionary fiscal policy.

Are the observed differences in fiscal policy due to differences in tax behavior or spending behavior? We start with the analysis of revenues in table 14. As in the panel, we look at the growth rate of revenues, the growth rate of cyclically adjusted revenues, and

the change in the revenue to GDP ratio. For completeness, we look at both the full sample and the post-1990 period.

Tax elasticities tend to be close to 1 and cyclically adjusted taxes tend to be less countercyclical (in many cases they are acyclical). There are some interesting changes from the full sample to the post-1990 sample. For example, the United Kingdom has a strong countercyclical policy after 1990 but not if we look at the full sample. Interestingly, it is four Anglo-Saxon countries where taxes react more than one-to-one to changes in output so that the ratio of taxes to income becomes countercyclical in the post-1990 period. There are other countries (Norway and Spain) where tax policy is also countercyclical, although not significant in all specifications.

To complete the analysis, table 15 presents a similar analysis for spending. If we focus on the post-1990 sample, there are countries that engage in both countercyclical tax and spending policy (such as the United States or Canada). Others, such as Ireland, have countercyclical spending but acyclical taxes.

In the case of the United States, we confirm that fiscal policy after the 1990s has become much more countercyclical when looking at spending.

4.3 Are Automatic Stabilizers and Discretionary Policy Substitutes?

In our analysis we argue that the fiscal policy stance should be measured by the cyclicality of the budget balance, and the degree to which the budget balance is countercyclical is a good indicator of the stabilizing effects of fiscal policy. But we have also seen that some countries have large automatic stabilizers, while others rely more on

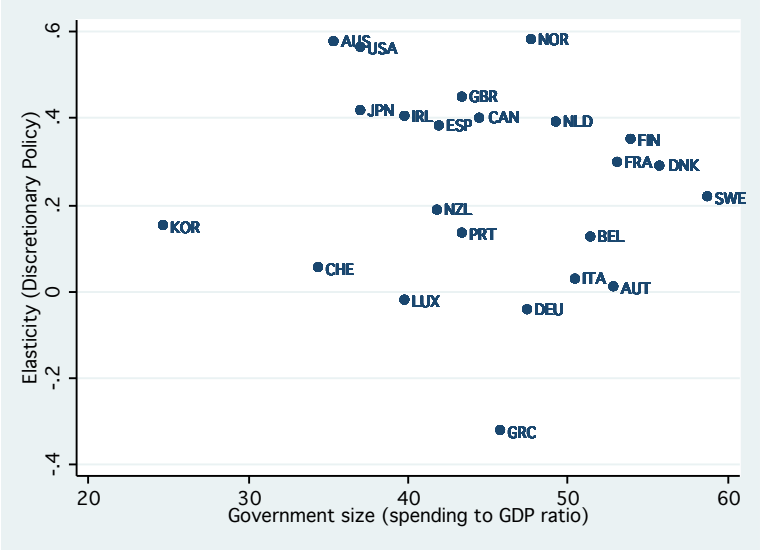
discretionary fiscal policy. Does discretionary fiscal policy serve as a substitute for small automatic stabilizers?

This is a possibility, given that how effective automatic stabilizers are is largely determined by government size. Countries choose the size of government for reasons other than economic stabilization and, given those choices, some countries end up with stronger stabilizers. Assuming stabilization preferences tend to be similar across countries, we would expect to see the countries with smaller governments being more aggressive when it comes to the use of discretionary fiscal policy.

Figure 2 shows that there is some evidence of this behavior. We focus our analysis on the post-1990 period to get a more consistent and balanced sample of years across countries. We plot the countercyclicality of discretionary policy on the vertical axis against government size on the horizontal axis (as an indicator of automatic stabilizers). The relationship is negative, although a regression produces a nonsignificant estimate partly because of the presence of outliers (such as Greece). But for some countries we see clearly that countercyclical policy is related to smaller government. And for some of the countries with large governments the aggressiveness of fiscal policy is smaller.

Figure 2: Government Size versus Discretionary Policy

(Post-1990 Sample)

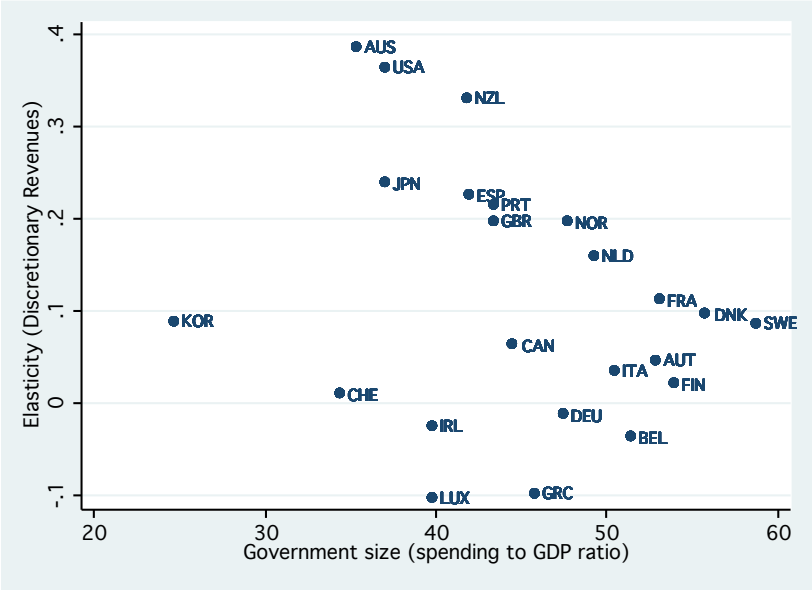


Source: Authors' calculations.

Similar evidence can be derived by looking at the countercyclicality of discretionary taxes, measured as movements in the cyclically adjusted revenues-to-GDP ratio, depicted in figure 3.

Figure 3: Government Size versus Discretionary Tax Policy

(Post-1990 Sample)



Source: Authors' calculations.

4.4 Are Recessions Different? Was the Great Recession Different?

Our analysis has looked at the cyclical behavior of fiscal policy over a large number of years. We have treated all years similarly, whether they were expansions or recessions. There are reasons to believe that fiscal policy can be asymmetric, in particular more countercyclical, during recessions. The issue of asymmetric fiscal policy has been analyzed in the literature with mixed results (Sorensen and Yosha 2001; Lane 2003; Wyplosz 2002; Balassone and Francese 2004; and Egert 2010).

We look for asymmetries in our sample by modifying our panel regressions. In particular, we create a dummy variable that takes a value of one if the output gap is below 1 percent. We use this cutoff to indicate a significant recession. We interact this dummy with the business cycle and run a regression similar to those in tables 1 to 3. The results

are shown in table 16 for the overall balance and table 17 for the cyclically adjusted balance. We find that the interaction term tends to be positive but is only significant when measuring the business cycle by the output gap.

We repeat a similar analysis, but the dummy variable now takes the value 1 for the years 2008 and 2009 and it interacts with the business cycle. Tables 18 and 19 show the results of this exercise. In some specifications we include both the interaction with the last recession and with recessions in general (as in tables 16 and 17). In all cases we see that the interaction is positive and significant, signaling that relative to a typical year the behavior of fiscal policy was more countercyclical during the last recession. To some extent, this effect is due to the stronger aggressiveness of discretionary fiscal policy, as shown in table 18.[9]

4.5 Effectiveness of Fiscal Policy

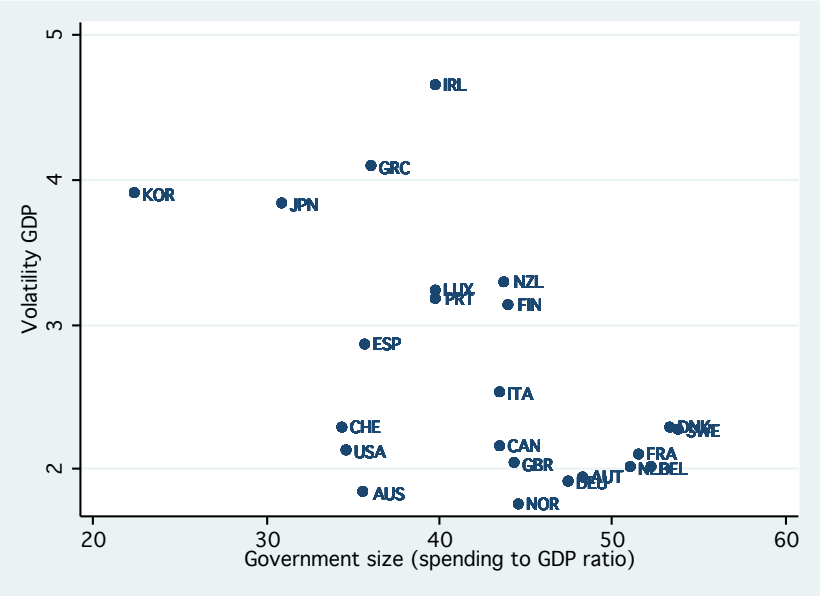
We have looked at the countercyclicality of fiscal policy as an indicator of the degree to which fiscal policy stabilizes output. Our interpretation of this coefficient is based on theoretical arguments derived from a framework where stabilizing aggregate demand matters. But so far our empirical analysis has not shown that such fiscal policy behavior provides any stabilization of economic activity. What do we know about the effectiveness of fiscal policy? The coefficient we have been analyzing has two components: the discretionary part and the automatic part. When it comes to the effects of discretionary fiscal policy, empirical work has measured the multiplier effects of discretionary changes

[9] Bénétrix and Lane (2010) produce a detailed analysis of the fiscal response to the 2008–2009 recession, although in their results the cyclicality of fiscal policy looks more similar to that of previous events.

in fiscal policy but focuses only on exogenous changes—never those that are a response to business cycles. The reason for this is because econometrically these models need to deal with exogenous events. In addition, the evidence is subject to a debate that has achieved very limited consensus on the size of the multiplier.

When it comes to automatic stabilizers, research has looked at their effects using a cross-section of countries and the logic that government size is responsible for most of the automatic response of the budget balance (as a percentage of GDP) to the business cycle. Because government size can potentially be seen as an exogenous variable contributing to volatility, we can run a regression of output volatility on government size to check the effectiveness of automatic stabilizers. We do not replicate all the results in the literature, but we want to show that the same result applies to our sample. Figures 4 and 5 show that there is a negative correlation between government size and the volatility of both GDP and consumption, as suggested by the model we presented in section 3.

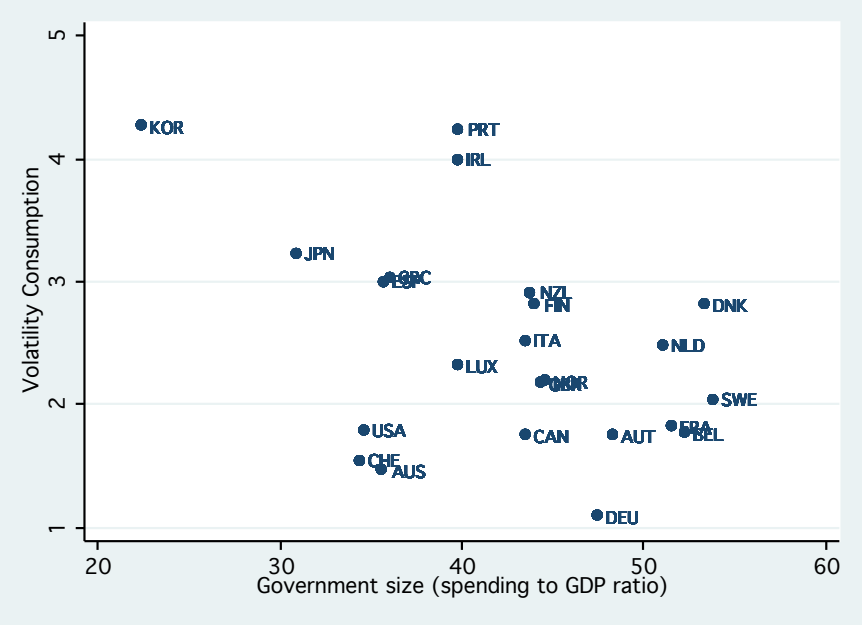
Figure 4: Automatic Stabilizers (Government Size) and the Volatility of GDP Growth



Source: Authors' calculations.

Of course, the correlation of the figure does not imply causation, but Fatás and Mihov (2001) show that the result is robust to a large number of controls and the use of instrumental variables. More recently, Debrun and Kapoor (2010) have updated the analysis and shown that the result is robust to a variety of samples and specifications. Additionally, and in the context of a simple Keynesian model, Fatás (2009) has calculated that the correlation between government size and the volatility of GDP requires parameters that will generate a fiscal multiplier of about 1.6–1.8. This multiplier is not very different from those calculated in discretionary fiscal policy literature. In particular, those studies that look at recessionary episodes (where the automatic stabilizers matter) tend to obtain higher estimates of multipliers.

Figure 5: Automatic Stabilizers (Government Size) and the Volatility of Consumption Growth



Source: Authors' calculations.

5. Conclusions

The "Great Recession" has brought fiscal policy back to the center of discussion among both academics and policymakers. After years in which it was seen as a poor stabilization tool and always second to monetary policy, the limitations faced by central banks when reaching the zero-lower bound on interest rates has led to a renewed interest in the stabilization potential of fiscal policy.

Our paper provides an analysis of fiscal policy's stabilization effects among the OECD economies. Our starting point is to build a framework to measure the potential stabilizing effects of changes in government spending and revenues. This framework cannot simply be an accounting exercise; it requires an economic model. We follow Blanchard (1993) and present a model along the lines of Mankiw and Weinzerl (2011) in which aggregate demand determines output. In this context, the stabilization effects of fiscal policy are related to two factors: the cyclical elasticities of spending and taxes and government size. The first factor is straightforward and well-recognized in the literature: lower taxes and higher spending during a recession help stabilize aggregate demand. The second factor, government size, is not properly understood. To illustrate its importance, we study a particular case where taxes are proportional to income and government spending is acyclical. In this case, what matters for stabilization of aggregate demand and output is simply the size of the government (as measured by the government spending to GDP ratio).

When we look at the data, we find that for a panel of OECD countries this scenario is not far from reality. On average, for the period 1960–2010, taxes among these countries are nearly proportional to output and spending does not react much to business cycles. The main stabilizing factor is therefore government size. This is the key channel through which automatic stabilizers operate, and discretionary policies are small compared to automatic stabilizers.

There are interesting differences across countries and over time. Some countries make more use of discretionary policy. In particular, we find that Anglo-Saxon economies are more aggressive when it comes to employing discretionary fiscal policy.

We show that in some cases this greater use of discretionary fiscal policy can be seen as a reaction to the fact that government size, and therefore automatic stabilizers, are small in these countries. We also find that in recent decades there has been a change toward stronger use of discretionary policy among many of the OECD economies. While most of our paper is about describing the behavior of fiscal policy as a stabilization tool, we conclude with some evidence about its effectiveness in terms of reducing volatility in both output and private consumption.

From a policy point of view, our paper makes it clear that for many of the OECD economies fiscal policy has been a stabilizing tool, operating mostly through the mechanical way in which large governments seek to stabilize aggregate demand. This stabilizing effect is not by design. The size of government is not determined by calculations about what constitutes optimal stabilization policy but by political choices. In addition, and from a welfare point of view, government size has implications that go beyond the potential benefits of business cycle stabilization.

Countries with smaller governments, such as the United States, show a more aggressive use of discretionary fiscal policy, which can be seen as a substitute for the lack of strong automatic stabilizers. But as the experience of the last three years has shown, relying on quick political decisions to achieve changes in fiscal policy may be less than ideal.

Given the strong role that government size plays as the stabilizing mechanism of fiscal policy and the fact that using discretionary policy may not be an optimal solution, the question is if we can design automatic stabilizers that rely less on the size of government but are still automatic and therefore not subject to political debate and

interference. Theoretically this is possible, although there is limited academic research on the subject. Moreover, there are both political and technical challenges to be overcome. On the technical side, the biggest difficulty will be to find an objective and accurate measure of cyclical fluctuations that can be used as an automatic trigger of fiscal policy actions. On the political side, the challenge will be to design stabilizers in a way that is seen as independent of other (political) goals.

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Data Appendix

All data are from the OECD Economic Outlook. Sample period is 1960–2010 although data availability is uneven across countries and variables. The variables used in the analysis and the corresponding codes are:

Overall balance: NLG

As a ratio to GDP: NLGQ

Primary Balance: NLGX

As a ratio to GDP: NLGXQ

Government spending: YPGT

As a ratio to GDP: YPGTQ

Current disbursements: YPG

Current disbursements as % of GDP: YPGQ

Current receipts: YRG

Current receipts as % of GDP: YRGQ

Total receipts: YRGT

Total receipts as % of GDP: YRGTQ

Cyclically adjusted overall balance: NLGA

As % GDP: NLGQA

Cyclically adjusted primary balance: NLGXA

As % of potential GDP: NLGXQA

Cyclically adjusted current disbursements: YPGA

As % of potential GDP: YPGQA

Cyclically adjusted current receipts: YRGA

As % of potential output: YRGQA

Real GDP: GDPV

Output gap: GAP

Debt as % of GDP: GGFLQ

Table 1: Cyclicality of Budget Balance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ BB/GDP	Δ BB/GDP	BB/GDP	BB/GDP	Δ BB/GDP	Δ BB/GDP	BB/GDP	BB/GDP
GDP growth	0.354***		0.378***		0.531***		0.527***	
	(0.0241)		(0.0232)		(0.0301)		(0.0296)	
Output Gap		0.271***		0.388***		0.364***		0.503***
		(0.0314)		(0.0311)		(0.0342)		(0.0341)
Lagged BB/GDP			0.842***	0.763***			0.893***	0.741***
			(0.0173)	(0.0215)			(0.0206)	(0.0242)
Lagged Debt/GDP					0.0231***	0.0223***	0.0186***	0.0148***
					(0.00326)	(0.00390)	(0.00331)	(0.00367)
Constant	-1.200***	-0.0423	-1.561***	-0.527***	-2.911***	-1.388***	-2.841***	-1.402***
	(0.0953)	(0.0755)	(0.0994)	(0.0828)	(0.230)	(0.248)	(0.226)	(0.229)

R-squared	0.195	0.089	0.762	0.720	0.330	0.170	0.767	0.735
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Cyclicality of Primary Budget Balance

Variables	(1) Δ PBB/GDP	(2) Δ PBB/GDP	(3) PBB/GDP	(4) PBB/GDP	(5) Δ PBB/GDP	(6) Δ PBB/GDP	(7) PBB/GDP	(8) PBB/GDP
GDP growth	0.423***		0.347***		0.474***		0.501***	
	(0.0276)		(0.0230)		(0.0345)		(0.0292)	
Output Gap		0.322***		0.329***		0.333***		0.463***
		(0.0339)		(0.0311)		(0.0369)		(0.0344)
Lagged PBB/GDP			0.848***	0.789***			0.857***	0.728***
			(0.0189)	(0.0225)			(0.0207)	(0.0246)
Lagged Debt/GDP					-0.0211***	-0.0178***	0.0197***	0.0209***
					(0.00377)	(0.00420)	(0.00318)	(0.00360)
Constant	-3.424***	-2.313***	-1.157***	-0.00503	-2.304***	-1.231***	-2.600***	-1.200***
	(0.110)	(0.0815)	(0.0911)	(0.0708)	(0.264)	(0.267)	(0.223)	(0.228)

Observations	905	786	905	786	700	670	700	670
R-squared	0.210	0.106	0.726	0.698	0.265	0.148	0.752	0.722
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Cyclicality of Cyclically Adjusted Budget Balance

Variables	(1) Δ CAB/PGDP	(2) Δ CAB/PGDP	(3) CAB/PGDP	(4) CAB/PGDP	(5) Δ CAB/PGDP	(6) Δ CAB/PGDP	(7) CAB/PGDP	(8) CAB/PGDP
GDP growth	0.172***		0.185***		0.225***		0.233***	
	(0.0276)		(0.0266)		(0.0297)		(0.0289)	
Output Gap		0.0978***		0.142***		0.163***		0.219***
		(0.0274)		(0.0269)		(0.0293)		(0.0291)
Lagged CAB/PGDP			0.833***	0.818***			0.847***	0.806***
			(0.0219)	(0.0226)			(0.0253)	(0.0263)
Lagged Debt/GDP					0.0161***	0.0168***	0.0124***	0.0128***
					(0.00334)	(0.00343)	(0.00331)	(0.00334)
Constant	-0.522***	-0.0329	-0.983***	-0.480***	-1.631***	-1.063***	-1.785***	-1.254***
	(0.0963)	(0.0668)	(0.111)	(0.0849)	(0.231)	(0.220)	(0.227)	(0.213)

Observations	748	748	748	748	645	645	645	645
R-squared	0.051	0.017	0.680	0.671	0.109	0.073	0.665	0.660
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Cyclicality of Revenues

Variables	(1) Δ t	(2) Δ t	(3) Δ t	(4) Δ t	(5) Δ *(T/Y)*	(6) Δ *(T/Y)*	(7) Δ *(T/Y)*	(8) Δ *(T/Y)*
GDP growth	0.948***		1.030***		-0.0215		-0.0108	
	(0.0731)		(0.0764)		(0.0148)		(0.0194)	
Output Gap		0.878***		0.823***		0.0539***		0.0499**
		(0.0864)		(0.0793)		(0.0172)		(0.0195)
Lagged Debt/GDP			-0.0943***	-0.101***			-0.00746***	-0.00711***
			(0.00828)	(0.00904)			(0.00211)	(0.00222)
Constant	5.699***	8.228***	9.873***	13.09***	0.272***	0.181***	0.616***	0.581***
	(0.289)	(0.208)	(0.580)	(0.576)	(0.0584)	(0.0415)	(0.148)	(0.141)
Observations	897	782	691	665	897	782	691	665
R-squared	0.162	0.120	0.348	0.295	0.002	0.013	0.019	0.029

Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Cyclicality of Expenditures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Δg	Δg	Δg	Δg	$\Delta (G/Y)$	$\Delta (G/Y)$	$\Delta (G/Y)$	$\Delta (G/Y)$
GDP growth	0.102		-0.150**		-0.378***		-0.546***	
	(0.0797)		(0.0730)		(0.0221)		(0.0257)	
Output Gap		0.280***		0.0381		-0.217***		-0.314***
		(0.0899)		(0.0717)		(0.0297)		(0.0311)
Lagged Debt/GDP			-0.147***	-0.151***			-0.0306***	-0.0295***
			(0.00791)	(0.00818)			(0.00278)	(0.00355)
Constant	8.572***	8.311***	16.41***	16.23***	1.483***	0.223***	3.534***	1.970***
	(0.315)	(0.217)	(0.555)	(0.521)	(0.0875)	(0.0716)	(0.195)	(0.226)
Observations	895	782	691	665	895	782	691	665
R-squared	0.002	0.013	0.341	0.353	0.251	0.066	0.440	0.191

Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Cyclicality of Budget Balance (IV)

Variables	(1) Δ BB/GDP	(2) Δ BB/GDP	(3) BB/GDP	(4) BB/GDP	(5) Δ BB/GDP	(6) Δ BB/GDP	(7) BB/GDP	(8) BB/GDP
GDP growth	0.524***		0.520***		0.698***		0.673***	
	(0.0409)		(0.0388)		(0.0470)		(0.0458)	
Output Gap		0.434***		0.578***		0.474***		0.628***
		(0.0516)		(0.0536)		(0.0521)		(0.0544)
Lagged BB/GDP			0.830***	0.718***			0.895***	0.707***
			(0.0178)	(0.0242)			(0.0210)	(0.0269)
Lagged Debt/GDP					0.0253***	0.0240***	0.0206***	0.0155***
					(0.00337)	(0.00398)	(0.00341)	(0.00371)
Constant	-1.712***	0.0218	-2.013***	-0.553***	-3.468***	-1.446***	-3.330***	-1.460***
	(0.139)	(0.0785)	(0.141)	(0.0850)	(0.263)	(0.251)	(0.257)	(0.232)
Observations	916	787	916	787	704	670	704	670

Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Cyclicality of Primary Budget Balance (IV)

Variables	(1) Δ CAB/PGDP	(2) Δ CAB/PGDP	(3) CAB/PGDP	(4) CAB/PGDP	(5) Δ CAB/PGDP	(6) Δ CAB/PGDP	(7) CAB/PGDP	(8) CAB/PGDP
GDP growth	0.346***		0.434***		0.365***		0.470***	
	(0.0468)		(0.0477)		(0.0456)		(0.0475)	
Output Gap		0.150***		0.195***		0.174***		0.252***
		(0.0438)		(0.0539)		(0.0439)		(0.0550)
Lagged BB/GDP			0.663***	0.611***			0.648***	0.566***
			(0.0199)	(0.0247)			(0.0217)	(0.0274)
Lagged Debt/GDP					0.0172***	0.0169***	0.0144***	0.0110***
					(0.00342)	(0.00347)	(0.00357)	(0.00377)
Constant	-0.970***	-0.0100	-2.214***	-1.115***	-2.033***	-1.068***	-3.116***	-1.846***
	(0.138)	(0.0686)	(0.149)	(0.0873)	(0.255)	(0.221)	(0.262)	(0.237)

Observations	748	748	766	766	645	645	657	657
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Cyclicality of Budget Balance (Post-1990 Sample)

Variables	(1) Δ BB/GDP	(2) Δ BB/GDP	(3) BB/GDP	(4) BB/GDP	(5) Δ BB/GDP	(6) Δ BB/GDP	(7) BB/GDP	(8) BB/GDP
GDP growth	0.577***		0.579***		0.637***		0.643***	
	(0.0380)		(0.0366)		(0.0410)		(0.0401)	
Output Gap		0.315***		0.523***		0.447***		0.655***
		(0.0441)		(0.0447)		(0.0459)		(0.0463)
L.NLGQ			0.838***	0.669***			0.870***	0.674***
			(0.0264)	(0.0323)			(0.0281)	(0.0329)
Lagged Debt/GDP					0.0180***	0.0446***	0.00887	0.0281***
					(0.00636)	(0.00727)	(0.00651)	(0.00675)
Constant	-1.524***	-0.0211	-1.797***	-0.463***	-2.764***	-2.893***	-2.392***	-2.230***
	(0.125)	(0.106)	(0.128)	(0.105)	(0.422)	(0.482)	(0.420)	(0.439)

Observations	478	478	478	478	436	436	436	436
R-squared	0.337	0.101	0.737	0.687	0.393	0.218	0.758	0.736
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Cyclicality of Primary Budget Balance (Post-1990 Sample)

Variables	(1) Δ PBB/GDP	(2) Δ PBB/GDP	(3) PBB/GDP	(4) PBB/GDP	(5) Δ PBB/GDP	(6) Δ PBB/GDP	(7) PBB/GDP	(8) PBB/GDP
GDP growth	0.466***		0.561***		0.517***		0.622***	
	(0.0420)		(0.0362)		(0.0460)		(0.0396)	
Output Gap		0.327***		0.482***		0.391***		0.640***
		(0.0446)		(0.0452)		(0.0482)		(0.0473)
Lagged PBB/GDP			0.819***	0.682***			0.828***	0.644***
			(0.0278)	(0.0348)			(0.0285)	(0.0345)
Lagged Debt/GDP					-0.00727	0.0152**	0.00968	0.0340***
					(0.00713)	(0.00763)	(0.00622)	(0.00650)
Constant	-3.736***	-2.484***	-1.420***	0.243**	-3.247***	-3.390***	-2.145***	-1.908***
	(0.138)	(0.107)	(0.120)	(0.103)	(0.474)	(0.506)	(0.416)	(0.437)
Observations	478	478	478	478	436	436	436	436

R-squared	0.213	0.106	0.726	0.665	0.236	0.138	0.748	0.721
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Cyclically Adjusted Budget Balance (Post-1990 Sample)

Variables	(1) Δ CAB/PGDP	(2) Δ CAB/PGDP	(3) CAB/PGDP	(4) CAB/PGDP	(5) Δ CAB/PGDP	(6) Δ CAB/PGDP	(7) CAB/PGDP	(8) CAB/PGDP
GDP growth	0.249***		0.279***		0.280***		0.312***	
	(0.0349)		(0.0335)		(0.0379)		(0.0370)	
Output Gap		0.117***		0.209***		0.209***		0.308***
		(0.0363)		(0.0366)		(0.0384)		(0.0390)
Lagged CAB/PGDP			0.781***	0.747***			0.805***	0.744***
			(0.0313)	(0.0342)			(0.0343)	(0.0367)
Lagged Debt/GDP					0.0162***	0.0283***	0.00550	0.0180***
					(0.00589)	(0.00610)	(0.00598)	(0.00596)
Constant	-0.635***	0.00338	-1.136***	-0.446***	-1.762***	-1.835***	-1.513***	-1.608***
	(0.115)	(0.0873)	(0.131)	(0.103)	(0.392)	(0.405)	(0.380)	(0.385)

Observations	477	477	477	477	435	435	435	435
R-squared	0.100	0.022	0.627	0.599	0.145	0.096	0.640	0.633
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11: Cyclicality of Budget Balance

Controls	**No Controls**						**Time and Squared Trends**		
Fiscal Policy	**Δ BB/GDP**	**Δ BB/GDP**	**Aut. Stab.**	**Aut. Stab.**	**Δ CAB/ PGDP**	**Δ CAB/ PGDP**	**Δ BB/GDP**	**AS**	**Δ CAB/PGDP**
Measure of Cycle	**GDP growth**	**Output Gap**	**GDP growth**	**Output Gap**	**GDP growth**	**Output Gap**	**GDP growth**	**GDP growth**	**GDP growth**
Australia	0.871***	0.743***	0.370***	0.245***	0.751***	0.564**	1.081***	0.376***	0.675***
Austria	0.290***	0.294**	0.370***	0.273***	-0.082	-0.00145	0.366***	0.376***	-0.107
Belgium	0.377**	-0.00464	0.470***	0.230***	-0.0768	-0.235	0.464***	0.517***	-0.053
Canada	0.519***	0.327***	0.334***	0.173***	0.269***	0.154*	0.683***	0.361***	0.319***
Switzerland	0.396***	0.162	0.342***	0.119	0.0542	0.0426	0.339**	0.335***	0.00444
Germany	0.439	0.319	0.478***	0.365*	-0.0403	-0.0286	0.429	0.489***	-0.0701
Denmark	0.768***	0.661***	0.415***	0.332***	0.385***	0.358***	0.798***	0.413***	0.388***
Spain	0.372***	0.188	0.376***	0.141***	0.345**	0.0464	0.476***	0.399***	0.302*
Finland	0.482***	0.363***	0.372***	0.169***	0.286***	0.193**	0.519***	0.372***	0.301***

France	0.577***	0.201	0.366***	0.203***	0.210*	-0.00166	0.596***	0.372***	0.224*
UK	0.356***	0.206	0.350***	0.216***	0.0694	-0.0173	0.338***	0.360***	0.0161
Greece	0.039	-0.199	0.284***	0.192***	-0.281*	-0.416**	0.0535	0.283***	-0.305*
Ireland	0.668***	0.695***	0.260***	0.222***	0.408**	0.472**	-0.086	0.268***	-0.354
Italy	0.176**	0.0952	0.305***	0.239***	-0.0174	-0.11	0.460***	0.401***	0.0584
Japan	0.168**	0.283*	0.167***	0.150***	0.174	0.13	0.422***	0.231***	0.273**
Korea	0.208***	0.109	0.115***	0.104***	0.0819	-0.00682	0.233***	0.148***	0.0723
Luxembourg	0.292*	0.0897	0.314***	0.175***	-0.0212	-0.0855	0.268	0.317***	-0.0494
Netherlands	0.532***	0.274	0.302***	0.291***	0.295	-0.0155	0.548***	0.300***	0.294
Norway	0.571***	0.284	0.489*	-0.0952	0.411**	0.366***	0.826***	0.526*	0.506***
New Zealand	0.346*	0.243	0.289***	0.126**	0.0569	0.118	0.382*	0.301***	0.0816
Portugal	0.308**	0.0687	0.316***	0.0897*	0.0122	-0.00416	0.294*	0.373***	-0.0472
Sweden	0.550***	0.325**	0.487***	0.202***	0.226	0.128	0.629***	0.491***	0.207
United States	0.540***	0.383***	0.290***	0.182***	0.344***	0.265***	0.568***	0.296***	0.332***

*** p<0.01, ** p<0.05, * p<0.1

Table 12: Cyclicality of Budget Balance (Full Sample and Post-1990 Sample)

Fiscal Policy	**Δ BB/GDP**		**Aut. Stab.**		**Δ CAB/PGDP**	
Measure of Cycle	**GDP Growth**		**GDP Growth**		**GDP Growth**	
Sample	**Full Sample**	**Post-1990**	**Full Sample**	**Post-1990**	**Full Sample**	**Post-1990**
Australia	0.871***	0.901***	0.370***	0.321***	0.751***	0.580***
Austria	0.290***	0.404**	0.370***	0.394***	-0.082	0.0106
Belgium	0.377**	0.631***	0.470***	0.504***	-0.0768	0.127
Canada	0.519***	0.746***	0.334***	0.343***	0.269***	0.403***
Switzerland	0.396***	0.396***	0.342***	0.342***	0.0542	0.0542
Germany	0.439	0.439	0.478***	0.478***	-0.0403	-0.0403
Denmark	0.768***	0.704***	0.415***	0.411***	0.385***	0.293**
Spain	0.372***	0.773***	0.376***	0.387***	0.345**	0.386*
Finland	0.482***	0.724***	0.372***	0.373***	0.286***	0.351***
France	0.577***	0.673***	0.366***	0.371***	0.210*	0.302**
United Kingdom	0.356***	0.818***	0.350***	0.366***	0.0694	0.452***
Greece	0.039	-0.0213	0.284***	0.300***	-0.281*	-0.321

Ireland	0.668***	0.668***	0.260***	0.260***	0.408**	0.408**
Italy	0.176**	0.456***	0.305***	0.426***	-0.0174	0.0295
Japan	0.168**	0.675***	0.167***	0.254***	0.174	0.420**
Korea	0.208***	0.277**	0.115***	0.124***	0.0819	0.152
Luxembourg	0.292*	0.292*	0.314***	0.314***	-0.0212	-0.0212
Netherlands	0.532***	0.734**	0.302***	0.339***	0.295	0.395
Norway	0.571***	1.233**	0.489*	0.647*	0.411**	0.586**
New Zealand	0.346*	0.499***	0.289***	0.308***	0.0569	0.191
Portugal	0.308**	0.452**	0.316***	0.318***	0.0122	0.134
Sweden	0.550***	0.704***	0.487***	0.485***	0.226	0.219
United States	0.540***	0.840***	0.290***	0.276***	0.344***	0.565***

*** p<0.01, ** p<0.05, * p<0.1

Table 13: Cyclicality of Budget Balance (Post-1990 Sample)

Fiscal Policy	**Δ BB/GDP**		**AS**		**Δ CAB/PGDP**	
Measure of Cycle	**GDP Growth**		**GDP Growth**		**GDP Growth**	
Estimation	**OLS**	**IV**	**OLS**	**IV**	**OLS**	**IV**
Australia	0.901***	1.653***	0.321***	0.397***	0.580***	1.256**
Austria	0.404**	0.508**	0.394***	0.357***	0.0106	0.151
Belgium	0.631***	0.882***	0.504***	0.483***	0.127	0.399
Canada	0.746***	1.013***	0.343***	0.322***	0.403***	0.691***
Switzerland	0.396***	0.432**	0.342***	0.386***	0.0542	0.0455
Germany	0.439	0.706	0.478***	0.501***	-0.0403	0.205
Denmark	0.704***	0.801***	0.411***	0.412***	0.293**	0.390***
Spain	0.773***	1.226***	0.387***	0.418***	0.386*	0.808***
Finland	0.724***	0.745***	0.373***	0.374***	0.351***	0.372***
France	0.673***	0.835***	0.371***	0.358***	0.302**	0.477***
United Kingdom	0.818***	0.984***	0.366***	0.425***	0.452***	0.558***

Greece	-0.0213	1.33	0.300***	0.363***	-0.321	0.967
Ireland	0.668***	0.454*	0.260***	0.257***	0.408**	0.197
Italy	0.456***	0.597***	0.426***	0.451***	0.0295	0.145
Japan	0.675***	0.905**	0.254***	0.318***	0.420**	0.587
Korea	0.277**	1.005*	0.124***	0.164***	0.152	0.841
Luxembourg	0.292*	0.619**	0.314***	0.311***	-0.0212	0.307
Netherlands	0.734**	0.776**	0.339***	0.251***	0.395	0.525
Norway	1.233**	2.453***	0.647*	1.424**	0.586**	1.029***
New Zealand	0.499***	0.702**	0.308***	0.330***	0.191	0.372
Portugal	0.452**	1.048**	0.318***	0.318***	0.134	0.730*
Sweden	0.704***	0.659***	0.485***	0.482***	0.219	0.177
United States	0.840***	0.958***	0.276***	0.299***	0.565***	0.659***

*** p<0.01, ** p<0.05, * p<0.1

Table 14: Cyclicality of Revenues (Full Sample and Post-1990 Sample)

Fiscal Policy	**Δ t**		**Δt^{CAB}**		**Δ (T/Y)**	
Measure of Cycle	**GDP Growth**		**GDP Growth**		**GDP Growth**	
Sample	**Full Sample**	**Post-1990**	**Full Sample**	**Post-1990**	**Full Sample**	**Post-1990**
Australia	1.043**	2.201**	0.138	1.009**	0.138	0.464*
Austria	1.159***	0.763**	-0.286	0.133	-0.0563	-0.116
Belgium	0.602*	0.620**	-0.167	-0.0801	-0.222***	-0.14
Canada	1.324***	1.063***	0.804**	0.444	-0.00241	-0.0342
Switzerland	0.673*	0.673*	-0.116	-0.116	-0.0481	-0.0481
Germany	0.672**	0.672**	-0.179	-0.179	-0.083	-0.083
Denmark	1.112***	1.007***	0.439	0.390**	0.0351	-0.0442
Spain	1.034**	1.784***	0.706	1.101**	0.048	0.201
Finland	0.863***	0.831***	0.438*	0.231	-0.148**	-0.113
France	1.004*	0.935***	0.47	0.417**	-0.0617	-0.0221
United Kingdom	-0.137	1.387***	-0.894*	0.545**	-0.189*	0.234**

Greece	-0.21	0.251	-0.934*	-0.427	-0.114***	-0.0951
Ireland	1.430***	1.430***	0.858***	0.858***	-0.0175	-0.0175
Italy	1.101***	0.987**	1.280**	0.376	-0.0626	-0.0654
Japan	1.545***	1.517***	1.189***	0.984***	0.0314	0.146
Korea	1.185***	1.264***	0.431	0.718**	-0.00537	0.0314
Luxembourg	0.654***	0.654***	-0.127	-0.127	-0.162	-0.162
Netherlands	1.160***	1.189***	0.518	0.691**	-0.0471	0.0165
Norway	1.835***	1.820*	0.339	0.296	0.321***	0.295
New Zealand	1.360***	1.696***	0.745*	1.022***	0.259*	0.296**
Portugal	1.671**	1.782***	0.722	1.212**	0.11	0.177
Sweden	0.710**	0.713***	-0.173	-0.0256	-0.0125	-0.00975
United States	1.234***	1.899***	0.742***	1.317***	0.153***	0.303***

*** p<0.01, ** p<0.05, * p<0.1

Table 15: Cyclicality of Expenditures (Full Sample and Post-1990 Sample)

Fiscal Policy	**Δg**		**$\Delta (G/Y)$**		**Δg^{CAB}**	
Measure of Cycle	**GDP Growth**		**GDP Growth**		**GDP Growth**	
Sample	**Full Sample**	**Post-1990**	**Full Sample**	**Post-1990**	**Full Sample**	**Post-1990**
Australia	-1.559**	-0.45	-0.736***	-0.437***	-0.123	-0.107
Austria	0.544*	-0.00743	-0.346***	-0.520**	0.0592	0.0372
Belgium	-0.0537	-0.579	-0.599***	-0.771***	0.0114	-0.117
Canada	-0.0405	-0.594**	-0.605***	-0.780***	-0.117	-0.336***
Switzerland	-0.51	-0.51	-0.444***	-0.444***	-0.217***	-0.217***
Germany	-0.297	-0.297	-0.522*	-0.522*	-0.0516	-0.0516
Denmark	-0.362	-0.268*	-0.733***	-0.748***	-0.13	-0.210*
Spain	0.0961	-0.0729	-0.324***	-0.572***	-0.12	-0.158**
Finland	-0.0833	-0.516***	-0.630***	-0.836***	-0.236***	-0.304***
France	-0.0837	-0.311	-0.638***	-0.695***	-0.0852	-0.228***
United Kingdom	-0.949**	-0.469	-0.577***	-0.584***	-0.206***	-0.192**

Greece	-0.318	0.358	-0.153***	-0.0738	0.125	0.201
Ireland	-0.0304	-0.0304	-0.685***	-0.685***	-0.210***	-0.210***
Italy	0.700*	0.0908	-0.239***	-0.521***	-0.00924	-0.0575
Japan	1.077***	-0.277	-0.136**	-0.528***	-0.0363	-0.0597
Korea	0.291	0.216	-0.214***	-0.245**	-0.0516**	-0.0149
Luxembourg	-0.102	-0.102	-0.454***	-0.454***	-0.0646	-0.0646
Netherlands	0.0875	-0.34	-0.579***	-0.717***	-0.104	-0.145
Norway	0.658*	-0.728***	-0.261	-0.937***	-0.116	-0.384**
New Zealand	0.455	0.486	-0.0868	-0.203	-0.00955	0.00465
Portugal	0.921	0.747	-0.198*	-0.275*	0.095	0.067
Sweden	-0.234	-0.453*	-0.563***	-0.713***	-0.0632	-0.0744
United States	-0.333*	-0.429**	-0.386***	-0.537***	-0.0605*	-0.141**

*** p<0.01, ** p<0.05, * p<0.1

Table 16: Cyclicality of Budget Balance (Recessions)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Δ BB/GDP	Δ BB/GDP	BB/GDP	BB/GDP	Δ BB/GDP	Δ BB/GDP	BB/GDP	BB/GDP
GDP growth	0.539***		0.363***		0.502***		0.518***	
	(0.0473)		(0.0252)		(0.0339)		(0.0335)	
GDP growth x Recession	0.0822		0.0576		0.0888*		0.0298	
	(0.0611)		(0.0387)		(0.0490)		(0.0497)	
Output Gap		0.0893		0.186***		0.207***		0.318***
		(0.0650)		(0.0609)		(0.0729)		(0.0678)
Output Gap x Recession		0.295***		0.332***		0.247**		0.293***
		(0.0928)		(0.0860)		(0.101)		(0.0932)
Lagged BB/GDP			0.849***	0.760***			0.896***	0.737***
			(0.0179)	(0.0213)			(0.0212)	(0.0240)
Lagged Debt/GDP					0.0225***	0.0221***	0.0186***	0.0144***

					(0.00327)	(0.00389)	(0.00332)	(0.00364)
Constant	-1.466***	0.191*	-1.528***	-0.271**	-2.839***	-1.189***	-2.819***	-1.165***
	(0.133)	(0.105)	(0.102)	(0.105)	(0.232)	(0.261)	(0.229)	(0.240)
Observations	478	787	916	787	704	670	704	670
R-squared	0.339	0.101	0.763	0.725	0.334	0.177	0.767	0.739
Number of countries	23	23	23	23	23	23	23	23

Table 17: Cyclicality of Cyclically Adjusted Budget Balance (Recessions)

Variables	(1) Δ CAB/PGDP	(2) Δ CAB/PGDP	(3) CAB/PGDP	(4) CAB/PGDP	(5) Δ CAB/PGDP	(6) Δ CAB/PGDP	(7) CAB/PGDP	(8) CAB/PGDP
GDP growth	0.151***		0.176***		0.207***		0.227***	
	(0.0317)		(0.0308)		(0.0343)		(0.0336)	
GDP growth x Recession	0.0552		0.0236		0.0509		0.0165	
	(0.0403)		(0.0391)		(0.0477)		(0.0468)	
Output Gap		0.00128		0.0287		0.0995		0.135**
		(0.0578)		(0.0555)		(0.0639)		(0.0614)
Output Gap x Recession		0.155*		0.184**		0.0987		0.131
		(0.0820)		(0.0786)		(0.0883)		(0.0848)
Lagged CAB/PGDP			0.835***	0.816***			0.849***	0.804***
			(0.0220)	(0.0226)			(0.0255)	(0.0263)

Lagged Debt/GDP					0.0159***	0.0166***	0.0123***	0.0125***
					(0.00335)	(0.00343)	(0.00332)	(0.00334)
Constant	-0.494***	0.0902	-0.968***	-0.340***	-1.595***	-0.981***	-1.772***	-1.147***
	(0.0983)	(0.0931)	(0.114)	(0.104)	(0.234)	(0.232)	(0.230)	(0.224)
Observations	748	748	748	748	645	645	645	645
R-squared	0.054	0.022	0.680	0.674	0.111	0.075	0.665	0.662
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 18: Cyclicality of Budget Balance (2008–2009 and Recessions)

Variables	(1) Δ BB/GDP	(2) Δ BB/GDP	(3) BB/GDP	(4) BB/GDP	(5) Δ BB/GDP	(6) Δ BB/GDP	(7) BB/GDP	(8) BB/GDP
GDP growth	0.299***		0.328***		0.286***		0.328***	
	(0.0260)		(0.0251)		(0.0267)		(0.0261)	
GDP Growth x 2008–2009	0.486***		0.441***		0.415***		0.442***	
	(0.0948)		(0.0910)		(0.0999)		(0.0961)	
Output Gap		0.169***		0.293***		0.107*		0.188***
		(0.0321)		(0.0327)		(0.0624)		(0.0592)
Output Gap x 2008 –-2009		0.751***		0.602***		0.725***		0.556***
		(0.0851)		(0.0816)		(0.0879)		(0.0844)
Lagged BB/GDP			0.847***	0.792***			0.846***	0.788***
			(0.0171)	(0.0211)			(0.0177)	(0.0211)
GDP growth x Recession					0.0892**		-0.00163	

					(0.0406)		(0.0403)	
Output Gap x Recession						0.106		0.183**
						(0.0918)		(0.0867)
Constant	-0.997***	0.0170	-1.367***	-0.420***	-1.001***	0.0990	-1.367***	-0.287***
	(0.102)	(0.0723)	(0.106)	(0.0813)	(0.102)	(0.101)	(0.107)	(0.103)
Observations	916	787	916	787	916	787	916	787
R-squared	0.218	0.173	0.768	0.739	0.222	0.175	0.768	0.740
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 19: Cyclicality of Cyclically Adjusted Budget Balance (2008–2009 and Recessions)

Variables	(1) Δ CAB/PGDP	(2) Δ CAB/PGDP	(3) CAB/PGDP	(4) CAB/PGDP	(5) Δ CAB/PGDP	(6) Δ CAB/PGDP	(7) CAB/PGDP	(8) CAB/PGDP
GDP growth	0.138***		0.154***		0.128***		0.154***	
	(0.0312)		(0.0301)		(0.0335)		(0.0325)	
GDP Growth x 2008–2009	0.222**		0.196**		0.202**		0.195**	
	(0.0942)		(0.0908)		(0.0976)		(0.0941)	
Output Gap		0.0401		0.0902***		0.0117		0.0354
		(0.0288)		(0.0286)		(0.0568)		(0.0548)
Output Gap x 2008 –2009		0.417***		0.355***		0.406***		0.332***
		(0.0755)		(0.0732)		(0.0779)		(0.0756)
Lagged CAB/PGDP			0.835***	0.830***			0.835***	0.828***
			(0.0219)	(0.0224)			(0.0220)	(0.0225)

GDP growth x Recession					0.0327		0.00187	
					(0.0417)		(0.0404)	
Output Gap x Recession						0.0482		0.0941
						(0.0832)		(0.0803)
Constant	-0.410***	-9.66e-05	-0.880***	-0.422***	-0.404***	0.0372	-0.879***	-0.354***
	(0.107)	(0.0658)	(0.120)	(0.0845)	(0.107)	(0.0921)	(0.121)	(0.102)
Observations	748	748	748	748	748	748	748	748
R-squared	0.058	0.057	0.682	0.682	0.059	0.058	0.682	0.682
Number of countries	23	23	23	23	23	23	23	23

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1