Cyclicality of Fiscal Policy: Permanent and Transitory Shocks

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Abstract

This paper examines the optimal reaction of fiscal policy to permanent and transitory output shocks in a model where taxes and public consumption are smoothed over time. It shows that public expenditures and deficits should counter transitory shocks. Using the Blanchard and Quah (1989) identification of permanent and transitory shocks, we test these predictions for 22 OECD countries in 1961-2010. We find that both expenditures and deficits are countercyclical with respect to transitory shocks, mainly for transfers and mainly with respect to negative shocks.

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1. Introduction

Recently there is an increase in research on the cyclicality of fiscal policy. This research is both theoretical, asking how governments should react to output fluctuations, and empirical, studying how governments actually react to such fluctuations. This paper presents a contribution to this research. Instead of considering only aggregate fluctuations, we decompose these fluctuations to permanent and to transitory shocks. We then analyze theoretically how a government should react to each such shock, and then study it empirically in the OECD countries. We approach the optimality of fiscal policy through smoothing public consumption over time and show that it should lead the government to run a counter-cyclical policy with respect to transitory shocks. In this sense our theoretical analysis differs from many other studies on this issue, that adopt a New-Kyenesian approach and use fiscal policy to smooth output fluctuations. We believe that our empirical results are relevant to both theoretical approaches.

The paper presents a simple model of a government that derives utility from its provision of the public good, derives disutility from taxes, since it is benevolent, and obeys a No-Ponzi-Game condition that precludes diverging debt levels. Maximization of this intertemporal utility by the government leads to a policy which is counter-cyclical with respect to transitory shocks, and accommodating with respect to permanent shocks. This holds both with respect to public expenditures and with respect to the deficit as well. Next we test the model, using the Blanchard and Quah (1989) decomposition of cycles to transitory and permanent shocks in OECD countries, and find strong support to our theoretical results.

The literature on cyclicality of fiscal policy is rooted mainly in the Keynesian tradition, which advocates countercyclical fiscal policy in order to stimulate aggregate demand in times of negative shocks to output.[1] But this literature has also roots in the neoclassical model. The most well-known example is Barro (1979), who models a government that minimizes the cost of taxation over time by smoothing the tax rate. Such a policy leads to counter-cyclicality of budget deficits, while public consumption is constant over time by assumption. Actually our theoretical model extends the approach of Barro (1979), but it adds smoothing of the provision of the public good to smoothing taxes, and it also adds to the analysis the distinction between transitory and permanent shocks. The literature on cyclicality of fiscal policy within the neoclassical approach has been quite scarce and much of it has focused on the role of specific components of fiscal policy such as automatic stabilizers, as in Christiano (1984) and Cohen and Follette (1999). Gordon and Leeper (2005) use a similar framework of intertemporal optimization by the government and conclude that counter-cyclical fiscal policy is undesirable, but they do not consider transitory shocks. There are a number of papers which distinguish between demand and supply shocks with respect to fiscal policy, such as Cohen and Follette (1999) and Taylor (2000), but few focus on transitory and permanent shocks.[2] Interestingly, our theoretical results are similar to those reached within the New-Keynesian approach. Our choice of the Neoclassical model does not reflect any strong preference between the two approaches. We just find that the Neoclassical model offers a

[1] See Hansen (1969) and Blinder and Solow (1974). The New Keynesian literature is huge, but most of it focuses on monetary rather than fiscal policy.

[2] One example is Carey and Tanner (2005), who simulate optimal fiscal rules using empirically plausible parameters for permanent and transitory shocks.

more transparent way to present the different effects of permanent and transitory shocks on fiscal policy. It therefore serves as a better tool for structuring our empirical tests.

Recently there has been renewed interest, mainly empirical, in the cyclicality of fiscal policy. This new empirical literature began with Galí (1994), Fiorito and Kollintzas (1994), and Fiorito (1997), who found that fiscal expenditures are counter-cyclical or a-cyclical in developed countries. In contrast, Gavin and Perotti (1997) found that fiscal policy is highly pro-cyclical in Latin American countries. These findings led to much research that re-examined these findings and corroborated them to a large extent.

Lane (2003) shows that cyclicality of fiscal expenditures varies significantly across categories of expenditures and also across OECD countries, but in most advanced economies they are counter-cyclical. Arreaza, Sørensen, and Yosha (1999) and Gali and Perotti (2003) find further support for counter-cyclical fiscal policy in EU and in OECD countries. Gali (2005) even finds that fiscal policy is counter-cyclical in all industrialized countries and that counter-cyclicality even intensified after 1991. Darby and Melitz (2007) find that social expenditures account for the vast majority of countercyclical overall expenditures. Fatas and Mihov (2003) find that most of the counter-cyclicality of deficits in developed countries is a result of automatic stabilizers. As mentioned above, the findings in developing countries are very different. Talvi and Vegh (2005) show, based on a large sample of less developed countries, that government spending and taxes are highly pro-cyclical. This finding is also corroborated by Akitoby et al (2004), by Alesina and Tabellini (2005), and by Ilzetzki and Vegh (2008). The main explanation for this difference in fiscal policy between developed and less developed countries is that governments in less developed countries face credit constraints, which force them to

reduce expenditures during recessions. Recently other explanations were offered, based on political economy, as in Talvi and Vegh (2005), Alesina and Tabellini (2005) and Ilzetzki (2008).

This paper clearly belongs to this empirical literature and mainly to the research on OECD countries. Our main contribution is moving from testing the relation between fiscal policy and output to testing the relations between fiscal policy and the transitory and permanent shocks separately. We show that the two types of shocks have very different effects on fiscal policy and the main counter-cyclical effect comes from the transitory shocks and not from the permanent ones.

The paper is organized as follows. Section 2 presents a model of intertemporal optimal fiscal policy that reacts to permanent and temporary shocks. Section 3 describes the derivation of transitory and permanent shocks to output in a sample of 22 OECD countries. Section 4 outlines the empirical implications of the model and the general empirical strategy. Section 5 tests the cyclicality of public expenditures and deficits in OECD countries in reaction to temporary and permanent shocks. Section 6 concludes. In the appendices we show the proof of one of our theoretical results, examine robustness of the empirical results by testing for individual countries, and we provide the basic statistical properties of the main variables.

2. Optimal Fiscal Policy

2.1. The Model

We present a simple model in which the government maximizes a welfare function. The maximization determines both the level of taxation and the level of public expenditures,

and consequently also the level of public debt. The government maximizes welfare in an uncertain environment, where output is driven by shocks. The reaction of the government to these shocks determines the cyclicality of fiscal policy. We go one step further and differentiate between transitory and permanent shocks to output. This enables us to distinguish between the optimal reactions of government to each type of shocks. We can therefore derive the cyclicality of optimal fiscal policy with respect to permanent and to transitory shocks separately.

Assume that permanent output Y^p changes over time as a result of permanent shocks p_t in the following way:

(1) $$Y_t^p = Y_{t-1}^p(1+p_t),$$

Assume that the permanent shock p_t is a random variable, independent and identically distributed (i.i.d.), with a positive expectation $p > 0$. Assume further that the permanent shock is bounded: $p_{\min} < p_t < p_{\max}$. Output is equal to permanent output with the addition of a temporary shock e_t:

(2) $$Y_t = Y_t^p(1+e_t).$$

The random variable e_t is i.i.d. as well, but with expectation 0. It is independent of the permanent shock p_t, as well. Assume that the random variable e is bounded as well: $e_{\min} < e_t < e_{\max}$. It is easy to see how equations (1) and (2) imply that the p shocks are permanent while the e shocks are temporary and affect output for one period only.[3]

Assume that the government is supplying one aggregate public good at an amount G_t in each period t. The public good can be financed either by taxes, which have a flat tax

[3] It is assumed that both shocks are exogenous, and especially that the transitory shock is not affected by fiscal policy. This is of course a simplifying assumption. This issue is dealt with in the empirical analysis.

rate, T_t in period t, or by debt issue, where the amount of debt by the end of period t is D_t. The government temporal budget constraint is therefore:

(3) $$D_t = D_{t-1}(1+r) + G_t - T_t Y_t.$$

The government is benevolent, so it derives utility from supply of the public good and from disposable income, which is income net of tax left to private consumption. Assume that utilities from the public good and from disposable income are concave. For simplicity assume logarithmic utility functions, so that the temporal utility of the government is:

$$\alpha \ln G_t + \ln[(1-T_t)Y_t].$$

We therefore assume that the government maximizes the following intertemporal utility, which in every period is affected positively by public good supply and by disposable income. For simplicity we assume that the rate of discount of the government is equal to the interest rate. Thus the government maximizes:

(4) $$E_0 \sum_{t=0}^{\infty} \frac{1}{(1+r)^t} \left[\alpha \ln \frac{G_t}{Y_t} + \ln(1-T_t) + (1+\alpha) \ln Y_t \right].$$

To ensure that this discounted utility is finite assume that $r > p$, namely the interest rate is higher than the average rate of growth. Since in this model output is completely exogenous and does not depend on the fiscal policy, we can rewrite the welfare maximized by the government, (4), as:

(5) $$E_0 \sum_{t=0}^{\infty} \frac{1}{(1+r)^t} \left[\alpha \ln \frac{G_t}{Y_t} + \ln(1-T_t) \right].$$

2.2. The No-Ponzi-Game Condition

Note, that since the government derives utility from *G* and disutility from *T*, it has an incentive to produce as much as possible public good and collect as little as possible taxes, and to finance all public consumption by debt, as shown in (3). This of course should not be possible under market discipline and the government should be barred from accumulating endless debt relative to output. This is achieved by a no-Ponzi-game condition. We impose an additional condition that the public debt relative to output cannot diverge to infinity even if no public good is produced, namely if $G = 0$ and even if all output is taxed, namely if $T = 1$. Note that assuming non-divergence of debt to output is equivalent to assuming non-divergence of debt to permanent output.

The dynamics of debt to permanent output when there is no public good and when taxes are 1, are described according to (3) by the following equation:

$$\frac{D_{t+1}}{Y_{t+1}^{p}} = \frac{D_t}{Y_t^{p}} \frac{1+r}{1+p_{t+1}} - (1+e_{t+1}). \tag{6}$$

Using equation (6) we can prove the following Lemma:

Lemma 1: The ratio of debt to permanent output does not diverge if debt to permanent output is bounded by *A*, $D_t / Y_t^{p} \le A$, where:

$$A = \frac{(1+e_{\min})(1+p_{\min})}{r - p_{\min}}.$$

Proof: in the Appendix.

Following Lemma 1 we reformulate the government problem as maximizing (5) given the constraint $D_t / Y_t^{p} \le A$ for all $t \ge 0$.

2.3. Optimal Fiscal Policy

We next turn to analyze the solution of the optimization problem of the government. Denote by V_t the optimal value of the government utility in period t. Then the Bellman equation in period 0 can be written as:

$$(7) \qquad V_0 = \max\left[\alpha \ln\frac{G_0}{Y_0} + \ln(1-T_0) + \frac{1}{1+r}E_0(V_1)\right], \text{ such that } \frac{D_0}{Y_0^p} \le A.$$

Using the government budget constraint (3) we can rewrite the Bellman equation by use of the debt and the tax rate only:

$$(8) \quad V_0 = \max\left[\alpha \ln\left(\frac{D_0 - D_{-1}(1+r)}{Y_0} + T_0\right) + \ln(1-T_0) + \frac{1}{1+r}E_0(V_1)\right], \text{ such that } \frac{D_0}{Y_0} \le \frac{A}{1+e_0}.$$

Note that the tax rate chosen in period 0 has no effect on the future public welfare except through public debt. Hence, V_1 does not depend on current taxes but on debt only. We therefore can derive from the first order condition of (8) the optimal tax rate and the optimal amount of the public good, as functions of the levels of public debt:

$$(9) \qquad T_0 = \frac{1}{1+\alpha}\left[\alpha - \frac{D_0 - D_{-1}(1+r)}{Y_0}\right],$$

and:

$$(10) \qquad \frac{G_0}{Y_0} = \frac{\alpha}{1+\alpha}\left[1 + \frac{D_0 - D_{-1}(1+r)}{Y_0}\right].$$

Substituting (9) and (10) in the Bellman condition (8) we get:

$$(11) \quad V_0 = \max\left[\varepsilon + (1+\alpha)\ln\left(1 + \frac{D_0 - D_{-1}(1+r)}{Y_0}\right) + \frac{1}{1+r}E_0(V_1)\right], \text{ such that } \frac{D_0}{Y_0} \le \frac{A}{1+e_0},$$

where $\varepsilon \equiv \alpha\ln\alpha - (1+\alpha)\ln(1+\alpha)$. From (11) it follows that the optimal value function V has the following shape:

(12) $$V_0 = \varphi\left(\frac{D_{-1}}{Y_0}, e_0\right).$$

Hence, the expectation in period 0 of the optimal value V_1 is equal to:

(13) $$E_0(V_1) = E_0\left\{\varphi\left[\frac{D_0}{Y_0}\frac{1+e_0}{(1+p_1)(1+e_1)}, e_1\right]\right\}.$$

Note that the RHS of (13) is a function of $D_0(1+e_0)/Y_0$, which is actually the ratio of debt to permanent output. Let us denote this function by ψ. It is easy to show that it is a decreasing and concave function. Hence, (13) can be rewritten as:

$$E_0(V_1) = \psi\left[\frac{D_0}{Y_0}(1+e_0)\right].$$

Assuming that the bound *A* is never reached, the first order condition of the Bellman equation (11) is:

(14) $$\frac{1+\alpha}{1+\frac{D_0}{Y_0}-\frac{D_{-1}}{Y_0}(1+r)} + \frac{1}{1+r}\psi'\left[\frac{D_0}{Y_0}(1+e_0)\right](1+e_0) = 0.$$

It follows from this FOC that the optimal new debt depends on the old debt and on the temporary shock e_0 only, so it is described by the following function *f*:

(15) $$\frac{D_0}{Y_0} = f\left(\frac{D_{-1}}{Y_0}, e_0\right).$$

Note that $0 < f_1 < 1+r$ and if the debt to output ratio is close to *A* we have $f_1 < 1$. As for the cyclicality of fiscal policy, it follows from condition (14) that $f_2 < 0$ since $\psi' < 0$. Hence, the optimal debt policy reacts counter-cyclically to transitory shocks. The reason for this result is that when the shocks are transitory, the debt does not increase in the long

run, and thus it efficiently acts as a shock absorber against transitory shocks. Substituting (15) in (9) and (10) leads to:

$$(16) \qquad \frac{G_0}{Y_0} = g\left(\frac{D_{-1}}{Y_0}, e_0\right), \text{ and } T_0 = t\left(\frac{D_{-1}}{Y_0}, e_0\right).$$

Clearly, $g_1 < 0, g_2 < 0, t_1 > 0, \textit{and } t_2 > 0$. Hence public expenditures relative to GDP are counter-cyclical with respect to transitory shocks and are a-cyclical with respect to permanent shocks. Taxes follow the same pattern. The intuition for these results is straightforward. When the economy experiences a temporary positive output shock, the government likes to increase public expenditure in the present but in all future periods as well. As a result current public expenditures, but also debt is reduced, to be able to pay for higher public expenditures in the future. Note also that the share of the public deficit in GDP is:

$$(17) \qquad def_0 = \frac{D_0 - D_{-1}}{Y_0} = f\left(\frac{D_{-1}}{Y_0}, e_0\right) - \frac{D_{-1}}{Y_0}.$$

Hence, the deficit relative to GDP is negatively related to the lagged debt to output ratio and is negatively related to the transitory shock. The deficit is, therefore counter-cyclical with respect to transitory shocks.

3. Empirical Implications

As shown in Section 2 the debt to output ratio is converging stochastically to a neighborhood of some long-run level. Denote this level by *d**. We can rewrite a linear approximation of the main dynamic equation of the model (15) in the following way:

(18) $$\frac{D_0 - D_{-1}(1+r)}{Y_0} = a\left(d^* - \frac{D_{-1}}{Y_0}\right) - be_0.$$

Note that the coefficient *a* is positive but smaller than 1 and the coefficient *b* is positive. Substituting (18) in equation (10) we get:

(19) $$\frac{G_0}{Y_0} = \frac{\alpha}{1+\alpha} + \frac{\alpha a}{1+\alpha}\left(d^* - \frac{D_{-1}}{Y_0}\right) - \frac{b\alpha}{1+\alpha}e_0.$$

Hence, public primary expenditure relative to GDP should fluctuate, according to our model, around an average $\alpha/(1+\alpha)$, as is quite intuitive in light of the utility function between public and private consumption. The available budgetary data usually reports the overall public expenditures *E*, which are the sum of public consumption, investment, transfers and interest payments. In our model this variable includes also the payment of interest for past debt, so that:

(20) $$\frac{E_0}{Y_0} = \frac{\alpha}{1+\alpha} + \frac{\alpha a}{1+\alpha}d^* - \left(\frac{\alpha a}{1+\alpha} - r\right)\frac{D_{-1}}{Y_0} - \frac{b\alpha}{1+\alpha}e_0.$$

This equation describes the main empirical implication of the model and its main hypothesis is that *b* is positive.

In our empirical analysis we will not test directly equation (21) but the difference between expenditures over time, and we do it for two reasons. The main reason is that as equation (20) itself reveals, the effect of the temporary shock on total expenditures is rather small, while the effect of the temporary shock on the change in expenditures in that period is much more pronounced. Hence, the difference equation of (21) is more likely to track the effect of the transitory shock on expenditures. The second reason is that all other studies of cyclicality of fiscal policy measure the response of the change in expenditures.

Thus, running a similar test will make the results of this paper more comparable to the existing literature.

We therefore next calculate the difference over time of the logarithm of equation (20). Note that:

$$\ln E_0 = \ln Y_0 + \ln\alpha - \ln(1+\alpha) + \ln\left[1 + ad^* - \left(a - \frac{r(1+\alpha)}{\alpha}\right)\frac{D_{-1}}{Y_0} - be_0\right] \cong$$
$$\cong \ln Y_0 + \ln\alpha - \ln(1+\alpha) + ad^* - \left(a - \frac{r(1+\alpha)}{\alpha}\right)\frac{D_{-1}}{Y_0} - be_0.$$

Hence a linear approximation of a difference of ln of (20) over time is:

$$\ln E_0 - \ln E_{-1} \cong \ln(1+e_0) + \ln(1+p_0) - \ln(1+e_{-1}) -$$
$$-b(e_0 - e_{-1}) - \left(a - \frac{r(1+\alpha)}{\alpha}\right)\left(\frac{D_{-1}}{Y_0} - \frac{D_{-2}}{Y_{-1}}\right).$$

As a result, the rate of change of public expenditures is equal to:

$$\ln E_0 - \ln E_{-1} \cong \ln(1+e_0) + \ln(1+p_0) - \ln(1+e_{-1}) - b(e_0 - e_{-1}) -$$
(21)
$$-\left(a - \frac{r(1+\alpha)}{\alpha}\right)def_{-1} + \left(a - \frac{r(1+\alpha)}{\alpha}\right)\frac{D_{-1}}{Y_{-1}}\left(1 - \frac{1+e_{-1}}{(1+e_0)(1+p_0)}\right).$$

Note, that the coefficient of D_{-1}/Y_{-1} is small, so we can write the empirical implication of equation (21), namely the regression of the rate of change of public expenditures, in the following way:

(22) $d\ lnE(0) = B_0 + B_1\ Temp(0) + B_2\ Temp(-1) + B_3\ Perm\ (0) + B_4\ Def(-1) + B_5\ X(0).$

The coefficients of the regression should satisfy according to equation (20): B_1 and B_2 have unclear signs, B_3 is positive, and B_4 is negative. X is a vector of control variables. Our main hypothesis is that temporary shocks have a negative effect on expenditures, namely that *b* is positive. This is translated to the condition that:

(23) $B_1 = -B_2$, and $B_1 < B_3$.

But note that if B_1 comes out negative it means that *b* is not just positive but also greater than 1, namely this is a strong support to our result that the reaction of fiscal policy to temporary shocks is negative.

We next examine the dynamics of deficits. From equations (17) and (18) it follows that:

$$(24) \qquad def_0 - def_{-1} = -b(e_0 - e_{-1}) - (a-r)def_{-1} + (a-r)\left[1 - \frac{1+e_{-1}}{(1+e_0)(1+p_0)}\right].\frac{D_{-1}}{Y_{-1}}$$

Again, the coefficient of D_{-1}/Y_{-1} is small, so we can write the empirical implication of equation (24), namely the regression of the absolute change of deficits, in the following way:

(25) d [def(0)] = C_0 + C_1 Temp(0) + C_2 Temp(-1) + C_3 Perm (0) + C_4 def(-1) + C_5 X(0).

The coefficients of this regression should satisfy according to equation (25): C_3 is positive and C_4 is negative, since $a > r$. The signs of C_1 and C_2 are ambiguous but it is clear that $C_1 = -C_2$, and that $C_3 > C_1$. Again if the sign of C_1 comes out negative, it gives further support to the hypothesis that *b* is positive and that the deficit is counter-cyclical with respect to transitory shocks.

4. Permanent and Temporary Shocks in OECD Countries

We begin our empirical exploration by using the Blanchard and Quah (1989) methodology to calculate permanent and transitory shocks for 22 OECD countries (source: various OECD databases). According to this methodology, the vector *Z*, that includes both GDP and unemployment, follows a stationary process:

$$(26) \qquad Z(t) = A(0)e(t) + A(1)e(t-1) + ... = \sum_{j=0}^{\infty} A(j)e(t-j), \text{ where } VAR(e) = \text{I},$$

and where the sequence of matrices A is such that its upper left hand entries, $a_{11}(j)$, j=1,2,…, sum up to zero. This assumption implies that the transitory shocks e_r do not affect the level of GDP in the long-run, while the permanent shocks, e_p, have a permanent effect on output.

In order to apply the methodology we first run VAR equations for the difference of logarithm of GDP and unemployment, controlling for the logarithmic change of government expenditure.[4] After experimenting different lag durations, we found that one lag for each variable fits the data relatively well.[5] Although according to our theoretical model shocks are exogenous, from an empirical point of view we cannot completely ignore a causal relationship between government expenditures and output shocks.[6] We therefore include government expenditure in the VAR equations. This is intended to ensure that the shocks we identify from the residuals are exogenous to fiscal policy as much as possible. Since government expenditure includes cyclical components, we pursue a TSLS approach using the HP-filtered series as an instrument.[7]

We run these equations for 22 OECD countries during the period 1961-2010. Then, by using the above identifying assumption, we solve the system according to the Blanchard and Quah (1989) methodology and calculate the permanent and the transitory shocks. In Figure 1 we show the shocks for the different countries. It is interesting to note that some of the shocks are well known, like the negative impact of the fall of former USSR in Finland's output (1990-1991) and the positive permanent impact of the German

[4] To assure stationarity, we used first differences of ln(unemployment).
[5] For space considerations we do not show the VAR regressions. They are available from the authors. Sensitivity analysis included VAR regressions with different lags for dln(gdp) and dln(unemployment): one and one, one and two, two and two, two and three and so on. Using Akaike and Schwarz information criteria, we found that the one and one lags are the best specification.
[6] See Blanchard and Perotti (2002).
[7] For an analysis of the cyclical component of government expenditure see Lamo, Perez and Shuknecht (2007).

Unification (after 1991). In a more systematic analysis, Table 1 shows the impact of global shocks like the 1973, 1979 (negative) and 1986 (positive) oil shocks on the different countries.

We also compare our shocks to those reported by Smets and Wouters (2007) for the US. They report the shocks classified into monetary and demand shocks (which are close to transitory shocks in our analysis), and productivity and mark-up shocks (which are close to our permanent shocks). In our comparison we have looked whether their demand shocks match our temporary shocks and whether their supply shocks match our permanent shocks. Out of 39 common observations, 82 percent of our transitory shocks match the sign of their demand shocks, and 64 percent of the permanent shocks. Out of 27 (24) of the big temporary (permanent) shocks identified in our framework during the common part of the sample, where big is defined as bigger than half of the standard deviation, about 50 percent (30 percent) are identified as big demand (supply) shocks by Smets and Wouters.

Table 1 - Global Shocks

	Permanent Shock		**Temporary Shock**		**Big Temporary Shock**	
	Number of Countries	%	Number of Countries	%	Number of Countries	%
1973 (-)	7	31.8	9	40.9	12	54.5
1974 (-)	8	36.4	13	59.1	13	59.1
1973-1974 (-)	8	36.4	12	54.5	16	72.7
1979 (-)	8	36.4	5	22.7	12	54.5
1986 (+)	12	54.5	9	40.9	12	54.5
1993 (-)	13	59.1	15	68.2	16	72.7
2000 (-)	11	50.0	7	31.8	13	59.1
2001 (-)	13	59.1	17	77.3	13	59.1

This evidence allows us to conclude that the Blanchard and Quah methodology produces permanent and transitory shocks that are relatively consistent with our ex-ante expectations and with existing empirical evidence in the literature.

5. Fiscal Policy in OECD Countries and Permanent and Temporary Shocks

In order to test our theory we use the sample of 22 OECD countries, for the period 1961 to 2010.[8] We look at actual data on general government expenditure and budget deficits as a percent of GDP.[9] For government expenditure we use the logarithmic change of government expenditure, deflated by GDP prices. As explained by Lane (2003), this measure accounts for real changes in government wages, and thus it is one of the channels for cyclical policy. In all regressions we control for fixed effects for countries and years. Data sources and descriptive statistics can be found in appendix III.

5.1 Government Expenditure

In Table 2 we test the cyclicality of expenditure to permanent (PERM) and temporary (TEMP) shocks. In the first column we use the main control variables together with the permanent and transitory shocks, according to equation (22). The significant control variable for expenditure is the sum of the logarithmic change of children less than 15 years old [dlog(POP15)] and the logarithmic change of the old population, beyond 65 years old [dlog(POP65)]. We tried also election dates (ELECT), and the logarithmic change of the population [dlog(POP)], but these variables were not significant. This

[8] Since our methodology includes lags, the effective sample period in the regressions shown from Table 2 onwards becomes 1963-2010.

[9] For works that differentiate between actual data and ex-ante (planned) fiscal policy, see Golinelli and Momigliano (2006), and Beestma and Giuliodori (2008).

column shows, in accordance to our model, that government expenditure reacts counter-cyclically to temporary shocks, since the effect of temporary shocks, which is significantly negative, is much smaller than the effect of the permanent shock, which is positive and significantly different from 0. In the second column we run the same regression computed without country fixed effects, in order to compare results and check sensitivity to the heterogeneity of the countries included in our panel. The results remain unchanged, and in particular the coefficient of counter-cyclicality remains negative and similar in size. In the appendix we present results of a test for the fitness of our sample to panel analysis. For that purpose we run 22 regressions at the country level. We test whether the coefficients of temporary shocks are significant also at the country level. We found that for 15 out of the 22 countries in our sample the coefficients are negative at a 10 percent significance (among them 14 are significant at 5 percent). The outliers were Belgium, Greece, Iceland and Spain.

In the third regression we test whether the introduction of the Maastricht Treaty (MAAS) in the early nineties changed the cyclical behavior of the governments. In fact, Galí and Perotti (2003) found that policy became more countercyclical for countries that signed the Treaty. By using a dummy variable that takes the value of 1 for the countries and years relevant in the Treaty and 0 otherwise, we find that the coefficient is not significant at 5 percent – i.e., policy continued to be countercyclical in a similar way. Finally, we perform a similar test for the countries participating at the Euro agreement (EURO), and find that in this case as well the change in behavior is not significant. In

summary, Table 2 shows that expenditures tend to react counter-cyclically to temporary shocks, in a strong way, as predicted by the model.

Table 2 – Expenditure Reaction to Permanent and Transitory Shocks
(t statistic in parentheses, using fixed effects for years and Period Panel Corrected Standard Errors (PSCE))

Equation number	1	2	3	4
Dependent\ independent variable	dlog(G)			
Number of observations	941	941	941	941
Period	1963-2010	1963-2010	1963-2010	1963-2010
Country fixed effects	yes	No	Yes	yes
C	0.045 (22.86)***	0.040 (21.24)***	0.045 (22.83)***	0.045 (22.79)***
PERM	0.005 (3.27)***	0.005 (2.86)***	0.006 (3.01)***	0.006 (3.29)***
TEMP	-0.005 (-2.66)** *	-0.005 (-2.90)***	-0.005 (-2.61)***	-0.005 (-2.57) **
TEMP(-1)	-0.002 (-1.31)	-0.002 (-1.38)	-0.002 (-1.32)	-0.002 (-1.31)
DLOG(POP15)+DLOG(POP65)	0.16 (2.65) ***	0.18 (2.90) ***	0.16 (2.62)***	0.16 (2.61)***
DEFICIT/Y (-1)	-0.004 (-7.01)***	-0.001 (-3.65)***	-0.004 (-7.01)***	-0.004 (-7.02)***
MAAS*PERM			-0.003 (-0.95)	
MAAS*TEMP			0.003 (0.75)	
EURO*PERM				-0.004 (-0.93)
EURO*TEMP				0.002 (0.35)
Adj. R squared	0.30	0.25	0.30	0.30
Durbin Watson	2.04	1.98	2.05	2.05

In all tables: * Significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent.

Table 3 examines whether the countercyclical reaction to shocks is stronger to negative shocks than to positive shocks. The first regression tests whether the counter-cyclicality of expenditure is due to temporary negative shocks or temporary positive shocks. The coefficients for temporary negative shocks are significant. In the second regression we check whether countercyclical reactions are related to big shocks – defined

as more than half (BIG) of the standard deviation of shocks.[10] The coefficients are insignificant.

Table 3 - Cyclicality of Expenditure in Negative and Positive Shocks

(t statistic in parentheses, using fixed effects for countries and years and Period Panel Corrected Standard Errors (PSCE))

Equation number	1	2	3
Dependent\ independent variable	dlog(G)		
Number of observations	941	941	655
Period	1963-2010	1963-2010	1980-2010
C	0.04 (12.88)***	0.04 (15.56)***	0.03 (7.78)***
Permanent shocks	0.006 (3.56)***	0.006 (3.48)***	0.01 (3.80)***
Temporary negative shocks	-0.01 (-3.72) ***		-0.02 (-3.59) ***
Temporary positive shocks	0.003 (0.94)		-0.0001 (-0.03)
TEMP		-0.008 (-1.12)	
Big (0.5 standard deviation) temporary shocks		0.009 (1.17)	
Big (0.5 standard deviation) temporary negative shocks		-0.002 (-0.25)	
TEMP(-1)	-0.002 (-1.42)	-0.002 (-1.41)	-0.001 (-0.56)
DLOG(POP15)+DLOG(POP65)	0.16 (2.64)***	0.16 (2.65)***	0.14 (2.06)**
DEFICIT/Y (-1)	-0.004 (-6.71)***	-0.004 (-6.74)***	-0.004 (-5.79)***
Adj. R squared	0.31	0.31	0.25
Durbin Watson	2.03	2.04	2.09

The third regression examines the claim by Perotti (2005), who found a significant change in the impact on fiscal policy after 1980. In regression 3 we check the reaction of fiscal policy in this period and find an increase in counter-cyclicality.

Table 4 presents the results of a more disaggregated examination, which checks the main components of expenditure, as in Lane (2003). We split expenditures to transfers (GT), government consumption (GC) and government investment (GI), where

[10] We estimate this regression using a dummy variable where big is defined as one standard deviation and we get similar results.

usually the first two are much larger than the third. The first regression examines transfers. The control variables include the change in the permanent level of unemployment (d(Uhp)), calculated using an HP filter, in order to control for unemployment benefits.[11] Results show that the lagged coefficient of transitory shocks is significant, i.e., transfer payments react counter-cyclically (with a one-year lag) to temporary shocks. This finding is in line with findings by Melitz (2005) and Darby and Melitz (2007). The second and third regressions consider government consumption and public investments respectively. For government consumption the lagged temporary shocks coefficient is found to be significant. In order to learn more about these results we proceed as in the previous analysis by differentiating between positive and negative shocks. Column 4 reports this test for transfers, showing that counter-cyclicality is stronger for negative shocks (significant at 1 percent). Column 5 and 6 reports the results for government consumption and investment. Both don't show contemporaneous countercyclical behavior.

[11] The substitution of the labor force by capital intensive production technique is one of the reasons for the increase in the permanent level of unemployment. Alesina and Zeira (2006) provide an explanation for this substitution at different skill levels.

Table 4 – Reaction of Expenditure Components to Permanent and Temporary Shocks

(t statistic in parentheses, using fixed effects for countries and years and Period Panel Corrected Standard Errors (PSCE))

Equation number	1	2	3	4	5	6
Dependent\ independent variable	dlog (GT)	Dlog (GC)	Dlog (GI)	Dlog (GT)	dlog (GC)	Dlog (GI)
Number of observations	917	939	917	917	939	917
Period	1963-2010	1963-2010	1963-2010	1963-2010	1963-2010	1963-2010
C	0.05 (18.33)***	0.05 (36.50)***	0.07 (11.98)***	0.04 (8.50)***	0.05 (25.92)***	0.07 (8.30)***
PERM	-0.002 (-1.08)	0.004 (4.08)***	0.007 (1.61)	-0.002 (-0.71)	0.004 (4.01)***	0.007 (1.60)
TEMP	-0.002 (-0.56)	-0.001 (-0.42)	-0.008 (-1.71) *			
Temporary negative shocks				-0.02 (-3.53) ***	0.001 (0.33)	-0.01 (-0.92)
Temporary positive shocks				0.01 (2.59) ***	-0.001 (-0.76)	-0.01 (-0.86)
TEMP(-1)	-0.007 (-2.71)***	-0.002 (-2.18) **	-0.005 (-0.97)	-0.007 (-2.87) ***	-0.002 (-2.16)**	-0.005 (-0.97)
DLOG(POP15)+DLOG(POP65)	0.18 (2.06)**	-0.08 (-0.16)	0.40 (2.71)***	0.20 (2.04) **	-0.008 (-0.16)	0.40 (2.71) ***
DEFICIT/Y (-1)	-0.004 (-4.57)***	-0.003 (-8.03)***	-0.008 (-4.69)***	-0.003 (-4.14)***	-0.003 (-8.03)***	-0.008 (-4.62)***
D(Uhp)	0.03 (4.54)***			0.03 (4.60)***		
Adj. R squared	0.27	0.50	0.17	0.29	0.50	0.17
Durbin Watson	2.13	1.57	2.00	2.12	1.59	2.00

5.2 Government Budget Deficit

We next turn to examine the counter-cyclicality of the deficit. Table 5 presents the main results. The control variables used for the deficit are different from those used for expenditure. Following Barro (1979), we add a control variable of temporary expenditure (like war-related spending), measured as the gap between actual expenditure and its HP-filtered trend. To ensure that it controls for "one-time" expenditures we define this variable by restricting it to have particularly high deviations from trend – more than one standard deviation. This variable, GYGAP, also enters with a one year lag. Another control variable, which turns out to be significant, is election years (ELECT), as implied by the political economy literature.[12] Finally, we control for the permanent level of unemployment, as in the previous table.

The first regression tests whether changes in the deficit/output ratio are related to temporary shocks. It shows that, similar to expenditures and consistently with the theoretical model, deficits are counter-cyclical to temporary shocks with a one-year lag. In the second regression we check whether there was a change in behavior for countries that joined the Maastricht Treaty and we find that policy was procyclical.[13] This is also the case for countries joining the Euro agreement (third regression), although in this case the significance is at a 10 percent level. The fourth regression checks the cyclicality of deficits in reaction to positive and negative shocks. It shows that the one-year lag of counter-cyclicality with respect to temporary shocks is significant mainly for negative shocks.

[12] This variable is insignificant for expenditure.
[13] Note that our sample period includes the global crisis.

Table 5 – Deficit Reaction to Temporary and Permanent Shocks

(TSLS[1],t statistic in parentheses, using fixed effects for countries and years and Period Panel Corrected Standard Errors (PSCE))

Equation number	1	2	3	4
Dependent\ independent variable	d(DEFY)			
Number of observations	908	908	908	908
Period	1963-2010	1963-2010	1963-2010	1963-2010
C	0.32 (4.77)***	0.33 (4.89)***	0.33 (4.86)***	0.25 (2.13)**
PERM	0.05 (1.01)	0.05 (1.95)	0.04 (0.87)	0.05 (1.01)
TEMP	0.01 (0.1)	-0.07 (-1.01)	-0.04 (-0.72)	
TEMP(-1)	-0.14 (-2.53)* *	-0.16 (-2.59) ***	-0.16 (-2.79)***	
ELECT	0.18 (1.76) *	0.18 (1.82) *	0.19 (1.86) *	0.18 (1.75) *
GYGAP	0.65 (17.97)***	0.65 (18.03)***	0.65 (17.90)***	0.65 (18.11)***
GYGAP(-1)	-0.46 (-11.60)***	-0.45 (-11.52)***	-0.46 (-11.57)***	-0.46 (-11.73)***
D(Uhp)	0.09 (6.28)***	1.05 (6.07)***	1.04 (6.00)***	1.09 (6.27)***
DEFICIT/Y (-1)	-0.19 (-9.06)***	-0.19 (-9.16)***	-0.19 (-9.15)***	-0.19 (-8.95)***
MAAS*TEMP		0.25 (2.08) **		
MAAS*TEMP(-1)		0.02 (0.17)		
EURO*TEMP			0.25 (1.70) *	
EURO*TEMP(-1)			0.18 (0.82)	
Temporary negative shocks				-0.02 (-0.23)
Temporary positive shocks				0.02 (0.2)
Temporary negative shocks (-1)				-0.22 (-2.09)**
Temporary positive shocks (-1)				-0.07 (-0.64)
Adj. R squared	0.61	0.61	0.61	0.61
Durbin Watson	2.05	2.06	2.06	2.06

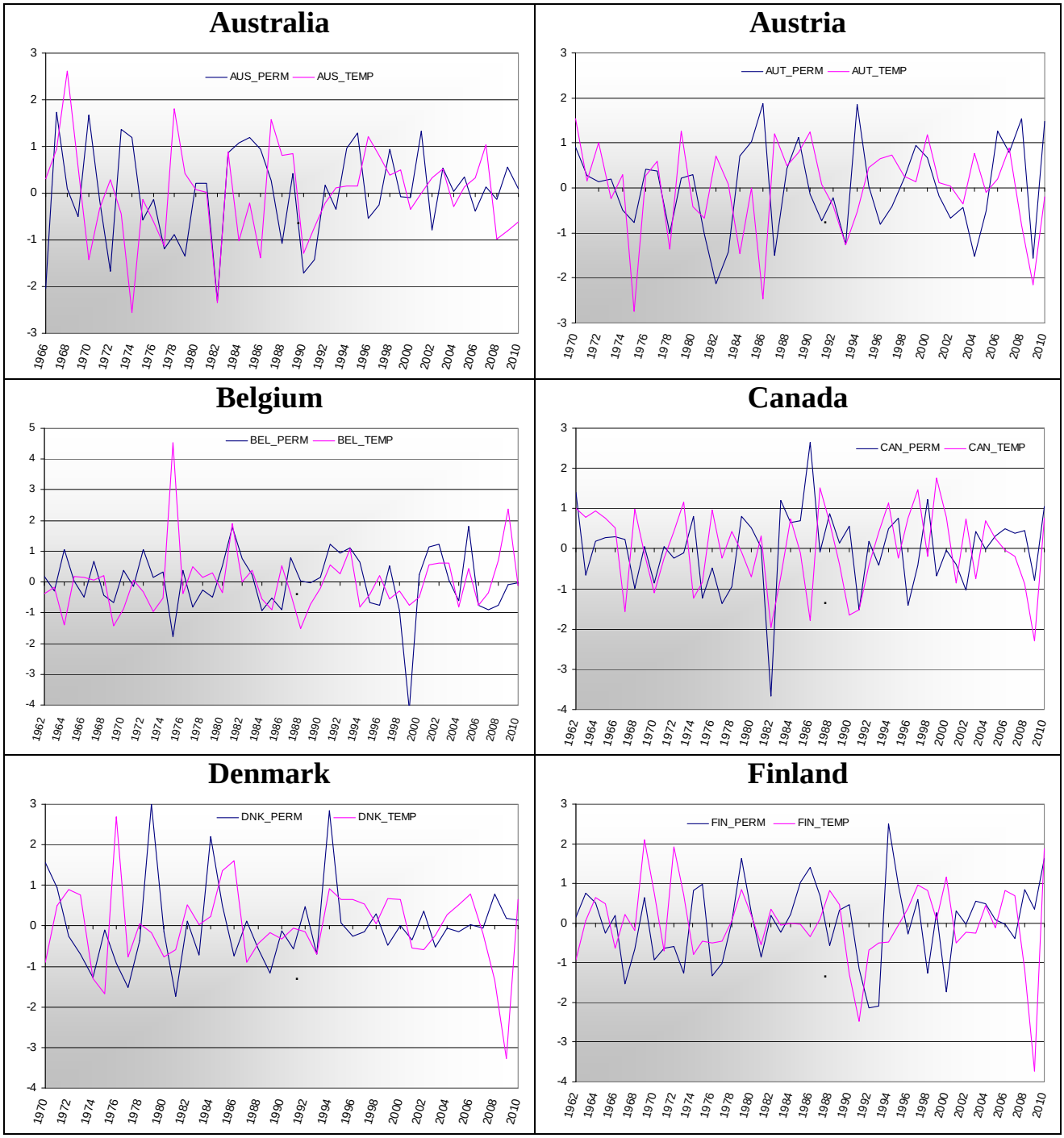
1. Instrument variables include lagged values for GYGAP and for the government deficit.

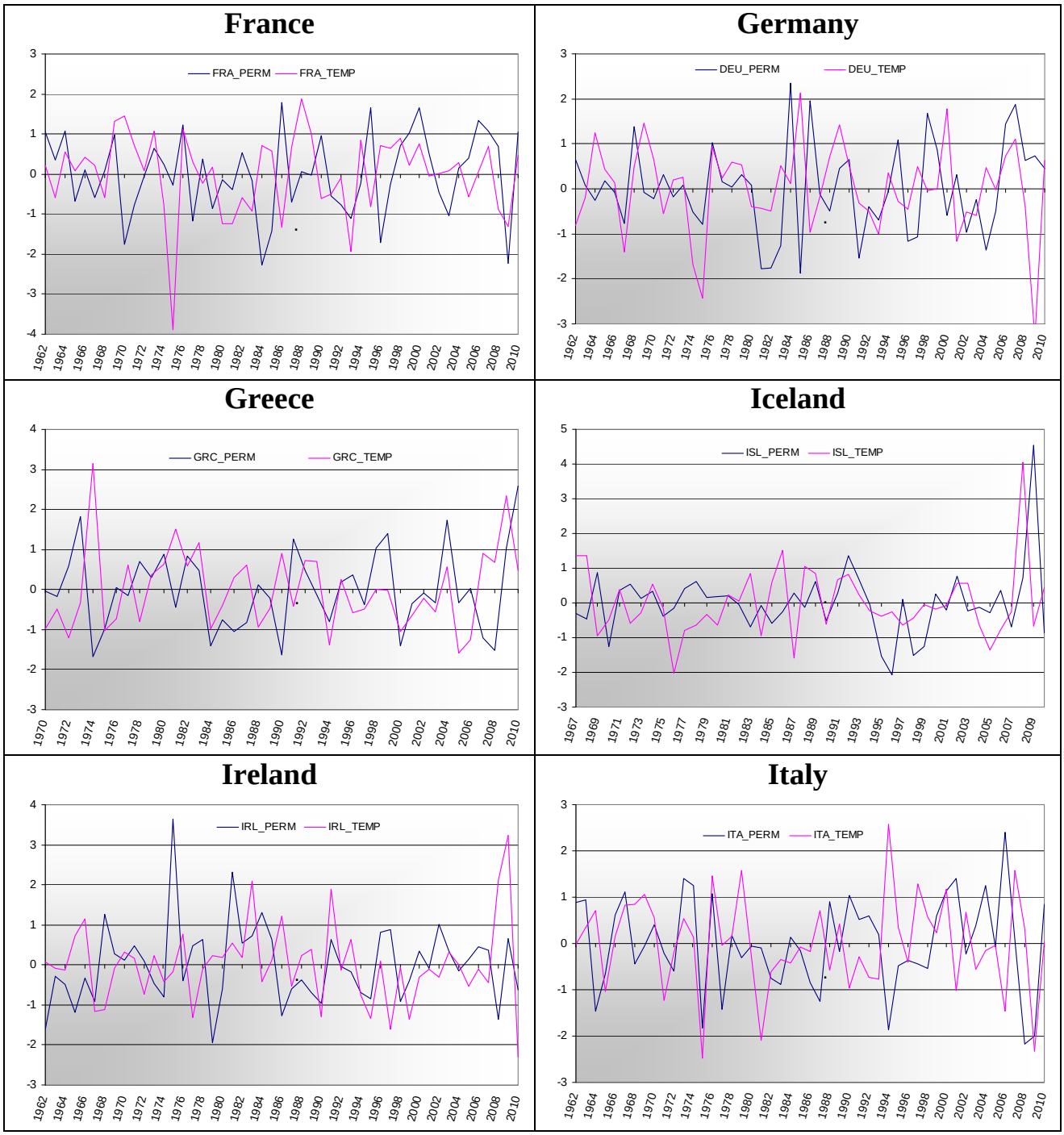
6. Conclusions

This paper examines the optimal reaction of fiscal policy to permanent and transitory shocks. In an uncertain environment, we find that the optimal reaction of fiscal policy relative to GDP to a temporary shock is countercyclical due to smoothing of consumption of the public good and of tax rates. Concerning permanent shocks, our theoretical model suggests that reaction of fiscal policy relative to GDP to permanent shocks should be a-cyclical. By using Blanchard and Quah (1989) methodology for differentiating between permanent and temporary shocks, we test these implications for a sample of 22 OECD countries in the period 1961-2010 using both panel and individual country regressions. We find that both deficits and expenditures react counter-cyclically to temporary shocks, mainly through public transfers and mainly in negative shocks.

This paper is a first exploration in the direction of the differential reaction of fiscal policy to permanent vs. transitory shocks. It shows that the difference is significant and should be further explored. One possible extension is to examine this issue in less developed countries, unlike our sample of OECD countries. It would be interesting to examine whether less developed countries differ in their fiscal policy because they differ in the type of output shocks they face, namely are their shocks more permanent than transitory? If on the contrary it is found that they face similar shocks, then it would lend support to the view that their pro-cyclical fiscal policies are caused by other reasons, like credit constraints.

Figure 1 – Permanent and Temporary Shocks in OECD Countries

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Greece
GRC_PERM
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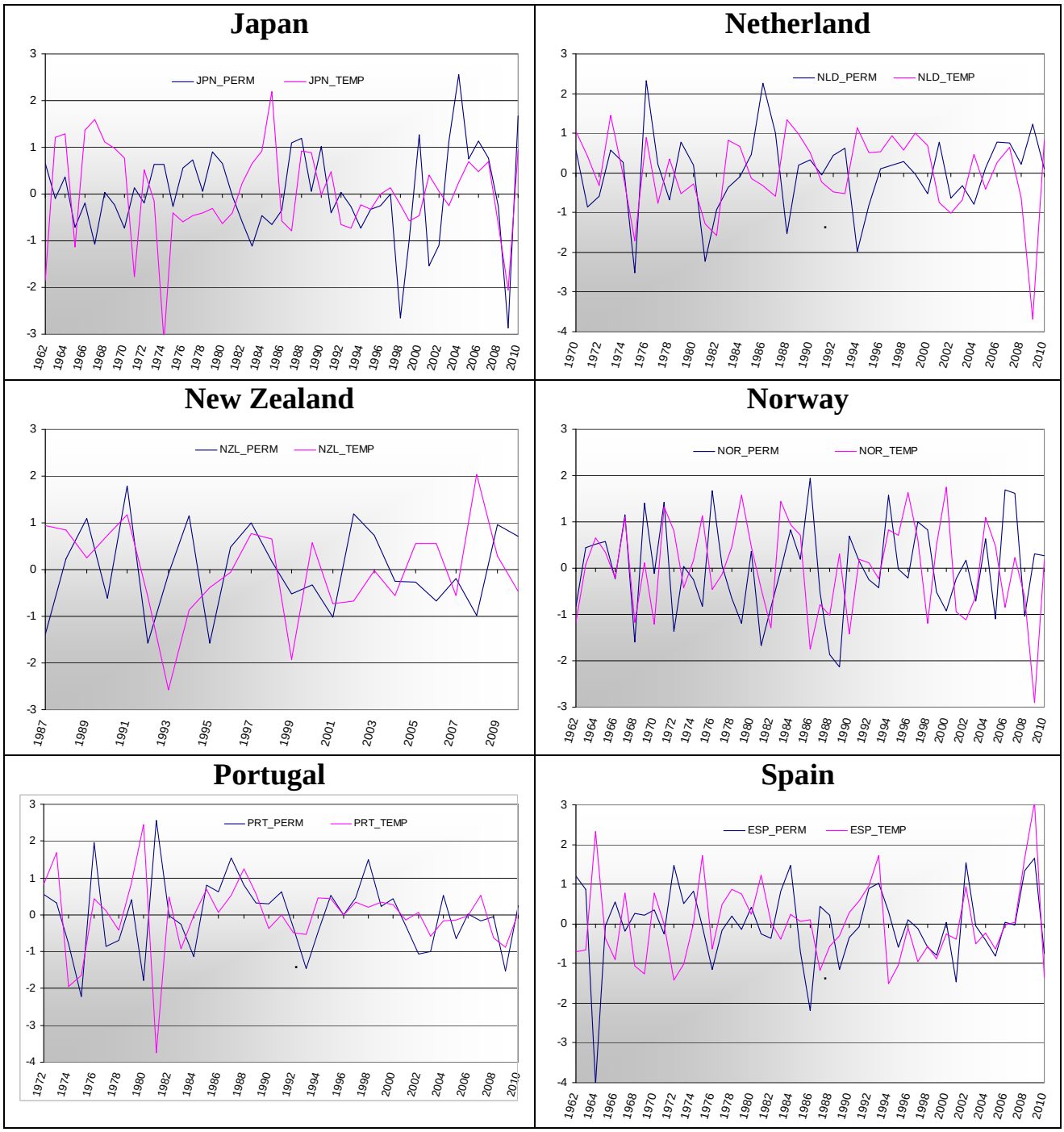
ISL_PERM
ISL_TEMP
Ireland
IRL_PERM
IRL_TEMP
Italy
ITA_PERM
ITA_TEMP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JPN_TEMP
Netherland
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NLD_TEMP
New Zealand
NZL_PERM
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Norway
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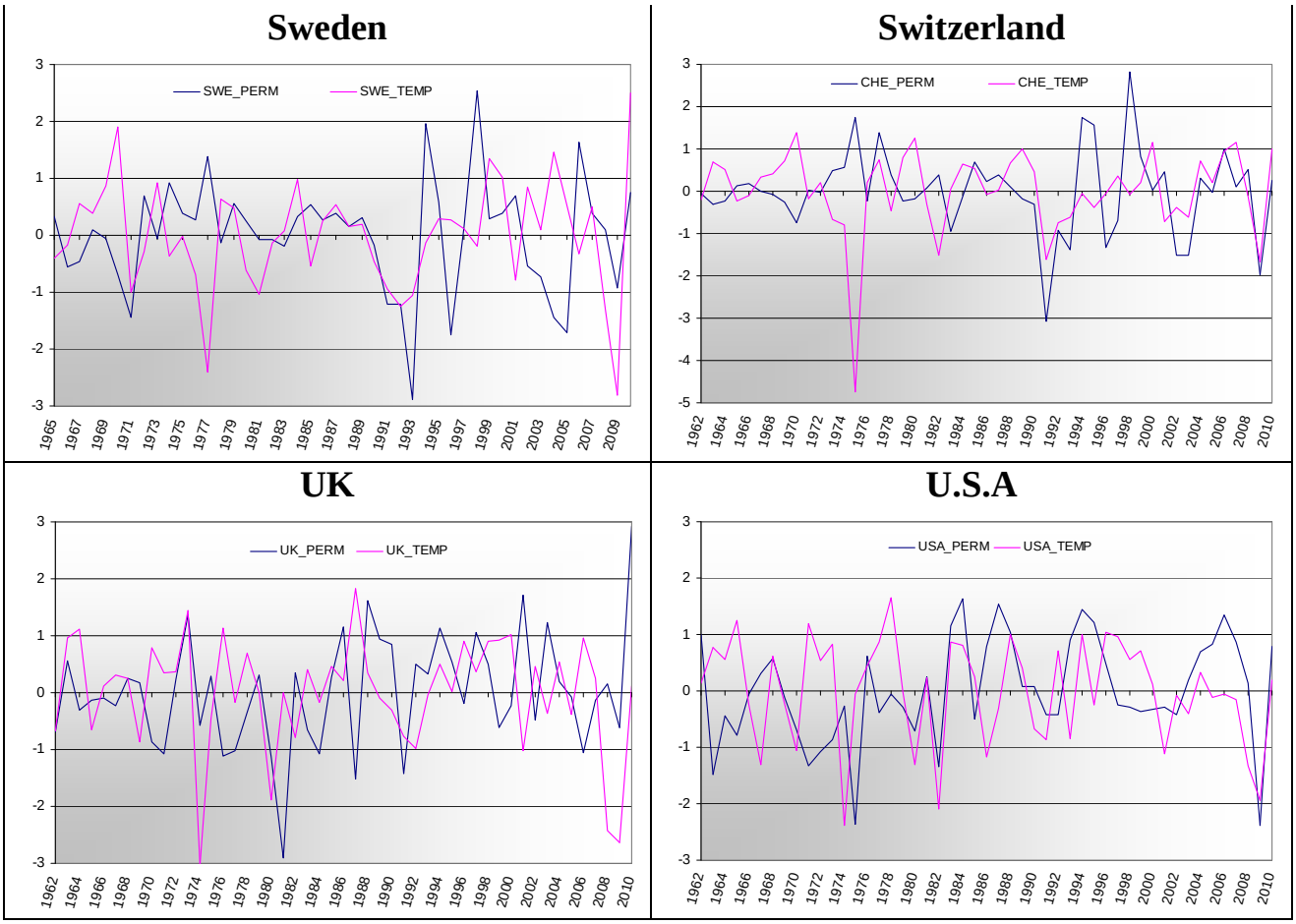
NOR_TEMP
Portugal
PRT_PERM
PRT_TEMP
Spain
ESP_PERM
ESP_TEMP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SWE_PERM
SWE_TEMP
Switzerland
CHE_PERM
CHE_TEMP
UK
UK_PERM
UK_TEMP
U.S.A
USA_PERM
USA_TEMP

Appendix

I: Proof of Lemma I:

Assume that in all period of time we have:

$$p_t < p_{\min} + \delta, \text{ and } e_t < e_{\min} + \delta.$$

This is a feasible dynamic path of shocks. From equation (6) we get:

$$\frac{D_{t+1}}{Y_{t+1}^p} > \frac{D_t}{Y_t^p}\frac{1+r}{1+p_{\min}+\delta} - (1+e_{\min}+\delta).$$

Hence, debt to permanent output does not diverge if:

$$\frac{D_t}{Y_t^p} \le \frac{(1+e_{\min}+\delta)(1+p_{\min}+\delta)}{r-p_{\min}-\delta}.$$

This condition must hold for any $\delta > 0$. Hence, it must hold for zero as well. This proves Lemma 1.

II: Individual Country Estimations of Government Expenditure Reaction to Permanent and Transitory Shocks

In this appendix we apply the first regression in table 2 for each country individually:

dlog(G) = B_0 + B_1 Temp(0) + B_2 Temp(-1) + B_3 Perm (0) + B_4 def(-1) + B_5 dlog(pop(-1)) + B_6 dlog(pop15(-1)).

The coefficients for the Temp, Temp(-1) and Perm are reported in the table below.

Table A.1 – Expenditure Reaction to Permanent and Transitory Shocks
(t statistic in parentheses)

Independent variable: dlog(g)							
Country	Period	Obs.	Perm	Temp	Temp(-1)	Adj. R^2	D.W
Australia	1967-2010	43	0.026 (7.00)***	-0.020 (-6.02)***	-0.001 (-3.13)**	0.76	1.77*
Austria	1971-2010	39	0.005 (1.43)	-0.012 (-2.90)**	-0.002 (-0.44)	0.33	2.10*
Belgium	1963-2009	46	-0.006 (-2.23)**	0.030 (9.90)***	0.005 (1.38)	0.75	2.47*
Canada	1963-2010	47	0.010 (3.80)**	-0.015 (-5.39)***	-0.009 (-3.00)*	0.64	2.37*
Denmark	1971-2010	39	0.005 (1.23)	-0.008 (-2.13)**	-0.0002 (-0.06)	0.31	1.95*
Finland	1963-2010	47	0.008 (1.93)*	-0.007 (-1.59)	-0.012 (-2.48)**	0.32	1.96*
France	1963-2009	47	0.005 (2.36)**	-0.01 (-4.74)***	-0.006 (-2.78)**	0.65	1.92
Germany	1963-2009	46	0.009 (3.3)*	-0.01 (-4.40)***	0.002 (0.47)	0.60	2.20*
Greece	1971-2009	39	-0.02 (-2.97)***	0.015 (2.52)**	0.004 (0.56)	0.39	2.09
Iceland	1968-2010	42	-0.003 (-0.40)	0.06 (8.86)***	0.006 (0.6)	0.79	1.81*
Ireland	1963-2010	46	-0.007 (-1.19)	-0.028 (-4.36)***	-0.003 (-0.44)	0.50	1.91*
Italy	1963-2010	46	0.001 (0.34)	-0.017 (-5.62)***	0.0006 (0.16)	0.59	2.45*
Japan	1963-2009	46	0.004 (0.79)	-0.009 (-1.90)*	-0.007 (-1.49)	0.64	1.97*
Netherlands	1971-2009	39	0.013 (3.1)***	-0.013 (-2.86)***	0.009 (1.62)	0.49	2.23
New Zealand	1988-2010	23	0.001 (0.07)	-0.002 (-0.37)	0.001 (0.12)	0.35	2.42
Norway	1963-2010	47	0.02 (3.95)***	-0.02 (-2.72)***	-0.008 (-1.32)	0.33	2.50*
Portugal	1973-2009	37	0.05 (7.21)***	-0.08 (-9.33)***	-0.002 (0.2)	0.87	1.96
Spain	1963-2010	47	-0.04 (-6.89)***	0.029 (5.06)***	0.002 (0.33)	0.71	2.07*
Sweden	1966-2010	44	0.004 (0.63)	-0.004 (-0.80)	-0.001 (-0.17)	0.06	2.05*
Switzerland	1991-2010	20	0.001 (0.28)	-0.019 (-2.41)**	-0.012 (-1.32)	0.25	2.37
UK	1963-2010	48	0.01 (1.91)**	-0.015 (-2.87)***	-0.0005 (-0.09)	0.19	1.95
USA	1963-2010	47	-0.0002 (-0.49)	-0.008 (-2.10)**	-0.006 (-1.82)*	0.16	2.00*

*** The regression includes an autoregressive term.**

III: Data appendix

Table A.2 – data source for main variables

Variable name	Coverage (Maximum, for some countries coverage is only for part of the sample)	Source
GDP	1960-2010	OECD Historical statistics, IFS and WDI
Total Government expenditure and Government composition	1960-2010	OECD Historical Statistics
Government deficit	1960-2010	OECD Historical Statistics (calculated using government expenditure and revenue) and OECD Economic Outlook
Population	1960-2010	WDI
Population under 15	1960-2010	WDI
Population above 65	1960-2010	WDI
Unemployment	1960-2010	OECD statistics database

Table A.3 – data descriptive statistics

Variable name	mean	maximum	Minimum	Standard deviation
Dlog(GDP)	0.030	0.136	-0.086	0.03
Dlog(Total Government expenditure)	0.043	0.582	-0.323	0.05
d(Government deficit/Y)	-0.146	11.9	-18.9	2.19
PERM	0.741*	4.5	-4.1	0.98
TEMP	0.739*	4.5	-4.7	0.98
D(Unemployment)	0.12	6.67	-3.30	0.97

*** The mean of TEMP and PERM variables are calculated using absolute value.**

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