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 shocks to output in a model of tax and public consumption smoothing. The model predicts that optimal reaction of public expenditures and deficits to transitory shocks should be countercyclical, while optimal reaction to permanent shocks should be a-cyclical. Using the Blanchard and Quah (1989) methodology for identifying permanent and transitory shocks, we test these predictions for a sample of 22 OECD countries over the years 1963-2006. We find that both expenditures and deficits are countercyclical to transitory shocks, mainly through public transfers and mainly in recessions. We find that government investment is pro-cyclical with respect to permanent shocks, but total expenditures are not.

Keywords: Business Cycles, Fiscal Policy, Permanent and Transitory 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 two main contributions to this line of research. The first contribution is that 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 of such shocks, and also study it empirically within OECD countries. Our second contribution is that we examine the motive of smoothing of public consumption over time and show that it should lead the government to run a counter-cyclical policy with respect to transitory shocks, namely a negative transitory shock should increase the supply of the public good relative to output.

The paper presents a simple model of a government that derives utility from its supply of the public good, it derives disutility from the tax rate, since it is benevolent, and it derives disutility from the size of its debt relative to output, to avoid 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 a-temporal with respect to permanent shocks. This holds both with respect to public expenditures and with respect to the deficit as well. We then 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 began with the Keynesian theory, which advocated countercyclical fiscal policy in order to stimulate aggregate demand in times of recession.[1] The first study of fiscal policy in the context of the neoclassical model was Barro (1979), who analyzes 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 model follows closely the approach of Barro (1979), but it adds smoothing of public consumption to smoothing of taxes, and it also adds to the analysis the distinction between transitory and permanent shocks.

The theoretical literature on cyclicality of fiscal policy since Barro (1979) has been quite scarce.[2] Much of it has focused on the role of various components of fiscal policy such as automatic stabilizers, in Christiano (1984) and Cohen and Follette (1999). Gordon and Leeper (2005) use a similar framework of intertemporal optimization of the government and reach a conclusion that counter-cyclical fiscal policy is undesirable, but they do not consider transitory shocks. There are a number of papers who make a distinction 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.[3]

Recently there has been renewed interest in cyclicality of fiscal policy, which is mainly empirical. This new empirical literature began with Galí (1994), Fiorito and Kollintzas (1994), and Fiorito (1997), who found that fiscal expenditures are counter-

[1] See Hansen (1969) and Blinder and Solow (1974).
[2] In the opening of his paper, Blinder (2004) states his frustration by quoting Solow: "Serious discussion of fiscal policy has almost disappeared."
[3] One example is Carey and Tanner (2005), who simulate optimal fiscal rules using empirically plausible parameters for permanent and transitory shocks.

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 policy varies significantly across categories 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 fiscal policy. Fatas and Mihov (2003) also find that most of the counter-cyclicality of deficits in developed countries is a result of the action 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 the difference between cyclicality of fiscal policy between developed and less developed countries are credit constraints faced by governments in poor countries. Recently new explanations were offered, based on political economy, as in Talvi and Vegh (2005), Alesina and Tabellini (2005) and Ilzetzki (2008).

This paper is related 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 that generate business cycles 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 contains a discussion of policy implications and Section 7 concludes.

2. A model of Optimal Fiscal Policy

We present a simple model in which the government maximizes a welfare function which depends on its fiscal policy. This 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 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 $p > 0$. 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. Note that equations (1) and (2) imply that the p shocks are permanent while the e shocks are temporary and have an effect for one period only.[4]

Assume also 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 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 derives utility from supplying the public good and disutility from taxes, since they reduce the income left to private taxation and they are also distortionary, although these distortions are not explicitly modeled. We assume that utility from the public good is concave while disutility from taxation is convex. For simplicity we assume logarithmic utilities, so temporal utility of the government from these two components is:

$$\alpha \ln \frac{G_t}{Y_t} + \ln(1-T_t).$$

Note that utility is from the share of public consumption of output, but utility can be derived from public consumption only as well.[5] The results of the analysis are similar.

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

Note also, 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 and the model should also have a mechanism that prevents accumulating endless debt relative to output. Note that a no-Ponzi-game condition for the government is not always sufficient to rule out the solution of zero taxes and full public consumption.[6] Hence, we assume a slightly stronger assumption, that the government has disutility from public debt, and more precisely from debt as a share of output.

We therefore assume that the government maximizes the following intertemporal utility, which in every period is affected positively by public consumption, negatively by the tax rate, and also negatively by the relative size of the public debt. For simplicity we assume that the rate of discount of the government is equal to the interest rate. Thus the government maximizes:

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

This utility function guarantees that the public debt never exceeds the upper bound *D*.

We cannot derive a full analytic solution of the maximization of (4), but we can derive the optimal cyclical fiscal policy. 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:

$$V_0 = \max \left[\alpha \ln \frac{G_0}{Y_0} + \ln(1-T_0) + \beta \ln\left(D - \frac{D_0}{Y_0} \right) + \frac{1}{1+r} E_0(V_1) \right]. \tag{5}$$

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[5] If utility is derived both from public consumption and from disposable income, which goes to private consumption, then it is described by: $\alpha \ln G_t + \ln[Y_t(1-T_t)]$. This is equivalent to our utility function.

[6] If the average rate of growth *p* is sufficiently higher than the interest rate *r* the ratio of debt to output D_t/Y_t is bounded for any choice of public consumption and taxation.

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

$$(6) \qquad V_0 = \max\left[\alpha \ln\left(\frac{D_0 - D_{-1}(1+r)}{Y_0} + T_0 \right) + \ln(1-T_0) + \beta \ln\left(D - \frac{D_0}{Y_0} \right) + \frac{1}{1+r} E_0(V_1) \right].$$

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 (6) the optimal tax rate and the optimal amount of the public good, as functions of the levels of public debt:

$$(7) \qquad T_0 = \frac{1}{1+\alpha}\left[\alpha - \frac{D_0 - D_{-1}(1+r)}{Y_0} \right],$$

and:

$$(8) \qquad \frac{G_0}{Y_0} = \frac{\alpha}{1+\alpha}\left[1 + \frac{D_0 - D_{-1}(1+r)}{Y_0} \right].$$

Substituting (7) and (8) in the Bellman condition (6) we get:

$$(9) \qquad V_0 = \max\left[\varepsilon + (1+\alpha)\ln\left(1 + \frac{D_0 - D_{-1}(1+r)}{Y_0} \right) + \beta \ln\left(D - \frac{D_0}{Y_0} \right) + \frac{1}{1+r} E_0(V_1) \right],$$

where $\varepsilon \equiv \alpha \ln \alpha - (1+\alpha)\ln(1+\alpha)$. From (9) it follows that the optimal value function V has the following shape:

$$(10) \qquad V_0 = \varphi\left(\frac{D_{-1}}{Y_0}, e_0, p_0 \right).$$

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

$$(11) \qquad E_0(V_1) = E_0\left\{ \varphi\left[\frac{D_0}{Y_0} \frac{1+e_0}{(1+p_1)(1+e_1)}, e_1, p_1 \right] \right\} = \psi\left[\frac{D_0}{Y_0}(1+e_0) \right].$$

As a result the first order condition of the Bellman equation (9) is:

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

It follows from this FOC that the optimal new debt depends on the old debt and on the temporary shock e_0:

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

Note that $0<d_1<1+r$ and if the debt to output ratio is close to D we have $d_1<1$. Hence, the debt to output ratio does not diverge, but is bounded by D. As for the cyclicality of fiscal policy, it follows from condition (12) that $d_2<0$ 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 (13) in (7) and (8) leads to:

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

Clearly, $g_1<0, g_2<0, t_1>0, \textit{and}\ t_2>0$. Hence public expenditures are counter-cyclical with respect to transitory shocks. Interestingly they 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 output shock, the government likes to increase public consumption in the present but in all future periods as well. As a result taxes are increased, but also current public expenditures, though by less then output. Note also that the share of the public deficit in GDP is:

(15) $$def_0 = \frac{D_0 - D_{-1}}{Y_0} = d\left(\frac{D_{-1}}{Y_0}, e_0\right) - \frac{D_{-1}}{Y_0}.$$

Hence, the deficit 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. Permanent and Temporary Shocks in OECD Countries

In this section we use the Blanchard and Quah (1989) methodology to calculate permanent and transitory shocks for 22 OECD countries. According to this methodology, the vector X, including both the GDP and unemployment, follows a stationary process:

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

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 (instrumented in a TSLS procedure).[7] Although according to our theoretical model shocks are exogenous, from an empirical point of view we cannot completely ignore a causal relationship between government expenditure and output shocks.[8] We therefore include government expenditure in the VAR equations. Since

[7] To assure stationarity, we used first differences of ln(unemployment).
[8] See Blanchard and Perotti (2002).

government expenditure includes cyclical components, we pursue a TSLS approach using the HP-filtered series as an instrument.[9]

We run these equations for 22 OECD countries during the period 1963-2006. 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 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 40 common observations, 43 percent of our transitory shocks match the sign of their demand shocks, and 61 percent of the permanent shocks. Out of 21 (23) 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 30 percent (two thirds) are identified as big demand (supply) shocks by Smets and Wouters.

[9] For an analysis of the cyclical component of government expenditure see Lamo, Perez and Shuknecht (2007).

Table 1 - Global Shocks

	Permanent Shock		**Temporary Shock**		**Big Temporary Shock**	
	Number of Countries	%	Number of Countries	%	Number of Countries	%
1973 (-)	6	28.6	10	47.6	8	38.1
1974 (-)	18	85.7	13	61.9	10	47.6
1973-1974 (-)	18	85.7	16	76.2	15	71.4
1979 (-)	8	38.1	10	47.6	5	23.8
1986 (+)	9	42.9	4	19.0	2	9.5
1993 (-)	17	77.3	12	54.5	10	45.5
2000 (-)	6	27.3	11	50.0	7	31.8
2001 (-)	13	59.1	13	59.1	7	31.8

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.

4. Empirical Implications

In this section we return to our theoretical model in order to derive its empirical implications, in order to test them with the data of these OECD countries. 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 (13) in the following way:

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

Note that the coefficient *a* is positive but smaller than 1 and the coefficient *b* is positive. Substituting (17) in equation (8) we get:

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

Hence, public primary expenditure fluctuates around an average $\alpha/(1+\alpha)$, as is quite intuitive in light of the utility function between public and private consumption (see footnote 4). The 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:

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

Hence, the main empirical implication of the model can be described by the following regression, where "Temp" are transitory shocks and "Perm" are permanent shocks, and X is a vector of control variables:

(20) $E(0)/GDP(0) = A_0 + A_1\, D(-1)/GDP(0) + A_2\, Temp\,(0) + A_3\, X(0).$

The main hypothesis of our model is that the coefficient of the temporary shocks is negative, namely: $A_2 < 0$. As for the sign of lagged debt it is not clear, but since $a > r$, as implied by (17), it is likely that A_1 is negative as well.

Direct estimation of equation (20) requires availability of data on debt to output ratios. If this data is less available than other fiscal variables, for example available for fewer periods of time, we can use instead a difference version of (19). 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 (19) 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) $\quad d\ lnE(0) = B_0 + B_1\ Temp(0) + B_2\ Temp(-1) + B_3\ Perm\ (0) + B_4\ def(-1) + B_5\ X(0).$

The coefficients of the regression should satisfy according to equation (21): B_1 and B_2 have unclear signs, B_3 is positive, and B_4 is negative. 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) $\quad B_1 = -\ B_2$, 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 (15) and (17) 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 (24): 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 result that b is positive and that the deficit is counter-cyclical with respect to transitory shocks.

In order to test our thesis we use a sample of the 22 OECD countries, for the period 1963 to 2006. We look at actual data on general government expenditure and budget deficits as a percent of GDP.[10] 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.

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

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

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 variables for expenditure are the logarithmic change of the population with one-year lag (POP(-1)) and the share of children less than 15 years old in the population (POP15). We tried also the election dates (ELECT), and the share of 65+ years old in the population (POP65), but these variables were not significant. This 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 insignificantly different than 0. In the second 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 found 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 is predicted by the model.

Table 2 – Expenditure Reaction to Permanent and Transitory Shocks

(t statistic in parentheses, using fixed effects for countries and years)

Dependent\ independent variable	Dlog (G)	dlog (G)	dlog (G)
Equation number	(1)	(2)	(3)
Number of observations	841	841	841
Period	1964-2006	1964-2006	1964-2006
C	0.05 *** (21.0)	0.05 *** (21.3)	0.05 *** (21.3)
PERM	-0.002 (-1.1)	-0.001 (-0.7)	-0.002 (-1.0)
TEMP	-0.014 *** (-9.8)	-0.015 *** (-9.8)	-0.014 *** (-9.8)
TEMP(-1)	-0.002 (-0.8)	-0.001 (-0.9)	-0.001 (-0.8)
DLOG(POP(-1))	0.26 * (1.6)	0.25 (1.6)	0.26 * (1.6)
DLOG(POP15)	0.16 * (2.1)	0.17 ** (2.1)	0.16 ** (2.1)
DEFICIT/Y (-1)	-0.004 *** (-6.5)	-0.004 *** (-6.7)	-0.004 *** (-6.6)
MAAS*PERM		-0.003 (-0.7)	
MAAS*TEMP		0.007 * (1.8)	
EURO*PERM			-0.002 (-0.3)
EURO*TEMP			0.007 (1.2)
Adj. R squared	0.38	0.38	0.38

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

Table 3 checks whether the countercyclical reaction to shocks is due to the reaction in recessions –negative shocks (REC) - or in expansions – positive shocks (EXP). We also check whether they are related to big – defined as more than half (BIG) and one (BIG 1) standard deviation of shocks - and persistent (PERS) shocks – defined as more than 4 consecutive years. The first regression tests whether the counter-cyclicality of expenditure is due to recessions (negative shocks) or expansions (positive shocks). The significant coefficients are for temporary shocks, both in recessions and expansions with a higher coefficient in recessions.

Table 3 - Cyclicality of Expenditure in Expansions and Recessions

(t statistic in parentheses, using fixed effects for countries and years)

Dependent\ independent variable	dlog (G)	dlog (G)	dlog (G)	dlog (G)
Equation number	(1)	(2)	(3)	(4)
Number of observations	841	841	841	575
Period	1964-2006	1964-2006	1964-2006	1980-2006
C	0.04*** (12.3)	0.04*** (13.8)	0.04 * (18.3)	0.03*** (7.8)
REC*PERM	-0.001 (-0.4)			-0.002 (-0.6)
REC*TEMP	-0.020*** (-7.5)	-0.020*** (-7.5)		-0.023*** (-6.1)
EXP*PERM	-0.002 (-0.8)			-0.003 (-0.7)
EXP*TEMP	-0.008*** (-3.0)	-0.008*** (-3.0)		-0.013*** (-3.6)
TEMP(-1)	-0.002 (-1.1)	-0.002 (-1.2)	-0.002 (-1.4)	0.002 (1.2)
DLOG(POP(-1))	0.25 (1.6)	0.25 (1.6)	0.21 (1.3)	0.21 (1.3)
DLOG(POP15)	0.16** (2.0)	0.16** (2.0)	0.16** (2.0)	0.10 (1.1)
DEFICIT/Y (-1)	-0.003*** (-6.2)	-0.003*** (-6.2)	-0.003*** (-6.4)	
REC_PERS*PERM		-0.002 (-0.5)		
EXP_PERS*PERM		0.0009 (0.2)		
BIG1R_PERS*PERM			-0.002 (-0.5)	
BIG1E_PERS*PERM			-0.002 (-0.4)	
BIG_REC*TEMP			-0.021*** (-8.3)	
BIG_EXP*TEMP			-0.010*** (-4.3)	
Adj. R squared	0.39	0.39	0.39	0.38

A similar result is obtained when we look at persistent permanent shocks: coefficients are not significant while they remain significant for temporary shocks. These results allow us to conclude that while expenditure is countercyclical with respect to temporary shocks, there is no evidence of pro-cyclicality with respect to permanent shocks. In the third regression we look at big temporary shocks: significance of coefficients remain in both expansions and recessions (with a higher coefficient). The fourth regression relates to Perotti (2005), who found a significant change in his

assessment of the impact of fiscal policy since 1980. In regression 4 we check the reaction of fiscal policy in this period and we find a very similar pattern.

Table 4 looks at the components of expenditure, as in Lane (2003). We look at transfers (GT), government consumption (GC) and government investment (GI). The first regression is for transfers, which is one of the two main items together with government consumption. The control variables include the change in unemployment (d(U)), in order to see whether the countercyclicality of transfers is beyond the one of unemployment payments. Results show that the coefficient of transitory shocks is significant, i.e., transfer payments react countercyclically to temporary shocks. This finding is in line with findings by Melitz (2005) and Darby and Melitz (2007). The second regression is for government consumption, and we found that coefficients are not significant at 5 percent. Finally, results for public investment show that they are procyclical against permanent shocks. In order to learn more about these results we proceed as in the previous analysis by differentiating between expansions and recessions. Column 4 reports this test for transfers, showing that countercyclicality is due to recessions. Column 5 reports the results (not significant) for government consumption. Concerning investment, results show that procyclicality occurs both in expansions and recessions (significant at 10 percent).

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

(t statistic in parentheses, using fixed effects for countries and years)

Dependent\ Independent variable	dlog (GT)	Dlog (GC)	Dlog (GI)	Dlog (GT)	dlog (GC)	Dlog (GI)
Equation number	(1)	(2)	(3)	(4)	(5)	(6)
Number of observations	802	818	800	802	818	800
Period	1964-2006	1964-2006	1964-2006	1964-2006	1964-2006	1964-2006
C	0.05*** (16.6)	0.04*** (29.6)	0.07*** (9.5)	0.05*** (10.8)	0.05*** (19.2)	0.07*** (6.2)
PERM	0.001 (0.3)	0.001 (1.2)	0.017*** (3.3)			
TEMP	-0.003* (-1.89)	-0.002* (-1.7)	-0.013** (-2.5)			
TEMP(-1)	-0.002 (-1.4)	-0.004*** (-4.0)	-0.005 (-1.0)	-0.003 (-1.6)	-0.004***(-3.9)	-0.005 (-1.0)
REC*PERM				-0.003 (-1.1)	0.0004 (0.2)	0.017* (1.7)
REC*TEMP				-0.006* (-1.9)	0.0003 (0.2)	-0.010 (-1.0)
EXP*PERM				0.005 (1.5)	0.002 (1.1)	0.018* (1.8)
EXP*TEMP				-0.0002 (-0.1)	-0.004 (-2.0)	-0.015* (-1.6)
DLOG(POP15)	0.27*** (3.0)	0.001 (0.0)	0.44 (1.6)	0.26*** (3.0)	0.002 (0.0)	0.44 (1.6)
DEFICIT/Y (-1)	-0.002*** (-3.5)	-0.002*** (-5.7)	-0.006***(-3.2)	-0.002***(-3.2)	-0.002***(-5.7)	-0.006***(-3.2)
DLOG(POP65)	0.001 (0.0)			0.007 (0.0)		
Dlog(POP(-1))		0.06 (0.5)	0.66 (1.2)		0.06 (0.5)	0.66 (1.2)
D(U)	0.01*** (5.8)			0.01 * (5.5)		
Adj. R squared	0.48	0.20	0.20	0.48	0.19	0.19

5.2 Government budget deficit

Table 5 focuses on the general government deficit. The control variables used for the deficit are different from those for expenditure. Following Barro (1979), we use the control variable of temporary expenditure (like war-related spending), measured as the gap between actual expenditure and its HP-filtered trend. We control for "one-time" expenditures in the spirit of Barro (1979) by a variable of particularly high deviations from trend – more than one standard deviation. We use this variable, GYGAP, also with a

one year lag. Another control variable, which turns to be significant, is election years (ELECT), as implied by the political economy literature.[11]

Table 5 – Deficit Reaction to Temporary and Permanent Shocks

(TSLS[1],t statistic in parentheses, using fixed effects for countries and years)

Dependent\ Independent variable	d(DEFY)	d(DEFY)	d(DEFY)
Equation number	(1)	(2)	(3)
Number of observations	815	815	815
Period	1964-2006	1964-2006	1964-2006
C	0.22 *** (2.9)	0.21 *** (2.9)	0.22 *** (2.9)
TEMP	-0.18 *** (-3.0)	-0.19 *** (-3.1)	-0.18 *** (-3.0)
TEMP(-1)	0.01 (0.1)	0.02 (0.4)	0.01 (0.1)
ELECT	0.25 ** (2.3)	0.26 ** (2.4)	0.25 ** (2.3)
GYGAP	0.54 *** (13.2)	0.54 *** (13.1)	0.54 *** (13.1)
GYGAP(-1)	-0.40 *** (-9.8)	-0.40 *** (-9.8)	-0.40 *** (-9.8)
MAAS*TEMP		0.12 (0.9)	
MAAS*TEMP(-1)		-0.09 (-0.6)	
EURO*TEMP			0.06 (0.3)
EURO*TEMP(-1)			-0.01 (-0.1)
D(U)	0.54 *** (4.5)	0.54 *** (4.5)	0.54 *** (4.4)
DEFICIT/Y (-1)	-0.18 *** (-8.1)	-0.18 *** (-8.2)	-0.18 *** (-8.2)
Adj. R squared	0.53	0.53	0.53

1. Instrument variable to d(u) is D(Uhp), where Uhp is the HP filtered trend of unemployment.

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. In the second regression we check whether there was a change in behavior for countries that joined the

[11] This variable is insignificant for expenditure. It suggests that in elections governments reduce taxes. In a regression of revenues on ELECT (controlling for GDP changes), we found a significant negative effect.

Maastricht Treaty. Results are not significant. This is also the case for countries joining the Euro agreement (third regression).

Table 6 checks the cyclicality of deficits in expansions and recessions. The first regression shows a similar result to the one found for expenditures: the counter-cyclicality with respect to temporary shocks is mainly for recessions, although the significant result was found for a one-year lag. Concerning expansions the coefficient is significant both for contemporary and for one-year lag coefficients, with an opposite sign. In the next regression we test the reaction to big shocks, larger than half standard deviation, and we get similar results compared to the ones for all shocks. The last regression concentrates on a shorter sample, beginning at 1980. It shows a counter-cyclical reaction in recessions and a pro-cyclical reaction in expansions with respect to temporary shocks, with a one-year lag. For recessions, contemporary counter-cyclicality is significant at 5 percent.

Table 6 – Cyclicality of Deficits in Expansions and Recessions

(TSLS[1], t statistic in parentheses, using fixed effects for countries and years)

Dependent\ Independent variable	d(DEFY)	d(DEFY)	d(DEFY)
Equation number	(1)	(2)	(3)
Number of observations	815	815	575
Period	1964-2006	1964-2006	1980-2006
C	0.13 (1.1)	0.18 ** (2.1)	-0.1 (-0.8)
TEMP*EXP	-0.31 *** (-3.1)		-0.13 (-1.1)
TEMP*REC	-0.02 (-0.2)		-0.27 ** (-2.2)
TEMP(-1)*EXP	0.27 *** (2.8)		0.30 *** (2.8)
TEMP(-1)*REC	-0.25 ** (-2.6)		-0.34 *** (-2.8)
ELECT	0.25 ** (2.4)	0.24 ** (2.6)	0.23 ** (2.1)
GYGAP	0.54 *** (13.5)	0.55 *** (13.7)	0.64 *** (15.2)
GYGAP(-1)	-0.42 *** (-10.2)	-0.42 *** (-10.4)	-0.49 *** (-11.1)
BIG*TEMP*EXP		-0.24 *** (-2.6)	
BIG*TEMP*REC		-0.03 (-0.3)	
BIG*TEMP(-1)*EXP		0.20 ** (2..3)	
BIG*TEMP(-1)*REC		-0.16 * (-1..8)	
D(U)	0.51 *** (4.3)	0.52 *** (4.3)	0.47 *** (4.0)
DEFICIT/Y (-1)	-0.17 *** (-8.0)	-0.18 *** (-8.1)	-0.16*** (-6.6)
Adj. R squared	0.54	0.54	0.62

1. Instrument variable for d(u): d(Uhp).

6. Policy Interpretation

One clear implication of our theoretical model is that there is a role for automatic stabilizers against temporary shocks. As well-known, the main automatic stabilizers are taxes and unemployment benefits. Concerning other sources of government expenditure, like wages and transfers, the results of our theoretical model are more difficult to interpret. However, it is important to stress that our model does not necessarily imply that

governments should use discretionary expenditures policy with respect to temporary shocks. This conclusion stems from the fact that in real life temporary shocks are in many times candidates for becoming permanent shocks. For example, if there is a temporary recession, our model recommends increasing transfers during the negative shock; however, if the shock becomes permanent and persistent, then, according to our model, transfers should be cut and thus it would be wrong to increase transfers in a discretionary manner from the very beginning. This conflict is more relevant if there are lags in the implementation of fiscal policy, as is usually the case in parliamentary democracies. Discretionary policy would be desirable only if the source of the shock is temporary in an unambiguous way and implementation of this policy is quick.

Another possible interpretation of our results is that governments should search for predetermined rules that imply a different reaction of fiscal policy to temporary and to permanent shocks. An example of such a rule would be indexation of transfers to the Consumer Price Index or to the average wage. The reason is that wages tend to be downward rigid.[12] As a result, during a temporary negative shock wages do not fall significantly and that causes transfers to be countercyclical as suggested in our model. However, if the shock persists and becomes permanent, downward rigidity of wages does not hold for long and wages fall, causing a downward adjustment of transfers, which is pro-cyclical.[13] A less extreme alternative would be to index transfers to the CPI, a rule

[12] This is a well documented empirical observation. A broad study of OECD countries is presented by Holden and Wulfsberg (2007). Some of the many micro-based country studies for the countries included in our sample are Fares and Lemieux (2001) and Cristofides and Stengos (2003) for Canada, Bockerman, Laaksonen and Vainiomaki (2006) for Finland, Agel and Lundborg (1999) for Sweeden, and Kawaguchi and Ohtake (2004) who tried to asses the morale theory of nominal wage rigidity using data for Japan. Brzoza-Brzezina and Socha (2007) document downward wage rigidity in Poland.

[13] A documentation of such a phenomenon is provided by the Finnish reaction to the dramatic decline of trade with the Soviet Union in 1990-91, which constituted 20 percent of exports. This triggered a persistent recession, in which unemployment rose from 3 percent in 1989 to 16 percent by 1993. Bockerman,

that may work similarly in recessions (because of downward price rigidity) but is less pro-cyclical in expansions (because of lower pro-cyclicality of prices compared to wages).[14] Another example of such a rule would be to announce a government wage policy that mimics (with a lag) wage developments in the private sector.[15] Under temporary negative shocks this policy is countercyclical because of downward wage rigidity in the private sector.[16] If the temporary shock is positive, the lags in wage adjustments reduce significantly the wage increase. It is important to stress that according to our model the success of such policies in the long-run depend on the commitment of governments for a pro-cyclical policy with respect to persistent shocks. This is not easy to follow and indeed we observe in the empirical results above little evidence of pro-cyclicality of government expenditure even when shocks are permanent and persistent.[17]

Table 7 shows some regressions that discuss these policy interpretations. The first two regressions analyze the role of automatic stabilizers. The first regression checks the role of unemployment benefits as an automatic stabilizer, by multiplying the change in unemployment to dummy variables that take the value of 1 in recessions (REC_temp) or in expansions (EXP_temp), and 0 otherwise. Results show that unemployment benefits indeed act as an automatic stabilizer. When unemployment goes up (down) the social transfers increase (decline). The second regression checks the impact of changes in revenues on government deficits. It shows that there is a tendency to allow the automatic

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Laaksonen and Vainiomaki (2006) show that this recession led to a large decline of real wages. This contrasts with downward nominal and real rigidity in regular times.

[14] To characterize each of them is beyond the scope of the present research.

[15] In fact, Lamo, Perez and Shuknecht (2007) found that European countries follow this policy with a two-years lag.

[16] Cardoso and Portela (2005) show that Portuguese firms adjust wages pro-cyclically to permanent shocks, but do not adjust wages to temporary shocks.

[17] Darby and Melitz (2007) stress that since automatic stabilizers are related to broader expenditure items than unemployment insurance, the countercyclical role of expenditure merits further research.

stabilizers to play a role against temporary shocks, both in recessions and expansions. A 1 percent temporary negative (positive) shock in revenues is translated into a 0.5 percent increase (decline) in deficit on average. The third regression checks whether the rate of increase in government wages is affected by persistent permanent shocks. For this purpose the persistence variable was defined as 4 or more years of positive and negative permanent shocks; we then multiply this variable by the change in unemployment, i.e., the coefficient is expected to be negative (pro-cyclical). We found a negative coefficient for recessions (significant at 10 percent).

Finally, we use Raffelhunschen (2001) findings which show that Ireland and Belgium are the only countries that credibly do not commit to indexation of transfers to wages, and consequently their implicit debt related to transfers indexation is negative.[18] By excluding these countries from the sample, we expect transfers policy to be more countercyclical against temporary recessions. While the coefficient becomes mildly higher, and significant at 5 percent, the difference between these coefficients is negligible (relatively to regression 1 in table 4) and is not significant according to a Wald test. Checking the impact of indexation policy clearly requires a structural test related to the indexation mechanism, which is beyond the scope of the present research.

[18] This author shows that it is important to base the analysis on realistic liabilities, given that time inconsistency compels countries to do unavoidable reforms. For example, Franco and Sartor (1999) show that pension debt in Italy would be 181 percent of GDP instead of 107, if reforms had not been enacted.

Table 7 – Policy Interpretation of the Results
(t statistic in parentheses, using fixed effects for countries and years)

Dependent\ Independent variable	Dlog(GT)	D(DEFY)	dlog (WG)	Dlog(GT)
Equation number	(1)	(2)	(3)	(4)
Number of observations	816	822	743	726
Period	1963-2006	1964-2006	1964-2005	1964-2006
C	0.06 *** (17.2)	0.00 (1.4)	0.10 *** (46.5)	0.05 *** (16.1)
DLOG(POP15)	0.26 *** (3.0)			0.22 ** (2.5)
DLOG(POP65)				0.02 (0.2)
PERM			-0.001 (-0.8)	0.001 (0.5)
TEMP			-0.000 (0.0)	-0.0036 ** (-2.07)
TEMP(-1)			-0.001 (-0.7)	-0.002 (-1.3)
TEMP*EXP		-0.002 ** (-2.1)		
TEMP*REC		-0.006 *** (-5.7)		
TEMP(-1)*EXP		0.002 * (1.9)		
TEMP(-1)*REC		-0.002 * (-1.9)		
REC_temp*d(REV_y)		-0.47 *** (-9.1)		
EXP_temp*d(REV_y)		-0.56 *** (-11.0)		
d(U)				0.01 *** (5.1)
REC_temp*D(U)	0.01 *** (4.6)			
EXP_temp*D(U)	0.01 *** (3.7)			
PERS*REC_temp*D(U)			-0.007* (-1.9)	
PERS*EXP_temp*D(U)			0.002 (0.5)	
DEFICIT/Y (-1)	-0.002 *** (-3.9)	-0.001 *** (-6.9)	-0.003 *** (-4.5)	-0.002 *** (-3.4)
Adj. R squared	0.46	0.64	0.40	0.40

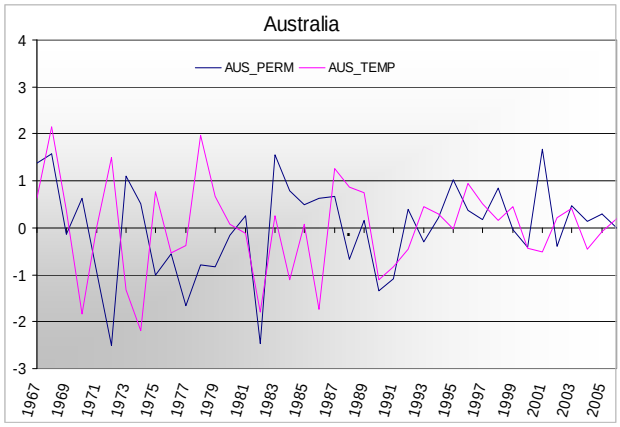
7. Conclusions

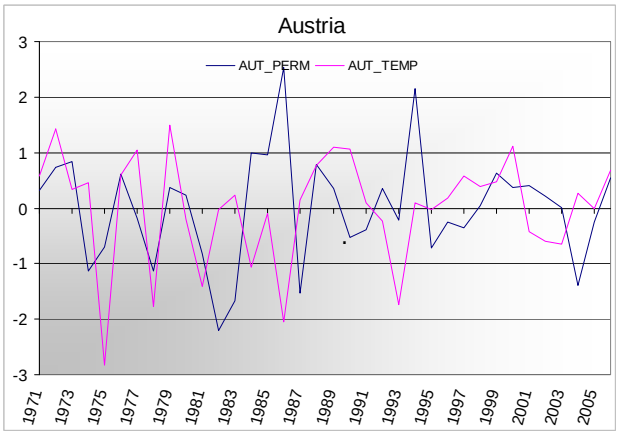
This paper characterizes the optimal reaction of fiscal policy to permanent and transitory shocks. In an uncertain environment, we find that the optimal reaction to a temporary shock is countercyclical. Concerning permanent shocks, our theoretical model suggests

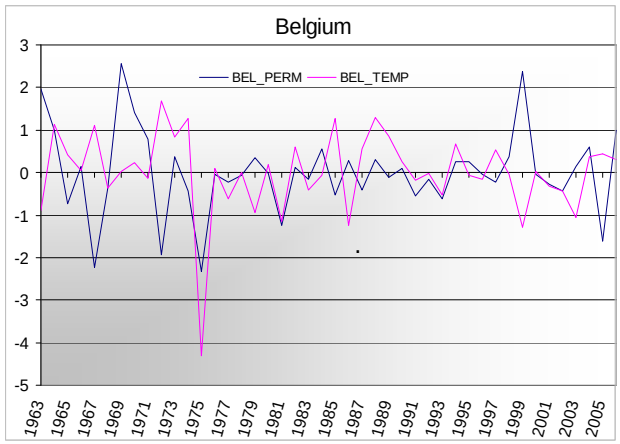
that reaction to permanent shocks shall be a-cyclical. By using Blanchard and Quah (1989) methodology for differentiating between permanent and temporary shocks, we test these theoretical results for a sample of 22 OECD countries in the period 1963-2006. We find that both deficits and expenditure react counter-cyclically to temporary shocks, mainly through public transfers and mainly in recessions. We did not find evidence of pro-cyclical expenditure policy when reacting to permanent shocks, except for government investment.

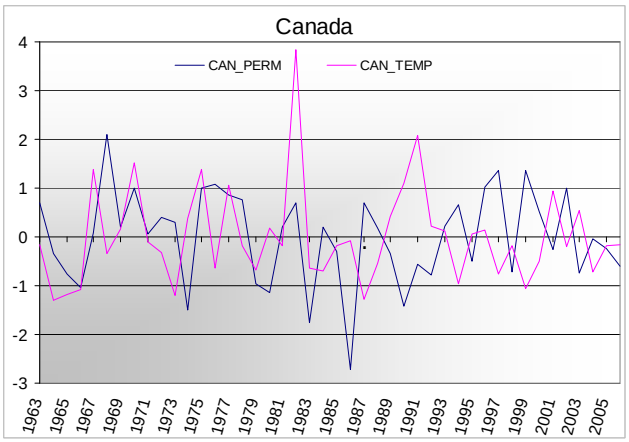
Our policy interpretation of the model and the empirical findings is that it is desirable to use automatic stabilizers against temporary shocks, and discretionary timely policy only in cases where the temporal character of the shock is evident. Countercyclical policy may also reflect the adoption of credible rules that imply counter-cyclical expenditure policy when output shocks are temporary, becoming pro-cyclical if the shock persists. Indexation of government transfers to the average wage, or to the Consumer Price Index, are examples of such rules.

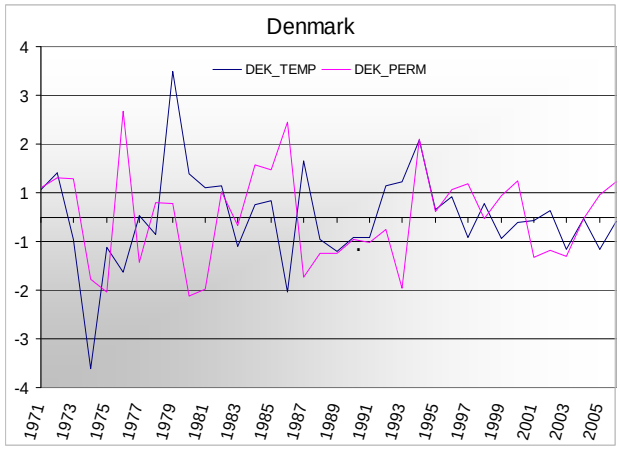
Figure 1 – Permanent and Temporary Shocks in OECD Countries

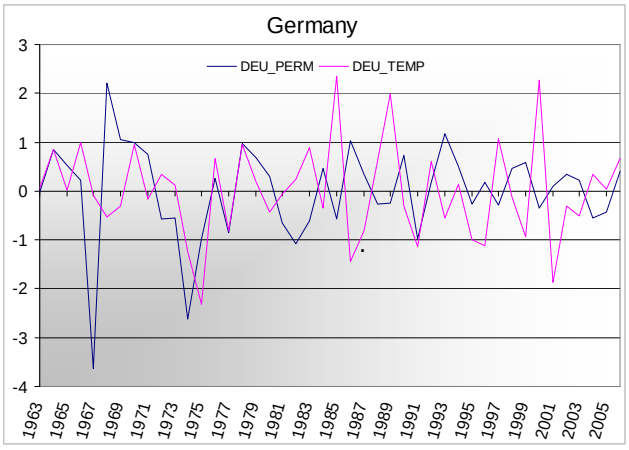


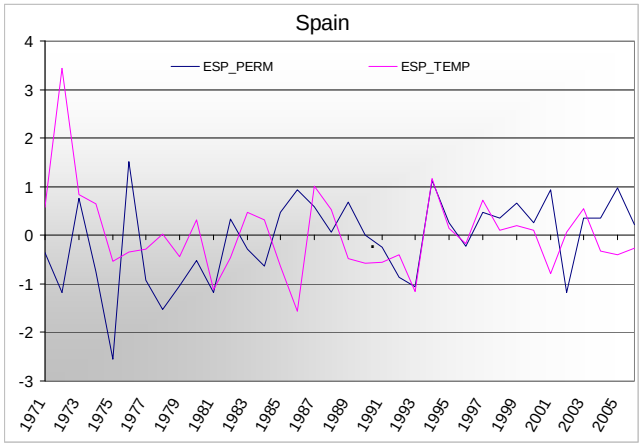








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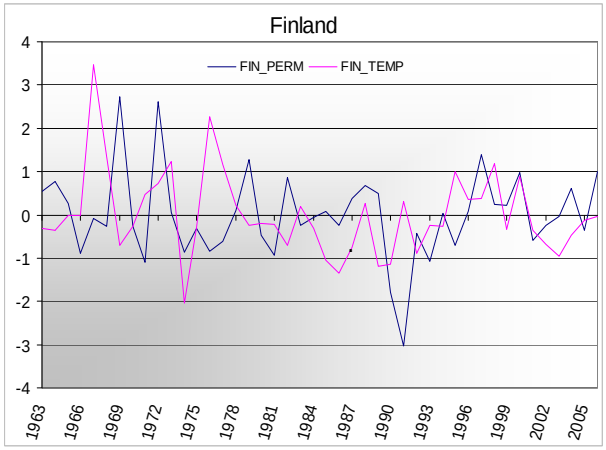
ESP_TEMP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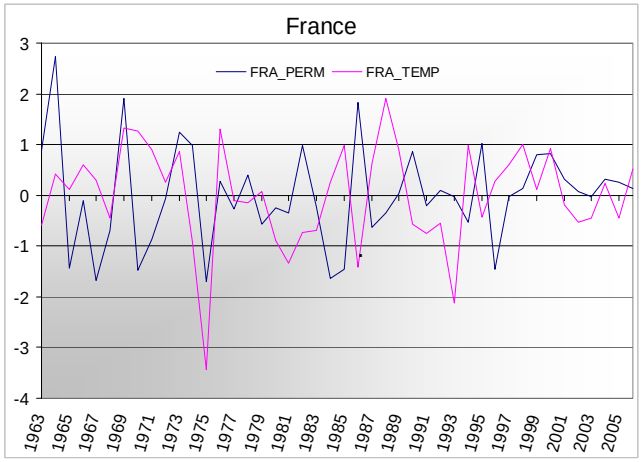
FIN_TEMP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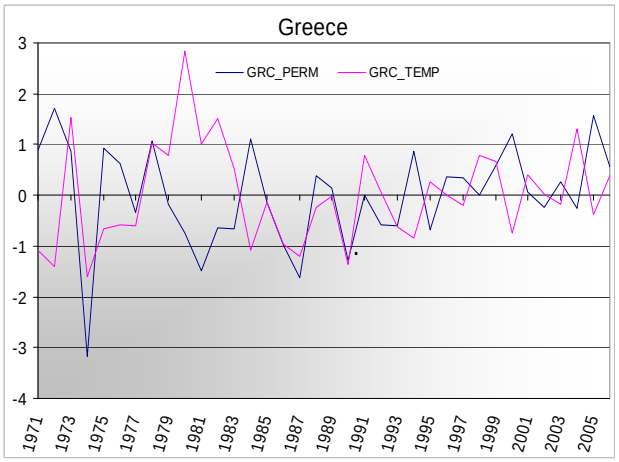
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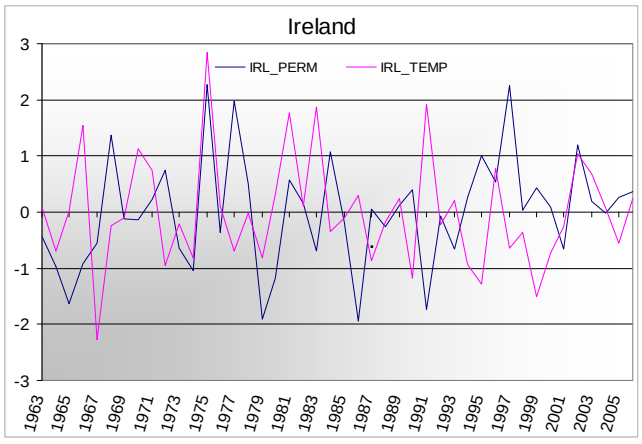
GRC_PERM
GRC_TEMP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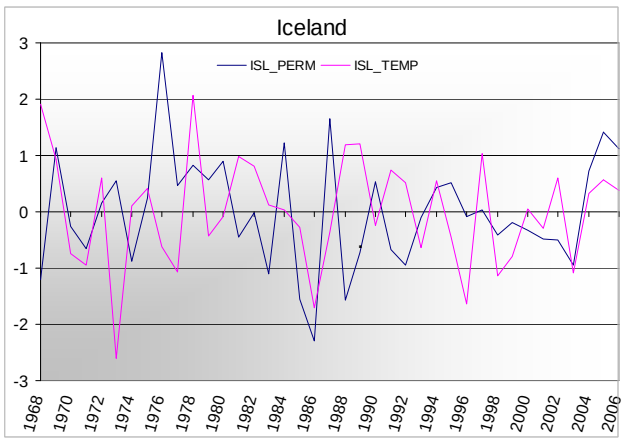
IRL_TEMP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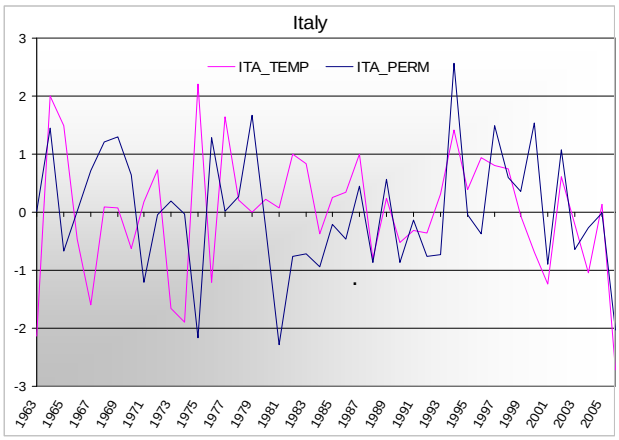
ISL_TEMP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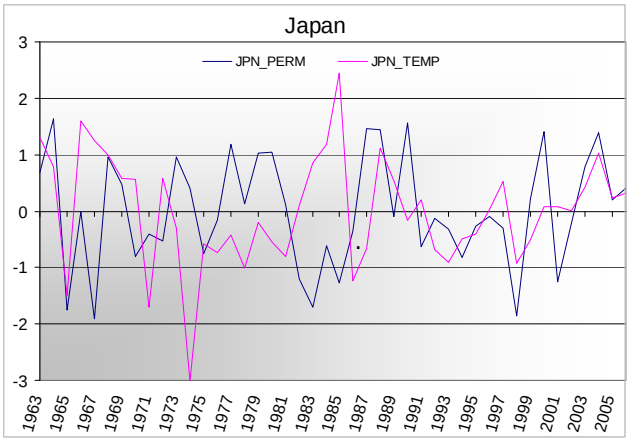
ITA_PERM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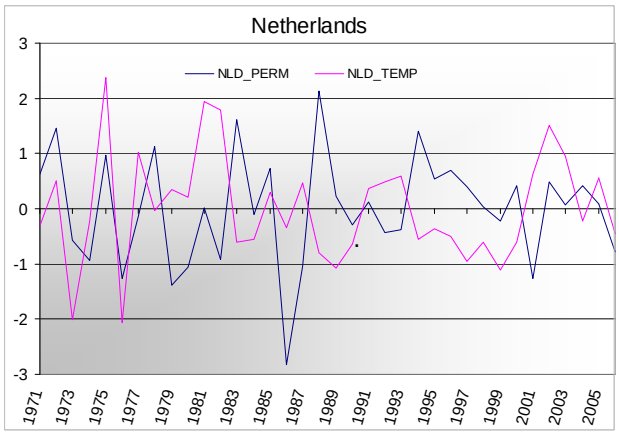
JPN_TEMP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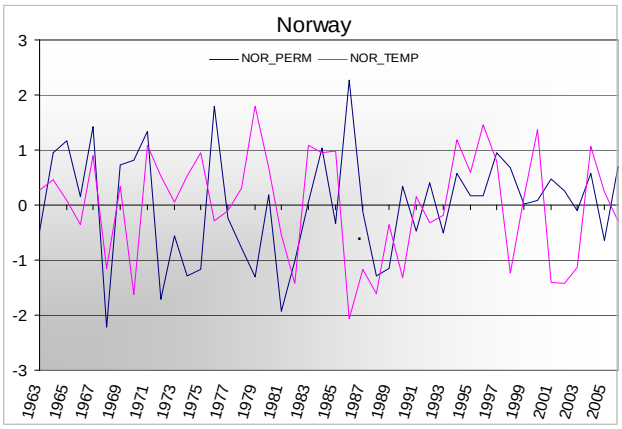
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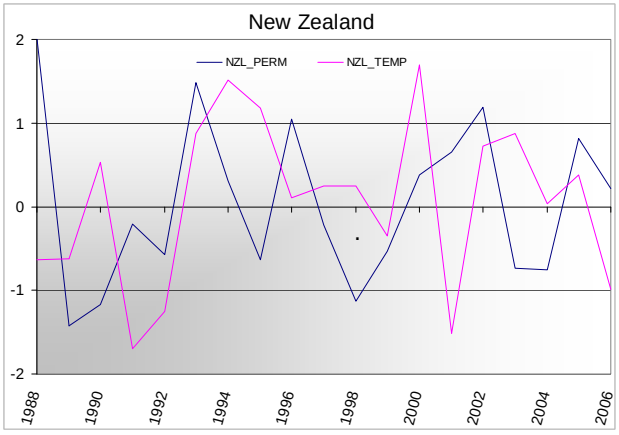
NOR_PERM
NOR_TEMP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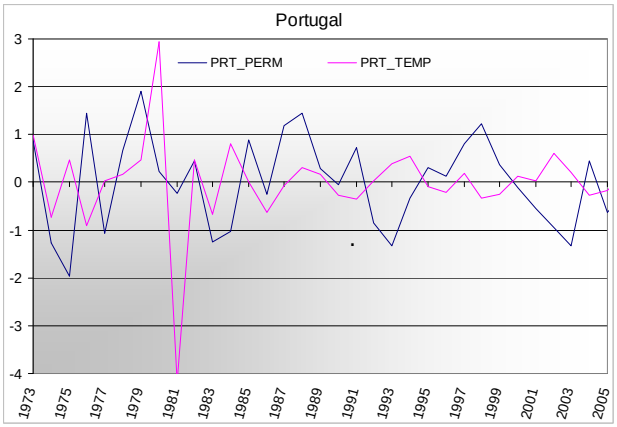
NZL_TEMP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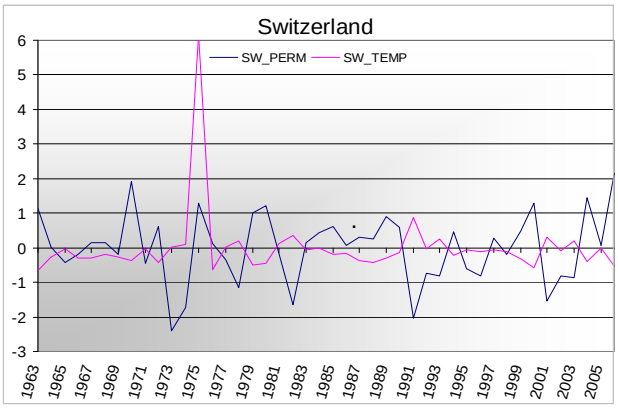
PRT_TEMP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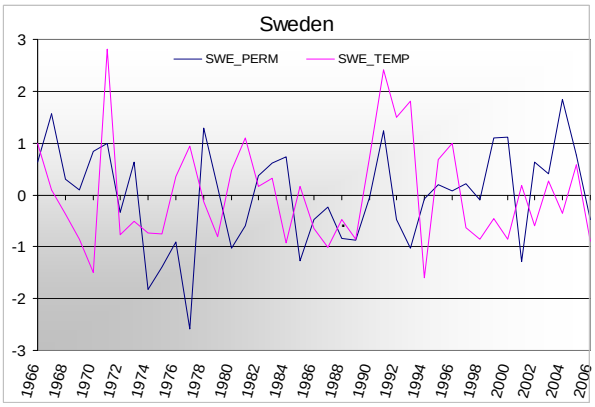
SW_TEMP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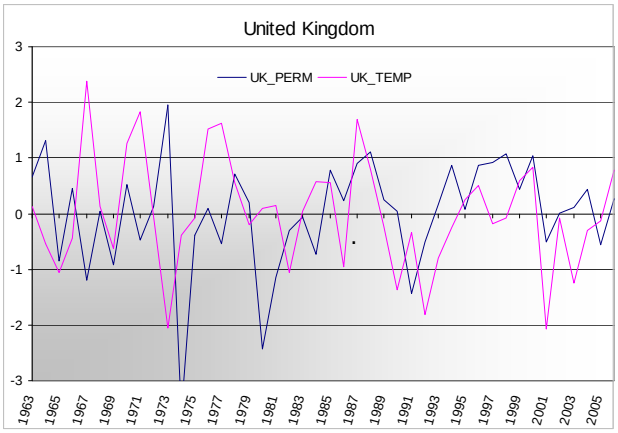
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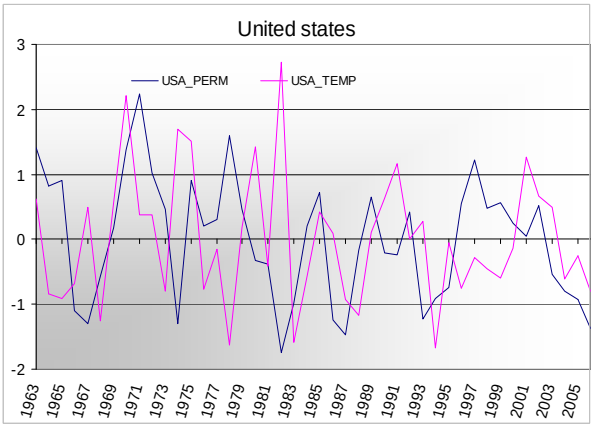
United states
USA_PERM
USA_TEMP

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