Cyclical Budgetary Policy and Economic Growth: What Do We Learn from OECD Panel Data?*

Philippe Aghion[†] and Ioana Marinescu[‡]

Abstract: This paper uses yearly panel data on OECD countries to analyze the relationship between growth and the cyclicality of government debt. We develop new time-varying estimates of the cyclicality of public debt. Our main findings can be summarized as follows: (i) public debt growth has become increasingly countercyclical in most OECD countries over the past twenty years, but this trend has been less pronounced in the EMU; (ii) more financially developed, less open economies and countries under an inflation targeting regime display more countercyclical public debt growth; (iii) less procyclical public debt growth can have significantly positive effects on productivity growth, in particular when financial development is lower.

1 Introduction

A common view among macroeconomists, is that there exists a perfect dichotomy between macroeconomic policy (budget deficit, taxation, money supply) which should affect primarily the short-run, and long-run economic growth which, if anything, should depend only upon structural characteristics of the economy (property right enforcement, market

*This work owes a lot to Robert Barro who contributed abundant comments and advice and also the theory section underlying the first stage analysis. At earlier stages of this project, we benefited from fruitful conversations with Philippe Bacchetta, Laurence Bloch, Elie Cohen, Jean Pisani-Ferry, Romain Ranciere, and Ken Rogoff. More recently, we greatly benefited from the comments and suggestions of Philippe Moutot and of our colleagues in the Institutions, Organizations and Growth group at the Canadian Institute for Advanced Research, especially Daron Acemoglu and Tim Besley. We are very thankful to Jorgen Van Hagen for providing his data so generously, and to Ann Helfman, Julian Kolev and Anne-Laure Piganeau for outstanding research assistance. Finally, we are highly indebted to Konrad Kording for his collaboration on the first stage analysis section and more specifically for helping us implement the MCMC methodology.

[†]Harvard University and NBER

[‡]University of Chicago.

structure, market mobility and so forth). That macroeconomic policy should not be a key source of growth, is further hinted at by recent contributions such as Acemoglu et al (2004) and Easterly (2005), which argue that the correlation between macroeconomic volatility and growth (Acemoglu et al) or those between growth and macroeconomic variables (Easterly), become insignificant once one controls for institutions.

In this paper we question that view by showing that the cyclicality of public debt growth is significant in explaining GDP growth, with a more countercyclical public debt policy being more growth-enhancing the lower the country's level of financial development. These results hold in a sample of OECD countries with comparable institutional environments.

Our contribution in this paper is three-fold. It is first to compute and analyze the cyclicality of government debt on a panel of OECD countries, that is, how government debt responds to fluctuations in the output gap over time. Second, it is to investigate some determinants of the procyclicality of public debt. Third, it is to use these yearly panel data to assess the importance for growth of moving towards more countercyclical budgetary policies at various levels of financial development. Our main findings can be summarized as follows: (i) public debt growth has become increasingly countercyclical in most OECD countries over the past twenty years, but this trend has been significantly less pronounced in the EMU; (ii) more financially developed, less open economies and countries under an inflation targeting regime display more countercyclical public debt growth; (iii) less procyclical public debt growth can have significantly positive effects on growth when financial development is lower; in particular our estimates suggest that the eurozone could increase its annual growth rate by 0.57 percentage points per year by making its public debt growth become as countercyclical as that in the US.

The idea that cyclical macroeconomic policy should affect productivity growth, is in line with the Schumpeterian view of business cycles and growth, whereby recessions provide a cleansing mechanism for correcting organizational inefficiencies and for encouraging firms to reorganize, innovate or reallocate to new markets. The cleansing effect of recessions is also to eliminate those firms that are unable to reorganize or innovate. Now, if firms could always borrow enough funds to either reorganize their activities or move to new activities and markets, and the same was true for workers trying to relocate from one job to another, the best would be to recommend that governments do not intervene over the business cycle, and instead let markets operate.

However, suppose that the borrowing capacity of firms is proportional to their current earnings (the factor of proportionality is what we refer to as the credit multiplier, with a higher multiplier reflecting a higher degree of financial development in the economy). In a recession, current earnings are reduced, and therefore so is the firms' ability to borrow in order to make new innovative investments or simply maintain previous innovation programs in the face of idiosyncratic liquidity shocks. This, in turn suggests that a countercyclical budgetary policy may foster innovation and growth by reducing the negative consequences of a recession (or a bad aggregate shock) on firms' innovative investments. For example, the government may decide to foster the demand for private firms' products by increasing spending. This could further increase firm's liquidity holdings and thus make it easier for them to face idiosyncratic liquidity shocks without having to sacrifice R&D or other types of longer-term growth-enhancing investments. On the other hand, in a recession, more workers face unemployment, so that their earnings are reduced. Government spending could help them overcome credit constraints either directly (social programs, etc.) or indirectly by fostering labor demand and therefore employment; this relaxation of credit constraints in turn would allow workers to make growth-enhancing investments in human capital, re-location, etc. A natural implication of the above argument is that the lower the level of financial development, that is, the tighter the credit constraints faced by firms and workers, the more growth-enhancing such countercyclical policies should be, a conclusion at odds with the dichotomous view that prevails among macroeconomists.

While we do not know of any previous attempt at analyzing the growth effects of countercyclical budgetary policies, analyses of the determinants of the cyclicality of budgetary policies already exist in the literature. For example, Alesina and Tabellini (2005) argue that more corrupt democracies will tend to run a more procyclical fiscal policy. The idea is that, in good times, voters demand that the government cut taxes or provide more public services instead of reducing debt, because they cannot observe the debt reduction and can suspect the government of appropriating the rents associated with good economic conditions. In equilibrium, this leads to a more procyclical policy as the moral hazard problem worsens, in the sense that governments are more likely to divert public resources in booms. They also show that this mechanism tends to be more powerful in explaining the variation observed in the data than borrowing constraints alone. While Alesina and Tabellini (2005) are using a large sample of countries and explore cross-sectional variations, in this study we use panel analysis on OECD countries. This makes the use of corruption indices impractical for two reasons. First, there is almost no cross-sectional variation in corruption indices within the OECD. Second, there is even less variation of these indices across time for individual countries.

In a similar vein, Calderon et al. (2004) show that emerging market economies with better institutions are more able to conduct a countercyclical fiscal policy[1]. Their empirical analysis is based on the International Country Risk Guide. Although the variation in this indicator is limited across OECD countries and time, it presents somewhat more variation than corruption indexes[2].

Other papers such as Gali and Perotti (2003) and Lane (2003) focus, as we do, on OECD countries. Gali and Perotti investigate whether fiscal policy in the European Monetary Union (EMU) has become more procyclical after the Maastricht treaty. They find no evidence for such a development. They do find however that while there is a

[1]There is also the paper by Talvi and Vegh (2000), where it is argued that high output volatility is most likely to generate a procyclical government spending. The idea is that running a budget surplus generates political pressures to spend more: the government therefore minimizes that surplus and becomes procyclical. This movement is then accentuated by a volatile output, and therefore a volatile tax base.

[2]We have also used these indicators in our analysis. However, they typically have no significant effect on GDP growth over time in our sample. Moreover, as they are less widely available than our main variables of interest, their use considerably restricts the available sample, leading to less precise estimates. We have therefore decided not to use these indicators in the results reported here.

trend in the OECD towards a more countercyclical fiscal policy over time, the EMU is lagging behind that trend. Lane (2003) is probably the paper that comes closer to the analysis developed in the third section of our paper. Lane examines the cyclical behavior of fiscal policy within the OECD. He then uses trade openness, output volatility, output per capita, the size of the public sector and an index for political power dispersion to examine cross-country differences in cyclicality. The reason why power dispersion may play a role is taken from Lane and Tornell (1998): when multiple political groups compete for public spending, the latter may become more procyclical. No group wants to let any substantial fiscal surplus subsist because they are afraid that this will not lead to debt repayment, but rather to other groups appropriating that surplus. Lane finds in particular evidence that GDP growth volatility, trade openness and political divisions lead to a more procyclical spending pattern, even though the effect of political divisions is not present for all categories of spending. We contribute to this literature by using yearly panel data to analyze the cyclicality of budgetary policies and its determinants within OECD countries, and we show that the degree of financial development is an important element to explain both, cross-country and within country variations in such policies, while future or present EMU membership explains cross-country variations. Moreover, we show that inflation targeting is associated with a more countercyclical public debt growth.

Most closely related to our second stage analysis of the effect of countercyclical budgetary policy on growth, are Aghion-Angeletos-Banerjee-Manova (2005), henceforth AABM, and Aghion-Bacchetta-Ranciere-Rogoff (2006), henceforth ABRR. AABM develop a model to explain why macroeconomic volatility is more negatively correlated with productivity growth, the lower financial development, and they test this prediction using cross-country panel data. ABRR move from a closed real to an open monetary economy and show that a fixed nominal exchange rate regime or lower real exchange rate volatility are more positively associated with productivity growth, the lower financial development and the lower the ratio of real shocks to financial shocks.

The remaining part of the paper is organized as follows. Section 2 develops the first stage analysis of the cyclicality of public debt growth for each OECD country and each year covered by our panel data set. In Section 3, we uncover some main determinants of the cyclicality of public debt. In Section 4, we regress GDP growth on financial development, the cyclicality coefficients computed in the first-stage regressions, and the interaction between the two. Finally, Section 5 concludes.

2 The cyclicality of public spending in the cross-country panel

2.1 Data

Panel data on GDP, the GDP gap (ygap), the GDP deflator, government gross debt (ggfl), and total government disbursements (ypgt) are taken from the OECD Economic Outlook annual series[3]. Total government disbursements include government investment, government consumption, debt repayment, subsidies to the private sector, social security and other related transfers, capital transfers and government consumption of fixed capital. Note that debt and other government data refer to general government. Financial development is measured by the ratio of private credit to GDP, and annual cross-country data for this measure of financial development can be drawn from the Levine database[4]. In this latter measure, private credit is all credit to private agents, and therefore includes credit to households. The 'average years of education in the population over 25 years old' series is directly borrowed from the Barro-Lee dataset; this measure is only available every five years and has been linearly interpolated to obtain a yearly series. The openness variable is defined as exports and imports over GDP and data on it come from the Penn World Tables 6.1. The population growth, government share of GDP and investment share of GDP also come from the Penn World Tables 6.1. The inflation targeting dummy

[3]Codes in parenthesis indicate the names of variables in the dataset. Full documentation available at http://www.oecd.org/findDocument/0,2350,en_2649_34573_1_119669_1_1_1,00.html. Data can be downloaded from sourceoecd.org for subscribers to that service.

[4]Data downloadable from Ross Levine's homepage.

is defined using the dates when countries adopted inflation targeting, as summarized in Vega and Winkelried (2005). All nominal variables are deflated using the GDP deflator. Summary statistics can be found in Table 1. The sample is an unbalanced panel including the following countries: Australia, Austria, Belgium, Canada, Denmark, Spain, Finland, France, United Kingdom, Germany[5], Greece, Iceland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Sweden, USA.

2.2 Public debt growth and the output gap

The baseline model for public debt growth as a function of the output gap, comes from the tax-rate-smoothing model by Barro (1979). In this framework, deficits emerge from temporary deviations of government expenditure from "normal" and from temporary deviations of the tax base, assumed to be represented by real GDP, from "normal." Since tax-rate smoothing relates to the ratio of public debt to GDP, an interaction of the level of debt with anticipated growth of GDP also factors into budget deficits. Moreover, given the way real deficits are usually calculated in national accounts (corresponding to changes in nominal debt divided by a price index), it is the growth of nominal GDP that matters. That is, anticipated inflation influences the "real" deficit.

We assume that the relevant tax base is proportional to real GDP, y_t. We assume further that smoothing of the relevant marginal tax rates (for example, on labor income or consumption or value added) corresponds to smoothing the average tax rates, T_t/y_t, where T_t is real taxes collected in year t.

Let g_t be real government expenditure on purchases and transfers. Suppose that $log(g_t)$ deviates temporarily from its trend, $[log(g_t)]^*$. Formally, the trend should correspond to the expected present value of expenditure. In practice, we use an H-P filter to estimate the trend in $log(g_t)$. The deviation, $log(g_t) - [log(g_t)]^*$, is the proportionate

[5] All level variables are adjusted for the German reunification. The adjustment involves regressing each variable of interest on time and a constant in the ten years before 1991 (data based on West Germany only). We then use the estimated coefficients to predict the values for 1991 to 2000. We take the average ratio between actual and predicted values in the years 1991 to 2000. We use this ratio to proportionally adjust values before 1991.

departure of g_t from normal. Multiplying by the trend or normal value, $(g_t)^*$, gives the amount of real debt issue required to finance temporary expenditure (rather than having temporarily high tax rates).

Suppose that $log(y_t)$ deviates temporarily from its trend, $[log(y_t)]^*$. A positive value corresponds to a boom and a negative one to a recession. We use an OECD measure of potential GDP based on of capacity output to measure $[log(y_t)]^*$. Given the behavior of g_t, tax-rate smoothing implies that a temporary excess of $log(y_t)$ from $[log(y_t)]^*$ calls for an equi-proportionate excess of real taxes, T_t, from normal. Normal real taxes correspond to normal or trend expenditure, $(g_t)^*$. Therefore, the product of $log(y_t) - [log(y_t)]^*$ and $(g_t)^*$ gives the budget surplus (corresponding to a temporarily high level of real taxes collected) associated with a boom.

Given $log(g_t) - [log(g_t)]^*$ and $log(y_t) - [log(y_t)]^*$, tax-rate smoothing calls for expanding the level of real debt, b_t, along with expansions of real GDP, y_t. That is, if $log(g_t) = [log(g_t)]^*$ and $log(y_t) = [log(y_t)]^*$, the debt-GDP ratio should stay constant. Therefore, the change in the real debt, $b_t - b_{t-1}$, includes a term γb_{t-1}, where γ is the (trend) growth rate of real GDP.

The national accounts typically measure the real budget deficit as the real value of the change in the nominal debt (because nominal government expenditure includes interest payments computed from the nominal interest rate). When measured this way, tax-rate smoothing implies that the real budget deficit includes another term, πb_{t-1}, where π is the (expected) inflation rate. That is, the measured real budget deficit depends on the overall term $(\gamma + \pi)b_{t-1}$, where $\gamma + \pi$ is the growth rate of nominal GDP.

The term $(\gamma + \pi)b_{t-1}$ should move closely with the real value of nominal interest payments. The difference is that nominal interest payments depend on the real interest rate, r, rather than the growth rate of real GDP, γ. If we generate a dependent variable by subtracting the real value of nominal interest payments from the measured real budget deficit, the coefficient on the variable b_{t-1} on the right-hand side should be $\gamma - r$, which we treat as a constant. This constant would be negative in the standard deterministic model. (However, with uncertainty, the real rate r on government debt could be smaller than γ, the mean growth rate of real GDP.)

The baseline tax-smoothing model has no tendency for the debt-GDP ratio to revert to a stationary mean, such as zero. (More generally, the ratio might revert to something positive, possibly dependent on other assets held by the government.) If there were a tendency for the debt-GDP ratio to revert toward zero, we might pick up this effect from the coefficient on the stock of real debt, b_{t-1}. Thus, a negative coefficient on b_{t-1} could represent this mean reversion, along with the effect $\gamma - r$ already mentioned.

Our empirical counterpart of the tax-rate smoothing model of budget deficits is then for each country i:

$$\begin{aligned} \frac{(b_{it} - b_{i,t-1}) - i_{it}}{y_{it}} &= a_{1it} y_{gap,it} \frac{\overline{g_{it}}}{y_{it}} \\ &\quad + a_{2it} \{\ln(g_{it}) - \overline{\ln(g_{it})}\} \frac{\overline{g_{it}}}{y_{it}} + a_{3it} \frac{b_{i,t-1}}{y_{it}} + a_{4it} + \varepsilon_{it} \\ \text{where } \varepsilon_{it} &\sim N(0, \sigma_{\varepsilon}^2). \end{aligned} \tag{1}$$

Empirically, the variables are defined as follows:

- b_{it} : gross government debt in country i at year t
- i_{it} : interest payments made by the government in country i and year t
- y_{it} : the GDP in country i and year t, in value
- $y_{gap,it}$: the GDP gap in country i and year t as computed by the OECD based on a production function approach.
- g_{it} : total government disbursements in country i and year t
- ε_{it} : error term

A bar above a variable indicates that one takes the prediction for this variable using the Hodrick-Prescott filter. A lambda parameter of 25 was chosen, following OECD(1995). The prediction was then computed separately for each country.

Note that $b_{it} - b_{i,t-1}$ is exactly equal to the opposite of the budget balance, so that our left-hand side variable is very close to the opposite of the budget balance as a share of GDP.

The a coefficients to be estimated are for the purpose of this paper, assumed to be potentially time-varying, which is why we write a_{jit} to denote the coefficient on the variable j in country i at time t.

With tax smoothing, the predicted coefficients are $a_{1it} = -1$ and $a_{2it} = 1$. The coefficient a_{3it} corresponds, as discussed, to $\gamma - r$ (plus a possible negative effect associated with reversion of the debt-GDP ratio toward zero or some other positive target value).

Even if a government does not precisely pursue tax-rate smoothing, the formulation in equation (1) is useful in the sense that the deviations of the estimated coefficients a from the values prescribed under tax smoothing are informative. For example, if $a_{1it} < -1$, the government is pursuing a more counter-cyclical deficit policy than called for by tax smoothing, and vice versa if $a_{1it} > -1$. A procyclical deficit policy, $a_{1it} > 0$, is very far from tax-rate smoothing; that is, $a_{1it} = 0$ is not the natural baseline.

We now move on to examine how the coefficients a_{jit} can be estimated econometrically.

2.3 Two econometric methods

Regression based approaches to measure the cyclicality of fiscal policies are now common in the literature and can be found for example in Lane (2003) and Alesina and Tabellini (2005). However, the methods used in these papers give rise to only one observation of cyclicality per country. In order to make full use of the panel structure of our data, we compute instead for each country yearly measures for the cyclicality of debt growth. Our first method uses local Gaussian-weighted ordinary least squares estimates (also called kernel-based nonparametric regression or local smoothing): for each year, points that are closer in time are given more weight than points that are further away. Our second method is to compute time-varying coefficients in the above equation 1 under the assumption that these coefficients follow an AR(1) process. We now describe each of these methods in more detail. [6]

The "local Gaussian-weighted ordinary least squares" method consists in computing the a_{jit} coefficients by using all the observations available for each country i and then performing one regression for each date t, where the observations are weighted by a Gaussian centered at date t:

$$
\begin{aligned}
\frac{(b_{it} - b_{i,t-1}) - i_{it}}{y_{it}} &= a_{1it} y_{gap,i\tau} \frac{\overline{g_{i\tau}}}{y_{i\tau}} + a_{2it}\{\ln(g_{i\tau}) - \overline{\ln(g_{i\tau})}\} \frac{\overline{g_{i\tau}}}{y_{i\tau}} \\
&\quad + a_{3it} \frac{b_{i\tau-1}}{y_{i\tau}} + a_{4it} + \varepsilon_{i\tau}, \qquad (2) \\
\text{where } \varepsilon_{i\tau} &\sim N(0, \sigma^2 / w_t(\tau)) \text{ and } w_t(\tau) = \frac{1}{\sigma\sqrt{2\Pi}} \exp\left(-\frac{(\tau - t)^2}{2\sigma^2}\right).
\end{aligned}
$$

Our second and preferred method, assumes that coefficients follow an AR(1) process, namely, using the notation from equation 1, for each country i and for each coefficient j:

[6] Another method is to compute finite (for example 10-years) rolling window ordinary least squares estimates. This kind of method is straightforward but very noisy and therefore not too reliable.

The ten-year rolling window OLS method simply amounts to estimating the procyclicality of the growth of public debt $\frac{(b_{it}-b_{i,t-1})-i_{it}}{y_{it}}$ at year t in country i by running the following regression for each country i, and all possible τ:

$$
\begin{aligned}
\frac{(b_{it} - b_{i,t-1}) - i_{it}}{y_{it}} &= a_{1it} y_{gap,i\tau} \frac{\overline{g_{i\tau}}}{y_{i\tau}} + a_{2it}\{\ln(g_{i\tau}) - \overline{\ln(g_{i\tau})}\} \frac{\overline{g_{i\tau}}}{y_{i\tau}} + a_{3it} \frac{b_{i,\tau-1}}{y_{i\tau}} + a_{4it} + \varepsilon_{i\tau}, \\
\text{for } \tau &\in (t-5, t+4).
\end{aligned}
$$

that is, one uses a ten year centered rolling window to estimate the pro-cyclicality of public debt growth at any date t. This method suffers however from serious shortcomings. First, by definition, we lose the first five years and the last four years of data for each country. Second, because the method involves estimating a coefficient by discarding at each time period one old observation and taking into account a new one, the coefficient can vary substantially when the new observation is very different from the one it replaces. This implies that the series may be jagged and affected by noise and transitory changes; moreover, a sudden jump in the series would not be coming from changes in the immediate neighborhood of date t, but from changes 5 years before and 4 years after.

$$a_{jit} = a_{ji,t-1} + \varepsilon_{it}^{a_j}, \varepsilon_{it}^{a_j} \sim N(0, \sigma_{a_j}^2). \quad (3)$$

The main challenge in implementing this method is to estimate $\sigma_{a_j}^2$ (the variance of the coefficient) at the same time as the variance of the observation, i.e. the variance σ_ε^2 in the formulation of equation 1. Once these variances are estimated, applying the Kalman smoother gives the best estimates for a_{jit}.

The optimal estimates for these variance are extremely hard to compute. While finding analytical closed form solutions turns out to be virtually impossible, Markov Chain Monte Carlo (MCMC) methods provide a feasible numerical approximation. We implement the method in Matlab, assuming that the variances of the coefficients and equation are the same for all countries[7]. We are thus left with five variances to estimate: four for the coefficient processes ($\sigma_{a_j}^2, j = 1, 2, 3, 4$) and one for the variance of the error in the equation (σ_ε^2). Intuitively, the MCMC method explores randomly (using a Markov chain, hence the name) a wide spectrum of possible values for the variances, and one then retains a set of values that is representative of probable values given the data[8]. An advantage of the MCMC method over maximum likelihood type methods is that it does not get stuck in local solutions and properly represents uncertainty about the variances[9]. Once we obtain the estimates of these five variances the a_{jit} coefficients can be calculated using the Kalman smoother.

AR(1) MCMC is our preferred method for two reasons. First, it reflects a reasonable assumption about policy, i.e. that policy changes slowly and depends on the immediate

[7]This assumption is reasonable since the OECD countries in our sample share similar institutions and degrees of economic development. Moreover, this assumption is similar to assuming no heteroskedasiticty across panels when estimating a panel regression, which is the standard assumption. Finally, assuming country-specific variances would make estimates much more imprecise due to the fact that our relatively small number of observations would have to be used to identify many more parameters.

[8]See appendix 1 for more details on the implementation of this method.

[9]It is indeed also possible to use maximum likelihood type methods to estimate the variances, but these are precisely liable to get stuck in local solutions. In a previous version of this paper, we used such a method, amended so that it does not systematically get stuck in a local solution. In practice, the estimates of the coefficients a_{jit} we had obtained using that method are highly correlated with the ones obtained here using MCMC.

past. Second, it is econometrically appealing in that it makes policy reflected in the a_{jit} coefficients depend on the past (because of the AR(1) specification), and not on the future; thus, when the a_{jit} coefficients are used as explanatory variables in panel regressions, it is less likely that there should be a reverse causation problem[10]. By contrast, the local Gaussian-weighted ordinary least squares method relies equally on past and future observations, which makes it less appealing as an exogenous explanatory variable. However, it still has the property of making the policy change slowly, as the estimates are smoothed by construction. We therefore also report results using this the local Gaussian-weighted ordinary least squares method, as a robustness check on our preferred estimates.

2.4 Results

We now use the Gaussian-weighted OLS and AR(1) methods as described above to characterize the level and time path of the procyclicality of government debt in the OECD countries in our sample. We also report some basic results with the 10 years rolling window method to illustrate the shortcomings of this estimation method.

Table 1 summarizes the descriptive statistics of our main variables of interest. It is worth noting that the three different methods used in the first stage to estimate procyclicality give very similar results. We note that gross debt is countercyclical (negative coefficient), which is consistent with Lane's (2003) finding that the primary surplus is procyclical, which in turn is equivalent to saying that government debt is countercyclical. Moreover, the mean of our gross debt procyclicality estimate[11] is very close to -1 for all methods considered, which is in line with the tax smoothing model described above.

TABLE 1 *HERE*

[10]Strictly speaking, even when using the AR(1) MCMC method, there is some dependency of estimates on future observations of the right-hand side variables. This is because some right-hand side variables are calculated using the HP filter; moreover, we use the Kalman smoother, which yields more precise estimates than the Kalman filter by conditioning the coefficient estimates on all observations, while still maintaining the constraint that the coefficients follow an AR(1) process.

[11]See Appendix 2 for detailed results by country and year.

We now look at the evolution of the procyclicality of public debt growth, as measured by the estimated coefficients a_{1it} from equation 1. Figure 1 shows the evolution of the procyclicality of debt for the US estimated by the three methods described above. We can readily see that, as expected, the 10 years rolling window yields most volatile results, and the AR(1) method is the smoothest with the Gaussian-weighted OLS method lying in between. Overall, all three methods show a decrease in procyclicality over time, with a recent trend towards increasing procyclicality shown by the 10 years rolling window and Gaussian-weighted OLS methods. Having thus illustrated how noisy the 10 years rolling window estimates are, we only use AR(1) MCMC and Gaussian-weighted OLS in the remainder of the paper.

FIGURE 1 *HERE*

In Figure 2, we then show the procyclicality of public debt estimated through the AR(1) method for a few countries in our sample . In general, and in line with US trends, procyclicality tends to diminish over time, especially since the 1980's. This downward trend in procyclicality is however more pronounced for the UK and the US than for the average of EMU countries. Also, one can observe some divergence between EMU and non-EMU countries: at the beginning of the period, the procyclicality of public debt growth in EMU countries was very similar to that in the US or the UK, however, as of the 1990's, the US and the UK became significantly more countercyclical whereas the EMU did not.

FIGURE 2 *HERE*

In Figure 3, we plot the same evolution, this time based on coefficients that are estimated using the Gaussian-weighted OLS. Trends in estimates are very similar to those obtained using the AR(1) method.

FIGURE 3 *HERE*

These results are consistent with Gali and Perotti (2003), who show, splitting their sample by decades, that in general fiscal deficits in the OECD have become more countercyclical, but less so in EMU countries. Here, we confirm these results using a full-fledged time-series measure of cyclicality.

To summarize our results from first stage regressions, we found that government debt has become more countercyclical in non-EMU countries than in EMU countries since the 1990s. In the next section we investigate possible explanations for these observed differences in the procyclicality of government debt across countries and over time.

3 First stage: determinants of public debt cyclicality

Since our sample is restricted to OECD countries, little variation should be expected from the corruption or other institutional variables considered by the literature so far[12]. Instead, we focus on the following candidate variables: financial development, openness, EMU membership, government share in GDP, and whether the country has adopted inflation targeting [13]. We also include GDP growth volatility as measured by the standard error of GDP growth, lag of log real GDP per capita, the government share of GDP, and EMU membership[14] as control variables.

Financial development is a plausible suspect as it influences both the ability and the willingness of governments to borrow in recessions. Lower financial development should thus translate into lower countercyclicality of public debt growth. While OECD countries are arguably less subject to borrowing constraints than other countries in the world, there

[12]As mentioned above, using ICRG indicators turns out not to be of interest for our analysis.

[13]In Table 1 of Appendix 3, we perform the same regression but adding budgetary rule indicators (See Van Hagen et al (2004).) which reflect the agenda-setting power of the finance minister or the extent to which budgets can be renegotiated in cabinet or in parliament. In particular, having multi-annual budgetary constraints on cabinet negotiations and/or on parliamentary discussions should reduce the countercyclicality of public debt growth, as this should reduce a country's ability to renegotiate its public debt upward in recessions. Having finance ministers with strong agenda-setting power first in cabinet negotiations with other ministers and then in parliamentary debates, should also affect the cyclicality of public debt.

[14]This dummy variable takes a value of 1 for all countries that currently belong to the EMU, and 0 for all the other countries. This is because the EMU has been prepared for many years so that the countries that would eventually join might be different even before the EMU is fully effective.

is still a fair amount of cross-country variation in financial development among OECD countries. Openness is also a plausible candidate as one can expect foreign capital to flow in during booms and flow out during recessions, implying that the cost of capital is higher during recessions than during booms. This in turn tends to increase the long-run cost of financing countercyclical public debt policies while maintaining the overall debt constant on average over the long run. The EMU dummy is also a plausible candidate, given: (i) our observation in Figures 2 and 3 that public debt growth is less countercyclical in the eurozone than in the US or the UK; (ii) the deficit and debt restrictions imposed by the Stability and Growth Pact and also the restrictions that individual countries imposed on themselves in order to qualify for EMU membership.

Inflation targeting should also improve a country's willingness or ability to conduct countercyclical budgetary policy. In particular, one potential factor that might discourage governments to borrow in recessions, is people's expectation that such borrowing might result in higher inflation in the future, for example as a way for the government to partially default on its debt obligations. This in turn would reduce the impact of current government borrowing on private (long-term) investment. Inflation targeting increases the effectiveness of government borrowing in recession by making such expectations unreasonable.

Table 2, where the procyclicality measures are derived using the AR(1) MCMC and Gaussian-weighted OLS methods, shows results that are consistent with these conjectures, namely: (i) in all specifications, higher financial development is positively and significantly correlated with the countercyclicality of government debt (the table shows a negative coefficient of public debt procyclicality); using the results from column 3, our estimates imply that a one standard deviation increase in private credit over GDP is associated with 37% of a standard deviation decrease in procyclicality of public debt growth; in other words, it is precisely when the countercyclicality of public debt is more positively correlated with growth, namely when financial development is low, that public debt countercyclicality seems hardest to achieve; (ii) in most specifications, more trade openness is negatively and significantly correlated with public debt countercyclicality (the table shows a positive coefficient on openness); (iii) according to the OLS estimates using the Gaussian-weighted OLS method, EMU countries appear to have a harder time achieving public debt countercyclicality[15]; the effect of the EMU dummy is more likely to be explained by rigidities already imposed by the precursor EMS regime and then reinforced by the Maastricht Treaty, rather than the 1999 implementation of the EMU itself[16]; further investigation of this question is however beyond the scope of this paper; (iv) a higher share of government in the GDP are associated with a more countercyclical debt policy; (v) pursuing inflation targeting is associated with more countercyclical public debt growth; using the results from column 3, our estimates imply that moving to inflation targeting would result in a 57% of a standard deviation decrease in the procyclicality of public debt, a very large effect.[17]

TABLE 2 HERE

Hence, a lower level of financial development, a higher degree of openness, belonging to the EMU group, and the absence of inflation targeting, are all associated with a lower degree of countercyclicality in government debt. In the next section we move to second stage analysis of the effect of public debt cyclicality on growth.

[15]When using AR(1) MCMC, the coefficient on EMU is also positive and significant IF we do not control for inflation targeting. This suggests that the positive effect on procyclicality of being in the EMU group may be partially explained by the fact that these countries, by and large, did not adopt inflation targeting. Therefore, if the EMU adopted inflation targeting, it would probably close at least some of the gap with such non-EMU countries as the UK.

[16]We have experimented with an interaction between the EMU dummy and a post-1999 dummy, but this interaction was typically insignificant, indicating that there is no substantial change occurring with the full implementation of the EMU in 1999.

[17]In Table 1 of Appendix 3 we also find that more powerful finance ministers in countries where the finance minister negotiates bilaterally with other cabinet members (Van Hagen et al (2004) refer to those countries as "delegation states")) is associated with more procyclical public debt growth, similarly, more stringent budgetary rules in countries where the executive has limited agenda-setting power (the so-called "contracts states" in Van Hagen et al) are also associated with more procyclical public debt growth.

4 Second stage: cyclical public debt and growth

In this section we regress growth on the cyclicality coefficients derived for public debt growth in the first stage regressions of the previous section, financial development, the interaction between the two variables, and a set of controls. Our conjecture is that the more firms are credit constrained, that is, the lower financial development, the more growth-enhancing countercyclical budgetary policies should be to the extent that they reduce the costs that negative liquidity shocks impose on credit-constrained firms. The underlying idea, modeled by AABM, is that, in an economy with tight credit constraints, the occurrence of a recession forces a number of firms to cut on innovative investments in order to survive idiosyncratic liquidity shocks. While we insist on the effects on firms, it is plausible that some of the growth-enhancing effect of countercyclical budgetary policies may come from the relaxation of workers' credit constraints; we leave to future work an attempt to disambiguate between these two channels.

To reduce the negative consequences of a recession (or a bad aggregate shock) on firms' innovative investments, the government may decide to increase the volume of its public investments, or public consumption, or to subsidize consumer credit in order to foster the demand for private firms' products. Alternatively, the government may choose to directly increase its subsidies to private enterprises, thereby increasing their liquidity holdings and thus making it easier for them to face idiosyncratic liquidity shocks without having to sacrifice R&D or other types of longer-term growth-enhancing investments. However, this may have the perverse effect of softening firms' budget constraints, thereby partly undermining the potential innovation-enhancing effect of recessions.

That government intervention might increase aggregate efficiency in an economy subject to credit constraints and aggregate shocks, has already been pointed out by Holmstrom and Tirole (1998). Our analysis in this section can be seen as a first attempt to explore potential empirical implications of this idea for the relationship between growth and public spending over the cycle.

4.1 Theoretical background

The following toy model is directly adapted from AABM and ABRR. Consider an economy composed of a continuum of firms, each of which lives for two periods. A firm born at date t produces at that date according to

$$y_t = a_t,$$

where a_t denotes the knowledge adjusted level of aggregate productivity. At the beginning of date t, the firm can also invest in R&D. Investing R&D effort $\frac{1}{2}z^2$, allows the firm innovate in period $(t+1)$ with probability z, provided the firm overcomes an idiosyncratic liquidity shock occurring at the end of period t. For simplicity, suppose that the liquidity shock $\widetilde{c}$ is independently and identically distributed across firms with uniform distribution over the interval [0,1], whereas the aggregate shock a_t over time is distributed according to

$$a_t = \begin{cases} 1+\varepsilon & \text{with probability } 1/2 \\ 1-\varepsilon & \text{with probability } 1/2 \end{cases} \tag{4}$$

The long-term R&D investment yields a (knowledge-adjusted) value equal to $\nu > 0$ in period $(t+1)$ whenever innovation is successful. The investment decision is made before the realization of the aggregate shock a_t. Finally, credit market imperfections prevent a firm with short-run profit flow a to invest more than μa, where $1 < \mu < \infty$, for the purpose of covering its idiosyncratic liquidity cost $\widetilde{c}$.

Before aggregate productivity a_t is realized, firms will choose to invest in R&D the amount of effort

$$z^* = \arg\max\{Vz - \frac{1}{2}z^2\} = V, \tag{5}$$

where

$$V = \nu.\mathbb{E}_t(\min[1, \mu a_t]), \tag{6}$$

with $\mathbb{E}_t$ denoting to the expected value at date t, and where

$$\min[1, \mu a_t] = \Pr(\widetilde{c} \leq \mu a_t) \tag{7}$$

is the probability of the firm overcoming its liquidity shock in period t conditional upon a_t.

One can easily show that increasing ε in equation 4, i.e. increasing the variance in a_t, will reduce V and therefore the firm's incentive to invest in R&D as it will reduce the expected probability of overcoming the liquidity shock. It will thus also reduce more the expected growth rate which we take to be equal to the expected innovation flow:

$$g_t = z^* \mathbb{E}_t(\min[1, \mu a_t]) = \nu\{\mathbb{E}_t(\min[1, \mu a_t])\}^2. \tag{8}$$

A countercyclical public debt policy that consists in taxing individuals when $a_t = 1+\varepsilon$ in order reduce the incidence of a low $a_t = 1-\varepsilon$ on firms' short term profits has the same effect as reducing the variance of a_t, which should then be growth-enhancing, and all the more so when μ is lower, i.e. when firms are more credit constrained.

4.2 Empirical specifications

In all the specifications we use for our second-stage regressions, we measure productivity growth by the first difference of the log of real GDP per capita. We then regress productivity growth on the lagged cyclicality of public debt growth as derived in the first stage regressions, the lagged private credit measure captured by the ratio of private credit to GDP and borrowed from Levine (2001), and the interaction between those two variables. As control variables, we typically use the lag of log real GDP per capita, the level of schooling, openness to trade, inflation, population growth, the government share of total

GDP, and inflation targeting. Moreover, in all specifications we weigh each observation by the inverse of the variance of the estimated cyclicality coefficient (aweights in Stata), thus giving higher weight to coefficients that are more precisely estimated in the first stage.

Using the set of cyclicality measures derived in the first stage respectively from the Gaussian-weighted least squares and AR(1) methods, we first perform ordinary least squares regressions, then move on to country fixed effect estimates, and we finally include year fixed effects on top of country fixed effects.

This empirical strategy raises however the question of whether our procyclicality variables are causal for growth. One simple step we took towards identifying a causal effect is to use the lagged procyclicality to explain growth, thus reducing the possibility of reverse causation. Second, we use GMM estimation to further probe the robustness of our results. In those GMM estimations, we instrument both the procyclicality variable and the lagged GDP per capita. For the latter, we use the classic instruments second and third lag of GDP per capita. For the procyclicality variable, we use inflation targeting as an instrument. Indeed, we have shown in Table 2 that inflation targeting is significant in predicting procyclicality; on the other hand, we find that inflation targeting has typically no independent effect on growth. This makes inflation targeting a good candidate instrument for procyclicality[18]. Excluded instruments in our GMM regressions are thus second and third lag of GDP per capita and the inflation targeting dummy.

Another source of concern for our estimation strategy is autocorrelation of residuals. Indeed, as is typical in panel growth regressions and can be confirmed by the Wooldridge test implemented in Stata's xtserial command, the errors are serially correlated (AR(1)) in first differences (this is true whether or not we include the lagged dependent variable, i.e. lag of log real GDP per capita). This implies that country fixed effect estimates may be biased. To correct for this potential bias, our GMM estimates allow for Newey errors

[18] We also experimented with adding the budgetary institutions variables from Hallerberg et al. (2004) as instruments, but those tend to have an independent effect on growth and therefore non-surprisingly failed the C test for validity of instruments.

(Bartlett kernel) of lag 1[19].

We perform the GMM estimates for both the AR(1) and Gaussian-weighted measures of procyclicality, using both country and country year fixed effects. In the case of AR(1) estimates, the model fails the J test for over-identification, and we cannot reject that procyclicality is exogenous. We therefore do not report GMM results for AR(1) estimates. The fact that AR(1) estimates of procyclicality are plausibly exogenous may be explained by the already pointed out fact that these estimates depend on the past and not on the future, while Gaussian-weighted estimates depend on both past and future. Even in the case of AR(1) estimates, one may still be concerned about autocorrelation of residuals. As a robustness check, we have used Stata's xtregar command, which implements the method described in Batalgi (2001) to estimate the coefficient of correlation between the errors and give unbiased estimates; since the coefficients on the variables of interests using this method were not statistically different from the ones found with simple fixed effects, we do not report these results.

4.3 Results

Table 3 shows the results of regressing the first difference of the log of real GDP per capita over the lagged cyclicality of government debt, measured by the coefficients obtained in the first stage regression using the AR(1) method. The prediction is that of a negative coefficient for the effect on growth of the procyclicality of public debt when private credit over GDP is 0, and of a positive coefficient on procyclicality interacted with financial development. We see that the corresponding coefficients in Table 3 always have the anticipated signs, and they are all significant: a more procyclical government debt is negatively correlated with growth, but the interaction term between public debt procyclicality and financial development is positive.

Table 3 is thus consistent with the prediction of a negative effect of procyclicality

[19] Varying the bandwidth of the Bartlett kernel (for autocorrelation) up to 5 does not affect results found with a bandwidth of 1.

in public debt on growth, whereas we see a positive and significant interaction effect between private credit and the procyclicality variable. Thus the less financially developed a country is, the more growth-enhancing it is for the government to be countercyclical in its debt policy.

TABLE 3 *HERE*

To get a better sense of the magnitude of the effects of public debt cyclicality on growth and the interaction of these effects with financial development, we can ask the following question: according to our estimates, what would happen if public debt in the EMU became as countercyclical as that in the US? Table 4 summarizes the answer to this question, which is based on the estimates in column 3 of Table 3, that is on the most demanding specification with both country and year fixed effects. Thus, if the EMU's government debt was to become as countercyclical as that in the US, which corresponds to a reduction in procyclicality equal to 1.18 units, then the EMU would gain 0.57 percentage points of growth. By contrast, if the US was to reduce its procyclicality by the same 1.18 units, it would grow *less* by 1 percentage point. While these figures should be taken with caution since we extrapolate well outside the range of average observed values for the EMU, they still point at significant growth effects of changes in the cyclicality of budgetary policy.

TABLE 4 *HERE*

Thus, paradoxically, EMU countries have public debt policies that are less countercyclical than in the US, even though the US are more financially developed than EMU (the ratio of private credit to GDP in 2000 in the EMU is equal 0.92 against 2.17 in the US and this does not take into account the difference in stock market capitalization and venture capital development between the two regions). Also, Table 4 suggests that growth in the US might benefit from a less countercyclical public debt policy, given the US level of financial development.

Finally, Table 5 performs the same second-stage exercise as in Table 3, but with the cyclicality coefficients on the right-hand side being computed using the Gaussian-weighted method. Overall, the results are similar to those found in Table 3. OLS estimates (column 1) do not yield significant effects of the procyclicality of debt growth and procyclicality interacted with private credit; however, when including country (column 2) or country and year (column 4) fixed effects, the coefficient on procyclicality becomes significant and of a magnitude similar to the one found for AR(1) estimates. While the coefficient on the interaction of procyclicality of public debt growth and private credit is significant with country fixed effects and of similar magnitude to the one found in Table 3, it becomes insignificant when adding year fixed effects. We also report results for GMM estimates. Generally speaking, first stage estimates are significant (see F test and Shea's partial R squared), but the explanatory power of inflation targeting for procyclicality is limited (Shea's partial R squared for procyclicality is around 1%). With country fixed effects (column 3), overidentifying restrictions are not rejected by the J test, and we reject that procyclicality and its interaction with private credit are exogenous. The point estimates (column 3) in the second stage on procycality and its interaction with private credit remain significant, and are larger than in the simple country fixed effects case. With country and year fixed effects (column 5), while the model still passes the overidentification test and the procyclicality variable and its interaction with private credit are still rejected to be exogenous, the coefficient on procyclicality becomes somewhat smaller and insignificant. Overall, we take these GMM results to be encouraging. Indeed, with country fixed effects, GMM estimates still yield significant effects of our variables of interest, and since inflation targeting is a relatively weak instrument for procyclicality, it is not surprising that significance can be sometimes lost, as is the case in column 5.

TABLE 5 *HERE*

5 Conclusion

In this paper we have analyzed the dynamics and determinants of the cyclicality of public debt on a yearly panel of OECD countries, and the relationship between public debt countercyclicality, financial development, and productivity growth. Our findings can be summarized as follows: first, countercyclicality has increased over time across all countries in our sample, however to a lower extent in EMU countries than in the US or the UK. Second, countercyclicality of government debt appears to be facilitated by a higher level of financial development, a lower degree of openness to trade, and a monetary policy committed to inflation targeting. Third, we found that countercyclical public debt policy is more growth enhancing the lower the country's level of financial development.

The line of research pursued in this paper bears potentially interesting growth policy implications. In particular, our second stage regressions suggest that productivity growth in EMU countries would be fostered if public debt growth in the eurozone became more countercyclical. Our first stage regression suggests that this in turn could be partly achieved by having the EMU area move to inflation targeting, e.g following the UK lead in this respect, and also by improving the coordination among finance ministers in the eurozone on fiscal policy over the cycle. One may alternatively argue that financial development is increasing in the EMU area over time, boosted by the monetary union itself, and that higher financial development reduces the need for countercyclical public debt growth. However, based on the historical growth trend of financial development, the EMU will not reach the current level of financial development of the USA until year 2084[20].

The analysis in this paper should be seen as one step in a broader research program. First, one could try to perform the same kind of analysis for other groups of countries,

[20]Even based on the faster growth trend of financial development of the 1990's, the EMU will only reach the USA level of financial development in 2068. In order for more countercyclicality to be no longer growth enhancing for the EMU, and based on growth trend of financial development of the 1990's, the EMU would still have to wait for several decades (at least until between 2020 and 2030, depending on which specification we base our estimates on).

e.g middle income countries in Latin America or in Central and Eastern Europe. Second, one could take a similar AABM-type of approach to volatility, financial development and growth to further explore the relationship between growth and the conduct of monetary policy. For example, to which extent allowing for higher procyclicality of short term nominal interest rates, can help firms maintain R&D investments in recessions and/or improve governments' ability to implement growth-enhancing countercyclical budgetary policies? Third, one could analyze in more detail which types of countercyclical public spending (consumption, investment) are most growth-enhancing, and on which sectors. Finally, one could investigate the possible interactions in growth regressions between countercyclical budgetary policy and structural reforms in the product and labor markets.

References

[1] Acemoglu, D, Johnson, S, Robinson, J, and Y. Thaicharoen (2003), "Institutional Causes, Macroeconomic Symptoms: Volatility, Crises, and Growth", *Journal of Monetary Economics,* 50,49-123.

[2] Aghion, P, Angeletos, M, Banerjee, A, and K. Manova (2005), "Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment", NBER Working Paper No 11349.

[3] Aghion, P, Bacchetta, P, Ranciere, R, and K. Rogoff (2006), "Exchange Rate Volatility and Productivity Growth: The Role of Financial Development", NBER Working Paper No 12117.

[4] Alesina, A, and R. Perotti. (1996), "Fiscal Adjustments in OECD Countries: Composition and Macroeconomic Effects", NBER Working Paper No 5730.

[5] Alesina, A, and G. Tabellini (2005), "Why is Fiscal Policy often Procyclical?", NBER Working Paper No 11600.

[6] Barro, R (1979), "On the Determination of Public Debt", *Journal of Political Economy*, 87, pp. 940-971.

[7] Batalgi, B (2001), *Econometric Analysis of Panel Data*, 2d ed. New York: John Wiley & Sons.

[8] Calderon, C, Duncan, R, and K. Schmidt-Hebbel (2004), "Institutions and Cyclical Properties of Macroeconomic Policies", Central Bank of Chile Working Papers No 285.

[9] Chib,S, and E. Greenberg (1995), "Understanding the Metropolis-Hastings Algorithm", *The American Statistician*, 49, 327-335.

[10] Easterly, W, (2005), "National Policies and Economic Growth: A Reappraisal", Chapter 15 in *Handbook of Economic Growth,* P. Aghion and S. Durlauf eds.

[11] Gali, J, and R. Perotti (2003), "Fiscal Policy and Monetary Integration in Europe", *Economic Policy*, 533-572.

[12] Hallerberg M., Strauch R., von Hagen J. (2004), "The design of fiscal rules and forms of governance in European Union countries," Working Paper Series 419, European Central Bank.

[13] Kording K. and Marinescu I. (2006), "Sampling approaches to Kalman learning", work in progress.

[14] Lane, P, (2002), "The Cyclical Behavior of Fiscal Policy: Evidence from the OECD", *Journal of Public Economics,* 87, 2661-2675.

[15] Lane, P, and A. Tornell (1998), "Why Aren't Latin American Savings Rates Procyclical?, *Journal of Development Economics*, 57, 185-200.

[16] OECD (1995), "Estimating Potential Output, Output Gaps and Structural Budget Balances", by Claude Giorno, Pete Richardson, Deborah Roseveare and Paul van den Noord, OECD Economics Department Working Paper No. 152.

[17] Talvi, E, and C. Vegh (2000), "Tax Base Variability and Procyclical Fiscal Policy", NBER Working Paper No 7499.

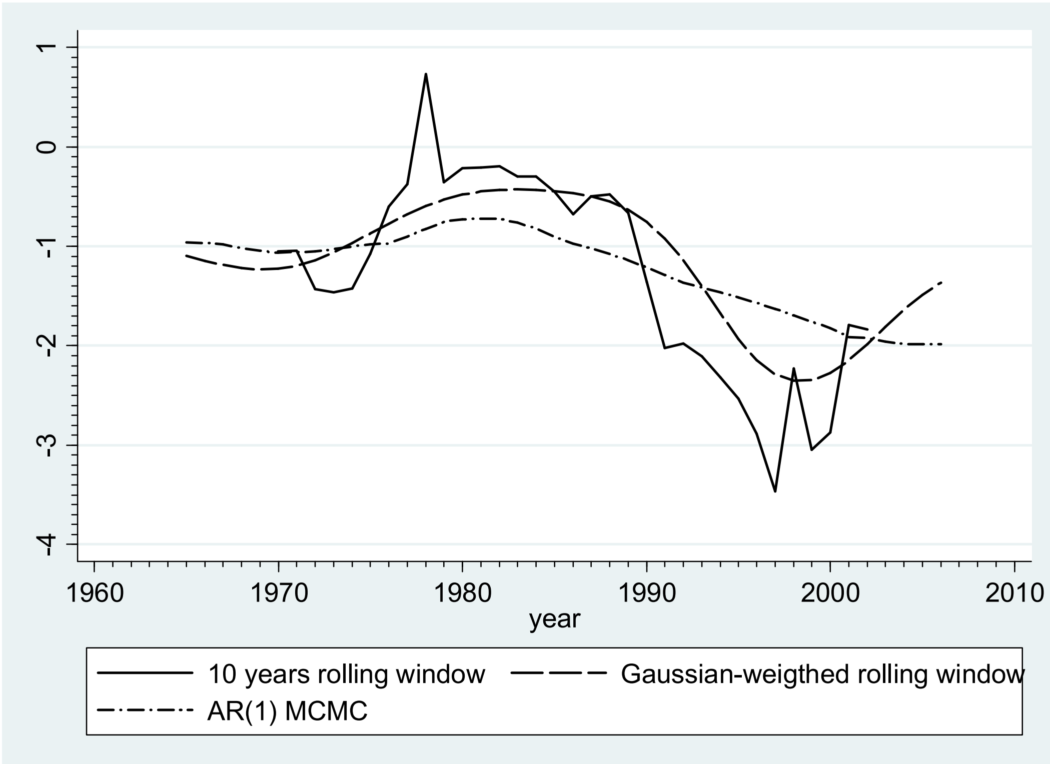
[18] Vega M. and Winkelried D. (2005), "Inflation targeting and inflation behavior: a successful story?", International Journal of Central Banking, Vol. 1, No. 3, December 2005, 153-175.

Table 1: Summary statistics

	Obs.	Mean	Std. Dev.	Min	Max
GDP gap	622	-0.003	0.029	-0.109	0.160
Gross government debt/GDP	622	0.553	0.274	0.073	1.608
(d.Gross government debt-interests)/GDP	622	0.007	0.044	-0.113	0.195
Procyclicality of gross government debt (AR(1))	612	-0.925	1.042	-4.206	1.447
Procyclicality of gross government debt (Gaussian weighted rolling window)	643	-1.072	1.169	-4.004	1.951
Procyclicality of gross government debt (10-years rolling window)	454	-1.179	1.923	-9.259	3.466
Growth of GDP per capita	565	0.022	0.023	-0.092	0.107
Private credit/GDP	515	0.831	0.388	0.132	2.240
Average years of schooling for the population over 25 years old	485	8.325	1.996	2.580	12.250
Openness	495	52.074	26.493	9.228	155.568
Inflation	622	0.058	0.065	-0.025	0.762
Population growth	565	0.005	0.005	-0.018	0.047
Government share of GDP (in %)	495	12.483	5.796	3.008	26.638
Investment/GDP (in%)	495	23.535	4.357	12.867	41.022
Inflation targeting dummy	643	0.142	0.349	0	1

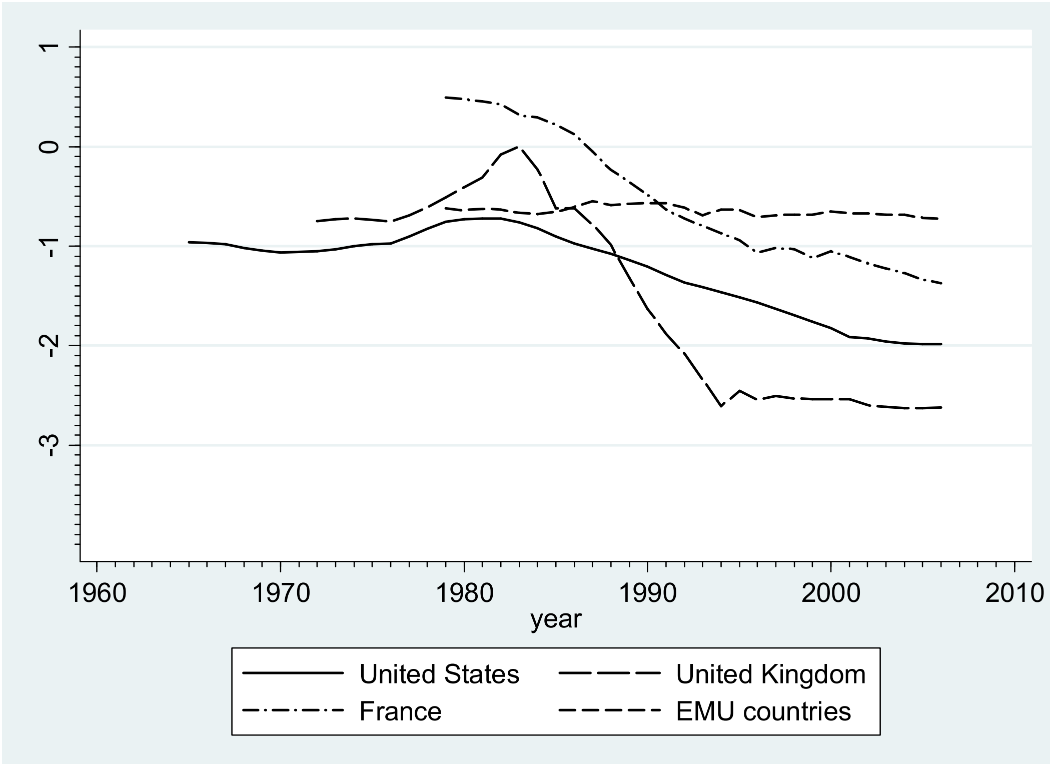
Note: sample restricted to observations where the procyclicality of gross government consumption computed using Gaussian weighted rolling windows is not missing.
Source: OECD Economic Outlook, Levine dataset, Barro Lee dataset, Penn World Tables 6.1.

Figure 1: the procyclicality of public debt in the USA



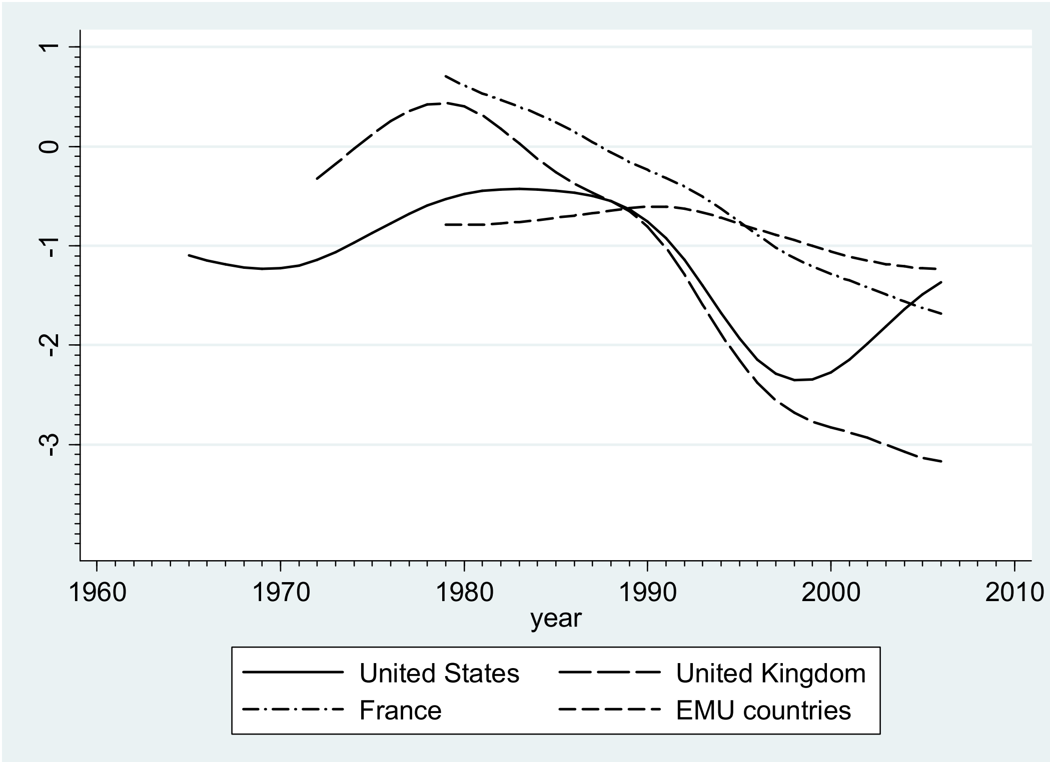
Note: the graph plots the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques.
Source: OECD Economic Outlook.

Figure 2: The procyclicality of public debt using the AR(1) MCMC method



Note: the graph plots the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using the AR(1) MCMC method. For EMU countries (i.e. countries who are or will be part of the EMU), the line represents the average of the estimated coefficients for the EMU countries present in the sample; the average is only computed for those years where all EMU countries have non-missing observations.
Source: OECD Economic Outlook.

Figure 3: The procyclicality of public debt using the Gaussian-weighted OLS method



Note: the graph plots the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using the Gaussian-weighted rolling window OLS method. For EMU countries (i.e. countries who are or will be part of the EMU), the line represents the average of the estimated coefficients for the EMU countries present in the sample; the average is only computed for those years where all EMU countries have non-missing observations.
Source: OECD Economic Outlook.

Table 2: The determinants of government debt procyclicality

	AR(1)			WRW		
	OLS	Country f.e.	Country year f.e.	OLS	Country f.e.	Country year f.e.
Private credit/GDP	-0.630	-0.982	-1.013	-0.487	-1.074	-0.977
	(0.118)***	(0.129)***	(0.140)***	(0.163)***	(0.123)***	(0.130)***
EMU country	-0.023			0.220		
	(0.085)			(0.101)**		
Standard error	-9.183			-4.737		
of GDP growth	(1.479)***			(1.555)***		
Lag(log (real GDP	-0.012	0.081	-0.202	-0.033	-0.719	-0.206
per capita))	(0.045)	(0.267)	(0.499)	(0.038)	(0.249)***	(0.568)
Openness	0.000	0.003	0.021	0.008	0.016	0.024
	(0.001)	(0.004)	(0.005)***	(0.002)***	(0.003)***	(0.005)***
Government share	-0.008	-0.009	-0.016	-0.031	-0.015	-0.024
of GDP (in %)	(0.008)	(0.006)	(0.007)**	(0.010)***	(0.005)***	(0.005)***
Inflation targeting	-1.249	-0.620	-0.593	-1.060	-0.429	-0.329
	(0.119)***	(0.100)***	(0.113)***	(0.130)***	(0.081)***	(0.091)***
Constant	0.370	0.804	-2.510	-0.576	-6.321	-2.676
	(0.527)	(2.347)	(4.312)	(0.555)	(2.105)***	(4.872)
Observations	515	515	515	489	489	489
R-squared	0.27	0.79	0.80	0.18	0.87	0.88

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The explained variable is the coefficient on the GDP gap composite variable from equation 1, estimated using the AR(1) MCMC method for columns 1-3, and the Gaussian-weighted rolling window method for columns 4-6. EMU country is a dummy variable equal to 1 for all countries that are part of the EMU as of 2006.
Source: OECD Economic Outlook, Levine dataset, Barro Lee dataset, Penn World Tables 6.1.

Table 3: The effect of public debt procyclicality on growth, AR(1) MCMC method

	OLS	Country f.e.	Country year f.e.
lag(Procyclicality of government debt)	-0.005	-0.023	-0.015
	(0.002)**	(0.005)***	(0.005)***
lag(Private credit/GDP)	0.002	-0.003	-0.012
	(0.005)	(0.009)	(0.009)
lag(Procyclicality of government debt*Private credit/GDP)	0.007	0.017	0.011
	(0.003)*	(0.005)***	(0.005)**
lag(log (real GDP per capita))	-0.001	-0.101	-0.135
	(0.001)	(0.015)***	(0.023)***
Average years of schooling for the population over 25 years old	-0.001	0.007	0.005
	(0.001)	(0.003)**	(0.003)**
Openness	-0.000	0.001	0.001
	(0.000)	(0.000)***	(0.000)**
Inflation	-0.047	-0.071	-0.043
	(0.021)**	(0.021)***	(0.022)*
Population growth	-1.279	-2.090	-1.481
	(0.402)***	(0.317)***	(0.283)***
Government share of GDP (in %)	0.000	-0.001	-0.001
	(0.000)	(0.000)**	(0.000)*
Investment/GDP (in%)	0.001	0.003	0.002
	(0.000)***	(0.000)***	(0.000)***
Inflation targeting	0.011	-0.003	-0.001
	(0.005)**	(0.005)	(0.004)
Constant	-0.005	-0.934	-1.162
	(0.021)	(0.142)***	(0.197)***
Observations	460	460	460
R-squared	0.19	0.40	0.61

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The explained variable is the first difference of the log of real GDP per capita.
Source: OECD Economic Outlook, Levine dataset, Barro Lee dataset, Penn World Tables 6.1.

Table 4: Implied effect on growth of a change in the procyclicality of public debt such that the EMU would have the same level of procyclicality as the US in 2000

	Estimated coef. on lag (Procyclicality of government debt)		Difference US-EMU		Estimated coef. lag(Procyclicality of government debt*private credit/GDP)		Difference US-EMU		Average(lag (private credit/ GDP))		Implied effect on growth
EMU in 2000	-0.0150	*	-1.1840	+	0.0110	*	-1.1840	*	0.9242	=	0.0057
US in 2000	-0.0150	*	-1.1840	+	0.0110	*	-1.1840	*	2.1696	=	-0.0105

Note: The estimated coefficients are taken from estimates column 3 of Table 3. The difference US-EMU is defined as: (procyclicality of government debt in the US in 2000)- (procyclicality of government debt in the EMU in 2000). The averages of variables are calculated using the same sample on which regressions were estimated.
Source: OECD Economic Outlook, Levine dataset, Barro Lee dataset, Penn World Tables 6.1.

Table 5: The effect of public debt procyclicality on growth, Gaussian-weighted OLS method

	OLS	Country f.e.		Country year f.e.	
		Standard	GMM+ Newey errors	Standard	GMM+ Newey errors
lag(Procyclicality of government debt)	-0.003	-0.029	-0.112	-0.010	-0.077
	(0.003)	(0.005)***	(0.059)*	(0.004)**	(0.052)
lag(Private credit/GDP)	-0.008	-0.002	0.086	-0.027	0.045
	(0.006)	(0.010)	(0.047)*	(0.009)***	(0.044)
lag(Procyclicality of government debt*Private credit/GDP)	-0.000	0.019	0.108	0.003	0.075
	(0.004)	(0.005)***	(0.052)**	(0.004)	(0.047)
lag(log (real GDP per capita))	-0.001	-0.114	-0.140	-0.153	-0.169
	(0.002)	(0.020)***	(0.026)***	(0.028)***	(0.032)***
Average years of schooling for the population over 25 years old	0.001	0.005	0.007	0.002	0.003
	(0.001)	(0.005)	(0.005)	(0.004)	(0.004)
Openness	-0.000	0.001	0.001	0.001	0.001
	(0.000)**	(0.000)***	(0.000)***	(0.000)**	(0.000)
Inflation	-0.047	-0.077	-0.115	-0.031	-0.040
	(0.025)*	(0.023)***	(0.040)***	(0.033)	(0.045)
Population growth	-0.490	-1.979	-2.480	-1.022	-1.778
	(0.374)	(0.498)***	(0.849)***	(0.374)***	(0.822)**
Government share of GDP (in %)	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.000)	(0.000)**	(0.001)*	(0.000)**	(0.001)
Investment/GDP (in%)	0.002	0.004	0.005	0.003	0.004
	(0.000)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Inflation targeting	0.003	-0.008		-0.003	
	(0.005)	(0.006)		(0.005)	
Constant	-0.021	-1.110		-1.364	
	(0.029)	(0.200)***		(0.241)***	
Observations	485	485	485	485	485
R-squared	0.11	0.37		0.64	
Robust standard errors in parentheses					
* significant at 10%; ** significant at 5%; *** significant at 1%					
GMM diagnostic statistics (P-values in parentheses)					
F test of excluded instruments					
lag(Proc. of gov. debt)			9.65 (0.000)		8.03 (0.000)
lag(Proc. of gov. debt* P. c.)			14.09 (0.000)		8.51 (0.000)
lag(log (r. GDP per cap.))			962.05 (0.000)		328.39 (0.000)
Shea's partial R squared					
lag(Proc. of gov. debt)			0.0143		0.0088
lag(Proc. of gov. debt* P. c.)			0.0167		0.0102
lag(log (r. GDP per cap.))			0.7371		0.4854
Hansen J statistic			0.275 (0.600)		0.039 (0.843)
Exogeneity test					
lag(Proc. of gov. debt) and lag(Proc. of gov. debt* P. c.)			7.243 (0.027)		5.712 (0.058)
lag(log (r. GDP per cap.))			2.530 (0.112)		9.426 (0.002)

Note: The explained variable is the first difference of the log of real GDP per capita. In columns 3 and 5, GMM estimation with fixed effects is performed using Stata's xtivreg2; estimation is robust to heteroskedasticity and autocorrelation (Bartlett kernel, bandwidth=1); endogenous variables are the lag of procyclicality, the interaction of procyclicality with private credit, and the lagged GDP per capita; excluded instruments are inflation targeting, the interaction of inflation targeting and private credit, and the second and third lag of GDP per capita.
Source: OECD Economic Outlook, Levine dataset, Barro Lee dataset, Penn World Tables 6.1.

Appendix 1: the AR(1) MCMC method for calculating cyclicality in the first stage

The aim of this section is to give a brief description of how we used the Kalman smoother together with Markov Chain Monte Carlo methods (MCMC) in order to estimate the coefficients a_{jit} from equation 1 under the assumption that they follow an AR(1) process as desribed by equation 2. The implementation was carried out in Matlab.

Estimating the means and variances of the coefficients of interest - that is a_{jit} in equation 2 - involves two procedures: Kalman smoothing[1] and MCMC.

To compute the coefficients with the Kalman smoother for each country, we need to know the values of five variances :

- $\sigma^2_{a_j}$ in equation 2, for $j = 1, 2, 3, 4$, i.e. the process variances in the terminology of the Kalman smoother
- the variance σ^2_ε of the error term ε_t in equation 1, i.e. the measurement error variance in the terminology of the Kalman smoother.

Moreover, to use the Kalman smoother, we need a prior for the first period of observation for each country, that is a specification of our expectation over the values a_{jit} at the first time step. As we do not have any meaningful prior information about cyclicality at the first observed period, we use a very high variance around the prior mean, so that this prior has a negligeable effect on the estimates. Specifically, the set of initial values for the coefficients were chosen to be the OLS estimates of the coefficients using the first 10 years of data for each country, and the value of the intial variance is set to be 100000 times the estimated variance of these coefficients.

[1]For an excellent overview of the Kalman filter and smoother, see the notes by Max Welling "Kalman Filters", available on the web at http://www.ics.uci.edu/˜welling/classnotes/classnotes.html. The difference between the Kalman filter and smoother is that the latter uses future values as well as past values to estimate the coefficients of interest. We use the Kalman smoother here rather than the filter for two reasons. First, we want to make maximum use of a limited data and the smoother uses more information. Second, given the nature of the problem at hand, the government has to rely on beliefs about future states in order to set policy, so that the future should matter as well as the present in defining policy cyclicality.

However, the process variances $\sigma^2_{a_j}$ and the measurement error variance σ^2_ε are unknown and we do not have any meaninful prior over them. We therefore need a method to find reasonable values for these five unknown variances. This is where MCMC methods are useful .

One can think of MCMC as the opposite of simulating. In the case of simulation we know the parameters of our process, for example the variances, and every time we run a simulation program, it gives us a set of possible observed data. More specifically, the probability of getting any set of observed data is the probability defined by the model that we have and the parameters. MCMC is the opposite: we assume that we have a given dataset, and we are producing a set of possible parameters. This is done in such a fashion that the probability of accepting a parameter value is identical to the probability that this parameter value has actually produced the data.

Specifically, in our implementation, we use the classic Metropolis-Hastings (MH) sampler to do MCMC (for an introduction to MCMC and Metropolis-Hastings, see for example Chib and Greenberg (1995)). In MH one starts with arbitrary parameters values. Every iteration one proposes a random change (in our case a small gaussian change) of the parameters. This is what is called the proposal distribution. Subsequently, this change is either accepted or rejected. The probability of acceptance is:

$$p_{accept} = min\left(1, \frac{p(data|new\_parameters)}{p(data|previous\_parameters)}\right) \tag{1}$$

It is easy to prove that this procedure is actually sampling from the correct posterior distribution over the parameter values.

MCMC algorithms go through two different stages. In the first stage the sampler converges to a probable interpretation of the data in terms of the parameters. This stage is called burn-in and took about 500 iterations in our case. Within these 500 iterations, probabilities increased dramatically and then converged to a stable high level. Afterwards, the MCMC algorithm is exploring the space of relevant parameters. Over 3 runs, we took

10000 samples per run after the end of burn-in. To avoid the autocorrelation that typically characterizes a Markov Chain, we only retain samples every 100 iterations in order to compute the final estimates. From these 3 runs, we thus get a total of 300 essentially uncorrelated samples for each of the five parameters we wish to estimate. Convergence of the Markov chain was assessed comparing the within chain correlation with the across chain correlation. From these 300 samples, we can then directly estimate means and variances of the 5 parameters of interest.

In order to correcly infer the effect of cyclicality on growth in our second stage regressions, we need to determine not only the value of the cyclicality (a_{1it}), but also the uncertainty we have about it. To estimate this uncertainty, or in other words the standard deviation of the cyclicality estimates, it is necessary to consider the relevant sources of uncertainty. Two sources are relevant in our case. One is the uncertainty that is represented by the Kalman smoother that stems from the finite number of noisy observations. The other source of uncertainty is uncertainty about the 5 parameters of the AR(1) processes that are modeled by the MCMC process. To combine them, we use the approximation $variance_{total} = variance_{MCMC} + \overline{variance_{Kalman}}$, where $\overline{variance_{Kalman}}$ denotes the average variance over the 300 Kalman smoother runs using the 300 samples that we retained from the MCMC estimates of the 5 variances. This approximation becomes correct if the variance as estimated by the Kalman smoother is similar over different runs of the Markov chain, which was a good apprriximation for our data.

Finally, a full general statistical description of the methods used here can be found in Kording-Marinescu(2006).

Appendix 2: Procyclicality estimates

Year	Country	Procyclicality of public debt		Year	Country	Procyclicality of public debt	
		WRW	AR(1)			WRW	AR(1)
				1972	**Austria**	-0.849	-0.345
				1973	**Austria**	-0.797	-0.362
				1974	**Austria**	-0.746	-0.342
				1975	**Austria**	-0.698	-0.332
				1976	**Austria**	-0.652	-0.290
				1977	**Austria**	-0.608	-0.247
				1978	**Austria**	-0.568	-0.253
				1979	**Austria**	-0.535	-0.259
				1980	**Austria**	-0.512	-0.250
				1981	**Austria**	-0.500	-0.233
				1982	**Austria**	-0.497	-0.224
				1983	**Austria**	-0.501	-0.215
				1984	**Austria**	-0.508	-0.188
				1985	**Austria**	-0.514	-0.117
				1986	**Austria**	-0.515	-0.115
				1987	**Austria**	-0.508	-0.079
				1988	**Austria**	-0.487	-0.034
1989	**Australia**	-0.337	-0.693	**1989**	**Austria**	-0.449	-0.006
1990	**Australia**	-0.542	-0.700	**1990**	**Austria**	-0.395	0.008
1991	**Australia**	-0.780	-0.724	**1991**	**Austria**	-0.329	-0.048
1992	**Australia**	-1.032	-0.786	**1992**	**Austria**	-0.262	-0.093
1993	**Australia**	-1.278	-0.929	**1993**	**Austria**	-0.199	-0.063
1994	**Australia**	-1.503	-1.154	**1994**	**Austria**	-0.142	-0.034
1995	**Australia**	-1.700	-1.222	**1995**	**Austria**	-0.086	-0.005
1996	**Australia**	-1.872	-1.292	**1996**	**Austria**	-0.031	0.034
1997	**Australia**	-2.025	-1.363	**1997**	**Austria**	0.021	0.064
1998	**Australia**	-2.172	-1.436	**1998**	**Austria**	0.063	0.090
1999	**Australia**	-2.322	-1.451	**1999**	**Austria**	0.091	0.130
2000	**Australia**	-2.485	-1.438	**2000**	**Austria**	0.104	0.083
2001	**Australia**	-2.665	-1.460	**2001**	**Austria**	0.106	0.090
2002	**Australia**	-2.864	-1.447	**2002**	**Austria**	0.102	0.087
2003	**Australia**	-3.078	-1.452	**2003**	**Austria**	0.100	0.081
2004	**Australia**	-3.297	-1.444	**2004**	**Austria**	0.102	0.024
2005	**Australia**	-3.509	-1.443	**2005**	**Austria**	0.112	0.017

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
1972	**Belgium**	0.371	0.145				
1973	**Belgium**	0.377	0.119				
1974	**Belgium**	0.374	0.154				
1975	**Belgium**	0.355	0.204				
1976	**Belgium**	0.307	0.255				
1977	**Belgium**	0.224	0.317				
1978	**Belgium**	0.106	0.374				
1979	**Belgium**	-0.037	0.431				
1980	**Belgium**	-0.186	0.526				
1981	**Belgium**	-0.324	0.423	**1981**	**Canada**	-0.318	-0.436
1982	**Belgium**	-0.438	0.334	**1982**	**Canada**	-0.355	-0.439
1983	**Belgium**	-0.524	0.314	**1983**	**Canada**	-0.395	-0.541
1984	**Belgium**	-0.579	0.325	**1984**	**Canada**	-0.435	-0.524
1985	**Belgium**	-0.603	0.345	**1985**	**Canada**	-0.473	-0.538
1986	**Belgium**	-0.597	0.334	**1986**	**Canada**	-0.506	-0.546
1987	**Belgium**	-0.564	0.269	**1987**	**Canada**	-0.536	-0.554
1988	**Belgium**	-0.506	0.243	**1988**	**Canada**	-0.562	-0.561
1989	**Belgium**	-0.431	0.212	**1989**	**Canada**	-0.589	-0.620
1990	**Belgium**	-0.352	0.253	**1990**	**Canada**	-0.624	-0.740
1991	**Belgium**	-0.277	0.232	**1991**	**Canada**	-0.673	-0.795
1992	**Belgium**	-0.206	0.351	**1992**	**Canada**	-0.745	-0.881
1993	**Belgium**	-0.119	0.409	**1993**	**Canada**	-0.842	-0.970
1994	**Belgium**	0.025	0.495	**1994**	**Canada**	-0.960	-0.929
1995	**Belgium**	0.245	0.573	**1995**	**Canada**	-1.088	-0.884
1996	**Belgium**	0.497	0.636	**1996**	**Canada**	-1.207	-0.802
1997	**Belgium**	0.691	0.634	**1997**	**Canada**	-1.303	-0.780
1998	**Belgium**	0.768	0.635	**1998**	**Canada**	-1.371	-0.767
1999	**Belgium**	0.736	0.629	**1999**	**Canada**	-1.420	-0.793
2000	**Belgium**	0.634	0.613	**2000**	**Canada**	-1.461	-0.829
2001	**Belgium**	0.505	0.647	**2001**	**Canada**	-1.496	-0.840
2002	**Belgium**	0.384	0.665	**2002**	**Canada**	-1.525	-0.852
2003	**Belgium**	0.293	0.685	**2003**	**Canada**	-1.540	-0.856
2004	**Belgium**	0.239	0.631	**2004**	**Canada**	-1.539	-0.856
2005	**Belgium**	0.224	0.617	**2005**	**Canada**	-1.519	-0.856

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
1973	**Germany**	-0.153	-0.165				
1974	**Germany**	-0.116	-0.202				
1975	**Germany**	-0.091	-0.215				
1976	**Germany**	-0.077	-0.197				
1977	**Germany**	-0.072	-0.167				
1978	**Germany**	-0.078	-0.101				
1979	**Germany**	-0.093	-0.134				
1980	**Germany**	-0.115	-0.198				
1981	**Germany**	-0.144	-0.251	**1981**	**Denmark**	-2.526	-3.854
1982	**Germany**	-0.182	-0.314	**1982**	**Denmark**	-2.583	-4.098
1983	**Germany**	-0.234	-0.377	**1983**	**Denmark**	-2.642	-4.061
1984	**Germany**	-0.307	-0.430	**1984**	**Denmark**	-2.713	-3.863
1985	**Germany**	-0.405	-0.496	**1985**	**Denmark**	-2.806	-3.694
1986	**Germany**	-0.523	-0.567	**1986**	**Denmark**	-2.928	-3.476
1987	**Germany**	-0.653	-0.640	**1987**	**Denmark**	-3.082	-3.587
1988	**Germany**	-0.790	-0.710	**1988**	**Denmark**	-3.264	-3.664
1989	**Germany**	-0.933	-0.779	**1989**	**Denmark**	-3.464	-3.725
1990	**Germany**	-1.079	-0.810	**1990**	**Denmark**	-3.661	-3.800
1991	**Germany**	-1.217	-0.840	**1991**	**Denmark**	-3.830	-3.884
1992	**Germany**	-1.336	-0.818	**1992**	**Denmark**	-3.948	-4.032
1993	**Germany**	-1.430	-0.835	**1993**	**Denmark**	-4.004	-4.206
1994	**Germany**	-1.501	-0.801	**1994**	**Denmark**	-4.001	-3.980
1995	**Germany**	-1.558	-0.858	**1995**	**Denmark**	-3.946	-3.768
1996	**Germany**	-1.610	-0.783	**1996**	**Denmark**	-3.846	-3.556
1997	**Germany**	-1.665	-0.758	**1997**	**Denmark**	-3.704	-3.351
1998	**Germany**	-1.726	-0.764	**1998**	**Denmark**	-3.522	-3.200
1999	**Germany**	-1.793	-0.746	**1999**	**Denmark**	-3.297	-3.112
2000	**Germany**	-1.862	-0.772	**2000**	**Denmark**	-3.022	-2.856
2001	**Germany**	-1.927	-0.811	**2001**	**Denmark**	-2.688	-2.580
2002	**Germany**	-1.985	-0.851	**2002**	**Denmark**	-2.286	-2.404
2003	**Germany**	-2.032	-0.860	**2003**	**Denmark**	-1.816	-2.255
2004	**Germany**	-2.070	-0.881	**2004**	**Denmark**	-1.288	-2.259
2005	**Germany**	-2.100	-0.899	**2005**	**Denmark**	-0.724	-2.274

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
				1976	**Finland**	-1.609	-1.340
				1977	**Finland**	-1.559	-1.354
1978	**Spain**	-3.334	-2.535	**1978**	**Finland**	-1.509	-1.374
1979	**Spain**	-3.121	-2.566	**1979**	**Finland**	-1.464	-1.384
1980	**Spain**	-2.892	-2.596	**1980**	**Finland**	-1.427	-1.394
1981	**Spain**	-2.655	-2.577	**1981**	**Finland**	-1.402	-1.408
1982	**Spain**	-2.419	-2.653	**1982**	**Finland**	-1.396	-1.417
1983	**Spain**	-2.194	-2.680	**1983**	**Finland**	-1.415	-1.424
1984	**Spain**	-1.993	-2.606	**1984**	**Finland**	-1.462	-1.422
1985	**Spain**	-1.829	-2.332	**1985**	**Finland**	-1.538	-1.448
1986	**Spain**	-1.711	-2.096	**1986**	**Finland**	-1.635	-1.474
1987	**Spain**	-1.642	-1.976	**1987**	**Finland**	-1.739	-1.505
1988	**Spain**	-1.616	-1.860	**1988**	**Finland**	-1.830	-1.547
1989	**Spain**	-1.625	-1.697	**1989**	**Finland**	-1.892	-1.642
1990	**Spain**	-1.666	-1.668	**1990**	**Finland**	-1.920	-1.819
1991	**Spain**	-1.738	-1.771	**1991**	**Finland**	-1.918	-1.967
1992	**Spain**	-1.847	-1.859	**1992**	**Finland**	-1.893	-2.284
1993	**Spain**	-1.992	-1.941	**1993**	**Finland**	-1.854	-1.738
1994	**Spain**	-2.164	-1.983	**1994**	**Finland**	-1.804	-1.411
1995	**Spain**	-2.348	-2.207	**1995**	**Finland**	-1.748	-1.610
1996	**Spain**	-2.522	-2.350	**1996**	**Finland**	-1.684	-1.389
1997	**Spain**	-2.674	-2.254	**1997**	**Finland**	-1.613	-1.367
1998	**Spain**	-2.796	-2.284	**1998**	**Finland**	-1.534	-1.221
1999	**Spain**	-2.890	-2.259	**1999**	**Finland**	-1.447	-1.026
2000	**Spain**	-2.962	-2.255	**2000**	**Finland**	-1.355	-0.942
2001	**Spain**	-3.018	-2.261	**2001**	**Finland**	-1.261	-0.907
2002	**Spain**	-3.064	-2.257	**2002**	**Finland**	-1.168	-0.887
2003	**Spain**	-3.104	-2.253	**2003**	**Finland**	-1.077	-0.876
2004	**Spain**	-3.140	-2.249	**2004**	**Finland**	-0.988	-0.859
2005	**Spain**	-3.172	-2.244	**2005**	**Finland**	-0.897	-0.843

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
				1971	**United Kingdom**	-0.321	-0.749
				1972	**United Kingdom**	-0.174	-0.730
				1973	**United Kingdom**	-0.023	-0.720
				1974	**United Kingdom**	0.123	-0.737
				1975	**United Kingdom**	0.254	-0.752
				1976	**United Kingdom**	0.357	-0.687
				1977	**United Kingdom**	0.421	-0.610
1978	**France**	0.708	0.491	**1978**	**United Kingdom**	0.438	-0.509
1979	**France**	0.615	0.477	**1979**	**United Kingdom**	0.402	-0.407
1980	**France**	0.536	0.453	**1980**	**United Kingdom**	0.313	-0.309
1981	**France**	0.466	0.424	**1981**	**United Kingdom**	0.182	-0.076
1982	**France**	0.400	0.317	**1982**	**United Kingdom**	0.028	0.003
1983	**France**	0.328	0.291	**1983**	**United Kingdom**	-0.125	-0.226
1984	**France**	0.244	0.220	**1984**	**United Kingdom**	-0.262	-0.617
1985	**France**	0.147	0.123	**1985**	**United Kingdom**	-0.373	-0.617
1986	**France**	0.043	-0.047	**1986**	**United Kingdom**	-0.463	-0.781
1987	**France**	-0.060	-0.237	**1987**	**United Kingdom**	-0.548	-0.987
1988	**France**	-0.153	-0.357	**1988**	**United Kingdom**	-0.653	-1.319
1989	**France**	-0.236	-0.484	**1989**	**United Kingdom**	-0.805	-1.627
1990	**France**	-0.316	-0.631	**1990**	**United Kingdom**	-1.020	-1.882
1991	**France**	-0.402	-0.725	**1991**	**United Kingdom**	-1.291	-2.080
1992	**France**	-0.504	-0.794	**1992**	**United Kingdom**	-1.591	-2.343
1993	**France**	-0.624	-0.870	**1993**	**United Kingdom**	-1.887	-2.608
1994	**France**	-0.758	-0.942	**1994**	**United Kingdom**	-2.153	-2.453
1995	**France**	-0.893	-1.067	**1995**	**United Kingdom**	-2.377	-2.541
1996	**France**	-1.016	-1.017	**1996**	**United Kingdom**	-2.553	-2.507
1997	**France**	-1.121	-1.032	**1997**	**United Kingdom**	-2.681	-2.531
1998	**France**	-1.207	-1.116	**1998**	**United Kingdom**	-2.767	-2.536
1999	**France**	-1.281	-1.054	**1999**	**United Kingdom**	-2.826	-2.536
2000	**France**	-1.349	-1.107	**2000**	**United Kingdom**	-2.876	-2.538
2001	**France**	-1.417	-1.170	**2001**	**United Kingdom**	-2.932	-2.598
2002	**France**	-1.488	-1.221	**2002**	**United Kingdom**	-3.000	-2.613
2003	**France**	-1.559	-1.271	**2003**	**United Kingdom**	-3.073	-2.627
2004	**France**	-1.625	-1.338	**2004**	**United Kingdom**	-3.136	-2.625
2005	**France**	-1.679	-1.374	**2005**	**United Kingdom**	-3.167	-2.622

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
1975	**Greece**	-0.109					
1976	**Greece**	-0.186					
1977	**Greece**	-0.269					
1978	**Greece**	-0.353		**1978**	**Ireland**	-3.113	-0.142
1979	**Greece**	-0.434		**1979**	**Ireland**	-3.136	-0.128
1980	**Greece**	-0.505		**1980**	**Ireland**	-3.135	-0.358
1981	**Greece**	-0.563		**1981**	**Ireland**	-3.104	-0.462
1982	**Greece**	-0.601		**1982**	**Ireland**	-3.038	-0.763
1983	**Greece**	-0.615		**1983**	**Ireland**	-2.927	-1.073
1984	**Greece**	-0.598		**1984**	**Ireland**	-2.764	-1.059
1985	**Greece**	-0.547		**1985**	**Ireland**	-2.545	-1.115
1986	**Greece**	-0.464		**1986**	**Ireland**	-2.277	-1.279
1987	**Greece**	-0.365		**1987**	**Ireland**	-1.982	-1.043
1988	**Greece**	-0.277		**1988**	**Ireland**	-1.702	-0.971
1989	**Greece**	-0.232		**1989**	**Ireland**	-1.475	-0.959
1990	**Greece**	-0.256		**1990**	**Ireland**	-1.311	-0.947
1991	**Greece**	-0.354		**1991**	**Ireland**	-1.183	-0.917
1992	**Greece**	-0.507		**1992**	**Ireland**	-1.059	-0.894
1993	**Greece**	-0.675		**1993**	**Ireland**	-0.925	-0.967
1994	**Greece**	-0.815		**1994**	**Ireland**	-0.784	-0.633
1995	**Greece**	-0.891		**1995**	**Ireland**	-0.649	-0.575
1996	**Greece**	-0.892		**1996**	**Ireland**	-0.531	-0.482
1997	**Greece**	-0.828		**1997**	**Ireland**	-0.439	-0.449
1998	**Greece**	-0.721		**1998**	**Ireland**	-0.378	-0.439
1999	**Greece**	-0.591		**1999**	**Ireland**	-0.348	-0.418
2000	**Greece**	-0.458		**2000**	**Ireland**	-0.343	-0.510
2001	**Greece**	-0.333		**2001**	**Ireland**	-0.354	-0.407
2002	**Greece**	-0.225		**2002**	**Ireland**	-0.373	-0.408
2003	**Greece**	-0.140		**2003**	**Ireland**	-0.396	-0.414
2004	**Greece**	-0.077		**2004**	**Ireland**	-0.419	-0.416
2005	**Greece**	-0.035		**2005**	**Ireland**	-0.440	-0.411

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
				1965	**Italy**	1.193	0.280
				1966	**Italy**	1.162	0.289
				1967	**Italy**	1.141	0.233
				1968	**Italy**	1.125	0.176
				1969	**Italy**	1.107	0.104
				1970	**Italy**	1.078	0.062
				1971	**Italy**	1.026	0.165
				1972	**Italy**	0.940	0.251
				1973	**Italy**	0.814	0.337
				1974	**Italy**	0.647	0.368
				1975	**Italy**	0.451	0.282
				1976	**Italy**	0.243	0.215
				1977	**Italy**	0.049	0.152
				1978	**Italy**	-0.111	0.092
				1979	**Italy**	-0.224	0.027
				1980	**Italy**	-0.291	0.018
1981	**Iceland**	-1.908	-1.588	**1981**	**Italy**	-0.317	0.037
1982	**Iceland**	-1.864	-1.442	**1982**	**Italy**	-0.309	0.084
1983	**Iceland**	-1.815	-1.479	**1983**	**Italy**	-0.268	0.140
1984	**Iceland**	-1.759	-1.445	**1984**	**Italy**	-0.191	0.162
1985	**Iceland**	-1.697	-1.364	**1985**	**Italy**	-0.073	0.183
1986	**Iceland**	-1.630	-1.309	**1986**	**Italy**	0.084	0.295
1987	**Iceland**	-1.565	-1.234	**1987**	**Italy**	0.273	0.365
1988	**Iceland**	-1.507	-1.207	**1988**	**Italy**	0.476	0.462
1989	**Iceland**	-1.464	-1.181	**1989**	**Italy**	0.666	0.566
1990	**Iceland**	-1.437	-1.161	**1990**	**Italy**	0.818	0.753
1991	**Iceland**	-1.428	-1.146	**1991**	**Italy**	0.910	0.814
1992	**Iceland**	-1.433	-1.248	**1992**	**Italy**	0.929	0.897
1993	**Iceland**	-1.444	-1.406	**1993**	**Italy**	0.866	1.017
1994	**Iceland**	-1.454	-1.425	**1994**	**Italy**	0.722	0.758
1995	**Iceland**	-1.457	-1.336	**1995**	**Italy**	0.501	0.725
1996	**Iceland**	-1.448	-1.169	**1996**	**Italy**	0.220	0.676
1997	**Iceland**	-1.424	-1.001	**1997**	**Italy**	-0.093	0.679
1998	**Iceland**	-1.385	-0.828	**1998**	**Italy**	-0.399	0.624
1999	**Iceland**	-1.332	-0.655	**1999**	**Italy**	-0.661	0.620
2000	**Iceland**	-1.260	-0.377	**2000**	**Italy**	-0.861	0.555
2001	**Iceland**	-1.162	-0.005	**2001**	**Italy**	-1.001	0.489
2002	**Iceland**	-1.026	-0.045	**2002**	**Italy**	-1.100	0.430
2003	**Iceland**	-0.844	-0.081	**2003**	**Italy**	-1.171	0.374
2004	**Iceland**	-0.612	-0.092	**2004**	**Italy**	-1.224	0.322
2005	**Iceland**	-0.334	-0.086	**2005**	**Italy**	-1.262	0.296

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

		Procyclicality of public debt				Procyclicality of public debt	
Year	Country	WRW	AR(1)	Year	Country	WRW	AR(1)
1971	**Japan**	-1.564	-1.220				
1972	**Japan**	-1.552	-1.242	**1972**	**Netherlands**	-0.486	-0.469
1973	**Japan**	-1.539	-1.280	**1973**	**Netherlands**	-0.528	-0.471
1974	**Japan**	-1.524	-1.287	**1974**	**Netherlands**	-0.570	-0.480
1975	**Japan**	-1.502	-1.336	**1975**	**Netherlands**	-0.610	-0.490
1976	**Japan**	-1.475	-1.427	**1976**	**Netherlands**	-0.647	-0.497
1977	**Japan**	-1.451	-1.449	**1977**	**Netherlands**	-0.678	-0.506
1978	**Japan**	-1.448	-1.466	**1978**	**Netherlands**	-0.705	-0.522
1979	**Japan**	-1.487	-1.452	**1979**	**Netherlands**	-0.725	-0.537
1980	**Japan**	-1.589	-1.435	**1980**	**Netherlands**	-0.737	-0.553
1981	**Japan**	-1.760	-1.436	**1981**	**Netherlands**	-0.739	-0.563
1982	**Japan**	-1.982	-1.439	**1982**	**Netherlands**	-0.728	-0.590
1983	**Japan**	-2.232	-1.444	**1983**	**Netherlands**	-0.702	-0.638
1984	**Japan**	-2.490	-1.444	**1984**	**Netherlands**	-0.662	-0.616
1985	**Japan**	-2.747	-1.458	**1985**	**Netherlands**	-0.611	-0.601
1986	**Japan**	-2.984	-1.486	**1986**	**Netherlands**	-0.552	-0.522
1987	**Japan**	-3.158	-1.464	**1987**	**Netherlands**	-0.494	-0.454
1988	**Japan**	-3.212	-1.506	**1988**	**Netherlands**	-0.450	-0.440
1989	**Japan**	-3.127	-1.544	**1989**	**Netherlands**	-0.439	-0.408
1990	**Japan**	-2.939	-1.572	**1990**	**Netherlands**	-0.476	-0.378
1991	**Japan**	-2.713	-1.603	**1991**	**Netherlands**	-0.559	-0.469
1992	**Japan**	-2.496	-1.490	**1992**	**Netherlands**	-0.666	-0.560
1993	**Japan**	-2.304	-1.412	**1993**	**Netherlands**	-0.771	-0.654
1994	**Japan**	-2.131	-1.332	**1994**	**Netherlands**	-0.879	-0.753
1995	**Japan**	-1.958	-1.270	**1995**	**Netherlands**	-1.010	-0.862
1996	**Japan**	-1.763	-1.201	**1996**	**Netherlands**	-1.170	-0.984
1997	**Japan**	-1.536	-1.140	**1997**	**Netherlands**	-1.341	-1.102
1998	**Japan**	-1.277	-1.090	**1998**	**Netherlands**	-1.498	-1.174
1999	**Japan**	-0.998	-1.015	**1999**	**Netherlands**	-1.627	-1.283
2000	**Japan**	-0.714	-0.872	**2000**	**Netherlands**	-1.725	-1.408
2001	**Japan**	-0.440	-0.731	**2001**	**Netherlands**	-1.796	-1.416
2002	**Japan**	-0.186	-0.618	**2002**	**Netherlands**	-1.847	-1.454
2003	**Japan**	0.044	-0.637	**2003**	**Netherlands**	-1.881	-1.492
2004	**Japan**	0.247	-0.634	**2004**	**Netherlands**	-1.904	-1.535
2005	**Japan**	0.425	-0.631	**2005**	**Netherlands**	-1.918	-1.554

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

		Procyclicality of public debt				Procyclicality of public debt	
Year	Country	WRW	AR(1)	Year	Country	WRW	AR(1)
1971	**Norway**	1.080	1.346				
1972	**Norway**	1.244	1.266				
1973	**Norway**	1.396	1.275				
1974	**Norway**	1.531	1.193				
1975	**Norway**	1.645	1.207				
1976	**Norway**	1.738	1.056				
1977	**Norway**	1.812	1.447				
1978	**Norway**	1.869	1.391				
1979	**Norway**	1.913	1.094				
1980	**Norway**	1.941	1.062				
1981	**Norway**	1.951	1.083				
1982	**Norway**	1.937	1.129				
1983	**Norway**	1.893	1.168				
1984	**Norway**	1.813	1.154				
1985	**Norway**	1.700	1.153				
1986	**Norway**	1.555	1.125				
1987	**Norway**	1.384	0.830				
1988	**Norway**	1.189	0.698				
1989	**Norway**	0.975	0.539				
1990	**Norway**	0.749	0.589				
1991	**Norway**	0.524	0.450				
1992	**Norway**	0.313	-0.061				
1993	**Norway**	0.121	-0.635				
1994	**Norway**	-0.053	-0.830				
1995	**Norway**	-0.218	-1.019	**1995**	**New Zealand**	-0.303	-0.252
1996	**Norway**	-0.384	-1.201	**1996**	**New Zealand**	-0.396	-0.252
1997	**Norway**	-0.558	-1.374	**1997**	**New Zealand**	-0.494	-0.208
1998	**Norway**	-0.749	-1.478	**1998**	**New Zealand**	-0.592	-0.172
1999	**Norway**	-0.966	-1.458	**1999**	**New Zealand**	-0.687	-0.150
2000	**Norway**	-1.215	-1.384	**2000**	**New Zealand**	-0.771	-0.136
2001	**Norway**	-1.501	-1.375	**2001**	**New Zealand**	-0.838	-0.127
2002	**Norway**	-1.817	-1.327	**2002**	**New Zealand**	-0.884	-0.135
2003	**Norway**	-2.146	-1.270	**2003**	**New Zealand**	-0.905	-0.143
2004	**Norway**	-2.456	-1.254	**2004**	**New Zealand**	-0.898	-0.145
2005	**Norway**	-2.703	-1.238	**2005**	**New Zealand**	-0.866	-0.145

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)	Year	Country	Procyclicality of public debt WRW	AR(1)
1971	**Portugal**	-2.163	-1.696	**1971**	**Sweden**	-0.856	-0.936
1972	**Portugal**	-2.226	-1.632	**1972**	**Sweden**	-1.016	-0.929
1973	**Portugal**	-2.278	-1.508	**1973**	**Sweden**	-1.181	-0.913
1974	**Portugal**	-2.310	-1.616	**1974**	**Sweden**	-1.348	-0.936
1975	**Portugal**	-2.308	-1.670	**1975**	**Sweden**	-1.513	-1.021
1976	**Portugal**	-2.259	-1.689	**1976**	**Sweden**	-1.670	-1.180
1977	**Portugal**	-2.162	-1.710	**1977**	**Sweden**	-1.814	-1.210
1978	**Portugal**	-2.027	-1.759	**1978**	**Sweden**	-1.940	-1.408
1979	**Portugal**	-1.873	-1.809	**1979**	**Sweden**	-2.048	-1.644
1980	**Portugal**	-1.718	-1.618	**1980**	**Sweden**	-2.138	-1.882
1981	**Portugal**	-1.568	-1.560	**1981**	**Sweden**	-2.216	-2.070
1982	**Portugal**	-1.421	-1.502	**1982**	**Sweden**	-2.286	-2.253
1983	**Portugal**	-1.274	-1.489	**1983**	**Sweden**	-2.353	-2.326
1984	**Portugal**	-1.122	-1.364	**1984**	**Sweden**	-2.416	-2.463
1985	**Portugal**	-0.971	-1.103	**1985**	**Sweden**	-2.480	-2.593
1986	**Portugal**	-0.826	-0.752	**1986**	**Sweden**	-2.546	-2.701
1987	**Portugal**	-0.693	-1.002	**1987**	**Sweden**	-2.621	-2.897
1988	**Portugal**	-0.576	-0.948	**1988**	**Sweden**	-2.708	-2.965
1989	**Portugal**	-0.479	-0.874	**1989**	**Sweden**	-2.805	-3.025
1990	**Portugal**	-0.404	-0.830	**1990**	**Sweden**	-2.906	-3.171
1991	**Portugal**	-0.358	-0.765	**1991**	**Sweden**	-3.000	-3.062
1992	**Portugal**	-0.346	-1.029	**1992**	**Sweden**	-3.079	-2.940
1993	**Portugal**	-0.375	-1.039	**1993**	**Sweden**	-3.138	-2.208
1994	**Portugal**	-0.444	-1.046	**1994**	**Sweden**	-3.177	-2.430
1995	**Portugal**	-0.548	-1.062	**1995**	**Sweden**	-3.199	-2.425
1996	**Portugal**	-0.677	-1.028	**1996**	**Sweden**	-3.211	-2.394
1997	**Portugal**	-0.821	-0.994	**1997**	**Sweden**	-3.216	-2.365
1998	**Portugal**	-0.969	-0.952	**1998**	**Sweden**	-3.220	-2.477
1999	**Portugal**	-1.111	-0.862	**1999**	**Sweden**	-3.224	-2.536
2000	**Portugal**	-1.240	-0.805	**2000**	**Sweden**	-3.228	-2.552
2001	**Portugal**	-1.350	-0.702	**2001**	**Sweden**	-3.231	-2.550
2002	**Portugal**	-1.440	-0.641	**2002**	**Sweden**	-3.235	-2.551
2003	**Portugal**	-1.512	-0.562	**2003**	**Sweden**	-3.238	-2.552
2004	**Portugal**	-1.571	-0.531	**2004**	**Sweden**	-3.241	-2.553
2005	**Portugal**	-1.624	-0.549	**2005**	**Sweden**	-3.241	-2.551

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Year	Country	Procyclicality of public debt WRW	AR(1)
1964	**United States**	-1.093	-0.962
1965	**United States**	-1.144	-0.964
1966	**United States**	-1.187	-0.981
1967	**United States**	-1.219	-1.016
1968	**United States**	-1.233	-1.045
1969	**United States**	-1.226	-1.066
1970	**United States**	-1.196	-1.056
1971	**United States**	-1.141	-1.054
1972	**United States**	-1.064	-1.029
1973	**United States**	-0.970	-1.002
1974	**United States**	-0.869	-0.981
1975	**United States**	-0.771	-0.972
1976	**United States**	-0.679	-0.900
1977	**United States**	-0.596	-0.827
1978	**United States**	-0.529	-0.753
1979	**United States**	-0.479	-0.728
1980	**United States**	-0.448	-0.720
1981	**United States**	-0.432	-0.721
1982	**United States**	-0.428	-0.763
1983	**United States**	-0.433	-0.822
1984	**United States**	-0.445	-0.904
1985	**United States**	-0.466	-0.973
1986	**United States**	-0.498	-1.023
1987	**United States**	-0.550	-1.078
1988	**United States**	-0.631	-1.139
1989	**United States**	-0.752	-1.208
1990	**United States**	-0.920	-1.288
1991	**United States**	-1.139	-1.366
1992	**United States**	-1.398	-1.412
1993	**United States**	-1.674	-1.464
1994	**United States**	-1.934	-1.516
1995	**United States**	-2.145	-1.567
1996	**United States**	-2.286	-1.630
1997	**United States**	-2.352	-1.694
1998	**United States**	-2.346	-1.759
1999	**United States**	-2.275	-1.822
2000	**United States**	-2.148	-1.911
2001	**United States**	-1.984	-1.923
2002	**United States**	-1.807	-1.958
2003	**United States**	-1.637	-1.979
2004	**United States**	-1.487	-1.987
2005	**United States**	-1.363	-1.986

Note: the table reports the a_{1it} coefficients, i.e. the coefficients on the output gap composite variable (see equation 1), using various estimation techniques. WRW stands for the Gaussian-weighted rolling window OLS method and AR(1) for the AR(1) MCMC method.
Source: OECD Economic Outlook.

Appendix 3: the impact of budgetary institutions

Table 1: The determinants of government debt procyclicality, including budgetary institutions

	AR(1)			WRW		
	OLS	Country f.e.	Country year f.e.	OLS	Country f.e.	Country year f.e.
Private credit/GDP	-0.869	-1.555	-1.631	-0.612	-1.282	-1.448
	(0.127)***	(0.133)***	(0.136)***	(0.097)***	(0.137)***	(0.109)***
EMU country	1.448			0.794		
	(0.170)***			(0.146)***		
Standard error	-0.422			0.345		
of GDP growth	(5.013)			(2.732)		
Lag(log (real GDP	-0.183	-0.454	-0.306	-0.323	0.003	0.778
per capita))	(0.093)*	(0.335)	(0.635)	(0.068)***	(0.349)	(0.503)
Openness	0.017	0.009	0.021	0.010	0.002	0.042
	(0.002)***	(0.004)**	(0.005)***	(0.002)***	(0.004)	(0.006)***
Government share	0.014	-0.026	-0.029	0.024	-0.019	-0.014
of GDP (in %)	(0.010)	(0.006)***	(0.006)***	(0.005)***	(0.005)***	(0.005)**
Inflation targeting	-0.179	-0.294	-0.250	-0.666	-0.486	-0.395
	(0.158)	(0.102)***	(0.112)**	(0.105)***	(0.104)***	(0.125)***
Delegation state	0.417			0.086		
	(0.174)**			(0.147)		
Contracts index*	-0.569	0.761	0.846	-0.237	0.236	0.551
(1-Delegation state)	(0.292)*	(0.218)***	(0.227)***	(0.162)	(0.238)	(0.243)**
Delegation index*	0.970	0.709	0.864	1.373	1.684	2.415
Delegation state	(0.239)***	(0.699)	(0.694)	(0.232)***	(0.691)**	(0.509)***
Constant	-4.387	-4.240	-3.586	-5.094	0.006	2.475
	(0.631)***	(2.947)	(5.495)	(0.446)***	(3.195)	(4.423)
Observations	230	230	230	251	251	251
R-squared	0.67	0.94	0.95	0.68	0.87	0.91

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The explained variable is the coefficient on the GDP gap composite variable from equation 1, estimated using the AR(1) MCMC method for columns 1-3, and the Gaussian-weighted rolling window method for columns 4-6. EMU country is a dummy variable equal to 1 for all countries that are part of the EMU as of 2006. The delegation dummy is 1 for delegation states, i.e. states where the management of the budget is in the main delegated to the finance minister; the dummy is 0 for contract states, i.e. states where the budget is decided through multi-annual targets and fiscal procedures. The contracts index measures how strict the implementation of the multi-annual targets is; the delegation index measures how much power the finance minister has.
Source: OECD Economic Outlook, Levine dataset, Barro Lee dataset, Penn World Tables 6.1. The delegation state dummy, contracts and delegation indices are from data kindly provided by Juergen von Hagen.