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Abstract

This paper studies how the spending side of fiscal policy reacts to the business cycle. I find that between 2000 and 2012, government spending is forward-looking in a number of countries—it reacts to forecasts of economic activity rather than to past economic realizations. I also study whether the response of government spending is countercyclical or procyclical. Spending responds countercyclically in countries such as the United States, Belgium, and Finland—when governments in these countries expect GDP to be below trend, they increase spending, and vice versa. In contrast, spending responds procyclically in places such as the United Kingdon, Argentina, and Ecuador—when governments in these countries expect GDP to be below trend, they decrease spending, and vice versa. The methodology I use exploits the fact that the government cannot forecast economic activity perfectly. The presence of shocks that cannot be forecast allows me to estimate reaction parameters under the framework of the Generalized Method of Moments.

JEL classification codes: E32, E62.

Keywords: Government spending, business cycle, forward-looking fiscal policy, GMM.

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1 Introduction

Government budgets in many advanced and developing nations are influenced by forecasts of variables such as GDP growth, the unemployment rate, inflation, and the level of incomes.[1] Forecasts are necessary because budgets provide estimates of revenues and expenditures for the future. For example, the government uses forecasts of the unemployment rate to estimate next year's unemployment-insurance transfers, it uses forecasts of economic activity and incomes to estimate next year's tax revenue, and it is likely that forecasts of GDP growth would affect the decision to introduce a temporary stimulus program. But how important, exactly, are such forecasts? Could fiscal policy be forward-looking as opposed to backward-looking? In that case, fiscal policy would respond to forecasts of economic activity as opposed to past economic data. The recent macroeconomic literature has paid little attention to this possibility, both empirically and theoretically. Indeed, most papers assume that fiscal policy reacts to past economic data.

In this paper, I study how the spending side of fiscal policy reacts to the business cycle. I find that in a number of countries, the government has, indeed, been forward-looking rather than backward-looking. Under a forward-looking procedure, the government responds to forecasts of economic activity and uses past economic data to the extent that it contributes to its forecasts. More specifically, I arrive at this result by removing the trend component from government spending and estimating reaction functions that identify whether governments react to forecasts of the output gap (the deviation of GDP from trend) or to past realizations of the output gap.

The empirical framework I use also allows me to study whether government spending is procyclical or countercyclical. Between 2000 and 2012, government spending is *countercyclical* in countries such as the United States, Belgium, and Finland—when governments in these countries expect GDP to be below trend, they increase spending, and vice versa. In contrast, spending is *procyclical* in places such as the United Kingdom, Argentina, and

[1] For the case of the United States see section 2 of U.S. Office of Management and Budget (2013)

Ecuador —when governments in these places expect GDP to be below trend, they decrease spending, and vice versa.

To give an idea of the magnitudes involved, spending by the U.S. government gradually increases 1.4 percent above trend when GDP is expected to be 1 percent below trend, on average, for the next four quarters; government spending is countercyclical in the U.S. In contrast, government spending is procyclical in the U.K.; it gradually decreases 1.7 percent below trend when GDP is expected to be 1 percent below trend, on average, for the next four quarters. These numbers describe the response of the *general government*, which includes the federal or central government, state and local governments, and social security funds.[2]

Thanks to data availability, I am able to study the reaction of three components of U.S. government spending: consumption, investment, and transfers. As expected, transfers respond countercyclically. Consumption and investment respond countercyclically as well. The reaction of all components is economically and statistically significant, but transfers respond most strongly to the business cycle, followed by investment in second place, while consumption responds the least.

Methodologically, the most important issue I confront is reverse causality. Government spending reacts to the business cycle, but it also affects it. To identify the response of spending to the business cycle, I rely on the fact that there are shocks to economic activity the government cannot forecast, which implies future shocks must be uncorrelated with currently available information. I exploit this fact to generate restrictions (or moment conditions) that allow me to estimate reaction functions using the Generalized Method of Moments (GMM).

There is a substantial empirical literature that measures how fiscal policy reacts to economic activity. The article most closely related to this paper is due to Galí and Perotti (2003). To study whether the strict fiscal rules in the Maastricht Treaty have limited the use of countercyclical fiscal policy in Europe, these authors focus on a government's primary surplus as the policy instrument and estimate how it reacts to the business cycle before and

[2]The availability of international data forces me to restrict the analysis to this level of government.

after Maastricht. Notably, Galí and Perotti allow the discretionary component of fiscal policy to react to a one-period-ahead forecast of the output gap. To my knowledge, this is the only paper that characterizes the response of fiscal policy to the business cycle as forward-looking, but Galí and Perotti do not test whether policy is forward-looking or backward-looking; they assume the discretionary component is forward-looking. In this paper, I focus on government spending and test whether it is forward-looking or backward-looking.

Several papers quantify how government spending or other measures of fiscal policy react to *past* or *contemporaneous* realizations of economic activity (Auerbach (2003), Auerbach and Gale (2009), Auerbach, Gale, and Harris (2010), Davig and Leeper (2007), Favero and Monacelli (2005), Taylor (2000)). Unlike my empirical analysis, these papers typically ignore the importance of expectations in the government's spending decision and assume it is backward-looking.

Auerbach and Gale (2009), for instance, measure the reaction of the discretionary primary surplus in the U.S. to the lagged output gap (a proxy for the business cycle) and conclude that fiscal policy has been countercyclical. These authors simply assume the response of fiscal policy to the business cycle is backward-looking. They also include, however, projections of the budget surplus as a proxy for fiscal conditions in their reaction function, i.e., they introduce a forward-looking dimension in this regard.

There are papers that estimate a time-varying reaction of fiscal policy to economic activity. Favero and Monacelli (2005), and Davig and Leeper (2007) use regime-switching regression methods to date, endogenously, changes in the fiscal policy regime. But again, they assume fiscal policy is backward-looking. Unlike these papers, I also consider the possibility that the government might be forward-looking. A drawback of my empirical framework is, however, that it implicitly assumes that the parameters of the reaction function are constant within the sample I study. This can be partially solved by testing for structural breaks at exogenously determined dates.

The papers I have mentioned focus on discretionary fiscal policy. In this paper, I measure how overall spending, which includes discretionary as well as automatic-stabilizing components, reacts to the business cycle. This is important because it makes international comparisons of the stance of spending policy more accurate. Consider that while transfers might be evidently countercyclical in the U.S. and other developed countries, their *degree* of countercyclicality might differ. For example, European countries might rely more heavily on automatic transfers than discretionary spending, while the U.S. might rely less on automatic transfers than its European counterparts. Thus, a valid comparison of the reaction of government spending should consider both automatic-stabilizing and discretionary components. This is more important when developing countries are part of the mix, because it is not evident that even components of spending such as transfers are countercyclical in many of these countries.

Methodologically, this paper draws heavily from Clarida, Galí, and Gertler (1998), who use the GMM framework to estimate monetary-policy reaction functions that identify whether a central bank is forward-looking or backward-looking. They propose that to set interest rates, the central bank could react to *expected* deviations of inflation from its target and to the *expected* output gap, in which case monetary policy would be forward-looking, or to *lagged* realizations of inflation and the output gap, in which case monetary policy would be backward-looking. Their identification strategy relies on the fact that the central bank cannot forecast inflation or output perfectly; there are unforecastable shocks to these variables. Thus, future shocks must be uncorrelated with currently available information.[3] This allows them to generate restrictions that fit the GMM framework to estimate reaction functions. My identification strategy is identical.

In section 2 of the paper, I derive the empirical specification I use to estimate how government spending reacts to the business cycle. Section 3 presents the results. Section 4 discusses whether the instruments I use are strong and the results robust. Section 5 offers concluding remarks.

[3] Clarida, Galí, and Gertler (2000) use the same framework.

2 Empirical Specification

In this section, I propose a reaction function for government spending and derive the empirical specification I use to estimate its parameters. I borrow from Clarida, Galí, and Gertler (1998), who conduct a similar exercise for monetary policy.

The budget process forces the government to think about spending in the future, say next period. The question is whether in this process the government reacts to forecasts of economic activity or to past economic realizations. For clarity of exposition, consider first a purely forward-looking procedure: in period t, the government comes up with the deviation of real government spending from trend for period $t+1$ that it considers most appropriate given its expectations of the business cycle, and call this *ideal spending*. Let g^*_{t+1} denote ideal spending. To determine g^*_{t+1}, the government considers only forecasts of the output gap, an indicator of economic activity at business-cycle frequencies. Let y_t denote the period-t output gap, given by the deviation of real GDP from trend. (I provide details on the detrending method below.) Since the government is purely forward-looking, it uses information up to and including period t only to the extent that it helps to forecast the output gap. Thus, ideal spending for $t+1$ is given by the following forward-looking reaction function:

$$g^*_{t+1} = \phi \mathrm{E}[y_{t+1,t+n}|\mathbf{\Omega_t}], \tag{1}$$

where $y_{t+1,t+n} \equiv (y_{t+1} + y_{t+2} + \ldots + y_{t+n})/n$ is the average output gap over an n-period horizon, E is the expectations operator, and $\mathbf{\Omega_t}$ is the government's information set, i.e., a vector of data that is known up to and including period t. I refer to n as the government's horizon and assume the unit of time is a quarter. ϕ is the reaction parameter. If $\phi > 0$, government spending is procyclical—spending *increases* if GDP is expected to be above trend, and vice versa. If $\phi < 0$, it is countercyclical—spending *decreases* if GDP is expected to be above trend, and vice versa.

Actual spending in period $t+1$, which I denote g_{t+1} (without the asterisk), is determined by the ideal spending the government came up with in period t, a potential desire to smooth spending, and an independent and identically distributed (i.i.d.) mean-zero shock:

$$g_{t+1} = (1-\rho)g^*_{t+1} + \rho g_t + v_{t+1}, \tag{2}$$

where $\rho \in [0,1]$ is the smoothing parameter, and v_{t+1} is an i.i.d. shock that could arise, for example, due to a hurricane that leads to an unexpected increase in government spending. The shock is uncorrelated with the output gap. If $\rho = 0$, the government has no desire to smooth spending; it immediately attains g^*_{t+1}. If $\rho = 1$, the government's desire to smooth spending is complete, which means its reaction to the business cycle is nonexistent. Intermediate values for ρ imply a partial smoothing desire, i.e., a gradual adjustment towards ideal spending g^*_{t+1}. The closer ρ is to 0, the faster the government gets to g^*_{t+1}.

An alternative interpretation of the parameter ρ is that it measures some underlying difficulty in adjusting spending quickly according to what forecasts of economic activity warrant. For example, the government might need more than one period to issue the debt that would allow it to attain g^*_{t+1}. Or the politics associated with the budget process might prevent the government from decreasing spending abruptly, even if that is what forecasts of economic activity warrant. Yet another possibility is that government projects may not be "shovel-ready" at the time an increase in spending is warranted. In any case, this framework is able to uncover a forward-looking reaction even if the government reacts only gradually, i.e., with a lag, to forecasts of economic activity. For simplicity, I will keep calling ρ the smoothing parameter.

Substituting equation (1) into (2),

$$g_{t+1} = (1-\rho)\phi \mathrm{E}[y_{t+1,t+n}|\mathbf{\Omega_t}] + \rho g_t + v_{t+1}.$$

Now, to derive a specification suitable for the estimation of parameters ρ and ϕ, I replace the conditional expectation of average output gaps ($\mathrm{E}[y_{t+1,t+n}|\mathbf{\Omega_t}]$) with its realization

$(y_{t+1,t+n})$ and add an expectational error. This gives:

$$g_{t+1} = (1-\rho)\phi y_{t+1,t+n} + \rho g_t + \epsilon_{t+1}, \tag{3}$$

where

$$\epsilon_{t+1} \equiv -(1-\rho)\phi[y_{t+1,t+n} - \mathrm{E}[y_{t+1,t+n}|\mathbf{\Omega_t}]] + v_{t+1} \tag{4}$$

is the sum of a forecast error and an i.i.d. mean-zero shock and is, thus, mean-zero: $\mathrm{E}[\epsilon_{t+1}] = 0$.

In equation (3), g_{t+1} and $y_{t+1,t+n}$ are observable, but the smoothing and reaction parameters, ρ and ϕ, should not be estimated by an ordinary least squares (OLS) regression, because simultaneous-equations bias would affect the estimates. Equation (3) says the output gap in periods $t+1$ through $t+n$ partially determines spending in period $t+1$. But surely there is reverse causality—spending in $t+1$ partially determines the output gap in period $t+1$, and possibly in future periods as well. Indeed, the log-linearized resource constraint in a standard closed-economy general-equilibrium model with government spending says that output is affected by government spending: $y_{t+1} = \alpha c_{t+1} + \beta i_{t+1} + \gamma g_{t+1}$, where c_{t+1} is cyclical consumption, i_{t+1} is cyclical investment, and α, β, and γ are constants.[4] Due to reverse causality, therefore, the restriction needed for OLS to produce unbiased estimates, $\mathrm{E}[\epsilon_{t+1}|y_{t+1,t+n}] = 0$, does not hold.

My identification strategy relies on the fact that, since ϵ_{t+1} is unforecastable, i.e., $\mathrm{E}[\epsilon_{t+1}|\mathbf{\Omega_t}] = 0$ for all t, any variable known in period t must be uncorrelated with ϵ_{t+1}. More formally, for a vector $\mathbf{z_t} \subset \mathbf{\Omega_t}$, i.e., a subset of the information set, $\mathrm{E}[\epsilon_{t+1}|\mathbf{z_t}] = 0$. Combining this with equation (3), I obtain the following vector of orthogonality restrictions, also known as moment conditions:

[4]Strictly speaking, y_{t+1} is not typically called the *output gap* in such models, but is commonly interpreted as the deviation of GDP from trend.

$$E[(g_{t+1} - (1-\rho)\phi y_{t+1,t+n} - \rho g_t)\mathbf{z_t}] = 0. \tag{5}$$

$\mathbf{z_t}$ is a vector of instruments used to estimate ρ and ϕ. With p instruments, $\mathbf{z_t}$ would be a p-by-1 vector, and vector (5) would also be p-by-1.[5] The vector of moment conditions (5) fits the framework of the Generalized Method of Moments (GMM); it could be exploited to obtain estimates of ρ and ϕ.[6] Since there are two parameters to estimate, they would be over-identified if $p \geq 3$.

The moment conditions would be violated, and the empirical framework would fail, if the hypothesized reaction function in equation (1) ignored forecasts of a variable unrelated the output gap, which proxies the business cycle, to which the government responds systematically. The reason is that such an omitted variable would be part of ϵ_{t+1}, and it is likely that it would be correlated with $\mathbf{z_t}$. Thus, an important assumption of my framework is that there are no such variables.

I have derived a purely forward-looking specification, but I am interested in testing whether government spending is forward-looking or backward-looking. For this purpose, consider now a specification that allows the possibility of backward-looking government spending. Ideal spending in period $t+1$, g^*_{t+1}, which the government determines in period t is now given by the following reaction function:

$$g^*_{t+1} = \phi E[y_{t+1,t+n}|\mathbf{\Omega_t}] + \psi y_{t-1,t-n}, \tag{6}$$

where $y_{t-1,t-n} \equiv (y_{t-1} + y_{t-2} + \ldots + y_{t-n})/n$ is the average output gap for the previous n periods, which is known at time t, and ψ measures the reaction to past realizations of the output gap.[7] The purely forward-looking specification, equation 1, is a special case of this

[5] To assume one's instrument set is a subset of the government's information set is to assume rational expectations, i.e., that there is no information the researcher could use to forecast more accurately than the government.

[6] See Hamilton (1994, ch. 14) for a textbook treatment of GMM.

[7] I assume that the government reacts to an n-period average of the output gap, be this of forecasts if the government is forward-looking, or of past realizations if it is backward-looking.

reaction function when $\psi = 0$. Government spending policy is purely forward-looking if $\phi \neq 0$ and $\psi = 0$, and purely backward-looking if $\phi = 0$ and $\psi \neq 0$.

For the baseline results, I assume the government does not observe the output gap contemporaneously, but with a one-period lag. This is why the current output gap, y_t, is not present in the reaction function in equation (6). According to this assumption, government spending may react to forecasts of the output gap for future periods or to past realizations of the gap, but not to its current value. In section 4, I show that most results are not sensitive to changes in this assumption.

If I manipulate the reaction function in equation (6)—the one that includes forward-looking and backward-looking terms—in the same way I manipulated the purely forward-looking reaction function in equation (1), actual spending in $t+1$ is given by:

$$g_{t+1} = (1-\rho)g^*_{t+1} + \rho g_t + v_{t+1}, \tag{7}$$

which is identical to equation (2). Substituting equation (6) into (7), replacing conditional expectations with realizations and adding an expectational error, I obtain:

$$g_{t+1} = (1-\rho)\phi y_{t+1,t+n} + (1-\rho)\psi y_{t-1,t-n} + \rho g_t + \epsilon_{t+1}, \tag{8}$$

where ϵ_{t+1}, again given by equation (4), is mean-zero. I will refer to ϕ as the forward-looking reaction parameter, to ψ as the backward-looking reaction parameter, and I will continue to call ρ the smoothing parameter. Estimation under the framework of GMM exploits the fact that, under the assumptions I have mentioned, ϵ_{t+1} in equation (8) is unforecastable, $\mathrm{E}_t[\epsilon_{t+1}] = 0$. Then it must be true that $\mathrm{E}[\epsilon_{t+1}|\mathbf{z_t}] = 0$, so that the following vector of orthogonality restrictions (or moment conditions) holds

$$\mathrm{E}[(g_{t+1} - (1-\rho)\phi y_{t+1,t+n} - (1-\rho)\psi y_{t-1,t-n} - \rho g_t)\mathbf{z_t}] = 0, \tag{9}$$

where $\mathbf{z_t}$ is a p-by-1 vector of instruments that includes variables known at time t. Equation

(9) is also a p-by-1 vector, which I use to test whether government spending is forward-looking or backward-looking and, additionally, whether it is countercyclical or procyclical. To close this section, I note that a limitation of the empirical framework is that it assumes the parameters of the reaction function are stable within a given sample.

3 Results

This section presents three main results: *a*) government spending has been forward-looking in a number of countries, including the United States and several in Europe and Latin America; *b*) the reaction of spending to the output gap varies across the countries I study; some exhibit a countercyclical response and others a procyclical response; and *c*) various components of government spending respond countercyclically in the U.S., but *transfers* is the most sensitive to the output gap, followed by *investment* in second place, while *consumption* reacts least strongly.

To estimate the parameters of the reaction function, I assume that the government targets a four-quarter average of the output gap, so that $n = 4$ in the p-by-1 vector of moment restrictions, equation (9). This means that in the case of a forward-looking government, I measure how spending reacts to the forecast average output gap over the next four quarters, while in the case of a backward-looking government, I measure how spending reacts to the average output gap over the previous four quarters.

I work with quarterly data from 2000:1 to 2012:4 for 11 European countries, 4 Latin American countries, and the United States, a group for which I could assemble a complete dataset.[8] I estimate a reaction function for each country separately. To measure the fluctuation of government spending over the business cycle, I apply the Hodrick-Prescott filter[9] to logged real spending by the general government, excluding interest payments.[10] Thus,

[8]The European countries are: Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Spain, Sweden, and the United Kingdom. The Latin American countries are: Argentina, Colombia, Ecuador, and Mexico.

[9]The HP parameter is set to 1600, as usual for quarterly data.

[10]Again, the general government includes the federal or central government, state and local governments,

the cyclical component is approximately the percent deviation of government spending from the HP trend.[11] I refer to this variable as *government spending* or, simply, *spending*. As a measure of the business cycle, I use the deviation of logged real GDP from an HP trend, and refer to this variable as the *output gap*. Section 4 shows most results are robust to an alternative way to compute the output gap. Appendix A offers details on data sources and definitions.

To give an idea of the evolution of government spending and the output gap, figure 1 plots these variables for three countries: Argentina, the United Kingdom, and the United States. In the case of Argentina (upper panel), the most striking feature is that spending plunged during the 2002 recession and returned to trend as the economy recovered, i.e., spending and the output gap move in the same direction during this episode. Indeed, for the whole sample, the correlation coefficient between these variables is 0.6. In the case of the U.K. (middle panel), we can see a positive correlation between spending and the output gap during the economy's expansion of 2006-2007 and its subsequent contraction (2008-2009); the correlation coefficient for the whole sample is 0.4. In the U.S. (lower panel), spending and the output gap move roughly in opposite directions for the entire sample; the correlation coefficient is -0.9. Just as for these countries, it is easy to spot correlations between spending and the output gap for other countries. What I am looking for, however, is how spending *responds* to the output gap.

3.1 Is Spending Policy Forward- or Backward-Looking?

Table 1 presents the baseline estimates of the smoothing, forward- and backward-looking reaction parameters in equation (9): ρ, ϕ and ψ, respectively, for the 16 countries I study. Below each parameter estimate, and in parenthesis, is its heteroskedasticity- and autocorrelation-consistent standard error.[12] Recall that ρ measures the extent to which the government

and social security funds. I restrict attention to this level of government due to data availability.

[11] I use deseasonalized government spending data.

[12] I use the variance-covariance matrix proposed by Newey and West (1987) for the estimates.

adjusts spending gradually. Recall also that a forward-looking spending policy would be characterized by $\phi \neq 0$ and $\psi \approx 0$, while a backward-looking policy would be characterized by $\phi \approx 0$ and $\psi \neq 0$. Therefore, I classify a country's spending policy as forward-looking if ϕ is statistically significant and ψ is not. Similarly, I refer to a country's policy as backward-looking if ψ is statistically significant and ϕ is not. The table also reports the p-value of the J-test of overidentifying restrictions, which tests the null hypothesis that the model is valid; I fail to reject this hypothesis for each country.

Spending is forward-looking in nine of the sixteen countries I study: the U.S., Austria, Belgium, Finland, Ireland, Sweden, the U.K., Argentina, and Ecuador. For these countries, the forward-looking reaction coefficient, ϕ, is statistically significant, while the backward-looking reaction coefficient, ψ, is not. Belgium is an exception; both ϕ and ψ are insignificant in the baseline specification, but ϕ is highly significant in all other variations, as shown in section 4. These results suggest that spending reacts systematically to forecasts of the output gap.[13] The baseline estimates suggest government spending is also forward-looking in the Netherlands and Colombia, but as I show in section 4, these results fail key robustness checks.

Government spending is backward-looking in one country—Italy, which means it reacts to past economic data and not to forecasts, but this result is not robust to several variations, as I discuss in section 4. Results are unusual for Spain—both ϕ and ψ are statistically significant; I offer a possible explanation below.

In the case of three countries, France, Germany, and Mexico, my empirical framework and/or choice of instruments are unable to determine whether spending policy is systematically forward- or backward-looking for the sample I consider. For France and Germany, neither ϕ nor ψ are significant, while for Mexico, the baseline specification results in huge and implausible values for parameters and standard errors.

A set of instruments, $\mathbf{z_t}$, is needed to estimate each country's reaction function. Recall that instruments should be a subset of the government's information set; variables

[13] The estimates in table 1 are computed with the so-called iterative GMM procedure. I offer details on computation in the appendix.

that it uses to forecast the output gap. For the baseline case, I assume the government observes the output gap with a one-period lag, so that the period-t gap is not part of the period-t information set. For each country, I test two potential sets of instruments: *a)* $\mathbf{z_t^i} = \{y_{t-1}, y_{t-2}, y_{t-3}, y_{t-4}, i_t, i_{t-1}, i_{t-2}, i_{t-3}\}$, which includes four lags of the output gap and four lags of a short-term interest rate i (I assume the government observes this rate contemporaneously); and *b)* $\mathbf{z_t^{US}} = \{y_{t-1}, y_{t-2}, y_{t-3}, y_{t-4}, y_{t-1}^{US}, y_{t-2}^{US}, y_{t-3}^{US}, y_{t-4}^{US}\}$, which includes four lags of the output gap and four lags the U.S. output gap. To choose the best among these two sets, I use the moment selection criteria proposed by Andrews (1999).[14] The last column of table 1 mentions the instrument set I use for each country.

I include lags of each country's output gap in the instrument set because this variable is autocorrelated. Thus, they should contribute to forecasts. Lagged values of a short-term interest rate are good candidates for the instrument set because they contain information on monetary policy, which has been shown to affect the economy with a lag,[15] and further, because financial conditions affect private investment decisions and, thus, future output. Finally, for countries other than the U.S., I include lags of the U.S. output gap in one of the potential instrument sets because it proxies international business-cycle developments. The reason I do not combine all these variables in one large instrument set is that identification in GMM is more likely attained when one uses a parsimonious set.[16] To assume that any set of lagged variables available to the researcher is a subset of the government's information set is to assume rational expectations, i.e., there is no information the researcher could use to forecast better than the economic agent.

3.2 Does Spending React Countercyclically or Procyclically?

I now classify a country's spending policy as countercyclical or procyclical. A country where government spending responds *countercyclically* has a negative and statistically significant

[14]The details of this selection are available upon request.
[15]See, e.g., Romer and Romer (1989).
[16]See Hamilton (1994, p. 426-7) and the references therein.

reaction parameter, either ϕ or ψ. As a consequence, spending moves in the opposite direction in which the output gap is expected to move (forward-looking policy) or has moved (backward-looking policy).

A country where government spending responds *procyclically* is one for which either ϕ or ψ is positive and statistically significant, so that spending moves in the same direction in which the output gap is expected to move (forward-looking policy) or has moved (backward-looking policy).

If neither ϕ nor ψ are statistically significant, my empirical framework and/or choice of instruments cannot determine precisely whether spending policy is countercyclical or procyclical for the sample I consider. An interesting possibility in this case is that the policy regime switches within the sample, a phenomenon that my framework cannot capture.

Spending responds countercyclically in six of the sixteen countries I study: the U.S., Austria, Belgium, Finland, Ireland, and Italy. (Spending is also forward-looking in all of them but Italy.) Government spending reacts most strongly to the output gap in Ireland, with a forward-looking reaction parameter $\phi = -1.97$. This suggests that general government spending in Ireland increases 1.97 percent above trend when GDP is expected to be 1 percent below trend, on average, for the next four quarters. The reaction of spending in Belgium and the U.S. is similar, with $\phi = -1.40$ and $\phi = -1.36$, respectively.[17] Spending in Finland, Austria, and Italy also responds countercyclically, but is not very sensitive to the output gap—the relevant reaction coefficient is less than one for these countries.

Among the countries where spending responds countercyclically, the U.S. adjusts spending most gradually towards its ideal deviation from trend. You can see this by noting its smoothing parameter $\rho = 0.67$, while it is 0.53 for Finland. In the cases of Austria, Ireland, and Italy, ρ is statistically insignificant, which suggests these countries adjust spending quickly towards its ideal deviation from trend. For Belgium, $\rho = 0.90$ in the baseline specification, but as I previously mentioned, the baseline results are exceptional for this country.

[17] For Belgium, ϕ is insignificant in the baseline specification. $\phi = -1.40$ in two-step GMM estimation (see table 4); all other variations confirm $\phi < 0$ and highly significant.

In some of the variations discussed in section 4, ρ is not statistically different from zero for Belgium; in other variations it is.

Government spending responds procyclically in four countries: Sweden, the U.K., Argentina, and Ecuador. (Spending is also forward-looking in these countries.) Argentine spending is the most strongly procyclical of the group, with a forward-looking reaction parameter $\phi = 2.86$. When the Argentine government expects GDP to be 1 percent below trend, on average, over the next four quarters, it reduces spending 2.86 percent below trend. Ecuador's spending is the second most strongly procyclical, with $\phi = 2.01$. Sweden and the U.K. follow in the ranking, with forward-looking reaction coefficients of 1.83, and 1.66, respectively. Among the countries that follow a procyclical policy, the smoothing parameter ρ is statistically different from zero only for Sweden, with a value of 0.68.

The empirical framework cannot distinguish precisely between a countercyclical and a procyclical policy in the case of six countries: France, Germany, the Netherlands, Spain, Colombia, and Mexico. ϕ and ψ are insignificant for France and Germany. In the Netherlands and Colombia, spending appears to be countercyclical, but as I have mentioned, these results are not robust; see section 4 for details. In the case of Spain, both ϕ and ψ are statistically significant; moreover, they have different signs: $\phi = -1.77$ and $\psi = 1.52$. A possible explanation is that the spending policy regime switches within the sample. Figure 2 lends some support to this hypothesis. It shows that government spending and the output gap in Spain are positively correlated during the boom years, roughly 2005-2008, but negatively correlated thereafter.

Table 2 summarizes the classification I have described in the last two subsections. The countries in the top left quadrant employ a forward-looking and countercyclical policy, those in the bottom left quadrant employ a forward-looking and procyclical policy, and so forth. Within each quadrant, countries are ranked by the absolute value of the relevant reaction parameter, from largest to smallest. I exclude from this table the countries for which I cannot draw precise conclusions about their spending policies.

3.3 The Reaction of Components of Spending in the U.S.

The availability of data for the U.S. allows me to estimate how three components of government spending respond to the business cycle: consumption, investment, and transfers. I constrain the backward-looking reaction parameter ψ to zero, since we have seen that spending is forward-looking in the U.S.[18] Table 3 presents the results. For the sample I consider, all three components respond countercyclically, as ϕ is negative and highly significant. As expected, transfers by the general government, which include, for example, unemployment insurance and food stamps, react most strongly, with $\phi = -2.14$. Investment comes second, with $\phi = -1.06$, while consumption is the least sensitive component, with $\phi = -0.78$.

I use a purely forward-looking specification for all three components, including transfers. Recall that ϕ is interpreted as the percent change in spending relative to trend when the government expects GDP to be 1 percent above trend, on average, over the next four quarters. But since transfers are automatic stabilizers, they are typically assumed to react *contemporaneously*.[19] In my framework, however, the government comes up with an estimate, at time t, of the deviation of transfers from trend for period $t+1$. For example, the government's budget contains an estimate of future expenditures on unemployment insurance. Even if the legislation on transfers does not change in $t+1$, this estimate depends on the government's forecast of economic activity (the output gap), and because the government cannot forecast economic activity perfectly, the actual deviation of transfers from trend in $t+1$ will generally differ from the government's estimate at t. In other words, actual transfers are determined contemporaneously, but due to budget planning, the government is constantly estimating the transfer payments it will make in future periods, and these estimates are a function of forecasts of economic activity. This is what justifies my forward-looking treatment of transfers.

[18] If I allow ψ to take any value, it is insignificant for the three components I study and the other parameters are largely unchanged.

[19] See, e.g., Blanchard and Perotti (2002).

4 Strength of Instruments and Robustness

In this section, I discuss the strength of the instruments, a critical issue in nonlinear GMM estimation.[20] This issue is closely related to the idea that results should be robust, as I explain below. The results for the Netherlands and Colombia fail several key robustness checks, which prevents me from classifying their spending as forward-looking and countercyclical.

Although the vector of moment conditions, equation (9), allows the inclusion of any variable known in period t or earlier in the vector of instruments $\mathbf{z_t}$, it is important to choose instruments that are strongly correlated with the average of future output gaps. Indeed, Stock, Wright, and Yogo (2002) argue that in nonlinear GMM, weak instruments lead to *weak identification*—the possibility that parameter values that are not the true values satisfy the moment conditions.

Unfortunately, there are no formal tests for weak identification in nonlinear GMM, but Stock, Wright, and Yogo (2002, pp. 526-7) discuss some symptoms that suggest weak identification may be present. Perhaps the most important indicator of this problem would be to obtain substantially different point estimates and confidence intervals under two alternative GMM algorithms: the *two-step estimator* and the *continuously updating estimator*. As I have mentioned, I use so-called *iterative* GMM to obtain the baseline results. The iterative GMM estimator has good properties,[21] but the two-step and the continuously updating estimators are also consistent. If they produce substantially different results, weak identification may be present.

Table 4 presents results produced by the two-step GMM estimator. (Table 4 and those that follow include only the ten countries for which I am able to determine whether spending policy is forward-looking or backward-looking and countercyclical or procyclical, plus the Netherlands and Colombia.) The baseline estimates of most countries, except the Netherlands and Colombia, are robust to two-step estimation; the magnitudes of the coefficients

[20] Nonlinearities arise because some parameters *multiply* each other in the vector of moment conditions, equation (9).

[21] See Hamilton (1994, p. 413)

are similar to the baseline estimates, and their level of significance is the same in almost all cases. The last column of the table highlights important differences between the results produced by the two-step estimator and the baseline results. It underscores that for Italy, ϕ is significant in addition to ψ, while for Ecuador, ϕ turns insignificant. It also shows that the two-step estimator suggests Belgian spending is forward-looking and countercyclical, a result that all of the robustness checks that follow corroborate.

Table 5 presents results produced by the continuously updating estimator (CUE).[22] Some baseline results are not robust to this estimator. Notably, parameter estimates and standard errors are huge and implausible for the U.S., Austria, and Sweden. Among other differences with respect to the baseline results, the backward-looking parameter ψ is significant for the U.K. and Colombia.

Another symptom of weak identification that Stock, Wright, and Yogo (2002) mention is sensitivity to small changes in the sample, so I recompute the baseline specification with about 9 percent fewer observations. I eliminate two observations from each end of the sample, so that the adjusted sample becomes 2001:4-2011:3 and the number of observations is reduced from 44 to 40. Table 6 presents iterative GMM estimates for this reduced sample. All of the baseline results are robust to this variation, with the exception of those related to Finland and Sweden. With respect to the baseline estimates, ρ turns insignificant and ψ turns significant for Finland, while ψ is negative and significant for Sweden.

As an additional robustness check, I verify the finding that spending is forward-looking in the U.S., Austria, Belgium, Finland, Ireland, Sweden, the U.K., Argentina, and Ecuador. If this were truly the case, the term that allows for the possibility of a backward-looking policy in the reaction function could be dropped, and the estimates from the resulting purely forward-looking specification should not differ much from their baseline counterparts. Table 7 presents results from a purely forward-looking specification (equations (1) and (5)) and, to facilitate comparison, reproduces the baseline results, which come from a specification that

[22] The continuously updating estimator was originally proposed by Hansen, Heaton, and Yaron (1996).

includes forward- and backward-looking terms.[23]

Most forward-looking reaction parameters are similar, in magnitude and significance, to those in the baseline specification, which suggests that it is safe to drop the backward-looking term and treat spending policy as purely forward looking in these countries. The smoothing parameter, however, becomes significant for the U.K. and Argentina.

I also check whether the baseline results are sensitive to a different assumption regarding the information set. Recall that for the baseline case, I assume the government observes the output gap with a one-period lag. Table 8 presents estimates of a reaction function that assumes the government observes the output gap contemporaneously, so that in addition to reacting to forecasts of the gap, it reacts to *current* and lagged values of the gap.[24] The results for Austria and Italy, in addition to those for the Netherlands and Colombia, are not robust to the alternative informational assumption.

As a final exercise, I check the robustness of the baseline results to a different detrending procedure. To compute the results in table 9, I remove a *quadratic trend* from logged real government spending and logged real GDP. (The data that underlie the baseline estimates are deviations from an *HP trend*.) The results for five countries fail this robustness check: Italy, the Netherlands, Sweden, Argentina, and Ecuador. For Italy and the Netherlands, the relevant reaction parameter is insignificant. For Sweden, Argentina, and Ecuador, the discrepancy is more serious—the reaction parameter that is insignificant in the baseline specification becomes significant. Furthermore, the sign of this parameter is different from the sign of the parameter that was significant in the baseline specification. For example, $\phi > 0$ and significant in the baseline specification for Sweden, but with quadratically detrended data, $\psi < 0$ and significant as well. Finally, the results for the U.K. fail this robustness check

[23] I exclude the Netherlands and Colombia from table 7, but I note that the former fails this check and the latter passes it.

[24] The reaction function becomes $g^*_{t+1} = \phi \mathrm{E}_t[y_{t+1,t+4}] + \psi y_{t,t-3}$, where spending now reacts to current and lagged values of the output gap ($y_{t,t-3}$). The corresponding vector of moment restrictions is given by $\mathrm{E}[(g_{t+1} - (1-\rho)\phi y_{t+1,t+4} - (1-\rho)\psi y_{t,t-3} - \rho g_t) * \mathbf{z_t}] = 0$, and the potential instrument sets contain the current output gap plus three lags: $\mathbf{z^i_t} = \{y_t, y_{t-1}, y_{t-2}, y_{t-3}, i_t, i_{t-1}, i_{t-2}, i_{t-3}\}$, $\mathbf{z^{US}_t} = \{y_t, y_{t-1}, y_{t-2}, y_{t-3}, y^{US}_t, y^{US}_{t-1}, y^{US}_{t-2}, y^{US}_{t-3}\}$.

in one dimension—both reaction parameters are positive and significant with quadratically detrended data, which challenges the baseline result that spending is forward-looking, but does not challenge the result that it is procyclical.

Table 10 summarizes the findings of the six robustness checks I conduct. For five countries (the U.S., Belgium, Finland, Ireland, and Argentina), the baseline results are quite robust; they do not fail more than one check. Austria, the U.K., and Ecuador fail two robustness checks. The baseline results for the Netherlands, however, fail four checks, so I do not classify its spending as forward-looking and countercyclical. The results for Colombia fail three checks, two of which are critical: two-step and continuously updating GMM estimation. Since sensitivity to these two estimators is a symptom of weak identification according to Stock, Wright, and Yogo (2002), I also exclude Colombia from the classification of government spending.

The baseline results suggest Italy's spending policy is purely backward-looking and countercyclical. These results fail three robustness checks: two-step estimation, the use of an alternative informational assumption, and an alternative detrending procedure (tables 4, 8 and 9). In two of these checks, the forward-looking reaction parameter is also statistically significant, which challenges the claim that spending policy is backward-looking. Nevertheless, both reaction parameters are negative, so that even if it is difficult to establish whether spending is forward-looking or backward-looking, the evidence suggests it is countercyclical.

Due to data availability, I can perform an additional robustness check for the U.S. Table 11 compares the baseline results for total U.S. spending and its components to results computed with so-called real-time data—the data that was available to policymakers at the time of their decisions. All of the baseline results are robust to the use of real-time data.

Considering real-time data in policy analysis is important because the agencies that produce data frequently revise previous statistics. These revisions can be substantial, so, for example, the output gap that a policymaker computes for last quarter can be substantially different from the output gap for that same quarter that is computed several years in the future with revised information. Orphanides (2001), for instance, argues that using revised data to study monetary policy can lead to misleading conclusions. In all of the results I have presented so far, I implicitly assume that fiscal policymakers use revised data to forecast the output gap, but this is not true. To check for robustness, I build an output gap series with real-time data on real GDP.[25] To compute the real-time results in table 11, I use the real-time output gap for the instrument set and the average of past output gaps (the term $y_{t-1,t-n}$ in the vector of moment conditions—equation (9)) and an output gap based on ex post revised data for the average of future output gaps (the term $y_{t+1,t+n}$ in equation (9)).

Taken together, the results from this section suggest that most of the baseline results are robust and, thus, the instruments are broadly strong.

5 Concluding Remarks

In this paper, I measure how government spending responds to the business cycle in various countries from 2000 to 2012. The evidence suggests that spending is forward-looking in a number of them: the U.S., Austria, Belgium, Finland, Ireland, Sweden, the U.K., Argentina, and Ecuador. It appears to be backward-looking in Italy. I also classify these countries' spending as countercyclical or procyclical. Spending responds countercyclically in: the U.S., Austria, Belgium, Finland, Ireland, and Italy; spending responds procyclically in: Sweden, the U.K., Argentina, and Ecuador.

In many of these countries, spending reacts substantially to the business cycle. For example, the U.S. government gradually increases spending 1.36 percent above trend when it expects GDP to be 1 percent below trend, on average, over the next four quarters. Gov-

[25]These real-time data on real GDP are available from the Federal Reserve Bank of Philadelphia. See their *Real-Time Data Set for Macroeconomists*. To build the real-time output gap series, I apply the HP filter to every vintage of logged real GDP and extract the last observation. For example, the first vintage available has data from 1947:1 to 1965:3. I apply the HP filter to this vintage and take the last observation, which corresponds to 1965:3, as the first observation of the real-time output gap series. I then apply the HP filter to the second vintage, which has data from 1947:1 to 1965:4, and extract the last observation, which corresponds to 1965:4, as the second observation of the real-time series, and so on, so that the t-th observation of the real-time output gap series is the last observation from the series that results from applying the HP filter to the vintage that has information from 1947:1 to t.

ernment spending in Argentina is the most strongly procyclical—the Argentine government decreases spending 2.86 percent below trend when it expects GDP to be 1 percent below trend, on average, over the next four quarters.

Due to data availability, I am able to study how various components of government spending react to the business cycle in the U.S. I find that all react countercyclically and, not surprisingly, that *transfers* react most strongly, followed by *investment*, while *consumption* is the least sensitive component. Future research might study the implications of these results.

A limitation of my analysis is related to the measure of the fluctuation of government spending over the business cycle that I use. As Auerbach (2003) points out, some spending decisions are set to take effect months or even years after they are approved. Thus, some of the variation in my measure of spending may be due to decisions that have nothing to do with the business cycle. I do not know the extent to which this problem affects the reliability of my results.

Finally, the evidence in this paper might be a useful input to studies of fiscal policy's ability to stabilize the economy under circumstances such as a binding zero-lower-bound on interest rates and a complicated long-term fiscal outlook. In future research, I will explore whether embedding forward-looking spending policy rules on dynamic general-equilibrium models generates interesting policy implications.

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Table 1: Baseline Estimates of the Government Spending Reaction Function

Country	ρ	ϕ	ψ	J-test p-value	Comments
United States	0.67*** (0.16)	-1.36*** (0.21)	0.11 (0.49)	0.49	Forward-looking, countercyclical; z_t^i
Austria	-0.21 (1.09)	-0.58*** (0.18)	-0.19 (0.24)	0.81	Forward-looking, countercyclical; z_t^{US}
Belgium[a]	0.90*** (0.18)	-4.24 (6.50)	3.96 (8.41)	0.70	z_t^i
Finland	0.53*** (0.11)	-0.59*** (0.11)	0.06 (0.10)	0.65	Forward-looking, countercyclical; z_t^i
France	0.86*** (0.29)	-3.40 (6.29)	1.18 (4.20)	0.65	z_t^i
Germany	0.83*** (0.23)	-1.71 (1.23)	0.44 (1.01)	0.89	z_t^i
Ireland	0.30 (0.42)	-1.97** (0.80)	-0.03 (0.73)	0.96	Forward-looking, countercyclical; z_t^{US}
Italy	-0.01 (0.27)	-0.34 (0.20)	-0.25** (0.12)	0.63	Backward-looking, countercyclical; z_t^i
Netherlands[b]	0.87*** (0.11)	-3.90** (1.92)	3.03 (2.95)	0.72	Forward-looking, countercyclical; z_t^i
Spain	0.48** (0.19)	-1.77*** (0.35)	1.52*** (0.44)	0.35	z_t^i
Sweden	0.68*** (0.11)	1.83*** (0.24)	-1.25 (0.85)	0.21	Forward-looking, procyclical; z_t^{US}
United Kingdom	0.25 (0.36)	1.66*** (0.32)	0.41 (0.39)	0.62	Forward-looking, procyclical; z_t^i
Argentina	-0.22 (0.24)	2.86*** (0.39)	0.00 (0.35)	0.64	Forward-looking, procyclical; z_t^i
Colombia[b]	-0.65** (0.29)	-1.33** (0.62)	-0.80 (0.62)	0.74	Forward-looking, countercyclical; z_t^{US}
Ecuador	-0.08 (0.32)	2.01* (1.07)	-0.95 (0.89)	0.50	Forward-looking, procyclical; z_t^i
Mexico[c]					Extreme values; z_t^{US}

Iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$ for various countries. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. ρ is the smoothing parameter, ϕ is the forward-looking reaction parameter, ψ is the backward-looking reaction parameter. Heteroskedasticity- and autocorrelation-consistent standard errors are in parenthesis, with ***, **, and * denoting significance at the 1, 5, and 10 percent levels, respectively. The superindexes of z_t indicate the instrument set used for each country (see the text for details). The J-test tests the null hypothesis that the overidentifying restrictions are valid. The adjusted sample is 2001:2-2012:1.

[a] All other specifications suggest spending policy is forward-looking and countercyclical.

[b] Results are not robust, as shown in section 4.

[c] Coefficients and standard errors are huge and implausible.

Table 2: A Summary

	Forward-looking	Backward-looking
Countercyclical	Ireland, $\phi = -1.97$ Belgium, $\phi = -1.40^{\dagger}$ United States, $\phi = -1.36$ Finland, $\phi = -0.59$ Austria, $\phi = -0.58$	Italy, $\psi = -0.25$
Procyclical	Argentina, $\phi = 2.86$ Ecuador, $\phi = 2.01$ Sweden, $\phi = 1.83$ United Kingdom, $\phi = 1.66$	

The countries in the top left quadrant employ a forward-looking and countercyclical policy, those in the bottom left quadrant employ a forward-looking and procyclical policy, and so forth. Within each quadrant, countries are ranked by the absolute value of the relevant reaction parameter, from largest to smallest.
†Result from two-step GMM estimation; see table 4.

Table 3: Estimates of the Reaction Function for Components of U.S. Spending

Component	ρ	ϕ	J-test p-value
Transfers	0.49***	-2.14***	0.75
	(0.10)	(0.30)	
Investment	-0.79	-1.06***	0.68
	(0.73)	(0.15)	
Consumption	0.59***	-0.78***	0.75
	(0.14)	(0.15)	

GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + \rho g_t + \epsilon_{t+1}$ for various components of U.S. spending. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$. The adjusted sample is 2001:2-2012:1. See the note on table 1 for a definition of the coefficients and additional information.

Table 4: Estimates of the Government Spending Reaction Function—Two-Step Estimator

Country	ρ	ϕ	ψ	J-test p-value	Vis-à-vis Baseline
United States	0.58*** (0.14)	-1.37*** (0.18)	-0.10 (0.29)	0.49	
Austria	0.32 (1.02)	-0.59* (0.31)	-0.07 (0.42)	0.88	
Belgium	-0.02 (0.20)	-1.40*** (0.17)	-0.08 (0.19)	0.43	Forward-looking, counter-cyclical
Finland	0.50*** (0.11)	-0.57*** (0.12)	-0.08 (0.10)	0.68	
Ireland	0.26 (0.49)	-1.91** (0.78)	-0.13 (0.76)	0.97	
Italy	0.11 (0.27)	-0.57*** (0.18)	-0.25* (0.14)	0.60	ϕ is significant
Netherlands	0.85*** (0.11)	-2.40 (1.56)	2.15 (1.94)	0.67	ϕ is insignificant
Sweden	0.87*** (0.11)	2.03** (0.80)	-3.76 (3.83)	0.24	
United Kingdom	0.26 (0.35)	1.67*** (0.34)	0.43 (0.38)	0.61	
Argentina	0.20 (0.28)	1.83*** (0.47)	-0.05 (0.41)	0.63	
Colombia	-0.26 (0.24)	-0.56 (0.85)	-0.59 (0.58)	0.71	ρ and ϕ are insignificant
Ecuador	0.37 (0.28)	1.95 (1.49)	-1.22 (1.27)	0.28	ϕ is insignificant

Two-step GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$ for various countries. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. The adjusted sample is 2001:2-2012:1. See the note on table 1 for a definition of the coefficients and additional information.

Table 5: Estimates of the Government Spending Reaction Function—CUE

Country	ρ	ϕ	ψ	J-test p-value	Vis-à-vis Baseline
United States					Extreme values
Austria					Extreme values
Belgium	-0.97** (0.47)	-1.47*** (0.14)	-0.13 (0.15)	0.53	Forward-looking, counter-cyclical
Finland	0.72*** (0.16)	-1.15** (0.54)	-0.25 (0.26)	0.73	
Ireland	0.20 (0.49)	-2.01*** (0.72)	-0.24 (0.67)	0.96	
Italy	-0.60 (0.56)	0.20 (0.20)	-0.18** (0.09)	0.73	
Netherlands	0.86*** (0.11)	-4.61** (2.22)	2.88 (2.73)	0.74	
Sweden					Extreme values
United Kingdom	-0.63 (0.63)	1.73*** (0.28)	0.67*** (0.19)	0.83	ψ is significant
Argentina	-0.92 (0.67)	2.84*** (0.39)	0.20 (0.35)	0.75	
Colombia	-2.13* (1.07)	-1.43** (0.57)	-1.09* (0.62)	0.80	ψ is significant
Ecuador	-0.53 (0.36)	1.61* (0.93)	-0.64 (0.80)	0.58	

Continuously updating GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$ for various countries. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. The adjusted sample is 2001:2-2012:1. See the note on table 1 for a definition of the coefficients and additional information.

Table 6: Estimates of the Reaction Function for a Slightly Shorter Sample

Country	ρ	ϕ	ψ	J-test p-value	Vis-à-vis Baseline
United States	0.62*** (0.15)	-1.43*** (0.21)	0.12 (0.44)	0.59	
Austria	0.04 (0.55)	-0.51** (0.19)	-0.13 (0.22)	0.98	
Belgium	-0.11 (0.22)	-1.21*** (0.15)	-0.11 (0.13)	0.42	Forward-looking, counter-cyclical
Finland	-0.11 (0.21)	-0.23*** (0.07)	-0.24*** (0.04)	0.66	ρ is insignificant; ψ is significant
Ireland	0.32 (0.40)	-2.02** (0.82)	-0.10 (0.74)	0.96	
Italy	-0.10 (0.33)	-0.29 (0.19)	-0.21* (0.11)	0.66	
Netherlands	0.84*** (0.10)	-4.71** (1.92)	3.26 (2.76)	0.79	
Sweden	0.62*** (0.06)	1.67*** (0.18)	-1.32*** (0.47)	0.39	$\psi < 0$ and significant
United Kingdom	0.42 (0.28)	1.62*** (0.41)	0.11 (0.53)	0.83	
Argentina	-0.13 (0.25)	3.07*** (0.36)	-0.30 (0.29)	0.49	
Colombia	-0.32 (0.19)	-1.20* (0.69)	-0.15 (0.64)	0.71	
Ecuador	-0.08 (0.19)	2.00* (1.02)	-0.91 (0.90)	0.67	

Iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$ for various countries. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. The adjusted sample is 2001:4-2011:3. See the note on table 1 for a definition of the coefficients and additional information.

Table 7: Estimates of a Purely Forward-Looking Reaction Function

Country	ρ	ϕ	ψ	J-test p-value	Vis-à-vis Baseline
United States	0.63*** (0.07)	-1.33*** (0.18)	–	0.60	
	0.67*** (0.16)	-1.36*** (0.21)	0.11 (0.49)	0.49	
Austria†	0.44 (0.52)	-0.57* (0.34)	–	0.94	
	-0.21 (1.09)	-0.58*** (0.18)	-0.19 (0.24)	0.81	
Belgium	-0.92* (0.46)	-1.47*** (0.12)	–	0.61	Forward-looking, countercyclical
	0.90*** (0.18)	-4.24 (6.50)	3.96 (8.41)	0.70	
Finland	0.57*** (0.12)	-0.66*** (0.14)	–	0.78	
	0.53*** (0.11)	-0.59*** (0.11)	0.06 (0.10)	0.65	
Ireland	0.33 (0.33)	-2.15** (0.87)	–	0.98	
	0.30 (0.42)	-1.97** (0.80)	-0.03 (0.73)	0.96	
Sweden	0.48*** (0.08)	2.20*** (0.25)	–	0.34	
	0.68*** (0.11)	1.83*** (0.24)	-1.25 (0.85)	0.21	
United Kingdom	0.45** (0.20)	1.61*** (0.41)	–	0.64	ρ is significant
	0.25 (0.36)	1.66*** (0.32)	0.41 (0.39)	0.62	
Argentina	-0.22* (0.13)	2.86*** (0.16)	–	0.76	ρ is significant
	-0.22 (0.24)	2.86*** (0.39)	0.00 (0.35)	0.64	
Ecuador	0.06 (0.32)	3.72** (1.64)	–	0.54	
	-0.08 (0.32)	2.01* (1.07)	-0.95 (0.89)	0.50	

For each country, the first set of results are iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4}\rho g_t + \epsilon_{t+1}$, a purely forward-looking specification. The second set of results are iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. The adjusted sample is 2001:2-2012:1. See the note on table 1 for a definition of the coefficients and additional information.

† ϕ is significant at the 10.2 percent level.

Table 8: Estimates of the Government Spending Reaction Function—Alternative Information Set

Country	ρ	ϕ	ψ	J-test p-value	Vis-à-vis Baseline
United States	0.73*** (0.26)	-2.00* (1.14)	0.47 (1.49)	0.40	
Austria	0.55 (0.79)	-0.29 (0.73)	-0.07 (0.45)	1.00	ϕ is insignificant
Belgium	0.74*** (0.20)	-2.32** (1.11)	1.12 (1.38)	0.65	Forward-looking, counter-cyclical
Finland	0.53*** (0.12)	-0.58*** (0.13)	0.01 (0.10)	0.96	
Ireland	-0.29 (0.53)	-1.55*** (0.45)	-0.36 (0.58)	0.91	
Italy	0.57** (0.22)	-1.00** (0.48)	-0.16 (0.29)	0.66	ρ and ϕ are significant; ψ is insignificant
Netherlands	0.97*** (0.08)	-10.15 (22.52)	13.09 (33.79)	0.83	ϕ is insigificant
Sweden	0.79*** (0.10)	2.94*** (0.88)	-1.79 (1.36)	0.34	
United Kingdom	0.57 (0.39)	1.71** (0.85)	-0.17 (1.19)	0.83	
Argentina	-0.05 (0.15)	2.37*** (0.47)	0.24 (0.35)	0.75	
Colombia	0.29 (0.30)	-1.34 (1.13)	-0.91 (1.12)	0.69	ρ and ϕ are insignificant
Ecuador	-0.25 (0.38)	2.70** (1.13)	-0.65 (0.90)	0.63	

Iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t,t-3} + \rho g_t + \epsilon_{t+1}$ for various countries. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t,t-3}$ is analogously defined. The adjusted sample is 2001:2-2012:1. See the note on table 1 for a definition of the coefficients and additional information.

Table 9: Estimates of the Government Spending Reaction Function—Quadratically Detrended Data

Country	ρ	ϕ	ψ	J-test p-value	Vis-à-vis Baseline
United States	0.78*** (0.16)	-1.39*** (0.33)	0.73 (1.10)	0.53	
Austria	-1.38 (2.24)	-0.54*** (0.18)	-0.06 (0.22)	0.99	
Belgium	0.96*** (0.17)	-8.84 (36.31)	10.81 (49.65)	0.68	
Finland	0.53*** (0.14)	-0.49*** (0.11)	-0.06 (0.08)	0.49	
Ireland	0.56** (0.25)	-2.51** (0.95)	1.55 (0.98)	0.97	
Italy	0.06 (0.37)	-0.25 (0.19)	0.03 (0.15)	0.74	ψ is insignificant
Netherlands	0.97*** (0.10)	-4.66 (13.96)	9.50 (33.79)	0.91	ϕ is insigificant
Sweden	0.73*** (0.08)	1.85*** (0.29)	-2.47*** (0.89)	0.24	ψ is negative and significant
United Kingdom	0.05 (0.37)	1.92*** (0.39)	0.65*** (0.24)	0.83	ψ is positive and significant
Argentina	0.04 (0.26)	2.59*** (0.42)	-0.87** (0.39)	0.65	ψ is negative and significant
Colombia	-0.63** (0.27)	-1.19** (0.57)	-0.02 (0.47)	0.62	
Ecuador	-0.68 (0.48)	0.38 (0.77)	-1.55* (0.85)	0.82	ϕ is insignificant; ψ is negative and significant

Iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$ for various countries. g is the percent deviation of government spending from a quadratic trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from a quadratic trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. The adjusted sample is 2001:2-2012:1. See the note on table 1 for a definition of the coefficients and additional information.

Table 10: Robustness Checks—A Summary

Country	(a)	(b)	(c)	(d)	(e)	(f)	(g)
United States	✓	×	✓	✓	✓	✓	1
Austria	✓	×	✓	✓	×	✓	2
Belgium[h]							1
Finland	✓	✓	×	✓	✓	✓	1
Ireland	✓	✓	✓	✓	✓	✓	0
Italy	×	✓	✓	N/A	×	×	3
Netherlands	×	✓	✓	×	×	×	4
Sweden	✓	×	×	✓	✓	×	3
United Kingdom	✓	×	✓	✓	✓	×	2
Argentina	✓	✓	✓	✓	✓	×	1
Colombia	×	×	✓	✓	×	✓	3
Ecuador	×	✓	✓	✓	✓	×	2

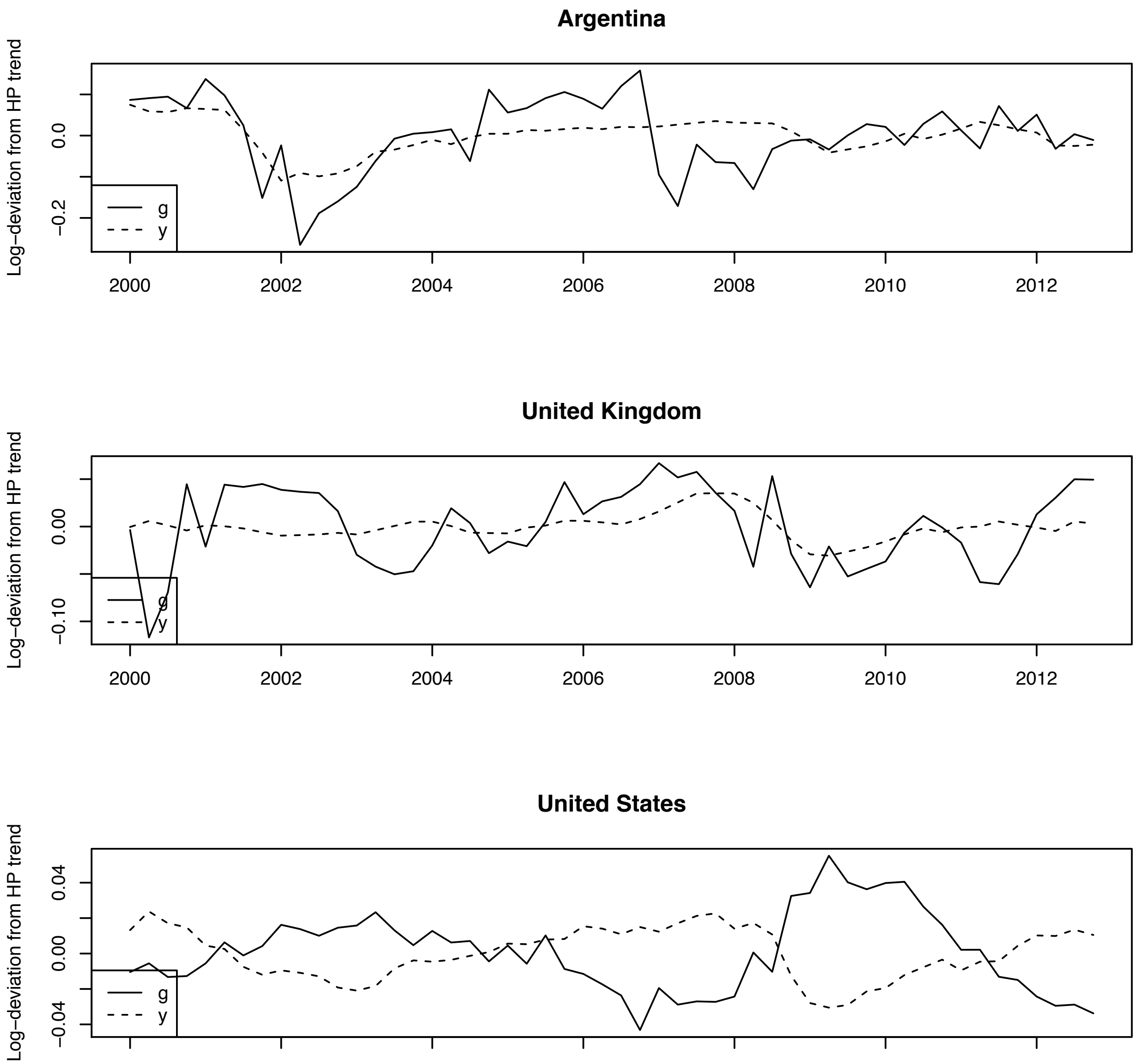
(a) Two-step GMM estimator.
(b) Continuously updating estimator.
(c) Slight change in the sample: 40 observations instead of 44.
(d) Purely forward-looking specification.
(e) Alternative assumption regarding the information set: the current output gap is known.
(f) Quadratically detrended data.
(g) Number of robustness checks failed.
[h]Forward-looking and countercyclical spending policy in all robustness checks except one, but not in baseline specification.

Table 11: Estimates of the Government Spending Reaction Function for the U.S.—Real-Time Data

		ρ	ϕ	ψ	J-test p-value
Total spending	Real-time data	0.65*** (0.12)	-1.49** (0.64)	-0.30 (0.52)	0.99
	Baseline	0.67*** (0.16)	-1.36*** (0.21)	0.11 (0.49)	0.49
Transfers	Real-time data	0.57*** (0.09)	-2.14*** (0.30)		0.90
	Baseline	0.49*** (0.10)	-2.14*** (0.30)		0.75
Investment	Real-time data	0.46** (0.20)	-1.32*** (0.15)		0.39
	Baseline	-0.79 (0.73)	-1.06*** (0.15)		0.68
Consumption	Real-time data	0.75*** (0.11)	-1.03*** (0.29)		0.67
	Baseline	0.59*** (0.14)	-0.78*** (0.15)		0.75

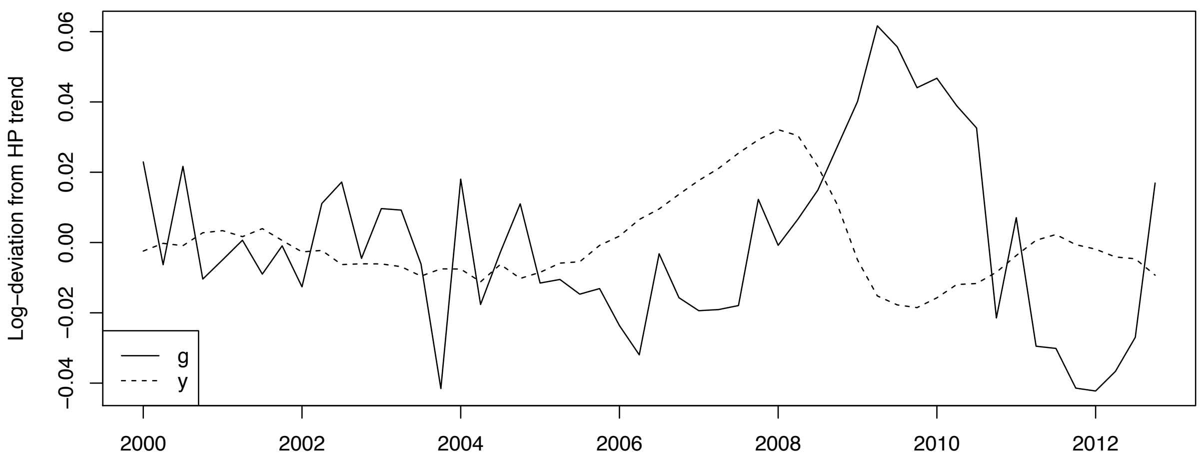
Iterative GMM estimates of $g_{t+1} = (1-\rho)\phi y_{t+1,t+4} + (1-\rho)\psi y_{t-1,t-4} + \rho g_t + \epsilon_{t+1}$ for total U.S. spending and its components. ψ is constrained to zero for components. g is the percent deviation of government spending from trend, $y_{t+1,t+4}$ is the average percent deviation of real GDP from trend between $t+1$ and $t+4$, $y_{t-1,t-4}$ is analogously defined. The instrument sets underlying the estimates in rows labeled "real-time data" contain real-time data on the output gap. The adjusted sample is 2001:4-2011:3. See the note on table 1 for a definition of the coefficients and additional information.

Figure 1: Government Spending and the Output Gap in Three Countries



g is the log-deviation of real government spending from an HP trend. y is the log-deviation of real GDP from an HP trend, what I call the output gap. The sample is 2000:1-2012:4. The HP parameter is 1,600.

Figure 2: Government Spending and the Output Gap in Spain



g is the log-deviation of real government spending from an HP trend. y is the log-deviation of GDP from an HP trend, what I call the output gap. The sample is 2000:1-2012:4. The HP parameter is 1,600.

Appendix

A Data and Computation

I use quarterly data from 2000:1 to 2012:4. U.S. data on general government expenditures come from the National Income and Product Accounts (NIPA).[26] Specifically, I use data from *General Government Current Receipts and Expenditures*, table 3.1 in the online publication. My baseline measure of government spending excludes *interest payments*, so I subtract this category (line 22 in the table) from *total expenditures* (line 32). I then deflate this series with the GDP deflator, which I obtain from the FRED database provided by the Federal Reserve Bank of St. Louis.[27] The details on the components of U.S. general government spending are as follows. What I call transfers is the sum of *current transfer payments* and *capital transfer payments*, lines 17 and 35, respectively, in NIPA table 3.1. What I call investment is the series *gross government investment*, line 34 in the same table. Finally, what I call purchases of goods and services is the series *consumption expenditures*, line 16. I also deflate these series with the GDP deflator. Data on real GDP and interest rates also come from FRED.[28] Finally, as I mentioned in section 3, I use the Hodrick-Prescott filter to extract the cyclical component from the logged deflated spending series and logged real GDP.

The data on European countries comes from two sources, Eurostat and the Organization for Economic Co-Operation and Development (OECD). To construct my measure of government spending, I subtract [*interest, payable*] from *total general government expenditure*; these series are reported in Eurostat's *Quarterly non-financial accounts for general government*.[29] I then deseasonalize the spending series with the Census Bureau's X-12-ARIMA method.[30] I then deflate the series with the GDP deflator, which I obtain from the OECD's

[26] NIPA data are available at `http://www.bea.gov/`. The data I use was last revised on July 31, 2013.

[27] The series ID is GDPDEF. The data I use was last updated on July 31, 2013.

[28] Series GDPC1 and FEDFUNDS, respectively. Again, the data I use were last updated on July 31, 2013.

[29] In Eurostat, this database has the label `gov_q_ggnfa`. These series were last updated on July 22, 2013.

[30] The United States Census Bureau provides free software for this purpose. It is available at `http://www.census.gov/srd/www/winx12/winx12doc.html`.

Economic Outlook Database.[31] Data on real GDP and interest rates come from the same source.[32] Finally, I apply the HP filter to logged real spending and logged real GDP.

The data for the Latin American countries I study come from several national and international sources. For brevity, I do not list them here, but the details are available upon request.

I estimate the baseline parameters and optimal weighting matrix with an iterative procedure. The weighting matrix and the variance-covariance matrix of the estimates is heteroskedasticity- and autocorrelation-consistent, as proposed by Newey and West (1987). I use a Bartlett kernel with Newey-West fixed bandwidth to compute the weighting matrix.

[31] Specifically, the OECD Economic Outlook No. 92: Statistics and Projections (database), which I extracted on August 1, 2013. The GDP deflator is labeled PGDP in the database.

[32] Series GDPV and IRS, respectively.