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Keywords: fiscal reaction function, fiscal policy, fiscal rule, euro area, primary surplus.

JEL classification: E62, H61, H62.

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January 27, 2014

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1 Introduction

The crisis in the euro area and the need to consolidate public finances have provoked a renewed discussion about fiscal rules.[1] Despite this interest in fiscal rules, not much consensus exists in the literature on the actual degree of anti-cyclical policy or consolidation in response to the debt ratio that euro area governments have historically pursued. These degrees of anti-cyclical policy or consolidation are given in the literature by coefficients in a fiscal policy reaction function, which represents a fiscal analogue to a monetary policy reaction function.[2] Time-series estimates of a fiscal policy reaction function for the euro area in levels have generally indicated a weak degree of anti-cyclical policy, while estimates of a fiscal policy reaction function in first differences have indicated a stronger degree of anti-cyclical policy, more in line with results from the cyclical adjustment literature (see e.g. Girouard and André (2005)). In order to reconcile these different results, we formulate a single fiscal policy reaction function and then estimate it under differing time-series assumptions (levels or first differences), differing choices of output gap measures, differing time periods, and an allowance or non-allowance for a stronger response to excessive debt levels. Our estimates indicate a consistently strong degree of anti-cyclical fiscal policy in line with the cyclical adjustment literature as well as consistently strong consolidation in response to the debt. Following an approach found in the monetary policy literature, we go on to show that our specification performs favorably compared with the specification more commonly found in the literature. We argue that our results can be used to help understand historical fiscal policy actions and to help guide the debate on fiscal rules.

Our fiscal policy reaction function allows for an automatic adjustment of the primary surplus to the output gap and to the public debt, alongside a slow-moving, exogenous fiscal policy shifter which may exhibit autocorrelation or unit-root behavior. As Taylor (2000) points out, a fiscal reaction function along these lines would be analogous in its form to a monetary policy reaction function. This specification of the fiscal reaction function reflects the goal of fiscal policymakers to jointly stabilize output and the public debt, just as monetary policymakers seek to stabilize output and inflation. The focus of this paper is on the estimation of this fiscal reaction function under a wide range of different assumptions. We estimate our baseline fiscal reaction function under different

[1] A number of countries (for instance, Germany) have introduced fiscal rules into their constitutions. Additionally, the euro area member states have introduced a series of measures including the fiscal compact, intended to encourage fiscal discipline.

[2] Golinelli and Momigliano (2009) offer an extensive survey and discussion of empirical research up to the year 2008 and stress large differences in results across studies based on the choice of fiscal indicators (e.g. primary or total deficits, or the debt level), data vintages, whether or not the dependent variable is cyclically adjusted, and the choice of any auxiliary variables, among other things. We view our work as aimed at reconciling some of these different results.

sets of assumptions on the order of integration of the policy shock as well as for a set of different output gap measures and different sample starting points. In particular, we look at specifications in levels and first differences, and we determine output gap measures by applying three different structural indicators: potential GDP, trend GDP, and trend growth in GDP (for the specification in first differences). Our estimated coefficients for the euro area across this wide range of assumptions find a strong anti-cyclical response of primary surpluses to the output gap (on the order of 0.4 to 0.5) and also a strong consolidating response of primary surpluses to the debt ratio (on the order of 0.1). Furthermore, our results are robust to restricting the sample to the post-Maastricht period, with our estimates indicating a possible increase in the degree of anti-cyclical policy.[3] We also find moderate (but not strong) evidence of increased fiscal consolidation at very high debt levels, using a reaction function with an extra component which reflects debt levels in excess of 60 percent of GDP.

The specification of our fiscal reaction function in levels resembles the specification in first differences, and it differs from much of the previous literature in an important way. The main studies in the literature – Afonso and Hauptmeier (2009), Fatás and Mihov (2010), and Bénétrix and Lane (2013) – specify a fiscal reaction function with a lagged dependent variable on the right-hand side, rather than a fiscal reaction with an autocorrelated error term as in our specification. These different specifications reflect different assumptions regarding the behavior of fiscal policy, as discussed by Rudebusch (2002) in the context of monetary policy.[4] A fiscal reaction function estimated in the typical manner found in the literature would yield a response of primary surpluses to the output gap which is neither large nor statistically distinguishable from zero. By contrast, our estimated fiscal reaction function in levels produces results which are in line with our estimated fiscal reaction function in first differences, the estimates of Fatás and Mihov (2012) and Reicher (2013) for the OECD, and importantly, the cyclical adjustment literature. Following an approach taken in the monetary policy literature, we provide statistical evidence in favor of our specification relative to the specification more commonly found in the literature.

Altogether, we argue that our results from this paper help to reconcile some of the differing results found in the literature on the behavior of fiscal policy in the euro area and

[3]Galí and Perotti (2003), García, Arroyo, Mínguez, and Uxó (2009), Bénétrix and Lane (2013), and others mention the choice of time period as a particular issue.

[4]Rudebusch (2002, p.1161) argues that "the illusion of monetary policy inertia evident in the estimated policy rules likely reflects the persistent shocks that central banks face" rather than an inherent motive for interest-rate smoothing. We argue in favor of a similar result in the context of fiscal policy.

EU, and that our results therefore provide a useful reference point for future work. Our specification in first differences parsimoniously captures the main time-series properties of the primary surplus, and our specification in levels generates similar results when we handle autocorrelation in a way similar to that which has been proposed in the literature on monetary policy reaction functions. We hope that our results may be of practical use when making forecasts, and we hope that they may provide useful input to policymakers. The coefficients from the estimated fiscal reaction function may be used to help develop better forecasts of future fiscal policy paths, to the extent that future policy might resemble past policy. We also believe that our estimated fiscal reaction function may help to provide a useful guide as to which types of proposed fiscal rules may be more likely to succeed than others. To the extent that a proposed fiscal rule is more in line with our estimated fiscal reaction function, we argue that such a fiscal rule may have a better chance of success than the original Stability and Growth Pact.

2 Specification of the fiscal reaction function

2.1 The components of the fiscal reaction function

In this section we derive the baseline fiscal reaction function used in our analysis. The analysis of Reicher (2012, 2013) treats individual fiscal instruments (for example, government purchases or transfer payments) for the OECD and its individual countries as having separate cyclical, consolidation, and structural components. Here, we treat the primary surplus for the euro area and its individual countries in a similar manner. Even though the behavior of specific fiscal policy instruments may certainly be an important issue in practice, we focus on the overall primary surplus in order to address the main technical issues regarding the estimation of a fiscal reaction function. We also do not look at cyclically-adjusted variables given that we explore different measures of the business cycle.[5] In order to make consistent use of cyclically-adjusted variables, we would require additional structural assumptions in order to undertake cyclical adjustment based on each of our different cyclical indicators. Given the already-extensive nature of our investigation, we leave an extension of our investigation to cyclically-adjusted variables to future research.

In our analysis, the primary surplus as a share of GDP follows a fiscal reaction function

[5]Studies which look at cyclically-adjusted variables include those of Galí and Perotti (2003), Annett (2006), Turrini (2008), García, Arroyo, Mínguez, and Uxó (2009), and Bénétrix and Lane (2013).

of the general form:

$$\frac{P_t}{Y_t} = k_t + a\left(1 - \frac{\bar{Y}_t}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - b^*\right) + e_t, \tag{1}$$

where the sustainable primary surplus ratio k_t is given by:

$$k_t = \left(\frac{(1+\bar{i}_t)}{(1+\bar{\pi}_t)(1+\bar{g}_t)} - 1\right) b^*, \tag{2}$$

and where an estimate of trend inflation is given by $\bar{\pi}_t$; an estimate of the trend nominal interest rate is given by $\bar{i}_t$; and an estimate of trend output growth is given by $\bar{g}_t$.[6] The constant b^* is some trend debt ratio, which is held constant. Y_t equals real output; $\bar{Y}_t$ represents a structural indicator such as potential GDP or trend GDP; B_t is the real end-of-period debt stock deflated by the GDP deflator; and e_t is some exogenous policy shifter affecting primary surpluses. We explore two different sets of time-series assumptions behind the order of integration of e_t, which affects the form that our estimated fiscal reaction function will take. The coefficient a represents the total response of the primary budget balance to the output gap, which may occur from some combination of discretionary fiscal actions and, in particular, automatic stabilizers. The coefficient c represents the strength with which fiscal consolidation occurs in response to the debt level. As shown by Bohn (2007), a value of c larger than the growth-adjusted interest rate ensures a nonexplosive path for the debt given any finite order of integration for e_t.

We choose to work with a primary surplus reaction function (1) instead of a total surplus reaction function for several reasons. First of all, given a constant trend real interest rate and a constant trend growth rate, the value of k_t in (1) is likely to be more stable in response to fluctuations in trend inflation and the trend nominal interest rate than the value of k_t that would appear in a total surplus reaction function. Since we rely on a sample containing data from the 1970s and 1980s, the stability of k_t is of practical econometric concern. Additionally, interest payments in time t are predetermined and are hence not amenable to contemporaneous policy actions, in contrast with the primary surplus.

2.2 A baseline reaction function in levels and in first differences

It is highly likely that e_t would exhibit autocorrelation if fiscal policy were not independent across time. This lack of independence across time would result from persistence in

[6]The omission of k_t from the fiscal reaction function as under a balanced-budget rule would send the debt-GDP ratio toward zero based on solving (2) for b^* upon setting k_t to zero.

political preferences, demographics, military expenditures, et cetera. We first examine a case where e_t follows an AR(1) with a persistence coefficient ρ. In this case, we rewrite (1) as following the law of motion:

$$\begin{aligned}\frac{P_t}{Y_t} = k_t + a\left(1 - \frac{\bar{Y}_t}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - b^*\right) \\ + \rho\left(\frac{P_{t-1}}{Y_{t-1}} - k_{t-1} - a\left(1 - \frac{\bar{Y}_{t-1}}{Y_{t-1}}\right) - c\left(\frac{B_{t-2}}{Y_{t-2}} - b^*\right)\right) + \varepsilon_t,\end{aligned} \tag{3}$$

where ε_t is independent across time.

Our specification of the fiscal reaction function in this manner differs from specifications more typically found in the previous literature. These more typical specifications simply include a lagged endogenous variable on the right-hand side of the fiscal reaction function in order to control for autocorrelation. Simply including a lagged endogenous variable would imply that the primary surplus adjusts only slowly in response to the output gap. Such a specification would offer a different interpretation of the cyclical component of primary surpluses from one consisting largely of fast-moving automatic stabilizers. Rudebusch (2002) discusses this issue in the context of monetary policy reaction functions, and we discuss this issue in section 4.3 below.

We also formulate a fiscal reaction function in first differences, as a special case of the specification in levels. If ρ were to equal one, then to a first-order approximation, (3) would collapse to:

$$\frac{P_t}{Y_t} - \frac{P_{t-1}}{Y_{t-1}} = k_t - k_{t-1} + a\left(\frac{\bar{Y}_{t-1}}{\bar{Y}_t} - \frac{Y_{t-1}}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - \frac{B_{t-2}}{Y_{t-2}}\right) + \varepsilon_t. \tag{4}$$

We specify the cyclical component in (4) in this manner in order to make it possible to easily estimate the model using a measure of trend growth as an alternative structural indicator, without needing to know the level of potential or trend GDP.

We motivate this specification by noting that the existing evidence does not necessarily rule out a unit root or near-unit-root behavior in the debt ratio, which would be implied by (4). Historical experience and econometric estimates (e.g. Bohn (1991) and Reicher (2013)) suggest that fiscal authorities in most countries stabilize either the deficit-GDP ratio or growth in the debt-GDP ratio, while the evidence on the stationarity of the level of the debt-GDP ratio is more ambiguous. A unit root in the debt-GDP ratio might result from a situation where the driving process behind fiscal policy, e_t, itself follows a random

walk. This random-walk hypothesis might be reasonable if, for example, the types of demographic shocks, changes in political preferences, or foreign conditions captured in e_t were permanent. As an additional motivation, a specification in first differences eliminates the need to estimate the additional free parameter ρ, which is present in the specification in levels.

2.3 Dealing with excessive debt levels

Under the baseline specification of the fiscal reaction function, fiscal policy responds in the same way to the debt level no matter how high the debt level happens to be. Starting with our baseline specification, we set up an alternate specification in order to see the degree to which the systematic marginal response of the primary surplus to the debt is higher at high debt levels than at low debt levels. Since the Maastricht criteria and the Stability and Growth Pact require a long-run debt-GDP ratio below 60 percent, we follow Snower et al. (2011) by adding an additional set of terms $c^{CR}\left(B_{t-1}/Y_{t-1} - b^{CR}\right)_+$ and $d^{CR}\left(B_{t-1}/Y_{t-1} - b^{CR}\right)_+$ to the reaction functions in levels and in first differences (3) and (4), respectively. When the debt ratio is below its 60 percent threshold, these terms equal zero. When the debt ratio is above its 60 percent threshold, these terms represent the degree to which the debt ratio exceeds that threshold. These terms capture the additional consolidation that is required at high debt levels in order to push the debt-GDP ratio below b^{CR} at a particular rate. In the reaction function in levels, a small but positive value for c^{CR} would cause fiscal authorities to run systematically tight fiscal policy in every period so long as the debt ratio remains above its long-run target. In the reaction function in first differences, a small but positive value for d^{CR} would cause fiscal authorities to tighten fiscal policy incrementally in every period so long as the debt ratio remains above its long-run target. The modified reaction function would now follow the form:

$$\begin{aligned}\frac{P_t}{Y_t} = k_t + a\left(1 - \frac{\bar{Y}_t}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - b^*\right) + c^{CR}\left(\frac{B_{t-1}}{Y_{t-1}} - b^{CR}\right)_+ \\ + \rho\left(\frac{P_{t-1}}{Y_{t-1}} - k_{t-1} - a\left(1 - \frac{\bar{Y}_{t-1}}{Y_{t-1}}\right) - c\left(\frac{B_{t-2}}{Y_{t-2}} - b^*\right) - c^{CR}\left(\frac{B_{t-2}}{Y_{t-2}} - b^{CR}\right)_+\right) + \varepsilon_t,\end{aligned} \tag{5}$$

and

$$\begin{aligned}\frac{P_t}{Y_t} - \frac{P_{t-1}}{Y_{t-1}} = k_t - k_{t-1} + a\left(\frac{\bar{Y}_{t-1}}{\bar{Y}_t} - \frac{Y_{t-1}}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - \frac{B_{t-2}}{Y_{t-2}}\right) \\ + d^{CR}\left(\frac{B_{t-1}}{Y_{t-1}} - b^{CR}\right)_+ + \varepsilon_t,\end{aligned} \tag{6}$$

under the specifications in levels and in first differences, respectively.

3 Data and estimation procedure

We rely on the European Commission's AMECO database for yearly data on real GDP, potential GDP, trend GDP, nominal GDP, the nominal debt level, and the primary budget balance.[7] Our sample covers all euro area countries except Luxembourg. Most series begin in the late 1960s or early 1970s and always end in 2007, in order to focus on fiscal policy before the Great Recession and debt crisis. For historical primary balance data for Italy before 1980 and Spain before 1995, we expand our dataset using data on net lending and borrowing as well as interest payments as a share of GDP from the OECD Economic Outlook 92 (2012) database. We level-splice the primary balance as a share of GDP at 1980 for Italy and 1995 for Spain, thus extending our series for those countries back to 1970. The actual number of countries reported differs among specifications, as we skip countries with an insufficient number of observations available for a particular specification. Additionally, we present a set of panel estimates, which may be interpreted as representing a set of central tendencies for the euro area as a whole. The panel estimates are always based on an unbalanced panel of all euro area countries excluding Luxembourg.

The estimation results for individual countries should be interpreted with some further caution, as our sample which spans several decades might include periods of different monetary and fiscal regimes, particularly during the 1970s and 1980s. A particular concern is the introduction of the Maastricht Treaty, which may have introduced a break into the way in which individual countries have conducted fiscal policy. Therefore, we estimate our reaction function for only the post-1992 period as well. Unfortunately, for individual countries, the post-1992 sample is too short to draw any firm statistical conclusions on the systematic behavior of fiscal policy. Therefore, we report a set of estimates restricted to the data from 1993 through 2007, but only for the entire panel as a whole.

We furthermore do not report individual-country results from (5) or from (6); we only provide panel estimates for those specifications using the full panel. To obtain panel estimates of c^{CR} or d^{CR}, we set $b^{CR} = 0.6$. We do not report country-level estimates since most countries in the sample did not experience an extended period with a debt ratio above 0.6 before 2007, and so those parameters are poorly identified. Again, despite

[7] We focus on ex-post data since we are mainly interested in the actual historical behavior of fiscal policy and because of data availability. Golinelli and Momigliano (2009) find important effects of data vintages on the measured cyclicality of fiscal policy. The real-time implementation of fiscal rules is an important practical concern which we do not address in this paper.

country-level heterogeneity, the panel estimates might represent a 'central tendency' of fiscal policy behavior within the EMU. Moreover, these results are useful for individual countries insofar as individual fiscal responses are poorly estimated and insofar as different countries conduct fiscal policy in broadly similar ways.

For the reaction function in levels given by (3), we estimate the reaction function using nonlinear two-stage least squares following Amemiya (1974) and Zellner, Huang, and Chau (1965), since it is highly conceivable that the output gap may be endogenously related to the fiscal impulse, and since the model is nonlinear in its parameters.[8] We use the lagged output gap and two lags of the output growth gap ($\bar{Y}_{t-1}/\bar{Y}_t - Y_{t-1}/Y_t$), as well as two lags of the debt ratio and excess debt ratio (where appropriate), as additional instruments for the output gap.[9] We assume that k_t is constant. We also include country-specific dummies in the panel estimates, and we also include a dummy to represent the period after the break in German data for 1991, both as an explanatory variable and as an instrument. That dummy variable takes a value of 1 for Germany post-reunification, and 0 otherwise. For the reaction function in first differences given by (4), we use the lagged output gap, two lags of the output growth gap, and the change in the lagged debt ratio (and the lagged excess debt ratio where appropriate) as instruments for growth in the output gap. We also include a dummy which equals 1 for Germany in 1991 and 0 otherwise. Again, we assume that k_t is constant and hence is differenced out. We do not include country-specific dummies in the panel estimates, as they are removed using the difference operator.

We report parameter results using three structural indicators: Potential GDP, trend GDP, and trend growth in GDP (for the specification in first differences).[10] These different indicators reflect different choices of methodology behind the calculation of $\bar{Y}_t$. This choice might affect the degree of measured cyclicality in primary surpluses and hence might potentially lead to different policy conclusions. For countries such as Spain and Greece, for instance, the use of trend GDP instead of potential GDP implies a notably larger positive output gap in the period before the crisis. This issue may be of particular concern during periods of economic boom and bust, especially during long-lived expansions and

[8] We accomplish this using proc model in SAS.

[9] Our instrumental variables approach, which is standard in the literature, cannot completely control for the possible endogeneity of past potential output or trend output in response to fiscal policy shocks, given that future shocks will affect filtered values of past variables. We acknowledge this issue (and other issues related to filtering), but we leave the treatment of filtering for future work.

[10] Potential GDP and trend GDP are readily available from the European Commission's AMECO database. Potential GDP is calculated using a production function approach, while trend GDP is obtained by applying the HP filter to the actual output series. We calculate trend growth in GDP ourselves as the HP trend of (Y_{t-1}/Y_t), applying a smoothing parameter of $\lambda = 100$.

slumps.[11] We worry that the issues related to the choice of indicators might not only apply to the real-time measurement of these variables but also to ex-post data.

4 Estimation results for the fiscal reaction function in levels

4.1 Main results

Table 1 contains the estimated coefficients of equation (3) estimated using potential GDP as a structural indicator, and Table 2 contains the estimated coefficients of equation (3) estimated using trend GDP as a structural indicator.

We focus first on the panel estimates. Both sets of panel estimates indicate that a value of a of about 0.4 to 0.5 seems to fit the data fairly well, and these estimates are statistically distinguishable from zero. This value of a is far lower than that of 0.9 proposed by Snower et al. (2011) and is far higher than that estimated by Afonso and Hauptmeier (2009), Fatás and Mihov (2010), or Bénétrix and Lane (2013) for the euro area using a model in levels. A value of a of about 0.4 to 0.5 is roughly in line with the proposed fiscal reaction function of Taylor (2000), the cyclical adjustment coefficients derived by Girouard and André (2005) using a structural approach, and the estimates of Reicher (2013) for the OECD using a model in first differences.[12] The estimated debt coefficient c equals 0.08 using potential GDP as a structural indicator and 0.09 using trend GDP as a structural indicator. It is in both cases statistically distinguishable from zero, and it sits at the high end of the results reported in the literature.[13] The primary balance does seem to increase with respect to the debt ratio, and so fiscal policy on average appears to adjust in order to satisfy the government's budget constraint. Interestingly, the residual governing the primary surplus is quite persistent, with the panel estimate of ρ coming in at about 0.72 to 0.75 per year.

[11] In the past, measures of the cyclical position of an economy have often been subject to significant revisions. For euro area or other OECD countries, revisions of more than one percentage point with respect to output gap estimates are quite common. See, for instance, Koske and Pain (2008), Marcellino and Musso (2011), and Klär (2013).

[12] The results from Fatás and Mihov (2010), Égert (2010), and Reicher (2013) point toward a stronger estimated fiscal policy response to output in the OECD as a whole relative to the euro area. Fatás and Mihov (2012) also find strong anti-cyclicality in OECD fiscal policy.

[13] A consolidation coefficient of 0.09 would imply that for a long-run trend debt ratio b^* of (for example) 60% of GDP, a country whose debt ratio equals 100% of GDP would run an additional primary surplus of 0.09(100% - 60%) = 3.6% of GDP.

Country-specific estimates are generally not estimated with a high degree of precision, but some interesting findings emerge when we compare the results for some major European countries. We mainly focus on Germany, Italy, Spain, France, Ireland, and Greece. Unlike for Spain and Ireland, the estimated value for c is positive and statistically distinguishable from zero for Germany and Italy, implying a tightening of these countries' fiscal policy in response to an above-average debt ratio. For France, results seem somewhat mixed, with a weakly negative estimated coefficient when using potential GDP and a strongly positive estimated coefficient when using trend GDP. By contrast, France significantly engages in anti-cyclical fiscal policy, with an a coefficient which is large, positive, and statistically distinguishable from zero using both structural indicators. While the evidence for Italy and Germany also points toward a positive a coefficient, the estimated a coefficients for these countries are not statistically distinguishable from zero.

Coefficient estimates, particularly in response to the output gap, seem to be sensitive to the choice of structural indicator, particularly at the country level. This statement is less true for the panel as a whole. The use of trend GDP versus potential GDP noticeably affects the estimated value of a for France and Spain, less so for Germany, and estimates at the country level do not always line up between the two structural indicators. While the choice of the structural indicator variable might matter for specific countries (e.g. Spain, Greece, and France), the differences in the panel estimates are in general relatively small. Additionally, fiscal impulses in Germany seem not to be particularly persistent under either structural indicator as given by a low estimated value for ρ, while fiscal impulses in Spain show a particularly high degree of persistence under both structural indicators, as given by a high estimated value for ρ.

4.2 The Maastricht criterion, excess debt levels, and sample length

Table 3 contains additional panel estimates for the post-1992 period as well as estimates of equation (5), which includes a provision for an additional reaction of fiscal policy to debt levels above the Maastricht criterion of 60 percent of GDP. First, we focus on the choice of a different sample period. The measured reaction of the primary surplus to the lagged debt-GDP ratio, given by the c coefficient, appears to be robust to a restriction of the sample to the post-1992 period. Some differences between the full and the restricted sample emerge with regard to the cyclical response coefficient a. Focusing on the post-1992 period, the use of potential GDP now suggests a stronger anti-cyclical policy than

the use of trend GDP, and this estimated degree of anti-cyclical policy is stronger using potential GDP post-1992 than it was for the whole sample. This difference might be explained by the larger (positive) estimated output gap before the crisis estimated when using trend GDP rather than potential GDP, the effect of which is magnified when using a shorter sample.

Next, we focus on excess debt levels, focusing on the whole sample. The estimated behavior implied by the fiscal reaction function is robust to estimating an equation of the form (5) instead of (3). There is moderate evidence in favor of more rapid stabilization at higher debt levels as given by the c^{CR} coefficient when considering the full sample, while that coefficient is not statistically distinguishable from zero when considering the shorter post-Maastricht period only. The point estimates of c^{CR} do not change substantially between samples, but the shorter sample reduces the statistical power of the test against the null hypothesis that c^{CR} is equal to zero. The estimated c coefficients drop accordingly since now c^{CR} captures some of the consolidation that c formerly captured, while a is little changed. Altogether, the evidence on the historical behavior of euro area governments at high debt levels ambiguously points toward an increased relative speed of consolidation.

4.3 Reconciliation with the previous literature: the specification of autocorrelation

Our results point toward a strong influence of the business cycle on the primary surplus, with a coefficient between 0.4 and 0.5 for the euro area. These values are in line with results from the cyclical adjustment literature and previous estimates in first differences. Other time-series studies based on a specification in levels, such as those of Afonso and Hauptmeier (2009), Fatás and Mihov (2010), and Bénétrix and Lane (2013), typically find a response of the primary surplus to the output gap which is neither large nor statistically distinguishable from zero. We argue that the differences between these time-series studies and our results may be explained by the exact manner in which different studies have handled the issue of autocorrelation in the primary surplus. In order to investigate these differences, we specify an alternative fiscal reaction function in line with the other time-series studies. This fiscal reaction function takes the form:

$$\frac{P_t}{Y_t} = k_t + a\left(1 - \frac{\bar{Y}_t}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - b^*\right) + \beta\left(\frac{P_{t-1}}{Y_{t-1}} - k_{t-1}\right) + \upsilon_t. \tag{7}$$

Again we assume a constant value of k_t given by k. Our estimation procedure mirrors the estimation procedure used for (3).

The top panel of Table 4 contains the coefficient estimates for this alternative fiscal reaction function. Using both potential GDP and especially trend GDP as structural indicators, the estimated cyclical coefficients a reported at the top panel of Table 4 are neither large nor statistically distinguishable from zero. This is in spite of the reaction function given by (7) being estimated on the same dataset as the reaction function given by (3), and this is also in spite of the superficial similarities between the two reaction functions. This difference implies that the estimation of a fiscal reaction function in levels appears to be highly sensitive to the manner in which autocorrelation is specified. If the primary surplus is assumed to respond slowly to the output gap (for instance, due to implementation lags), as in (7), then the measured degree of anti-cyclicality of fiscal policy is quite low. If the primary surplus instead is assumed to respond quickly to the output gap (for instance, due to automatic stabilizers), as in (3), then the measured degree of anti-cyclicality of fiscal policy is relatively high, in line with the cyclical adjustment literature. The results from this exercise underscore the importance of seemingly small changes to model specification in determining the estimated degree of anti-cyclicality in fiscal policy.

It is possible to set up a general specification which encompasses equations (3) and (7) as special cases. This approach mirrors the approach taken by English, Nelson, and Sack (2003) regarding the specification of a monetary policy reaction function.[14] We argue that the estimation of a fiscal policy reaction function is subject to the same set of issues as the estimation of a monetary policy reaction function. Our results favor an approach based on persistent fiscal policy shocks rather than fiscal policy smoothing as in the previous literature. One possible specification of a fiscal response function which nests (3) and (7) would take the form:

$$\begin{aligned}\frac{P_t}{Y_t} = k_t + a\left(1 - \frac{\bar{Y}_t}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - b^*\right) + \beta\left(\frac{P_{t-1}}{Y_{t-1}} - k_{t-1}\right) \\ - \rho\left(a\left(1 - \frac{\bar{Y}_{t-1}}{Y_{t-1}}\right) + c\left(\frac{B_{t-2}}{Y_{t-2}} - b^*\right)\right) + \upsilon_t.\end{aligned} \tag{8}$$

Based on this formulation we separately evaluate the evidence against the null hypotheses $H_0 : \rho = 0$ and $H_0' : \rho = \beta$. Under the first null hypothesis H_0, the alternative fiscal reaction function (7) found elsewhere in the literature is consistent with the more general

[14] English, Nelson, and Sack (2003) set up a monetary policy reaction function which allows for some combination of interest-rate smoothing (as is common in the literature) and persistent monetary policy shocks following Rudebusch (2002). They find that the inclusion of persistent monetary policy shocks improves the fit of a monetary policy reaction function to the data.

reaction function given by (8). Under the latter null hypothesis H_0', our specification of the fiscal reaction function (3) is consistent with the more general reaction function given by (8).

We present estimation results for the general fiscal policy reaction function (8) in the bottom panel of Table 4. The estimation results using both potential GDP and trend GDP as structural indicators reveal strong evidence against the null hypothesis $H_0 : \rho = 0$. A Wald test of the null hypothesis $H_0 : \rho = 0$ delivers a p-value of less than 0.001 when using either potential GDP or trend GDP as a structural indicator. This finding indicates that the fiscal reaction function (8) cannot be reduced to a specification like (7) with only a lagged dependent variable on the right-hand side. By contrast, a Wald test of the null hypothesis $H_0' : \rho = \beta$ delivers a p-value of 0.069 when using potential GDP as a structural indicator and a p-value of 0.239 when using trend GDP as a structural indicator. We therefore conclude that the evidence against H_0' is marginal or weak, depending on the choice of structural variable. Altogether, our findings indicate that our specification of the fiscal reaction function fits the general reaction function (8) better in certain ways than the specification typically used in the literature.

5 Estimation results for the fiscal reaction function in first differences

5.1 Main results

The estimated coefficients for the fiscal reaction function (4) in first differences are, in general, close to the estimated coefficients from the model (3) in levels. That both specifications provide similar coefficient estimates lends further support to our general treatment of the fiscal reaction function. Table 5 contains the estimated coefficients of equation (4) estimated using growth in potential GDP as a structural indicator, and Tables 6 and 7 contain the estimated coefficients using growth in trend GDP and trend growth in GDP, respectively, as structural indicators.

We start with the panel results, which offer a glimpse into the systematic behavior of fiscal policy across the euro area. As with the specification in levels, the estimated coefficients for a come in near 0.5 with only minor differences in relation to the structural variable used. In all three cases, the estimated 'error correction' parameter c comes in at a positive value which is statistically distinguishable from zero. Primary surpluses correct by about 0.09 per year using growth of potential GDP as a structural indicator and by

0.10 to 0.11 per year using growth of trend GDP or trend growth as a structural indicator. These sets of coefficients are broadly similar to those estimated using the specification in levels, which means that the order of integration makes little systematic difference in the estimated coefficients.

Some countries, such as Germany, feature large differences between the specifications in levels and in first differences with respect to the estimated c coefficient. For Germany, the estimated c coefficient rises from 0.12 to 0.53 when using potential GDP as a structural indicator. The estimated c coefficient for France turns positive and is now statistically distinguishable from zero. The c coefficients for Greece, Spain, and Italy remain approximately the same between the specifications in first differences and in levels. Across the three different structural indicators under the specification in first differences, the c coefficients at the country level tend to show a fair degree of stability.

Estimated a coefficients for individual countries again indicate strong fiscal responses to cyclical developments in France and Spain, with Italy showing acyclical fiscal policy and Greece showing a procyclical fiscal policy. The response of German fiscal policy to the business cycle seems to be fairly strongly anti-cyclical but is not precisely measured. With the exception of Greece, country-specific estimates of a under the specification in first differences seem to show a fair degree of stability across different structural indicators.

5.2 The Maastricht criterion, sample length, and excess debt levels

Table 8 contains additional panel results for the post-1992 period as well as for estimates of equation (6), which includes a provision for an additional reaction of the primary surplus to debt levels above the Maastricht criterion of 60 percent of GDP. First, we look at how the choice of time periods affects our estimates. The measured reaction of the primary surplus to the lagged debt-GDP ratio, given by the c coefficient, appears to be robust to a restriction of the sample to the post-1992 period; if anything, c may have increased over time, although it is difficult to say with any degree of statistical certainty. As under the specification in levels, some differences between the full and the restricted sample emerge with regard to the cyclical response coefficient a. Focusing on the post-1992 period, the use of potential GDP again suggests a stronger anti-cyclical policy than the use of trend GDP. This finding regarding the behavior of potential versus trend GDP in the post-1992 period appears to be robust to the specification of the fiscal reaction function. In contrast

to the specification in levels, the results for the specification in first differences indicate a stronger anti-cyclical policy post-1992 than for the whole sample, independently of the choice of the structural indicator.

Next, we examine the role of the excess debt ratio in affecting fiscal policy decisions. The evidence on the behavior of primary surpluses under high debt levels is robust to estimating an equation of the form (6) instead of (4). We remind the reader that the coefficient d^{CR} from this specification is not analogous to the coefficient c^{CR} from (5). The evidence in favor of an effect of high debt levels on the primary surplus is weak under this specification as given by an estimated coefficient d^{CR} which is neither large nor statistically distinguishable from zero, although the estimated coefficient d^{CR} is positive in both periods. Altogether, the evidence in favor of differing historical behavior of euro area governments at high debt levels seems to be weak under the specification in first differences.

5.3 Robustness: OLS versus 2SLS estimation

As a final exercise, we explore the degree to which OLS and 2SLS produce different estimates under the specification in first differences. The bottom panel of Table 8 contains estimates of equation (4) using OLS instead of two-stage least squares (2SLS) as in the baseline estimates. The OLS estimates of the coefficient a on average are somewhat lower than the 2SLS estimates, which makes sense given that one might expect a positive shock to the primary surplus to exert a contractionary effect on output. Under such a situation, two factors would drive the unconditional statistical relationship between output and the primary surplus which would be captured by an OLS regression. On the one hand, the fiscal reaction function would imply a strong positive relationship between output and the primary surplus. On the other hand, a multiplier relationship between the primary surplus and output would imply a negative relationship between the primary surplus and output. An OLS regression would capture both of these effects, measuring a less-positive relationship between output and the primary surplus than that implied by the fiscal reaction function. A properly-specified 2SLS regression would control for the endogeneity of output and therefore would produce larger coefficient estimates in the fiscal reaction function than the OLS regression. This pattern appears in Table 8 as expected. The estimated c coefficients are little changed.[15]

[15]Results for the specification in levels mirror these results and are available upon request.

6 Conclusion

In this paper we estimate a fiscal policy reaction function for the euro area under a number of different specifications, using a common dataset. In doing so, we paint a consistent picture which is in line with the cyclical adjustment literature but which is at odds with much of the previous time-series literature. Our fiscal reaction function features separate anti-cyclical, consolidation, and structural components of the primary surplus. We estimate this reaction function under differing assumptions about the order of integration of the observables as well as under different measures of the output gap. For the euro area as a whole over the full sample, all estimates point strongly toward a cyclical response coefficient a of about 0.4 to 0.5 and toward a debt response coefficient c of about 0.08 to 0.11. For the post-1992 sample, there are some important differences in our estimates of a which are driven by the choice of the structural indicator. The evidence on the behavior of fiscal policy at high debt levels is inconclusive but possibly points toward a stronger consolidating stance of fiscal policy at higher debt levels. We also test our specification against the specification more commonly found in the literature, based on the results from estimating a more general fiscal policy reaction function. Our fiscal policy reaction function is compatible in certain ways with this more general fiscal policy reaction function, while the more common specification is incompatible with this more general reaction function.

Our estimates point toward a number of possible issues and pitfalls to be considered when designing a future fiscal policy rule for the euro area or for individual countries. First of all, country-level estimates of a fiscal reaction function based on past data sometimes vary wildly under different assumptions regarding the order of integration or the output gap measure. The choice of filtering technique will affect the estimated output gap and hence will affect the allowable primary surplus or deficit. A further issue not addressed in this paper is the frequent large revisions that accompany real-time estimates of GDP and potential or trend GDP. The unreliability of these estimates introduces major problems into the implementation of a proposed fiscal rule, and it may also introduce additional econometric issues into the estimation of a fiscal reaction function. The practical implementation of a fiscal rule in a policy setting would require a satisfactory solution to these problems before a fiscal rule could be credibly implemented.

Keeping these issues in mind, our estimated fiscal reaction function might not only be useful for analyzing past fiscal behavior but also for forecasting and policy purposes. For instance, we undertake a policy simulation exercise in Plödt and Reicher (2014) based

on the estimates which we presented here. Given reasonable coefficients, it is possible using our estimated fiscal reaction function to forecast the effects of different possible consolidation paths of the euro area governments as they exit from the current crisis. Our empirical results could also provide useful information to policymakers who wish to implement a national or euro area-wide fiscal rule which would partially resemble past anti-cyclical policy but also result in a credible path for future consolidation. A well-designed, simple, flexible fiscal rule which takes historical fiscal policy behavior and implementation issues into account might have a better chance to be credibly enforced than the previous Stability and Growth Pact. In the case of adverse cyclical conditions, such a rule may provide more flexibility in the short run, and it may therefore face a better chance of success.

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Table 1: The fiscal reaction function in levels (Potential GDP used as structural indicator variable).

Country	k	c	a	ρ
Austria	−0.020	0.044	1.285	−0.030
	(0.012)	(0.020)	(0.616)	(0.221)
Belgium	−0.017	0.087	0.566	0.755
	(0.010)	(0.043)	(0.513)	(0.152)
Finland	0.023	−0.073	0.736	0.658
	(0.013)	(0.048)	(0.205)	(0.151)
France	0.000	−0.014	0.578	0.633
	(0.006)	(0.033)	(0.295)	(0.195)
Germany	−0.031	0.123	0.459	0.222
	(0.013)	(0.045)	(0.312)	(0.174)
Greece	−0.026	0.183	−0.662	0.852
	(0.030)	(0.092)	(0.643)	(0.173)
Ireland	0.004	0.039	0.182	0.614
	(0.009)	(0.032)	(0.323)	(0.258)
Italy	−0.052	0.140	0.420	0.604
	(0.017)	(0.022)	(0.381)	(0.135)
Malta	−0.231	0.298	0.828	−0.162
	(0.093)	(0.072)	(0.973)	(0.492)
Netherlands	−0.004	0.045	0.537	0.578
	(0.010)	(0.038)	(0.277)	(0.167)
Portugal	−0.040	0.143	0.387	0.526
	(0.015)	(0.060)	(0.259)	(0.162)
Spain	0.000	0.025	0.429	0.959
	(0.003)	(0.059)	(0.193)	(0.097)
Panel		0.081	0.493	0.717
		(0.014)	(0.133)	(0.040)

Standard errors are given in parentheses.

Estimates are derived using nonlinear 2SLS.

Table 2: The fiscal reaction function in levels (Trend GDP used as structural indicator variable).

Country	k	c	a	ρ
Austria	−0.011	0.036	0.707	0.233
	(0.011)	(0.024)	(0.360)	(0.227)
Belgium	−0.011	0.080	−0.106	0.817
	(0.011)	(0.077)	(0.563)	(0.153)
Cyprus	−0.066	0.133	1.513	0.124
	(0.029)	(0.053)	(0.162)	(0.140)
Estonia	0.027	−0.359	0.216	−0.131
	(0.047)	(0.786)	(0.127)	(0.405)
Finland	0.014	0.015	0.709	0.570
	(0.014)	(0.059)	(0.184)	(0.172)
France	−0.016	0.275	1.310	0.884
	(0.008)	(0.134)	(0.533)	(0.057)
Germany	−0.031	0.133	0.485	0.213
	(0.013)	(0.049)	(0.334)	(0.173)
Greece	−0.082	0.130	−0.546	0.308
	(0.036)	(0.039)	(0.240)	(0.272)
Ireland	0.007	0.027	−0.052	0.647
	(0.015)	(0.053)	(0.195)	(0.222)
Italy	−0.051	0.152	0.339	0.626
	(0.026)	(0.031)	(0.661)	(0.224)
Malta	−0.255	0.377	0.706	−0.032
	(0.081)	(0.119)	(0.541)	(0.394)
Netherlands	−0.013	0.075	0.561	0.471
	(0.010)	(0.034)	(0.242)	(0.180)
Portugal	−0.038	0.198	0.231	0.672
	(0.017)	(0.115)	(0.208)	(0.197)
Spain	0.001	0.015	0.098	0.969
	(0.002)	(0.081)	(0.398)	(0.107)
Panel		0.093	0.419	0.748
		(0.017)	(0.100)	(0.039)

Standard errors are given in parentheses.

Estimates are derived using nonlinear 2SLS.

Table 3: The fiscal reaction function in levels (Panel estimates of all specifications).

Specification	c	c^{CR}	a	ρ
Potential GDP, full sample	0.081		0.493	0.717
	(0.014)		(0.133)	(0.040)
Trend GDP, full sample	0.093		0.419	0.748
	(0.017)		(0.100)	(0.039)
Potential GDP, post-1992	0.082		0.715	0.557
	(0.023)		(0.161)	(0.068)
Trend GDP, post-1992	0.081		0.310	0.660
	(0.032)		(0.126)	(0.065)
Potential GDP, full sample, b^{CR} target	0.047	0.058	0.486	0.696
	(0.021)	(0.029)	(0.131)	(0.042)
Trend GDP, full sample, b^{CR} target	0.064	0.050	0.410	0.737
	(0.024)	(0.032)	(0.099)	(0.040)
Potential GDP, post-1992, b^{CR} target	0.058	0.044	0.728	0.553
	(0.037)	(0.052)	(0.160)	(0.070)
Trend GDP, post-1992, b^{CR} target	0.052	0.056	0.309	0.667
	(0.049)	(0.058)	(0.131)	(0.065)

Standard errors are given in parentheses.

Estimates are derived using nonlinear 2SLS.

Table 4: Specifications with lagged dependent variable.

Specification	c	c^{CR}	a	ρ	β
Potential GDP, full sample	0.031		0.111		0.690
	(0.005)		(0.059)		(0.036)
Trend GDP, full sample	0.030		0.033		0.716
	(0.005)		(0.044)		(0.036)
Potential GDP, full sample	0.058		0.364	0.496	0.709
	(0.014)		(0.150)	(0.131)	(0.038)
Trend GDP, full sample	0.075		0.299	0.631	0.743
	(0.020)		(0.111)	(0.113)	(0.039)

Standard errors are given in parentheses.

Estimates are derived using nonlinear 2SLS.

Table 5: The fiscal reaction function in first differences (Growth in potential GDP used as structural indicator variable).

Country	*const.*	c	a
Austria	0.000	0.079	−0.169
	(0.003)	(0.118)	(0.339)
Belgium	0.000	0.070	0.357
	(0.003)	(0.057)	(0.332)
Cyprus	0.004	0.232	1.792
	(0.007)	(0.368)	(0.872)
Estonia	−0.002	0.769	0.626
	(0.008)	(0.504)	(0.406)
Finland	0.000	−0.053	0.681
	(0.003)	(0.072)	(0.205)
France	−0.004	0.216	1.039
	(0.002)	(0.092)	(0.390)
Germany	−0.006	0.526	0.470
	(0.004)	(0.171)	(0.353)
Greece	−0.004	0.198	−0.705
	(0.005)	(0.082)	(0.578)
Ireland	0.003	0.123	0.653
	(0.004)	(0.067)	(0.371)
Italy	−0.001	0.129	0.074
	(0.003)	(0.079)	(0.317)
Malta	0.000	0.236	0.614
	(0.010)	(0.192)	(0.719)
Netherlands	0.000	0.092	0.558
	(0.002)	(0.075)	(0.276)
Portugal	−0.002	0.179	−0.028
	(0.003)	(0.096)	(0.244)
Slovakia	0.014	0.256	0.285
	(0.022)	(0.565)	(1.436)
Spain	0.001	0.026	0.629
	(0.002)	(0.049)	(0.203)
Panel	0.000	0.087	0.443
	(0.001)	(0.021)	(0.110)

Standard errors are given in parentheses.

Estimates are derived using 2SLS.

Table 6: The fiscal reaction function in first differences (Growth in trend GDP used as structural indicator variable).

Country	*const.*	c	a
Austria	0.000	0.076	−0.100
	(0.003)	(0.122)	(0.372)
Belgium	0.000	0.094	0.696
	(0.003)	(0.062)	(0.350)
Cyprus	0.000	0.054	1.540
	(0.005)	(0.145)	(0.352)
Estonia	0.003	1.415	0.130
	(0.007)	(0.942)	(0.304)
Finland	0.000	−0.007	0.686
	(0.003)	(0.073)	(0.184)
France	−0.004	0.243	0.830
	(0.002)	(0.087)	(0.257)
Germany	−0.007	0.567	0.618
	(0.004)	(0.170)	(0.351)
Greece	0.004	0.169	−1.616
	(0.011)	(0.130)	(1.452)
Ireland	0.005	0.202	0.926
	(0.005)	(0.108)	(0.612)
Italy	−0.001	0.141	−0.041
	(0.003)	(0.080)	(0.327)
Malta	−0.001	0.264	0.644
	(0.010)	(0.203)	(0.706)
Netherlands	0.000	0.115	0.523
	(0.002)	(0.076)	(0.261)
Portugal	−0.003	0.199	0.184
	(0.003)	(0.097)	(0.187)
Slovakia	0.006	−0.405	−0.717
	(0.012)	(0.324)	(0.868)
Slovenia	0.001	−0.249	0.123
	(0.004)	(0.415)	(0.226)
Spain	0.000	0.096	0.635
	(0.002)	(0.059)	(0.206)
Panel	−0.001	0.104	0.494
	(0.001)	(0.022)	(0.096)

Standard errors are given in parentheses.

Estimates are derived using 2SLS.

Table 7: The fiscal reaction function in first differences (Trend growth in GDP used as structural indicator variable).

Country	*const.*	c	a
Austria	0.000	0.076	−0.098
	(0.003)	(0.121)	(0.373)
Belgium	0.000	0.094	0.700
	(0.003)	(0.062)	(0.352)
Cyprus	0.005	0.040	1.387
	(0.003)	(0.129)	(0.263)
Estonia	0.001	1.010	0.289
	(0.009)	(0.864)	(0.339)
Finland	0.000	−0.008	0.687
	(0.003)	(0.073)	(0.185)
France	−0.004	0.243	0.832
	(0.002)	(0.087)	(0.258)
Germany	−0.007	0.568	0.623
	(0.004)	(0.170)	(0.351)
Greece	0.003	0.176	−1.512
	(0.009)	(0.122)	(1.331)
Ireland	0.004	0.201	0.929
	(0.005)	(0.108)	(0.614)
Italy	−0.001	0.142	−0.044
	(0.003)	(0.081)	(0.330)
Malta	−0.002	0.281	0.707
	(0.009)	(0.187)	(0.697)
Netherlands	0.000	0.114	0.523
	(0.002)	(0.076)	(0.262)
Portugal	−0.003	0.199	0.182
	(0.003)	(0.097)	(0.187)
Slovakia	0.007	−0.083	0.039
	(0.011)	(0.268)	(0.790)
Slovenia	0.003	−0.384	0.019
	(0.003)	(0.201)	(0.179)
Spain	0.000	0.092	0.625
	(0.002)	(0.059)	(0.206)
Panel	−0.001	0.107	0.482
	(0.001)	(0.022)	(0.095)

Standard errors are given in parentheses.

Estimates are derived using 2SLS.

Table 8: The fiscal reaction function in first differences (Panel estimates of all specifications).

Specification	*const.*	c	d^{CR}	a
Potential GDP, full sample	0.000	0.087		0.443
	(0.001)	(0.021)		(0.110)
Trend GDP, full sample	−0.001	0.104		0.494
	(0.001)	(0.022)		(0.096)
Trend growth, full sample	−0.001	0.107		0.482
	(0.001)	(0.022)		(0.095)
Potential GDP, post-1992	0.000	0.116		0.893
	(0.001)	(0.028)		(0.183)
Trend GDP, post-1992	0.000	0.117		0.555
	(0.001)	(0.029)		(0.153)
Trend growth, post-1992	0.000	0.121		0.532
	(0.001)	(0.029)		(0.149)
Potential GDP, full sample, b^{CR} target	0.000	0.087	0.005	0.437
	(0.001)	(0.021)	(0.004)	(0.110)
Trend GDP, full sample, b^{CR} target	−0.001	0.103	0.006	0.484
	(0.001)	(0.022)	(0.004)	(0.096)
Trend growth, full sample, b^{CR} target	−0.001	0.106	0.006	0.473
	(0.001)	(0.022)	(0.004)	(0.095)
Potential GDP, post-1992, b^{CR} target	0.000	0.116	0.002	0.893
	(0.001)	(0.028)	(0.006)	(0.184)
Trend GDP, post-1992, b^{CR} target	−0.001	0.118	0.002	0.558
	(0.001)	(0.029)	(0.006)	(0.153)
Trend growth, post-1992, b^{CR} target	0.000	0.122	0.002	0.534
	(0.001)	(0.029)	(0.006)	(0.149)

OLS estimates:

Specification	*const.*	c	d^{CR}	a
Potential GDP, full sample	−0.000	0.077		0.387
	(0.001)	(0.021)		(0.053)
Trend GDP, full sample	−0.000	0.096		0.342
	(0.001)	(0.021)		(0.046)
Trend growth, full sample	−0.000	0.097		0.337
	(0.001)	(0.021)		(0.045)

Standard errors are given in parentheses.

Unless otherwise noted, estimates are derived using 2SLS.