Estimating and forecasting using simple fiscal rules for euro area countries

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Preliminary version - please do not quote or cite!

This draft: May 7, 2013

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We estimate different specifications of a simple but flexible fiscal policy rule for euro area countries, where the primary budget balance responds to the output gap and to the public debt. We find some substantial differences in coefficient estimates based on the choice of the structural indicator variable. We then use the estimated parameters to calibrate a normative fiscal rule for a number of countries, and we use that rule to forecast the dynamics of the debt and primary balance under different convergence scenarios. We argue that a fiscal rule which only takes levels into account may not be sufficient to ensure a low future debt ratio, and that our forecasts may provide an early warning of future fiscal pressures.

Key words: fiscal rules, fiscal policy, euro area countries.
JEL classification: E62, E66, H60.

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1. Introduction

The failure of the Stability and Growth Pact and the European sovereign debt crisis have brought the implementation of fiscal rules to the fore of many policy discussions. Often, a clear constitutional agreement concerning targets for or restrictions on fiscal aggregates has been proposed in order to ensure sustainable government finances. The German "debt brake" is one example of a fiscal rule; (Snower, Burmeister, and Seidel, 2011) propose another fiscal rule which would allow for procyclical government net lending. Supporters argue that, given the credible commitment to such a rule, a fiscal rule might significantly reduce the uncertainty about future policy decisions and, hence, result in higher market confidence and a lower risk of self-fulfilling debt crises.

This paper aims at shedding some light on fiscal policy behavior in the euro area and proposing specifications for fiscal rules which would resemble past policy but result in a credible path for future consolidation. Its intention is to offer a closer link between the empirical and the policy literature on fiscal rules. We thereby focus on simple rules which do not explicitly regulate public expenditure and revenue structures even though the specific manner of fiscal policy may certainly be an important issue in practice. Instead, we focus on a simple fiscal rule which takes the business cycle and fiscal conditions into account.

We start by formulating a fiscal rule which consists of three components: a target level of long-run indebtedness, a convergence path towards this level, and a specification of the degree of counter-cyclical fiscal policy. This rule resembles a rule which has widely been adopted in both the policy literature and in the empirical literature. We estimate this rule (in levels) for all euro area countries except Luxembourg based on past data over the period through 2007. The empirical evidence suggests that the euro area countries have stabilized either changes in the debt-GDP ratio or the level of the debt-GDP ratio, with most countries showing a strong degree of automatic stabilizers. Fiscal impulses also show a high degree of autocorrelation. Moreover, estimation results depend on the choice of the structural indicator variable, particularly for the post-1992 period.

In a next step, taking the issues of autocorrelation and the imprecision in measuring the level of the structural indicator variable into account, we formulate the previous

rule in first differences and add an additional error correction component in levels, for high levels of debt. This formulation offers a balance between short-run flexibility and the possibility of long-run debt stabilization, and it does not depend on often unreliable estimates of the level of potential GDP. Estimates of the first difference rule are more precisely measured but in general confirm the results of the rule in levels.

We argue that, to the extent that a proposed fiscal policy rule can broadly match some basic aspects of past fiscal policy while encouraging more debt stabilization in levels, such a rule may have a greater chance of success than the previous Stability and Growth Pact. That rule could also be used for forecasting purposes - for instance, to provide an 'early warning' system for unsustainable debt dynamics. We show with a set of back-of-the-envelope calculations the projected debt paths of Germany, Italy, Spain, France, and Ireland following different specifications of our fiscal rule. The simulations suggest that a rule based on average euro area-wide behavior with a slightly higher reaction to the debt-GDP ratio might be successful in achieving debt sustainability within a reasonable time frame, without demanding unrealistic primary surpluses. Nonetheless, a fiscal rule based purely on backward-looking behavior would face difficulties in preventing the debt ratio in some countries from rapidly rising in the short run.

2. Specification

2.1. A rule in levels

Most of the literature regarding the empirical assessment of fiscal policy behavior in the euro area has estimated the reaction of the primary balance or the cyclically-adjusted primary balance to a previous state of fiscal aggregates and to the business cycle. Usually, the level of the output gap and government debt are included as regressors. Golinelli and Momigliano (2009) offer an extensive survey and discussion of empirical studies up to the year 2008. More recent studies include those of García, Arroyo, Mínguez, and Uxó (2009) who find some evidence for a less procyclical discretionary fiscal policy after the introduction of the Maastricht Treaty but (with the exception of Germany and Finland) and only a minor reaction to public debt levels. Bénétrix and Lane (2013) provide panel estimates for the group of early euro area countries and conclude that after the introduction of the common currency there is less evidence for stabilizing fiscal policies. Afonso and Hauptmeier (2009) estimate a fiscal reaction function for the primary balance using

a panel of EU countries and find a significant response to increases in government debt.

Our point of departure is the specification of Snower, Burmeister, and Seidel (2011). Snower, Burmeister, and Seidel (2011) suggest that the level of net lending L_t as a share of GDP Y_t should respond to the minimum sustainable net lending-GDP ratio k_t, the debt ratio B_{t-1}/Y_{t-1}, output Y_t, and trend (or potential) output $\bar{Y}_t$, through the equation:

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

where:

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

and e_t is assumed to be zero on average.

All variables are specified as real values, deflated by the GDP deflator. The parameter b^{CR} governs the long-run critical cutoff debt-GDP ratio, which Snower et al. (2011) set to 0.6. Minimum sustainable net lending k_t is that rate of net lending required to keep the debt-GDP ratio at b^{CR}, given estimated trend inflation $\bar{\pi}_t$ and trend (or potential) output growth $\bar{g}_t$. The omission of k_t from the fiscal rule, as in the German debt brake, would imply zero nominal deficits and a constant level of the nominal debt on average. Zero deficits would send the debt-GDP ratio toward zero over time due to trend inflation and trend growth. The parameter c^{CR} governs the speed with which deficits adjust relative to the debt imbalance, so long as the debt-GDP ratio is above the cutoff. A country such as Italy, with a large debt ratio, would be encouraged to run smaller deficits in order to get its debt-GDP ratio down toward this target. The coefficient c^{CR} has no effect for countries such as Estonia, whose debt ratio remains below 0.6 as of this writing. The coefficient a denotes the response of deficits to the output gap. Taylor (2000) suggests a coefficient of 0.5 for the United States. Snower et al. (2011) suggest a coefficient of 0.9 for the euro area. The residual e_t represents a fiscal impulse.

We instead specify the rule in (1) as a primary surplus rule, such that for a primary budget balance P_t, the target follows the form:

$$\frac{P_t}{Y_t} = k_t + a\left(1 - \frac{\bar{Y}_t}{Y_t}\right) + c\left(\frac{B_{t-1}}{Y_{t-1}} - b^*\right) + c^{CR}\left(\frac{B_{t-1}}{Y_{t-1}} - b^{CR}\right)_+ + e_t, \tag{3}$$

where now the sustainable primary surplus is given by:

$$k_t = \left(\frac{(1+\bar{i}_t)}{(1+\bar{\pi}_t)(1+\bar{g}_t)} - 1\right) b^*. \tag{4}$$

In this setup, $\bar{i}_t$ represents the trend nominal interest rate, and b^* is some trend debt level less than or equal to b^{CR}. This specification allows for fiscal authorities in individual countries to target long-run debt ratios below the cutoff level b^{CR} if they so wish. Otherwise, the fiscal rule would tend to encourage a debt ratio of b^{CR} in the long run as an average value, not as an upper bound. The parameter c represents the usual response of primary surpluses to the debt. A value of c larger than the growth-adjusted interest rate ensures a stable path for the debt given a finite order of integration for e_t. As before, c^{CR} ensures a stronger response of fiscal policy to the debt when the debt ratio is above its critical threshold b^{CR}, while a captures the response of primary surpluses to the business cycle.

We choose to work with a primary surplus rule (3) instead of (1) 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 (3) is likely to be more stable in response to fluctuations in trend inflation than the value of k_t in (1). 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. Finally, the specification of (3) is somewhat more general than that of (1) due to the inclusion of the parameters c and b^*.

It should be stressed that the choice of methodology behind the calculation of $\bar{Y}_t$ might heavily affect the degree of measured anticyclical policies and therefore might imply different allowable deficit or primary balance paths. Often, measures of the cyclical position of an economy have been subject to significant revisions.[1] This issue is of particular concern during periods of economic boom and bust, particularly during long-lived expansions and slumps. We worry that this might not only apply to the real-time

[1]For euro area or OECD countries, revisions of more than 1 percentage point with respect to output gap estimates are quite common. See, amongst others, Koske and Pain (2008) and Marcellino and Musso (2011).

measurement of these variables but also to ex post data. We therefore investigate both potential GDP and trend GDP as indicators of $\bar{Y}_t$ when estimating a fiscal rule in the form (3).[2] The use of trend GDP instead of potential GDP implies a notably bigger positive output gap in the period before the crisis for countries such as Spain and Greece.

Next, we consider a fiscal rule in first differences which is preferable for debt-GDP ratios that may not be stationary. We motivate this formulation by noting that our estimated fiscal impulses e_t from (3) show a high degree of persistence. This formulation also allows us to use the trend growth rate of GDP (instead of the growth rate of trend or potential GDP) and is thus likely to be somewhat more robust to potentially unreliable estimates of these unobservable variables.[3]

2.2. A rule in first differences

The existing evidence does not rule out a unit root or near-unit-root behavior in the debt ratio. Historical experience and econometric estimates (e.g. Bohn (1991), Galí and Perotti (2003), and Reicher (2013)), and also the evidence presented later in this paper, suggest that fiscal authorities in most countries stabilize the deficit-GDP ratio (or growth in the debt-GDP ratio) rather than the level of the debt-GDP ratio. This is equivalent to saying that the driving process behind fiscal policy, e_t, follows a random walk. This might be true if the military spending shocks, demographic shocks, and changes in political preferences captured in e_t are long-lived.

Taking the primary surplus rule (3) in first differences gives the following modified rule to a first-order approximation, after setting c^{CR} to zero:[4]

$$\Delta\frac{P_t}{Y_t} = a\left(\frac{1}{1+\bar{g}_t} - \frac{Y_{t-1}}{Y_t}\right) - c\Delta\frac{B_{t-1}}{Y_{t-1}} + \varepsilon_t, \tag{5}$$

where ε_t equals Δe_t. The modeling of output growth in this manner makes it unnecessary to obtain estimates of the level of potential GDP (which is much less precisely measured than the trend growth rate), thus removing one free time-varying parameter

[2] We refer to potential GDP as calculated by using a production function approach. In contrast, trend GDP is obtained by applying the Hodrick-Prescott (HP) filter to the actual output series.

[3] We calculate gross trend growth in GDP as the HP trend of (Y_{t-1}/Y_t), applying a smoothing parameter of $\lambda = 100$.

[4] This is for reasons of parsimony. An exploratory analysis reveals that including both c^{CR} and d^{CR} into (6) does not yield any additional explanatory power, while yielding less-precise estimates of d^{CR}.

from the fiscal rule.[5]

The type of rule embodied in (5) represents the behavior of a government which is concerned with keeping the debt-GDP ratio from exploding, while allowing for the debt-GDP ratio to have a unit root. Since the Maastricht criteria and the Stability and Growth Pact require a long-run debt-GDP ratio below 60 percent, we add an additional term $d^{CR}\left(B_{t-1}/Y_{t-1} - b^{CR}\right)$ to capture the additional consolidation which is required to push the debt-GDP ratio towards b^{CR}. 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 rule would now have the form:

$$\Delta\frac{P_t}{Y_t} = a\left(\frac{1}{1+\bar{g}_t} - \frac{Y_{t-1}}{Y_t}\right) + c\Delta\frac{B_{t-1}}{Y_{t-1}} + d^{CR}\left(\frac{B_{t-1}}{Y_{t-1}} - b^{CR}\right)_+ + \varepsilon_t. \tag{6}$$

3. Estimates from historical data

3.1. 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, net lending, and the primary budget balance.[6] 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 previous to the Great Recession. 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. We recognize that the pre-Maastricht era may represent a different regime for the euro area countries, and so we present two sets of estimates: A set of estimates covering the entire sample, and a set of estimates restricted to the data from 1993 through 2007. The latter results are presented only for the euro area as a whole, since the sample is too short in order to provide reliable estimates for individual countries.

[5] See also Orphanides (2010) for a discussion of a simple monetary policy rule in differences.

[6] We focus on ex post data since we are mainly interested in the actual rather the intended behavior of fiscal policy (cf. Golinelli and Momigliano (2009)). The real-time implementation of fiscal rules is of particular concern.

For the rule (3), we regress the primary balance ratio on a constant, the output gap $(1 - \bar{Y}_t/Y_t)$, the lagged debt ratio (B_{t-1}/Y_{t-1}), and the lagged excess debt ratio $((B_{t-1}/Y_{t-1} - b^{CR})_+)$, where appropriate. We assume that the composite residual e_t follows an AR(1) process with a persistence coefficient ρ. We estimate the rule using nonlinear two-stage least squares, since it is highly conceivable that the output gap is endogenously related to the fiscal impulse. 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, as additional instruments. We include country-specific dummies, 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 instruments. That dummy variable takes a value of 1 for Germany post-reunification, and 0 otherwise.

For the rule (6), we regress the change in the primary balance ratio on a constant, the output growth gap $(\bar{Y}_{t-1}/\bar{Y}_t - Y_{t-1}/Y_t)$, the change in the lagged debt ratio $(\Delta(B_{t-1}/Y_{t-1}))$, and the change in the lagged excess debt ratio $(\Delta(B_{t-1}/Y_{t-1} - b^{CR})_+)$, where appropriate. We use the lagged output gap, two lags of the output growth gap, and the change in the lagged debt ratio and excess debt ratio as instruments. We also include a dummy which equals 1 for Germany in 1991 and 0 otherwise. We do not include country-specific dummies, as they are removed using the difference operator.

We estimate both sets of rules using different indicators of the long-run output dynamic. We report parameter results and standard errors on a country-by-country basis for the full sample in Tables 1, 2, and 4 through 6. For the individual country and the baseline panel specifications, the term covering the excess debt ratio is excluded form the list of regressors, i.e. $c^{CR} = 0$ and $d^{CR} = 0$, respectively. This improves the statistical power. A priori there might also be no obvious reason to expect that policymakers have explicitly responded to a certain debt threshold in the period before the introduction of the Maastricht Treaty, and individual country coefficient estimates mostly confirm this suspicion. Moreover, the actual number of countries reported in these tables differs as we have skipped countries with an insufficient number of observations available for the respective specification.

The pooled estimates, however, are always based on an unbalanced panel of all euro area countries except Luxembourg. We produce estimates for all specifications of the

rule in levels and in first differences, respectively, for differing time periods and level coefficients. We also include the set of results derived by estimating a panel regression over the post-1992 period. Here a term capturing the additional consolidation necessary to push the debt-GDP ratio towards a certain threshold is of special interest since - setting $b^{CR} = 0.6$ - this allows for investigating potential reactions to excess debt levels. Despite countries' heterogeneity, the panel estimates might represent a 'central tendency' of fiscal policy behavior within the EMU. Moreover, the results are useful for individual countries insofar as individual fiscal responses are poorly estimated.

3.2. Results for the model in levels

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 pooled estimates. Both sets of pooled estimates indicate that a value of a of about 0.4 to 0.5 seems to fit the data fairly well. This value of a is far lower than that of 0.9 proposed by Snower et al. (2011) and is in line with the estimates of Reicher (2012, 2013a) and the previous literature for the United States and other industrialized countries. The estimated debt coefficient c equals 0.08 using potential GDP as a structural indicator and 0.09 using trend GDP and is in both cases statistically distinguishable from zero. The primary balance does seem to increase with respect to the debt ratio, and so fiscal policy on average appears to be Ricardian. Interestingly, the residual governing the deficit is highly persistent, with the pooled estimate of ρ coming in at about 0.75 per year.

Country-specific estimates are often not estimated with a high degree of precision, but some interesting findings emerge when we compare the results for major European countries.[7] Unlike Spain and Ireland, the value for c is statistically significant for Germany and Italy, implying a general reaction of these countries' fiscal policy to the debt ratio. For France results seem somewhat mixed, with a negative and imprecisely measured coefficient when using potential GDP and a precise positive reaction when using trend GDP. In contrast, France significantly engages in anticyclical fiscal policy, while the evidence is less strong for Italy and Germany. Moreover, among this subgroup, fiscal impulses in Germany seem to be least persistent.

[7] We mainly focus on Germany, Italy, Spain, France, and Ireland.

While the choice of the structural indicator variable might indeed matter for specific countries (e.g. France), the differences in the panel estimates are in general relatively small. Furthermore, the measured reaction to the lagged debt-GDP ratio appears also to be robust to a restriction of the sample to the post-1992 period (Table 3). The evidence on more rapid stabilization at higher debt levels as given by the c^{CR} coefficient is moderately strong, and it is robust to the sample length. Differences between the full and the restricted sample are more pronounced with regard to the cyclical response coefficient a. Focusing on the post-1992 period, the use of potential GDP suggests a stronger anticyclical policy than the use of trend GDP. This might be explained by the stronger impact of the implied larger (positive) output gap before the crisis when using the latter variable, as well as its generally greater volatility.

3.3. Results for the model in first differences

Table 4 contains the estimated coefficients of equation (6) estimated using growth in potential GDP as a structural indicator, and Table 5 and 6 contain the estimated coefficients using growth in trend GDP and trend growth, respectively. Again, we start with the pooled specification which offers a glimpse into the systematic behavior of fiscal policy across the euro area. Similar to the levels specification, the estimated coefficients for a come in near 0.5 with only minor differences due 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 0.1 per year using growth of trend GDP or trend growth as a structural indicator.

Results for individual countries again indicate strong fiscal responses to cyclical developments in France and Spain, with much weaker evidence for Italy. The response of German fiscal policy to the business cycle seems large but imprecisely measured. There seems to be a strong and precisely measured reaction to lagged debt growth in Germany, and to a somewhat lesser extent in France and Ireland.

When comparing the differences between the estimates based on the full sample and the restricted sample for all countries taken together (Table 7), the results resemble those from the model in levels. In the post-1992 period the choice of the structural indicator variable significantly affects the estimation results for the cyclical response

coefficient a, with a higher value using growth in potential GDP rather than growth in trend GDP. Not surprisingly, the additional differentiation between growth in trend and trend growth as structural indicator might more be an issue of real-time measurement. All estimated deficit responses are relatively similar across sample periods and structural variable specifications.

The evidence that fiscal policy in first differences responds to a high level of the debt ratio is weak. The estimated coefficients for d^{CR} come out at 0.002 based on the post-1992 period and slightly higher around 0.006 based on the full sample, and these coefficients are statistically not distinguishable from zero. While point estimates hint at the possibility of debt stabilization in levels, the historical behavior of fiscal policy only provides a loose guide as to how fiscal authorities behave above the debt cutoff. Future data will offer a better guide as to how European countries consolidate in the face of high debt levels.

In general, the models estimated in levels and in first differences tend to indicate that cyclical response coefficient of 0.4 to 0.5 captures the average behavior of countercyclical deficits across the euro area, with the model estimated using potential GDP after 1992 deviating strongly from that pattern. The models also point toward the strong possibility that euro area governments do stabilize the public debt. While the debt ratios of some individual countries may have grown over time, the presumed 'deficit bias' of euro area governments seems not to have led to ever-increasing debt-GDP ratios throughout the euro area on average.

4. Forecasting methodology

In this section, a simple framework for long-run projections is proposed under the assumption of the fiscal rule being normative. We simulate the path of the debt-GDP ratio and the primary balance-GDP ratio under our rule in first differences using trend output as a structural indicator, and we conduct an exercise to see what role the choice of different coefficients may play. We argue that the coefficient d^{CR} from the difference rule needs to be chosen in a way so as to balance the need for long-run stabilization with the desire for smooth fiscal policy in the medium run. Even so, doubling the value of d^{CR} from its estimated value is not enough to ensure rapid fiscal consolidation in the short term but only in the longer term, since that consolidation occurs only in the face

of debts which have already been incurred. Individual countries may wish to engage in proactive consolidation in the event that they aim to converge more quickly toward the 60 percent criterion.

4.1. Setting up a baseline level of output

To account for the endogeneity of output, first we set up a 'zero-fiscal' baseline level of actual and trend output which features no debt or primary net lending or borrowing. Zero-fiscal output is the level of output in the absence of any fiscal interventions, which we take as exogenous to the fiscal policymaker. First, we assume a simple multiplier relationship, where output is equal to zero-fiscal output Y_t^* plus the effects of the primary surplus mediated through a multiplier m, such that:

$$Y_t = Y_t^* - mP_t. \tag{7}$$

Similarly, trend output is equal to zero-fiscal trend output $\bar{Y}_t^*$ plus the effects of the trend primary surplus mediated through a multiplier m, such that:

$$\bar{Y}_t = \bar{Y}_t^* - m\bar{P}_t, \tag{8}$$

where the trend primary surplus $\bar{P}_t$ can be approximated through the formula:

$$\bar{P}_t = \left(\frac{(1 + \bar{i}_t)}{(1 + \bar{\pi}_t)(1 + \bar{g}_t)} - 1 \right) B_{t-1}, \tag{9}$$

implicitly assuming that the debt level is at or near its (possibly stochastic) trend. For $\bar{g}_t$ and $\bar{\pi}_t$ we use the geometric mean of trend GDP and the GDP deflator over the period 1999-2012, which includes values before and after the crisis. In the same vein, the trend interest rate $\bar{i}_t$ is assumed to equal its mean over the period 1999-2012.

We calculate zero-fiscal actual and trend output in this manner through 2014.[8] We then calculate the zero-fiscal log output gap, which is equal to $log(Y_t^*/\bar{Y}_t^*)$. It is assumed that in the years beyond 2014, the zero-fiscal log output gap is equal to 0.8 times its previous value, and that zero-fiscal trend output grows at its trend rate $\bar{g}_t$. We then calculate the path of zero-fiscal output Y_t^* implied by these two laws of motion. This value is used as an input into the next step.

[8] At the time of writing, forecasts by the European Commission up to this year were available.

4.2. Solving for the primary balance and output

We then estimate the equilibrium fiscal balance implied by equations (6) and (7) in the years after 2014. By combining the two equations and using the values of Y_t^* which we have already forecast, we find our forecast value of P_t:

$$P_t = \frac{1}{1 + mj_t} \left(Y_t^* j_t - aY_{t-1} \right), \tag{10}$$

where:

$$j_t = \frac{P_{t-1}}{Y_{t-1}} + c\Delta\frac{B_{t-1}}{Y_{t-1}} + d^{CR}\left(\frac{B_{t-1}}{Y_{t-1}} - b^{CR}\right) + a\frac{1}{1+\bar{g}_t} + \varepsilon_t, \tag{11}$$

We assuming that ε_t is set to zero in the future. Given a value of P_t from (10), we calculate Y_t using (7).

Finally, we iterate to the current period's end of period debt stock using the law of motion:

$$B_t = \frac{(1+i_t)}{(1+\pi_t)} B_{t-1} - P_t. \tag{12}$$

We iterate through these steps beginning in 2015 (the year in which we assume the fiscal rule to be eventually effective) and then for every following year in the subsequent decade.

4.3. Forecasts for specific countries

Figures 1 to 5 show the projections for Germany, Italy, Spain, France, and Ireland, respectively. Different paths of the debt-GDP ratio are plotted on the left panels, different paths for the primary balance-GDP ratio are plotted on the right panels. While we always assume a debt criterion of $b^{CR} = 0.6$ and a fiscal multiplier of $m = 0.9$, the projections vary with respect to the other parameters. We distinguish between three different scenarios.

1. Country-specific estimates for the pre-crisis response to the business cycle a and to debt growth c (see Table 5) are used for calibration. No debt level correction factor d^{CR} is included, since that coefficient is in general imprecisely measured at the country level. This first scenario illustrates a fiscal rule based on individual characteristics of each euro area country.

2. Estimated average euro area-wide pre-crisis response to the business cycle a and to debt growth c are used for calibration. The (imprecisely measured) response to the debt level target d^{CR} is set to 0.005, which seems a reasonable value across all specifications. This scenario allows for comparing a rule based on past individual fiscal behavior with a possible (proposed) euro area-wide specification.

3. Estimated average euro area-wide pre-crisis response to the business cycle a and to debt growth c are used for calibration. In order to analyze the implications of a somewhat higher level correction factor, d^{CR} is doubled to 0.01 in scenario 3.

Projections for Germany (Figure 1) suggest that a fiscal rule calibrated as described in scenario 3 would call for a future stabilization of the primary balance-GDP ratio on the most recent values (respectively on the EC forecasts for the years 2013 and 2014). This seems sufficient to reduce the debt-GDP ratio at least to around 70 percent within ten years. In contrast, the same rule would force Italy to run primary surpluses above 5 percent of GDP (Figure 2), which appears less feasible. The rule based on the country-specific calibration, however, would not reduce Italy's debt-GDP ratio over the forecasting horizon. (Figure 3) and (Figure 4) show the projections for Spain and France, respectively. A fiscal rule without an explicit level component seems to fail in pushing debt ratios downward. Governments seeking to reduce the debt-GDP ratio might wish to implement a rule calibrated with euro area-wide estimates and a somewhat higher debt level correction factor. Note that in this case even a slight primary deficit would be allowed in the first years after the fiscal rule being effective. Finally, calculations for Ireland (Figure 5) indicate that an individually calibrated rule would only require a balanced budget but also imply no considerable reduction of the debt ratio. Calibrations as specified under scenario 2 and 3 are more appropriate when a path of the debt-GDP ratio below 100 percent is targeted.

Overall, for the majority of countries under study, a rule based on euro area-wide estimates of a and c but with $d^{CR} = 0.01$ would bring about achievable primary balance-GDP ratios and in most cases a noticeable decline in the debt ratio. This might entail a significant period of high debt. Countries worried about this issue may wish to engage in proactive consolidation. Italy, however, would be forced to run extremely high surpluses in order to significantly reduce its debt ratio. However, we caution that our projections are sensitive to the choice of interest rates, growth rates, et cetera. We urge researchers interested in this approach to check the robustness of their results with respect to in-

dividual assumptions, such as growth rates. For countries like Ireland and Spain, the measurement of trend growth is a particular issue.

5. Conclusions

In this paper we measure systematic fiscal policy in the euro area based on different specifications of a simple and flexible fiscal rule. Our overall conclusions with respect to the countercyclical and the debt stabilizing behavior seem to be fairly robust across specifications for pooled estimates, with the the choice of the structural indicator variable playing some role when it comes to the response to the business cycle. This sensitivity holds all the more with respect to country-specific estimates. Estimation results for individual countries, however, should be interpreted with further caution as our sample comprised of yearly fiscal data over several decades might also include periods of different monetary and fiscal regimes, especially in the seventies or eighties.

These estimated rules are not only useful for analyzing past fiscal behavior but also for medium run forecasting purposes. By calibrating a theoretical rule based on the historical estimates we try to come up with a fiscal policy rule which appears broadly implementable. Our projections for the long run suggest that for most countries a fiscal rule based on average euro area-wide behavior and a slightly higher debt level correction appears feasible and sufficient for achieving a falling debt ratio. By projecting a fiscal rule forward, we can better understand the tradeoffs between medium run consolidation and the pain involved therein.

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A. Tables

Table 1: The fiscal rule 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)
Pooled		0.081	0.493	0.717
		(0.014)	(0.133)	(0.040)

Standard errors are given in parentheses.

Table 2: The fiscal rule 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)
Pooled		0.093	0.419	0.748
		(0.017)	(0.100)	(0.039)

Standard errors are given in parentheses.

Table 3: The fiscal rule 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, 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	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, 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.

Table 4: The fiscal rule in first differences (Using growth of potential GDP 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)
Pooled	0.000	0.087	0.443
	(0.001)	(0.021)	(0.110)

Standard errors are given in parentheses.

Table 5: The fiscal rule in first differences (Using growth of trend GDP 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)
Pooled	−0.001	0.104	0.494
	(0.001)	(0.022)	(0.096)

Standard errors are given in parentheses.

Table 6: The fiscal rule in first differences (Using trend growth of GDP 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)
Pooled	−0.001	0.107	0.482
	(0.001)	(0.022)	(0.095)

Standard errors are given in parentheses.

Table 7: The fiscal rule in first differences (Panel estimates of all specifications).

Country	*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, 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	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, 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)

Standard errors are given in parentheses.

B. Figures

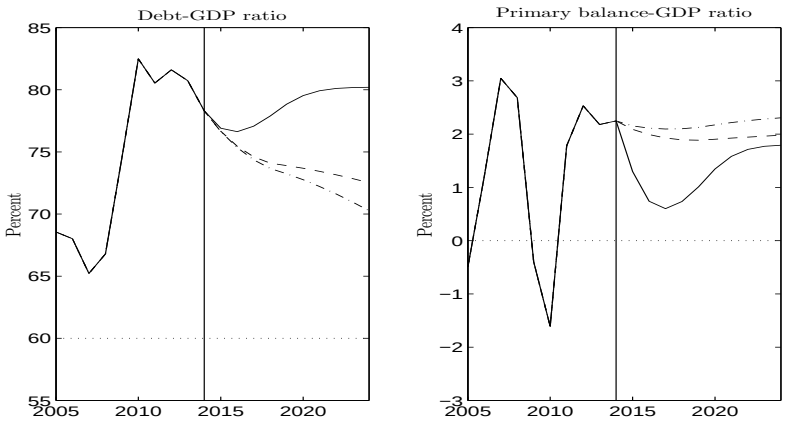

Figure 1: Projections for GERMANY under fiscal rule. (—) Rule based on country-specific estimates of a and c, no level correction factor. (- -) Rule based on euro area-wide estimates of a and c, correction factor $d^{CR} = 0.005$. (-.-) Rule based on euro area-wide estimates of a and c, doubled correction factor $d^{CR} = 0.01$.

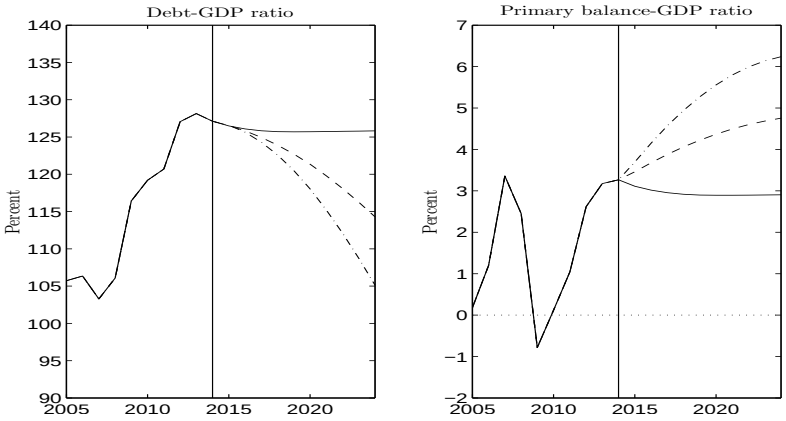

Figure 2: Projections for ITALY under fiscal rule. (—) Rule based on country-specific estimates of a and c, no level correction factor. (- -) Rule based on euro area-wide estimates of a and c, correction factor $d^{CR} = 0.005$. (-.-) Rule based on euro area-wide estimates of a and c, doubled correction factor $d^{CR} = 0.01$.

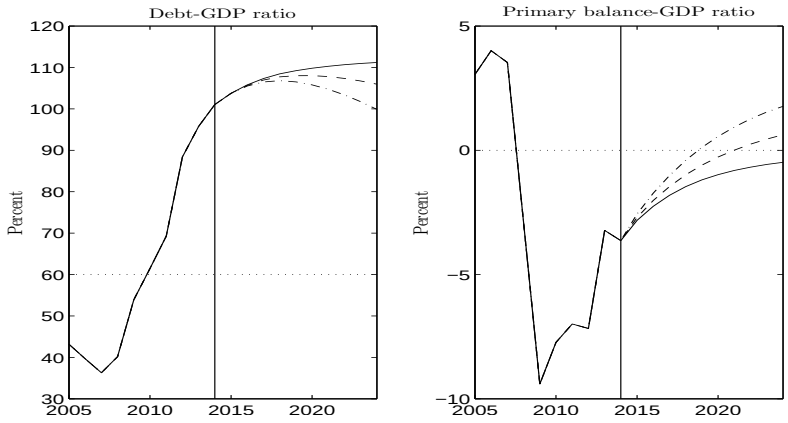

Figure 3: Projections for SPAIN under fiscal rule. (—) Rule based on country-specific estimates of a and c, no level correction factor. (- -) Rule based on euro area-wide estimates of a and c, correction factor $d^{CR} = 0.005$. (-.-) Rule based on euro area-wide estimates of a and c, doubled correction factor $d^{CR} = 0.01$.

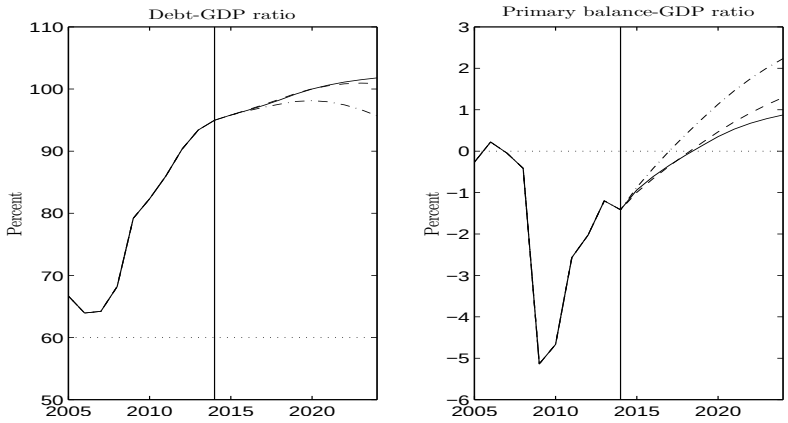

Figure 4: Projections for FRANCE under fiscal rule. (—) Rule based on country-specific estimates of a and c, no level correction factor. (- -) Rule based on euro area-wide estimates of a and c, correction factor $d^{CR} = 0.005$. (-.-) Rule based on euro area-wide estimates of a and c, doubled correction factor $d^{CR} = 0.01$.

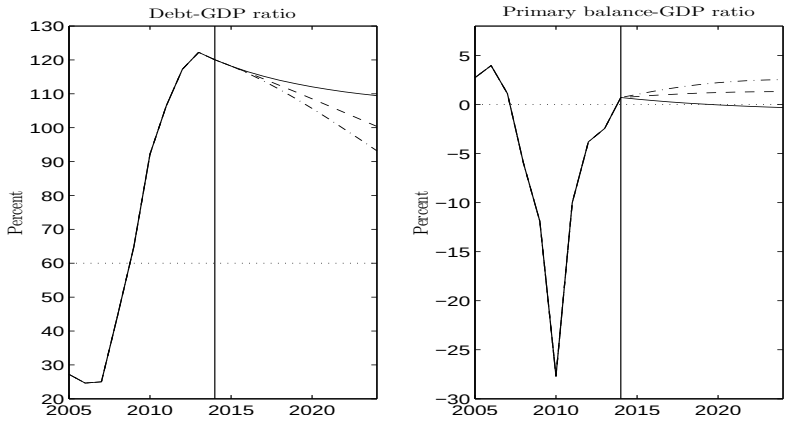

Figure 5: Projections for IRELAND under fiscal rule. (—) Rule based on country-specific estimates of a and c, no level correction factor. (- -) Rule based on euro area-wide estimates of a and c, correction factor $d^{CR} = 0.005$. (-.-) Rule based on euro area-wide estimates of a and c, doubled correction factor $d^{CR} = 0.01$.